FINAL

Revision 02
March 2023

BOUNDARY INVESTIGATION TECHNICAL MEMORANDUM WORK PLAN

Yakima Training Center

Yakima, Washington

Joint Base Lewis-McChord Public Works – Environmental Division
IMLM-PWE
MS 17 Box 339500
Joint Base Lewis-McChord, Washington 98433

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LIST OF ABBREVIATIONS AND ACRONYMS

AOI	Area of Interest
Arcadis	Arcadis U.S., Inc.
ASTM	American Society for Testing and Materials
bgs	below ground surface
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CLIN	Contract Line Item Number
CSM	Conceptual Site Model
ECC	Environmental Chemical Corporation
ECC Team	Environmental Chemical Corporation and Arcadis U.S., Inc.
EE/CA	Engineering Evaluation/Cost Analysis
LC/MS/MS	liquid chromatography with tandem mass spectrometry
PA	Preliminary Assessment/
PFAS	Per- and Polyfluoroalkyl Substances
PFOA	Perfluorooctanoic Acid
PFOS	Perfluorooctane Sulfonic Acid
PVC	polyvinyl chloride
RI	Remedial Investigation
SI	Site Inspection
SOP	Standard Operating Procedure
SSHP	Site Safety and Health Plan
TGI	Technical Guidance Instruction
UFP-QAPP	Uniform Federal Policy – Quality Assurance Project Plan
USEPA	United States Environmental Protection Agency
USAEC	United States Army Environmental Command
Work Plan	Boundary Investigation Work Plan
YTC	Yakima Training Center

1.0 INTRODUCTION

This Revised Boundary Investigation Work Plan (Work Plan) was prepared as a roadmap to describe the approach for a boundary investigation as an initial phase of data collection for the Per- and Polyfluoroalkyl Substances (PFAS) Remedial Investigation (RI) at the United States Army Yakima Training Center (YTC) in Yakima, Washington (**Figure 1**). Revision 01 of this document depicted the new surface geophysical transect alignments that were repositioned after a field truthing exercise (refer to **Section 2.0**). Revision 02 of this document was prepared for the following project developments:

- To include site preparation activities for boundary monitoring well locations (i.e., grading) and associated health and safety protocols.
- To include potential off-post sampling of private drinking water for PFAS analysis by Method 537, rev 1.1.
- To depict boundary well locations on Figure 3.
- To incorporate laboratory Standard Operating Procedures (SOPs) for Advanced Environmental Laboratories, Inc. (AEL) (Appendix D); and
- To update the Task Schedule (**Section 4.0**).

This RI is being conducted in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980 under United States Army Environmental Command (USAEC) Contract Number W9124J18D0004, Delivery Order Number W9124J22F0144 by Environmental Chemical Corporation (ECC) and Arcadis U.S., Inc. (Arcadis). This RI addresses the characterization and on- and off-post delineation of PFAS at YTC at and associated with the areas of interest (AOIs) (**Figure 2**) previously identified through the Preliminary Assessment (PA)/Site Inspection (SI) (Arcadis, 2021). This work plan focuses on the characterization of subsurface structural geology, identification of geologic features that may potentially act as preferential groundwater and PFAS migration pathways, and the installation and sampling of groundwater monitoring wells to characterize PFAS near YTC boundaries, where off-post PFAS migration is believed to be occurring. Field activities associated with this work Plan will be implemented in general accordance with the *Final Uniform Federal Policy-Quality Assurance Project Plan (UFP-QAPP) Addendum for the Yakima Training Center* (Arcadis 2020; **Appendix A**). A Site Safety and Health Plan, field guidance documents, and laboratory methods supplementing the UFP-QAPP specific to the tasks in this Work Plan are provided in **Appendices B, C** and **D**, respectively.

1.1 Objectives

The boundary investigation is being undertaken as an expedited first phase of the RI. Drinking water samples from private wells located downgradient of YTC have PFAS concentrations exceeding the United States Environmental Protection Agency's (USEPA's) Lifetime Health Advisory. The primary objective of the boundary investigation is to collect data that can be used to better understand the migration of PFAS in groundwater from the AOIs identified in the PA/SI across the YTC boundaries to downgradient receptors. The following elements will contribute to achieving the primary objective above, as well as other RI objectives:

- Characterization of the hydrostratigraphy along the YTC boundary, including geologic units and geologic discontinuities to provide insight into the possible locations of permeable groundwater flow pathways within the various geologic units beneath the site.
- Establishment of a monitoring well network along the YTC boundary to monitor PFAS concentrations migrating from YTC to downgradient receptors.

To meet these objectives, the scope of work described in this Work Plan includes: the application of surface geophysics in transects where monitoring wells will be installed, borehole geophysics to verify and correlate surface geophysics interpretations, and boundary groundwater monitoring wells to assist with mapping preferred flow pathways, understand transport mechanisms and mass-flux, and assess groundwater concentrations in the complex geologic setting at YTC.

The location of proposed transects are shown on **Figure 3**. This boundary investigation is intended to support the evaluation of off-post nature and extent of PFAS impacts and potential Engineering Evaluation/Cost Analysis (EE/CA) by providing data that could improve geologic interpretations for compilation into three-dimensional modeling, and by establishing a well network that could be adapted for potential incorporation into a future hydraulic containment system.

1.2 Preliminary Conceptual Site Model

The seven AOIs identified for the RI at YTC are situated within the Yakima River basin aquifer system, which consists of 1) basin-fill sedimentary deposits, 2) the Columbia River Basalt Group, and 3) deep bedrock consisting of Eocene and Oligocene-age volcanic and fluvial deposits. YTC is situated in a tectonically active zone known as the Yakima Fold Belt of south-central Washington, also called the Yakima Fold and Thrust Belt. **Exhibit 1** depicts mapped geologic structures associated with the Yakima Fold and Thrust Belt, which are expected to influence both regional and local hydrogeology and groundwater flow.

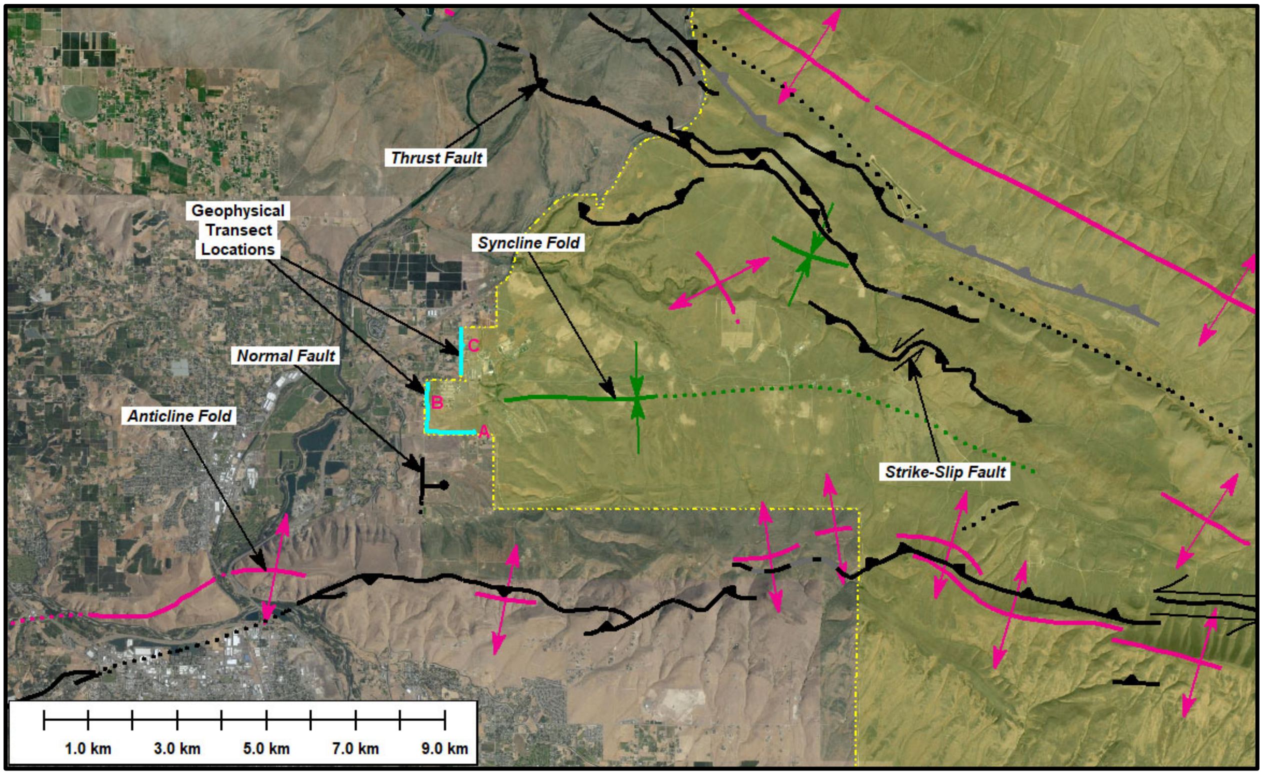

Exhibit 1. Major Structural Features of the Yakima Fold and Thrust Belt and Location of the Proposed Geophysical Transects

Extensive folding of the sedimentary and Columbia River basalt strata in the area has created a complex hydrogeologic system with highly variable groundwater chemistry, hydraulic properties, depths to water, and flow directions at YTC. Contaminant transport within the subsurface is correspondingly complex. Investigation is needed to better characterize the localized hydrostratigraphy, the effect of the regional folding and faulting at YTC, and how those subsurface conditions influence groundwater and PFAS migration in the subsurface.

Groundwater occurs within the alluvial deposits primarily in moderate to highly permeable sediments and may be under both confined and unconfined conditions. The water table in these deposits is typically at or near the elevation of the nearby streams. Within the sequences of basalt, groundwater is predominantly found within the weathered, more fractured contact zones and within sedimentary interflow zones.

Groundwater depths range from 20 feet below ground surface (bgs) in stream valleys to more than 200 feet bgs at higher elevations. Depth to groundwater ranges from 10 to 100 feet bgs in the cantonment area (**Figure 2**), and the flow direction of perched groundwater is generally to the west and southwest off-post toward the Yakima River.

A highly productive regional basalt aquifer underlies the cantonment area and potable wells that serve as the primary drinking water supply for YTC are installed in this aquifer with screen depths greater than 350 feet bgs. The groundwater in this regional aquifer occurs in basalt fractures and intercalated sediments. Regional groundwater in the basalt aquifers generally flows westward toward the Yakima River, with a more northwesterly flow component closer to the river.

The drinking water supply for YTC is provided entirely from groundwater sources. Wells provide water for three permitted drinking water distribution systems located in the cantonment area, at the Yakima Research Station and the Multi-Purpose Range Complex (Department of Defense, Department of the Army 2010). The supply well located at the Selah Airstrip is currently not in use, due to detections of PFAS in associated water quality samples. Areas west and southwest of the YTC cantonment area have detectable levels of Perfluorooctane Sulfonic Acid (PFOS) and Perfluorooctanoic Acid (PFOA) above the USEPA's Lifetime Health Advisory Level (May 2016) and 40 wells serving 54 residents as of May 2022 are provided bottled water.

1.3 Approach and Sequence

The boundary investigation will follow a data-driven, sequenced approach. Monitoring well locations and decisions guiding data collection intervals and well construction will be based on the surface and subsurface geophysics, off-post sampling results, and the updated Conceptual Site Model (CSM) as the work progresses. The following presents an overview of the investigation and decision-making approach. Further details are described in the following sections.

1. Surface geophysics investigation (**Section 2.0**) – interpretation of surface geophysics will preliminarily indicate the types of geologic materials present in the subsurface and their approximate depths/thicknesses beneath the geophysics transects.
2. The occurrence of subsurface anomalies, discontinuities, or other signals in the surface geophysics data set will be reviewed. These features will be evaluated in the context of downgradient drinking water results to identify potential preferential PFAS migration pathways.
3. Potential PFAS migration pathways identified from the surface geophysics data set and off-post well sampling will establish initial targets for monitoring well installation (**Section 3.0**).
4. Refinement of the subsurface geologic and structural interpretations by comparing borehole geophysics collected during installation of monitoring wells with surface geophysics signal.
5. Refinement of targets for installation of additional monitoring wells.

As the boundary investigation progresses, the ECC Team will engage with USAEC with the goal of collaboratively reviewing investigation data and aligning next steps to meet team objectives, complete the boundary investigation, and progress to subsequent phases of the RI. The ECC Team will host monthly project status meetings with Arcadis and USAEC to confirm alignment on implementation and approach, and after investigation results are available to seek USAEC concurrence as work progresses.

Given community awareness and interest in the PFAS investigation at YTC, it is likely that the field team will be approached by community members. Field teams will be instructed to respond by providing contact cards and/or information sheets identifying Ms. Lalita (Lally) Laksbergs as the USAEC point of contact for information related to the project.

2.0 SURFACE GEOPHYSICAL BOUNDARY INVESTIGATION

The first phase of the boundary investigation will include surface geophysics data collection. In consideration of the variable distribution of PFAS concentrations in off-post private wells that do not correlate to a common depth or recognizable subsurface feature, the overall objective of performing surface geophysics along the transects shown on **Figure 3** is to provide insight into the possible locations of permeable groundwater flow pathways within the various geologic units beneath the site. In general, two categories of geophysical properties can be directly related to the key hydrogeologic parameters, porosity and permeability, namely electrical resistivity and seismic velocity.

Electrical resistivity is a measure of how a geologic material resists the flow of an induced electrical current and tends to be inversely correlated with porosity. Degree of water saturation, the amount and nature of interconnected porosity, and the electrical conductivity of the groundwater, which is closely associated with total dissolved solids, collectively determine the electrical resistivity of the formation.

Seismic methods quantify the velocity that induced ground vibrations travel through the earth and tend to be inversely correlated with permeability. Because permeability is proportional to fracture density, seismic velocities are an indirect measurement of relative permeability.

Electrical resistivity and seismic data sets will be collected along the three proposed transects shown on **Figure 3**. The alignment of the transects target YTC boundaries where PFAS is migrating from the post into downgradient private drinking water wells. The transects are positioned to align with roadways and off the pavement or driving lanes to streamline right-of-entry access. The surface geophysics includes three transects, each approximately 3,640 linear feet and will be arrayed to achieve subsurface resolution to approximately 400 feet bgs. Where possible, resistivity and seismic data collection points will be co-located to facilitate interpretation.

These two independent, complementary geophysical methods are performed together to address potential ambiguities or non-uniqueness of each method. The combined surface geophysical data sets will be used to develop interpreted subsurface profiles and for the preliminary identification of subsurface features likely to be the more permeable zones. These interpretations will serve as the basis for siting monitoring wells and establishing target drilling depths.

While preliminary interpretation of the geophysical results will be useful for indicating hydrostratigraphic zones of interest, refinement of the interpretations will be possible by correlating the electrical resistivity and seismic signals with borehole logging that will be performed during well installation described in **Section 3**.

Implementation of the surface geophysics data collection is anticipated to require approximately five to seven field days. Data processing and interpretation are anticipated to require two to three weeks following data acquisition. The specific means that will be used to collect, process, and interpret the electrical resistivity and seismic data sets are presented in field guidance documents (**Appendix B**).

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3.0 BOUNDARY WELL NETWORK

The objective of the boundary well network is to better understand the migration of PFAS in groundwater from the AOIs identified in the PA/SI across the YTC boundaries to downgradient receptors. The following sections describe how the drilling locations, groundwater sample intervals, and well construction decisions will be made during the process of installing the boundary well network.

3.1 Location Rationale

Installation of the 15 boundary wells will be completed in phases designed to address specific data needs of the developing CSM and any identified data gaps. The final locations, well spacing, screen intervals, and well construction parameters will be determined by the results of previous phases of work and objectives for the particular wells being installed. The boundary wells will be installed to form the YTC boundary network and will be located along the geophysical transect lines shown in **Figure 3.** The boundary well locations will target areas adjacent to known off-post PFAS impacts in private wells and will be situated generally downgradient of AOIs. Final locations and target depths for the boundary wells will be based on access considerations, results of the surface geophysics surveys, and any additional analytical data that become available prior to mobilization. Some grading may be required for the drill rig and support trucks to access well locations.

Final locations will be adjusted to target preferential migration pathways identified between potential sources and off-post receptors. Potential migration pathways include, but are not limited to:

- Transmissive zones in basalt (e.g., flow top and/or bottom fracture zones within basalt flows)
- Faults either acting as a groundwater migration pathway or as a hydraulic barrier bounding a pathway; and
- Sedimentary interbeds with high relative permeability.

Eight monitoring well locations were initially selected based on review of available PFAS groundwater concentration data and interpretation of surface geophysical investigations (**Figure 3**). Findings obtained during the installation of initial wells will be reviewed and used to guide subsequent locations and well construction decisions. Potential objectives of subsequent wells may include:

- Bounding of PFAS plumes laterally and vertically along the boundary.
- Further evaluating risk presented by a potential AOI.
- Characterizing preferential flow pathways or geologic conditions that may be influencing flow regime.
- Filling data gaps for geologic unit interpolation.

Data inputs supporting objective-driven decisions include:

- Refined geologic interpretations based on correlation of surface geophysics with borehole geophysics.

- Calculation of hydraulic properties with simple specific capacity calculation from parameters collected during well development and low-flow sampling.
- PFAS analytical results.

As monitoring well locations are refined, the ECC Team will engage with USAEC and seek concurrence on the locations prior to installation. Collaborative activities will likely include review of geophysical interpretations in conjunction with mapped or modeled PFAS groundwater results. Concurrence will be documented in meeting minutes and will include a figure showing the final proposed well locations.

3.2 Well Installation and Sampling Approach

Boreholes for monitoring well installation will be advanced to the target depth using air-rotary drilling methods. Depths are anticipated to range from 175 to 210 feet bgs or as indicted based on nearby groundwater analytical results and/or geophysical interpretations. If necessary, surface casing may be used at locations at risk for borehole collapse.

Cuttings (rock chips) generated during drilling will be logged by a geologist in general accordance with the Technical Guidance Instruction (TGIs) for Soil Description, Soil Drilling and Sample Collection. Once the target depth has been achieved, borehole logging will be completed using various borehole geophysical methods described below to determine target intervals for collection of grab groundwater samples and the optimal interval for a well screen.

A grab groundwater sample will be collected from the shallowest significant water bearing zone (anticipated to be 80 to 120 feet bgs) using a temporary screen and inflatable packers to isolate the targeted interval. The objective of this sample is to capitalize on the opportunity to characterize multiple water-bearing zones during advancement of the boreholes. The results of these grab samples may be useful when evaluating future shallow monitoring well network needs to complete the RI. Grab groundwater samples will be collected in accordance with the TGI for PFAS Sampling Procedures (**Appendix A**).

3.2.1 Borehole Geophysical Surveys

Prior to constructing monitoring wells, borehole geophysics will be conducted in the open boreholes. Borehole geophysics can provide a detailed measure of the lithology, identify the presence of fractures, faults, geologic contacts, and other preferential flow pathways, and correlate/compare interpretations from the surface geophysical analyses. Boreholes will be digitally surveyed using tools to measure:

- natural gamma ray (an indication of mineralogy)
- spontaneous potential and single point resistance (an indication of lithology and fracturing); and
- three-arm caliper (an indication of fracturing, lithologic contacts, bedding planes, weathering, etc.).

Select boreholes will be surveyed with a televiewer probe (acoustic and/or optical), which provides a detailed three-dimensional visualization of the borehole.

Field work will be conducted in adherence to borehole logging standards found in American Society for Testing and Materials (ASTM) D5753-18 (ASTM, 2018).

3.2.2 Well Construction and Development

Monitoring wells will be constructed following grab sample collection at the selected target intervals. All equipment and materials used in well construction will be composed of non-PFAS-containing materials. The well type and construction materials will be selected for each well based on the specific subsurface conditions and data quality objectives for the individual wells. A range of construction styles may be appropriate, including:

- two-inch monitoring well with polyvinyl chloride (PVC) riser.
- four-inch monitoring well that could be repurposed for future use as a pumping well (i.e., part of a hydraulic capture system); and
- Open borehole well.

Screen length will be nominally 10 feet, to be finalized based on observed lithologic and PFAS concentration distribution. The monitoring wells will be constructed in accordance with Well Construction Standards for the State of Washington, the PFAS-Specific Drilling and Monitoring Well Installation TGI (**Appendix A**), with surface completions meeting YTC base-operations expectations and/or requirements.

Following construction, monitoring wells will be developed using surge and bail, surge and pump, or jet methods in accordance with the TGI for Monitoring Well Development (**Appendix A**).

3.2.3 Monitoring Well Sampling

Following well development, newly installed monitoring wells will be sampled following the TGI for PFAS Sampling Procedures and Low-Flow Groundwater Purging for Monitoring Wells (**Appendix A**). Analytical samples will be collected in laboratory provided containers, placed in coolers, and submitted under standard chain of custody procedures to the laboratory for PFAS analysis.

Groundwater samples will be submitted to AEL, a DoD-certified laboratory located in Jacksonville, Florida, for chemical analysis using Draft USEPA Method 1633 in accordance with requirements in the Department of Defense/Department of Energy Consolidated Quality Systems Manual for Environmental Laboratories Version 5.4 Table B-24 PFAS Analysis by liquid chromatography with tandem mass spectrometry (LC/MS/MS) (USEPA Draft Method 1633; **Appendix D**). Initial groundwater analytical data will be used to inform the UFP-QAPP and guide subsequent RI sampling programs.

3.2.4 Off-post Drinking Water Well Sampling

A select number of off-post privately owned drinking water wells may be included in the boundary well sampling event, provided right of entry (ROE) is established with the property owner(s). These water supply wells were observed during the November 2022 site visit and are associated with new residential construction. Drinking water samples will be shipped to Eurofins Lancaster, a DoD-certified laboratory located in Lancaster, Pennsylvania, for chemical analysis using USEPA

Method 537, Version 1.1: Determination of Selected Perfluorinated Alkyl Acids in Drinking Water by Solid Phase Extraction and LC/MS/MS (USEPA, September 2009). All off-post drinking water analytical data will be incorporated into the off-post sampling database developed as part of the PA/SI (Arcadis, 2021). Groundwater and Drinking Water analytical data will be validated with 90 percent Stage 2b and 10 percent level IV validation.

3.2.5 Investigation Derived Waste

Investigation derived waste will be managed in accordance with state requirements and YTC waste management plan and may include application to ground surface or containment and characterization for either off-site disposal or permitted discharge.

4.0 TASK SCHEDULE

Task Name	Start	Finish
Environmental Remediation Services - YTC, Yakima, WA - PFAS RI	Thu 9/29/22	Tue 4/11/23
Contract Award/ Notice to Proceed	Thu 9/29/22	Thu 9/29/22
CLIN 0001 - Boundary Investigation	Thu 9/29/22	Tue 4/11/23
Boundary Investigation Work Plan	Thu 9/29/22	Thu 11/10/22
Prepare Draft Work Plan	Thu 9/29/22	Mon 10/31/22
USAEC Review of Draft Work Plan	Mon 10/31/22	Fri 11/4/22
Revise to incorporate USAEC comments. Incorporate appendices (e.g., SSHP, Field Guidance Documents)	Mon 11/7/22	Tue 11/8/22
USAEC Concurrence with Work Plan	Thu 11/10/22	Thu 11/10/22
Boundary Investigation Field Activities	Mon 11/14/22	Tue 4/11/23
Surface Geophysics	Mon 11/14/22	Fri 12/16/22
Mobilization - Surface Geophysics	Mon 11/14/22	Mon 11/14/22
Surface Geophysics (Electrical Resistivity and Seismic)	Mon 11/14/22	Wed 11/23/22
Surface Geophysics Data Processing, Visualization, and Interpretation	Fri 11/25/22	Thu 12/15/22
Review Surface Geophysics Results with USAEC	Fri 12/16/22	Fri 12/16/22
Well Installation, Development, and Sampling	Tue 12/20/22	Tue 2/28/23
USAEC Concurrence on initial proposed well locations	Tue 12/20/22	Tue 12/20/22
Intermittent Review of Results w/ USAEC	Mon 1/9/23	Tue 2/28/23
Mobilization - Drilling	Mon 3/20/23	Mon 3/20/23
Drilling, Grab Groundwater Sampling, and Monitoring Well Installation (assume 3 days per well)	Mon 4/3/2023	Fri 4/28/23
Monitoring Well Development (assume 48 hours after installation)	Mon 4/17/23	Fri 4/28/23
Monitoring Well Sampling (assume 48 hours after well development)	Mon 5/1/23	Wed 5/3/23
Laboratory Analysis (Grab, Low-flow sampling)	Mon 4/10/23	Mon 6/5/23
Receive Monitoring Well Sample Results from Lab	Mon 5/1/23	Mon 6/5/23
Data Validation Complete	Mon 6/26/23	Mon 6/26/23

Notes:
CLIN – Contract Line Item Number
PFAS – Per- and Polyfluoroalkyl Substances
RI – Remedial Investigation
SSHP – Site Safety and Health Plan
USAEC – United States Army Environmental Command
YTC - Yakima Training Center

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5.0 REFERENCES

American Society for Testing and Materials (ASTM). 2018. ASTM Method D5753-18: *Standard Guide for Planning and Conducting Geotechnical Borehole Geophysical Logging*, ASTM International, West Conshohocken, Pennsylvania, 2018, DOI: 10.1520/D5753-18, www.astm.org.

Arcadis. 2020. *Uniform Federal Policy – Quality Assurance Project Plan Addendum. USAEC PFAS PA/SI*. Yakima Training Center, Washington. August.

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Department of Defense, Department of the Army. 2010. *Fort Lewis Grow the Army Final Environmental Impact Statement: Chapter 5 Affected Environment* – Yakima Training Center. July.

U.S. Environmental Protection Agency. 2009. Determination of Selected Perfluorinated Alkyl Acids in Drinking Water by Solid Phase Extraction and LC/MS/MS. Version 1.1. September.

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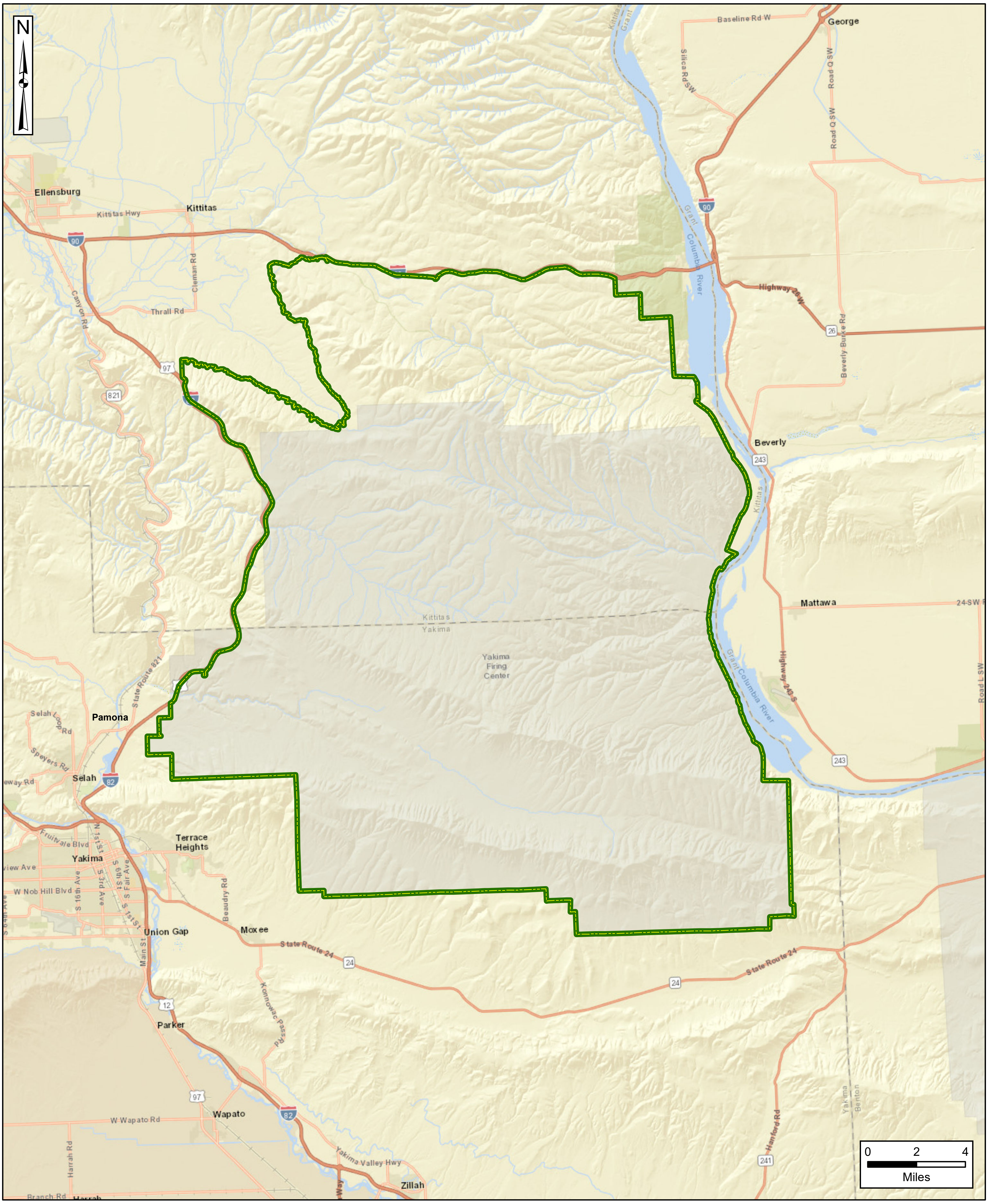
FIGURES

Boundary Investigation Work Plan
USAEC PFAS Remedial Investigation
Yakima Training Center, WA

Figure 1
Site Location



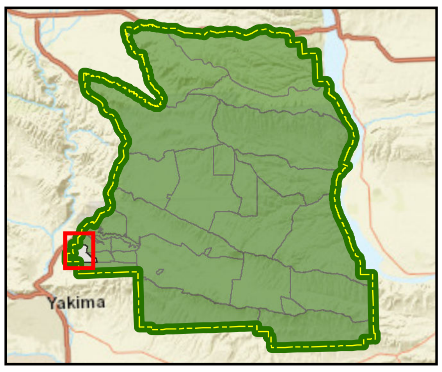
🟩 Installation Boundary

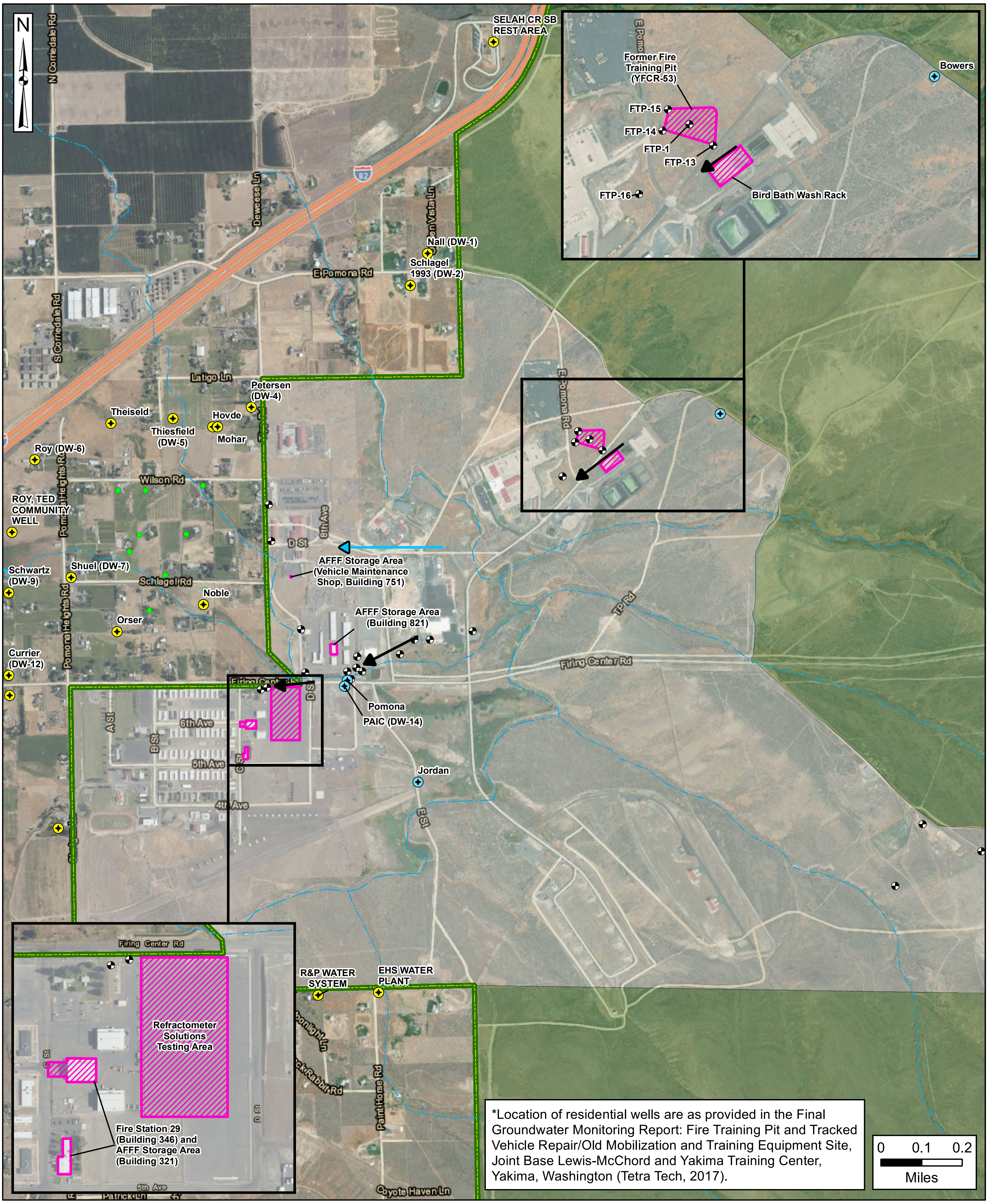
Data Sources:
Yakima Training Center, GIS Data, 2018
ESRI ArcGIS Online, Street Map Data

Coordinate System:
WGS 1984, UTM Zone 10 North

Boundary Investigation Work Plan
USAEC PFAS Remedial Investigation
Yakima Training Center, WA

Figure 2
Site Features and AOI Locations





*Location of residential wells are as provided in the Final Groundwater Monitoring Report: Fire Training Pit and Tracked Vehicle Repair/Old Mobilization and Training Equipment Site, Joint Base Lewis-McChord and Yakima Training Center, Yakima, Washington (Tetra Tech, 2017).

🟩	Installation Boundary	⊕	Potable Water Well (On-Installation)	➤	Deep Groundwater (i.e., Used for Installation Potable Supply) Flow Direction
⬜	Cantonment Area	⊕	Water Supply Well (Off-Installation)	➤	Perched Groundwater Flow Direction
🟩	Range/Training Area	●	Residential Supply Well*		
☐	AOI	〜	River/Stream (Perennial)		
▨	AFFF Use Area	〜	River/Stream (Intermittent)		
◐	Monitoring Well	⁄	Canal/Ditch		

AFFF = Aqueous Film-Forming Foam
AOI = Area of Interest

Data Sources:
Yakima Training Center, GIS Data, 2018
ESRI ArcGIS Online, Aerial Imagery

Coordinate System:
WGS 1984, UTM Zone 10 North

Boundary Investigation Work Plan
USAEC PFAS Remedial Investigation
Yakima Training Center, WA

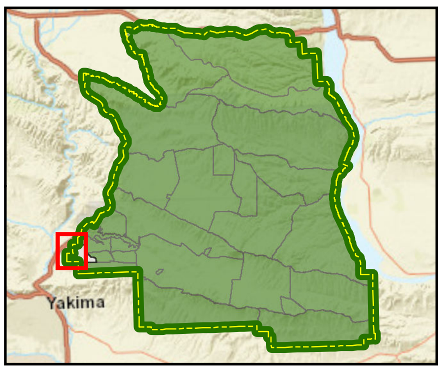
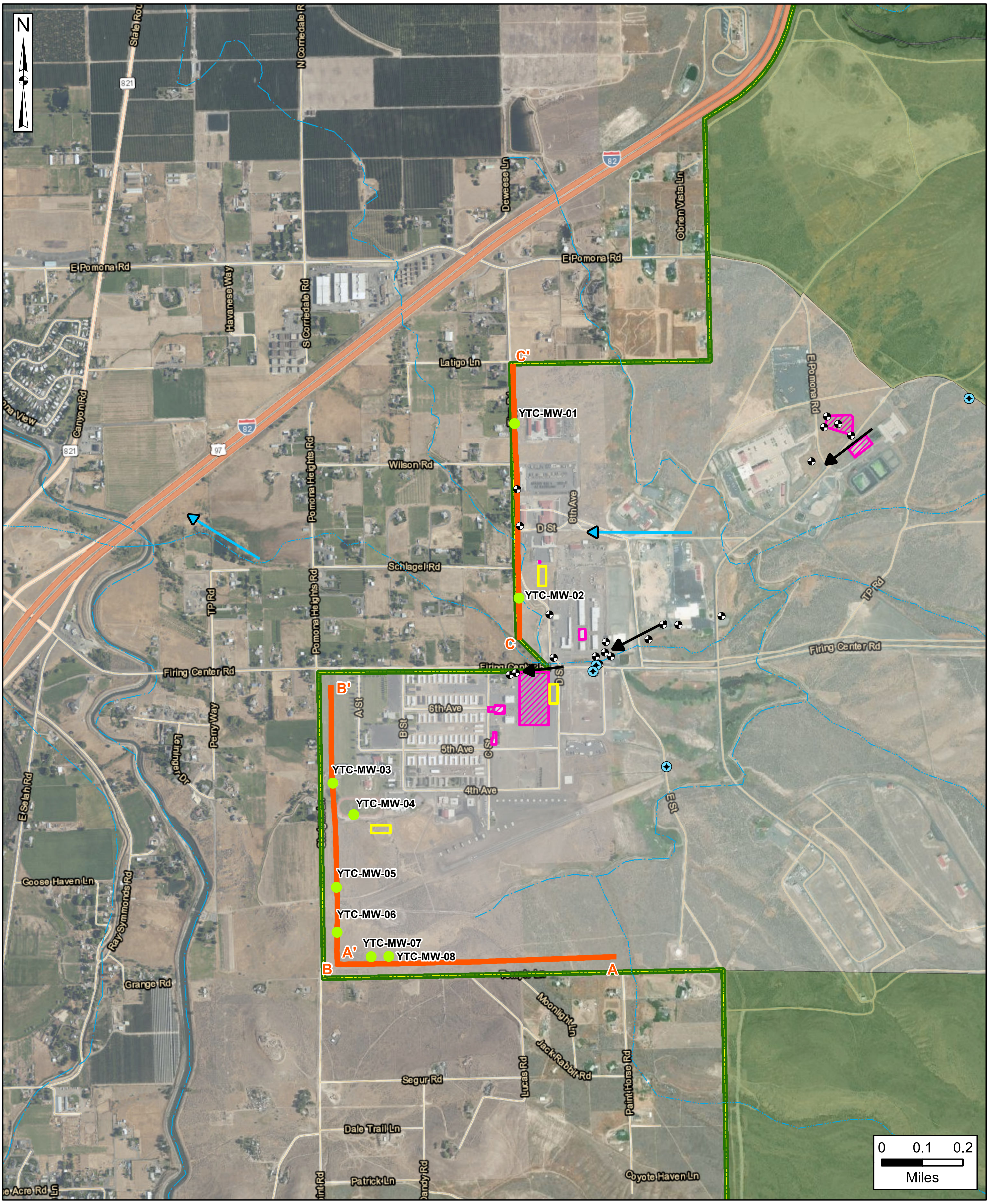


Figure 3
Surface Geophysics Transect Locations



- 🟩 Installation Boundary
- ⬜ Cantonment Area
- 🟩 Range/Training Area
- ⬜ AOI
- ▨ AFFF Use Area
- ◉ Monitoring Well
- ⊕ Potable Water Well (On-Installation)
- 〰 River/Stream (Perennial)
- 〰 River/Stream (Intermittent)
- ╱ Canal/Ditch

AFFF = Aqueous Film-Forming Foam
AOI = Area of Interest

- ▷ Deep Groundwater (i.e., Used for Installation Potable Supply) Flow Direction
- ➜ Perched Groundwater Flow Direction
- ━ Surface Geophysics Transect
- ⬜ Lay Down Area

Proposed Sampling Locations

- ● Boundary Monitoring Well

Data Sources:
Yakima Training Center, GIS Data, 2018
ESRI ArcGIS Online, Aerial Imagery

Coordinate System:
WGS 1984, UTM Zone 10 North

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APPENDIX A

Site Inspection Program UFP-QAPP and YTC UFP-QAPP Addendum

FINAL

Programmatic Uniform Federal Policy-Quality Assurance Project Plan

USAEC PFAS PA/SI
Active Army Installations, Nationwide, USA

October 2019

Contract No.: W912DR-18-D-0004
Delivery Order No.: W912DR18F0685

Prepared For:

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Programmatic Uniform Federal Policy-Quality Assurance Project Plan

USAEC PFAS PA/SI
Active Army Installations, Nationwide, USA

Prepared for:

US Army Corps of Engineers
Contract No.: W912DR-18-D-0004
Delivery Order No.: W912DR18F0685

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Our Ref.:

02118231.1000

Date:

October 2019

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List of Acronyms and Abbreviations

%	Percent
%R	Percent Recovery
ºC	Degrees Celsius
AFFF	Aqueous Film Forming Foam
AMC	Army Materiel Command
AOPI	Area of Potential Interest
APP	Accident Prevention Plan
Arcadis	Arcadis U.S., Inc.
Army	United States Army
ARNG	Army National Guard
BRAC	Base Realignment and Closure
CAC	Common Access Cards
CCV	Continuing Calibration Verification
COC	Chain of Custody
CONUS	Continental United States
COR	Contracting Officer’s Representative
CSM	Conceptual Site Model
CX	Center of Expertise
DFW	Definable Feature of Work
DoD	Department of Defense
DPM	Deputy Project Manager
DQI	Data Quality Indicator
DQO	Data Quality Objective
EDD	Electronic Data Deliverable
ELAP	Environmental Laboratory Accreditation Program
ELLE	Eurofins Lancaster Laboratories Environmental
ESM	Environmental Support Manager
FUDS	Formerly Used Defense Sites
GCAL	Gulf Coast Analytical Laboratory
GIS	Geographical Information System
HDPE	High Density Polyethylene
ICAL	Initial Calibration
ICV	Initial Calibration Verification
IDW	Investigation Derived Waste
IPR	In Progress Review
ISC	Instrument Sensitivity Check
LC/MS/MS	Liquid Chromatography / Tandem Mass Spectrometry
LCS	Laboratory Control Sample
LCSD	Laboratory Control Sample Duplicate
LOD	Limit of Detection
LOQ	Limit of Quantitation
mg/kg	milligrams per kilogram
MSC	Major Subordinate Command
MSD	Matrix Spike Duplicate

List of Acronyms and Abbreviations

N/A	Not Applicable
ng/g	nanograms per gram
ng/L	nanograms per liter
NTU	Nephelometric Turbidity Unit
OCONUS	Outside the Continental United States
OPORDER	Operations Order
OPSEC	Operations Security
PA	Preliminary Assessment
PE	Professional Engineer
PFAS	Per/Polyfluoroalkyl substances
PFOA	Perfluorooctanoic acid
PFOS	Perfluorooctane sulfonate
PG	Professional Geologist
PM	Project Manager
PMP	Project Management Professional
POC	Point of Contact
ppm	parts per million
PQAPP	Programmatic Uniform Federal Policy-Quality Assurance Project Plan
QA	Quality Assurance
QC	Quality Control
QP	Quality Procedure
QSM	Quality Systems Manual
RAB	Restoration Advisory Board
RL	Reporting Limit
RPD	Relative Percent Difference
SDG	Sample Delivery Group
SI	Site Inspection
SOP	Standard Operating Procedure
SSHP	Site Safety and Health Plan
su	Standard pH Unit
TBD	To Be Determined
TGI	Technical Guidance Instructions
TOC	Total Organic Carbon
U.S.	United States
UFP-QAPP	Uniform Federal Policy-Quality Assurance Project Plan
USACE	United States Army Corps of Engineers
USAEC	United States Army Environmental Command
USARC	United States Army Reserve Command
USEPA	United States Environmental Protection Agency
VOC	Volatile Organic Compound
WHO	World Health Organization

Introduction

This Programmatic Uniform Federal Policy-Quality Assurance Project Plan (PQAPP) addresses the per- and polyfluoroalkyl substances (PFAS) Preliminary Assessment (PA)-phase sampling and Site Inspections (SI) at active United States (U.S.) Army (Army and Reserves) installations within the U.S., including Hawaii and Alaska. The purpose of this PQAPP is to detail the planning processes for collecting data at 87 installations and to describe the implementation of the quality assurance (QA) and quality control (QC) activities developed for this program. More installations may be added as the program progresses. The objectives of this PQAPP are to generate project data that are technically defensible, and useful in meeting the project goals, which are to identify the presence or absence of PFAS at installation areas of potential interest (AOPI), and update the AOPI conceptual site models (CSMs).

This PQAPP addresses four primary elements:

- Project Management
- Measurement and Data Acquisition
- Assessment and Oversight
- Data Validation and Usability

The above elements incorporate QA/QC requirements from the following documents:

- U.S. Environmental Protection Agency (USEPA) *Requirements for Quality Assurance Project Plans,* USEPA QA/R-5, March 2001.
- USEPA *Uniform Federal Policy for Quality Assurance Project Plans,* Final Version, March 2005.
- USEPA *Guidance on Systematic Planning Using the Data Quality Objectives Process,* USEPA QA/G-4, EPA/240/B-06/001, February 2006.
- Department of Defense (DoD) *Quality Systems Manual,* Version 5.1.1, February 2018, 5.2, December 2018, 5.3, May 2019, and future versions.
- USEPA *Guidance on Quality Assurance Project Plans,* CIO-2106-G-05, January 2012

The PQAPP worksheet format used herein implements the systematic planning process for environmental sampling and was developed via collaboration between the USEPA, DoD, and the Department of Energy. In 2010, a subgroup composed of members from the participating agencies was established to review and optimize the PQAPP worksheets in close coordination with USEPA's update of QA/G-5 (i.e., CIO-2106-G-05, January 2012). The optimized worksheet format is used for this PQAPP. **Table 1** provides a crosswalk between the optimized PQAPP worksheet numbers and titles and the CIO-2106-G-05 guidance.

Several of the worksheets included in this PQAPP have been completed with overall programmatic information with reference to site specific QAPP addenda, which will be submitted separately. In these instances, instructions for the worksheet were left in the worksheet and a statement was added referring the reader to the site-specific QAPP addenda, including site specific information such as sampling locations, media or other methodologies. The worksheets that may be presented in the site specific QAPP addenda are 1/2, 4/7/8, 10, 11, 13, 14/16, 15, 17, 18, and 20. General procedures for conducting sampling for both the PA and the SI are presented in this document. Should site conditions warrant deviation from the perscribed procedures, in this PQAPP, a site-specific QAPP addendum will describe the proposed change and rationale.

Table 1: Crosswalk - UFP-QAPP Workbook to ANSI/ASQ E-4T

Optimized UFP-QAPP Worksheets		ANSI/ASQ E-4 QAPP Guidance Section	
1 & 2	Title and Approval Page	2.2.1	Title, Version, and Approval/Sign-Off
3 & 5	Project Organization and Quality Assurance Project Plan Distribution	2.2.3	Distribution List
		2.2.4	Project Organization and Schedule
4, 7 & 8	Personnel Qualifications and Sign-off Sheet	2.2.1	Title, Version, and Approval/Sign-Off
		2.2.7	Special Training Requirements and Certification
6	Communication Pathways	2.2.4	Project Organization and Schedule
9	Project Planning Session Summary	2.2.5	Project Background, Overview, and Intended Use of Data
10	Conceptual Site Model	2.2.5	Project Background, Overview, and Intended Use of Data
11	Project/Data Quality Objectives	2.2.6	Data/Project Quality Objectives and Measurement Performance Criteria
12	Measurement Performance Criteria	2.2.6	Data/Project Quality Objectives and Measurement Performance Criteria
13	Secondary Data Uses and Limitations	Chapter 3	QAPP Elements for Evaluating Existing Data
14 & 16	Project Tasks & Schedule	2.2.4	Project Organization and Schedule
15	Project Action Limits and Laboratory-Specific Detection / Quantitation Limits	2.2.6	Data/Project Quality Objectives and Measurement Performance Criteria
17	Sampling Design and Rationale	2.3.1	Sample Collection Procedure, Experimental Design, and Sampling Tasks
18	Sampling Locations and Methods	2.3.1	Sample Collection Procedure, Experimental Design, and Sampling Tasks
		2.3.2	Sampling Procedures and Requirements
19 & 30	Sample Containers, Preservation, and Hold Times	2.3.2	Sampling Procedures and Requirements
20	Field Quality Control	2.3.5	Quality Control Requirements
21	Field Standard Operating Procedures (SOPs)	2.3.2	Sampling Procedures and Requirements
22	Field Equipment Calibration, Maintenance, Testing, and Inspection	2.3.6	Instrument/Equipment Testing, Calibration and Maintenance Requirements, Supplies and Consumables
23	Analytical SOPs	2.3.4	Analytical Methods Requirements and Task Description

Optimized UFP-QAPP Worksheets		**ANSI/ASQ E-4 QAPP Guidance Section**	
24	Analytical Instrument Calibration	2.3.6	Instrument/Equipment Testing, Calibration and Maintenance Requirements, Supplies and Consumables
25	Analytical Instrument and Equipment Maintenance, Testing, and Inspection	2.3.6	Instrument/Equipment Testing, Calibration and Maintenance Requirements, Supplies and Consumables
26 & 27	Sample Handling, Custody, and Disposal	2.3.3	Sample Handling, Custody Procedures, and Documentation
28	Analytical Quality Control and Corrective Action	2.3.5	Quality Control Requirements
29	Project Documents and Records	2.2.8	Documentation and Records Requirements
31, 32 & 33	Assessments and Corrective Action	2.4	Assessments and Data Review
		2.5.5	Reports to Management
34	Data Verification and Validation Inputs	2.5.1	Data Verification and Validation Targets and Methods
35	Data Verification Procedures	2.5.1	Data Verification and Validation Targets and Methods
36	Data Validation Procedures	2.5.1	Data Verification and Validation Targets and Methods
37	Data Usability Assessment	2.5.2	Quantitative and Qualitative Evaluations of Usability
		2.5.3	Potential Limitations on Data Interpretation
		2.5.4	Reconciliation with Project Requirements

QAPP Worksheet #1 & 2: Title and Approval Page

(UFP-QAPP Manual Section 2.1)
(EPA 2106-G-05 Section 2.2.1)

1. Project Identifying Information
    a. Site name/project name: U.S. Army Environmental Command (USAEC) PFAS PA/SI
    b. Site location/number: Various Active Army (and Reserves) Installations, Nationwide Continental United States (CONUS) and Outside Continental United States (OCONUS) (Hawaii and Alaska)
    c. Contract/Work assignment number: W912DR-18-D-0004 / W912DR18F0685

2. Lead Organizations: U.S. Army Corps of Engineers (USACE) and USAEC
    a. Lead Organization Project Manager (PM) (name/title/signature/date)

USACE PM: ____
Printed Name/Organization: Riadh Hossain, USACE, Baltimore District

    b. Lead Organization Contracting Officer's Representative (COR) USACE (name/title/signature/date)

USACE COR: ____
Printed Name/Organization: Brant Crumbling, USACE, Baltimore District

    c. Lead Organization USAEC PM (name/title/signature/date)

USAEC PM: ____
Printed Name/Organization: Laurie Haines-Eklund, USAEC PM

3. List plans and reports from previous investigations relevant to this project

Title	Date
None	NA

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

(UFP-QAPP Manual Section 2.3 and 2.4)
(EPA 2106-G-05 Section 2.2.3 and 2.2.4)

Figure 1: Project Organization

Analytical Lab Primary

Eurofins Lancaster Laboratories Environmental (ELLE)

Analytical Lab Secondary

Gulf Coast Analytical Laboratories (GCAL)

Shealy Environmental Services (Shealy)

Table 2: Contact Information for Government Team Members

Name and Contact Information	Telephone/E-Mail	Roles/Responsibilities
Hap Gonser USAEC	PH: (210) 466-1777 Cell: Email: kent.r.gonser.civ@mail.mil	Army Environmental Command – NE Environmental Services and Support Division Chief and Co-PFAS Lead Driving programmatic decision-making
Laurie Haines-Eklund USAEC	PH: (210)-466-1873 Cell: (210) 793-6898 Email: laurie.b.haines-eklund.civ@mail.mil	Army Environmental Command – NE Environmental Services and Support Division Deputy Chief and Co-PFAS Lead Driving programmatic decision-making
Riadh Hossain North Atlantic Division (NAD) USACE Baltimore	PH: (410) 962-2342 Cell: (410) 428-5822 Email: Riadh.hossain@usace.army.mil	USACE, Program Manager responsible for overall program management.
Clifford Opdyke (NAD) USACE Baltimore	PH: (410) 962-6765 Cell: (410) 736-0491 Email: Clifford.A.Opdyke@usace.army.mil	Program-Wide Technical Leader and NAD Technical Support
Brant Crumbling NAD USACE Baltimore	PH: (410) 962-0004 Cell: (443) 447-5297 Email: Brant.M.Crumbling@usace.army.mil	COR and PA/SI Leader for NAD Sites: (18) Aberdeen Proving Ground, Carlisle Barracks, Fort AP Hill, Fort Belvoir, Fort Detrick, Forest Glen, Devens, Fort Meade, Fort Hamilton, Fort Lee, Phoenix Military Reservation, Letterkenny, Natick Soldier System, Picatinny, Radford, Tobyhanna, Watervliet, West Point, Fort Drum , Vint Hill
Craig Coombs Great Lakes and Ohio River Division (LRD) USACE Louisville	PH: (502) 315-6324 Cell: (502) 523-7084 Email: Craig.A.Coombs@usace.army.mil	PA Leader for LRD Sites: (5) Blue Grass Army Depot, Detroit Arsenal, Fort Campbell, Fort Knox, Rock Island, Lima Tank Plant
Amanda Chirpich, P.E., PMP, Northwestern Division (NWD), USACE Kansas City	PH: (816) 389-3654 Cell: (816) 820-8679 Email: Amanda.Chirpich@usace.army.mil	PA/SI Leader for NWD Sites: (8) Fort Carson, Fort Leavenworth, Fort Leonard Wood, Fort McCoy, Fort Riley, Iowa Army Ammunition Plant (AAP), Lake City AAP, Yakima
Jim Lukasko South Pacific Division (SPD) USACE Sacramento	PH: (916) 557-5392 Email: James.J.Lukasko@usace.army.mil	PA/SI Leader for SPD Sites: (12) Dugway Proving Ground, Fort Huachuca, Fort Hunter Liggett, Parks Reserve Forces Training Area, Fort Irwin, Hawthorne Army Depot, Mil Ocean Terminal Concord, Presidio of Monterey, Sharpe Depot, Sierra Army Depot, Tooele Army Depot, Yuma
Robert Glascott POD (Alaska sites) and Pacific Ocean Division (POD) (Hawaii Sites) USACE Alaska	PH: (907) 753-5771 Email: robert.a.glascott@usace.army.mil	PA Leader for Alaska/Hawaii Sites: (4) Fort Greely, Fort Wainwright, 3 Fort Wainwright Sub-Installations, Gerstle River Sites (12): Schofield Barracks and its 11 Sub Installations – Dillingham, Helemano, Kahuku, Kilauea, Kipapa, Kunia, Makua, Pohakuloa, Tripler, Waikakalaua, Wheeler, (Hawaii)

Name and Contact Information	Telephone/E-Mail	Roles/Responsibilities
Frank Cerio South Atlantic Division (SAD) USACE Savannah	PH: (912)-652-5120 Email: Frank.J.Cerio@usace.army.mil	PA Leader for SAD Sites: (13) Anniston Army Depot, Fort Benning, Fort Bragg, Fort Gordon, Fort Jackson, Fort Rucker, Fort Stewart, Hunter Army Airfield, Camp Mackall, Holston Army Depot, Milan AAP, Mil Ocean Term Sunny Point, Redstone, Fort Buchanan
Grady Greene Southwestern Division (SWD) USACE Tulsa	PH: (918) 669-4953 Email: grady.d.greene@usace.army.mil	PA Leader for SWD Sites: (10): Fort Bliss, Fort Hood, Fort Polk, Fort Sill, Peason Ridge, McAlester AAP, Pine Bluff Arsenal, Red River Army Depot, White Sands and Green River Test Site (White Sands).
Bridgett Lyons AMC Project Manager	Ph: 256 450-7145 Email: bridgett.e.lyons.civ@mail.mil	AMC Project Manager for AMC Installations: Sierra Army Depot, MCAAP, Red River AD, MOTSU, Hawthorne AD, IAAP, LCAAP, Pine Bluff, Holston AAP, Letterkenny, Blue Grass, Tobyhanna, Anniston, MOTCU, Milan AAP, Tooele, Radford AAAP, Watervliet

Table 3: Arcadis Project Personnel Roles and Responsibilities

Name and Contact Information	Telephone/E-Mail	Roles/Responsibilities
Rhonda Stone Delegate: Kimmie Schrupp	PH: (610) 563-6122 Email: rhonda.stone@arcadis.com	**Project Manager** • Single, project-dedicated, POC • Meet contractual obligations • Develop, update, and maintain compliance with project work breakdown structure and schedule • Prepare/submit daily/monthly/weekly progress and cost reporting and • Required periodic reports • Implement procedures to eliminate conflicts, errors, and omissions and ensure the accuracy of all output • Review all invoices and cost details • Maintain communication and coordination with all government stakeholders, including USAEC and USACE
Kimmie Schrupp	PH: (720) 344-3712 Cell: (303) 916-1193 Email: kimmie.schrupp@arcadis.com	**Deputy Project Manager** • Support/implement project controls on a day-to-day basis • Perform day-to-day project communication tasks • Lead day to day coordination of tasks, field work, and deliverables • Prepare/submit monthly/weekly progress and cost reporting and periodic reports • Assist the PM with any client meeting and submittals • Develops / supports training on PFAS as needed • Maintain communication and coordination with all government stakeholders, including USAEC and USACE • Attendance at all meetings
Erika Houtz, PhD	PH: (415) 432-6947 Cell: (937) 307-9323 Email: erika.houtz@arcadis.com	**Quality Control – Sampling** • Subject matter expert for PFAS Sampling • Provide technical input on development of plans, templates, and reports • Perform technical review of all project deliverables relating to sampling • On-Site work and subcontractor management, QA/QC and safety compliance • Participates in project meetings, as needed

Name and Contact Information	Telephone/E-Mail	Roles/Responsibilities
Jeffrey McDonough, Professional Engineer (PE) Delegate: Jessica Travis	PH: (267) 685-1812 Cell: (267) 615-1863 Email: jeffrey.mcdonough@arcadis.com Delegate: PH: 302-561-4904 Email: jatravis@seres-es.com	**Quality Control – Technical** • Subject matter expert for PFAS • Provide technical input on development of plans, templates, and reports • Perform technical review of all project deliverables • On-Site work and subcontractor management, QA/QC and safety compliance • Participates in project meetings, as needed
Jeff Burdick Delegate: Joe Quinnan	PH: (267) 685-1804 Cell: (215) 375-4879 Email: Jeff.Burdick@arcadis.com Delegate: PH: (810) 225-1943 Cell: (248) 789-4951 Email: Joseph.Quinnan@arcadis.com	**Senior Scientist** • Technical Lead and subject matter expert for PFAS • Provide technical input on development of plans, templates, and reports • Perform technical review of all project deliverables • Develops / supports training on PFAS as needed Participates in project meetings, as needed
Heather Polinsky Delegate: Jennifer Mayers	PH: (410) 230-9961 Cell: (410) 353-7855 Email: heather.polinsky@arcadis.com Delegate: PH: (434) 390-3273 Cell: (434) 390-3273 Email: jennifer.buckelsmayers@arcadis.com	**Program Manager** • Single POC for Contracting Officer • Meet contractual obligations of the contract / task order • Provides programmatic support and reporting to the USACE and USAEC • Addresses overall management and contracting issues • Maintain communication with USACE and USAEC on project performance and risk management • Attendance at select project meetings

Table 4: Arcadis Installation-Specific Team Leads

Installation	Team Lead	Contact Information
Anniston Army Depot	Daria Navon	PH: 813-353-5739 Email: Daria.Navon@arcadis.com
Fort AP Hill, Fort Stewart, Fort Stewart Sub Installation – Hunter Army Field	Courtney Ingersoll	PH: (757) 873-4423 Email: Courtney.Ingersoll@arcadis.com
Fort Belvoir, Fort Bragg, Tobyhanna Army Depot	Afton Hess	PH: 410-332-4836 Email: Afton.Hess@arcadis.com
Fort Benning, Fort Jackson	Mark Albe/ Catherine Coffey	PH: 864-987-3919 / 804-665-1110 Email: Mark.Albe@arcadis.com / Catherine.Coffey@arcadis.com
Fort Gordon, Fort Gordon Sub Installation Gillem Enclave	Kirstyn White	PH: 919-415-2261 Email: Kirstyn.White@arcadis.com
Fort Lee, Holston SI	Catherine Coffey	PH: 804-665-1110 Email: Catherine.Coffey@arcadis.com
Fort Rucker	Scott Bostian	PH: 919-415-2291 Email: curtis.bostian@arcadis.com
Milan Army Ammunition Plant, Detroit Arsenal, Letterkenny Army Depot, Carlisle Barracks	Meredith Braverman	PH: 484-232-9850 Email: Meredith.Braverman@arcadis.com
MOTSU	Lauren Henderson	PH: 757-419-3982 Email: Lauren.Henderson@arcadis.com
Radford Army Ammunition Plant, Blue Grass Army Depot	Jason Artrip	PH: 276-322-3879 Email: jason.artrip@arcadis.com
Redstone Arsenal	Daria Navon	PH: 813-353-5739 Email: Daria.Navon@arcadis.com
Fort Campbell	Meredith Braverman/ Olivia Miller	PH: 484-232-9850 / 512-527-6086 Email: Meredith.Braverman@arcadis.com / Olivia.Miller@arcadis.com
Fort Carson	Kimmie Schrupp	PH: 720-344-3712 Email: Kimberley.Schrupp@arcadis.com

Installation	Team Lead	Contact Information
Fort Greely, Fort Wainwright	Kimmie Schrupp/ Olivia Miller	PH: 720-344-3712 / 512-527-6086 Email: Kimberley.Schrupp@arcadis.com / Olivia.Miller@arcadis.com
Fort Knox, Fort Riley, Rock Island Arsenal	Britt Phillips	PH: 720-409-0768 Email: Britt.Phillips@arcadis.com
Fort Leonard Wood	Tim Derstine	PH: 817-595-0614 Email: Timothy.Derstine@arcadis.com
Fort McCoy	Kimmie Schrupp/Kevin Engle	PH: 720-344-3712 / 414-277-6296 Email: Kimberley.Schrupp@arcadis.com / Kevin.Engle@arcadis.com
Fort Wainwright Sub Installations Gerstle River Test Site, Haines Pipeline Facilities	Kimmie Schrupp/ Becca Ingwers	PH: 720-344-3712 / 720-386-5602 Email: Kimberley.Schrupp@arcadis.com / Rebecca.ingwers@arcadis.com
Iowa Army Ammunition Plant	Kevin Engle	PH: 414-277-6296 Email: Kevin.Engle@arcadis.com
LCAAP	Kimmie Schrupp/Angie Barber	PH: 720-344-3712 / 303-471-3417 Email: Kimberley.Schrupp@arcadis.com / Angela.Barber@arcadis.com
Yakima Training Center	Olivia Miller	PH: 512-527-6086 Email: Olivia.Miller@arcadis.com
Camp Parks, Fort Hunter Liggett, Hawthorne Army Depot, Military Ocean Terminal Concord	Wendy McClellan	PH: 510-284-9846 Email: Wendy.McClellan@arcadis.com
Dugway Proving Ground, Fort Irwin National Training Center, Sharpe Army Depot	Mike Asakawa	PH: 714-508-2679 Email: Mike.Asakawa@arcadis.com
Fort Huachuca, Tooele Army Depot North, Tooele Army Depot South - Deseret	Layne Young	PH: 410-332-4806 Email: Layne.Young@arcadis.com
Sierra Army Depot	Hoa Voscott	PH: 312-575-3738 Email: Hoa.Voscott@arcadis.com
USAG HI - Schofield Barracks - Part 1, Part 2, Part 3,	Nick Wood	PH: 808-522-0342 Email: Nick.Wood@arcadis.com
Yuma Proving Ground	Scott Bostian	PH: 919-415-2291 Email: curtis.bostian@arcadis.com

Installation	Team Lead	Contact Information
Fort Bliss	Garrett Ferguson	PH: 915-747-3902 Email: garett.ferguson@arcadis.com
Fort Hood, Fort Polk, Fort Polk Sub Installation – Peason Ridge, McAlester Army Ammunition Plant	Alex Walter	PH: 913-998-6925 Email: Alex.Walter@arcadis.com
Fort Sill, Pine Bluff Arsenal	Tim Derstine	PH: 817-595-0614 Email: Timothy.Derstine@arcadis.com
Red River Army Depot	Alex Walter /Mike Madl	PH: 913-998-6925 / 817-502-1165 Email: Alex.Walter@arcadis.com / Mike.Madl@arcadis.com
White Sands Missile Range, White Sands Sub Installation – Green River Test Site	Garrett Ferguson	PH: 915-747-3902 Email: garett.ferguson@arcadis.com
APG, Edgewood, West Point	Ankit Gupta	PH: N/A Email: Ankit.Gupta@arcadis.com
Fort Detrick, Fort Detrick Sub Installation – Forest Glen Annex	Rosemarie Potocky	PH: 410-923-7848 Email: Rosemarie.Potocky@arcadis.com
Fort Hamilton	Ankit Gupta/Matt Blower	PH: N/A / 703-842-5606 Email: Ankit.Gupta@arcadis.com / Matthew.Blower@arcadis.com
Fort Meade, Fort Meade Sub Installation – Phoenix Military Reservation	Keith Shepherd	PH: 410-987-0032 Email: Keith.Shepherd@arcadis.com
U.S. Army Natick Soldier Systems Center	Ankit Gupta/Aubrey Thomas	PH: N/A / 518-250-7387 Email: Ankit.Gupta@arcadis.com / Aubrey.Thomas@arcadis.com
Watervliet Arsenal	Andy Vitolins	PH: 518-250-7359 Email: Andy.Vitolins@arcadis.com
Fort Buchanan, Fort Drum, Joint Systems Manufacturing System	Carla DaParma	PH: 724-742-9180 Email: Carla.DaParma@arcadis.com
Vint Hill Farms	Christopher Spooner	PH: 703-465-4225 Email: Christopher.Spooner@arcadis.com
Picatinny	Lisa Szegedi	PH: 201-398-4328 Email: Lisa.Szegedi@arcadis.com

QAPP Worksheet #4, 7 & 8: Personnel Qualifications and Sign-off Sheet

(UFP-QAPP Manual Sections 2.3.2 – 2.3.4)
(EPA 2106-G-05 Section 2.2.1 and 2.2.7)

This worksheet is used to identify key project personnel for each organization performing tasks defined in this PQAPP.

LEAD ORGANIZATION: USACE, USAEC

Name	Agency	Project Title/Role	Signature*/Date
Laurie Haines-Eklund	USAEC	USAEC PM	☐
Riadh Hossain	USACE	USACE PM	☐

*Signatures indicate personnel have read and agree to implement this PQAPP as written

ORGANIZATION: Arcadis U.S., Inc. (Arcadis)

Name	Project Title/Role	Education/Experience	Signature*/Date
Rhonda Stone, PMP	PM	B.S. Environmental Science, 24 years of experience. Program/PM for Hazardous, Toxic and Radioactive Waste projects and USAEC Environmental Remediation Multiple Award contracts. Previously a Program Manager for the Army's Operational Range Assessment Program for the USAEC and USACE.	☒
Kimberley Schrupp	Deputy PM (DPM)	B.S. Biochemistry, 16 years of experience. This experience includes strategy development and environmental cost estimating for multiple clients including federal. Previously a task manager for commercial and federal performance-based projects.	☒
Joseph Quinnan, PE, Professional Geologist (PG)	Technical Quality Control Manager	B.S. Geological Engineering, Master of Science (M.S.) Geological Engineering. 27 years of experience. Global lead for site characterization, North American lead for emerging contaminants.	☒
Erika Houtz, PhD, PE	Sampling and Analytical Quality Control Lead and Senior Chemist	B.S. Chemical Engineering, M.S. and Ph.D. Environmental Engineering, 9 years of experience, including 6 years as a PFAS analytical chemist. Project chemist on PFAS projects for private clients, USACE, and Air Force Civil Engineer Center.	☒

Name	Project Title/Role	Education/Experience	Signature*/Date
Grey Coppi, Certified Industrial Hygienist, Certified Safety Professional	Program Health and Safety Manager	M.S. Industrial Hygiene. 30 years of experience. Involved in numerous remediation/ construction projects; procedure and training course development and presentations; site safety audits/reviews for USACE projects; development of Site Safety and Health Plans (SSHPs) and Accident Prevention Plans (APPs).	☒
Lyndi Mott	Project Chemist and Data Validator	B.S. Chemistry, MBA. 33 years of environmental chemistry experience, including over 13 years of project chemistry experience in coordination with Air Force Civil Engineer Center, USACE, and USEPA.	☒

*Signatures indicate personnel have read and agree to implement this PQAPP as written

ORGANIZATION: Eurofins Lancaster Laboratories Environmental (ELLE)

Name	Project Title/Role	Education/Experience	Signature*/Date
Kathy Klinefelter	PM	B.S. Chemistry, M.S. Physiology. 24+ years of experience	☒
Dorothy Love	QA Director	B.S. Environmental Health. 28+ years of experience	☒

ORGANIZATION: Gulf Coast Analytical Laboratory (GCAL)

Name	Project Title/Role	Education/Experience	Signature*/Date
Brenda Martinez	PM	B.S. Bioenvironmental Science, M.S. Environmental Management. 15 years of experience.	☒
William Perry	QA Manager	B.S. Chemistry. 32 years of experience.	☒

*Signatures indicate personnel have read and agree to implement this PQAPP as written

ORGANIZATION: Shealy Environmental Services (Shealy)

Name	Project Title/Role	Education/Experience	Signature*/Date
Nisreen Saikaly	PM	B.S. Chemistry; 14 years of experience	☒
Stephanie Atkins	QA Manager	M.S. 2018 in Environmental Management, B.S. 2007 in Biology, 13 years of experience	☒

*Signatures indicate personnel have read and agree to implement this PQAPP as written

QAPP Worksheet #6: Communication Pathways

(UFP-QAPP Manual Section 2.4.2)
(EPA 2106-G-05 Section 2.2.4)

Communication Driver	Organization	Name	Contact Information	Procedure (e.g., timing, pathway, documentation)
Technical lead decisions and modifications	USAEC	Laurie Haines-Eklund USAEC PM	(210) 466-1873	Communicate technical lead decisions and modifications to USACE and/or Arcadis as necessary. All approved modifications will be included in the amendments to the PQAPP by Arcadis and approved within seven working days.
Aid in technical decisions and modifications	USACE	Clifford Opdyke, Ph.D. USACE Technical Lead	(410) 736-0491	Aid in technical decisions and modifications and communicate to client as necessary. All approved modifications will be included in the amendments to the PQAPP by Arcadis and approved within seven working days.
Programmatic and project issues	Arcadis	Rhonda Stone, PMP / PM Kimberley Schrupp / DPM	(610) 563-6122 (720) 344-3712	Arcadis management team will notify USACE Program team and USAEC Program team of any programmatic and project issues.
Minor field modifications not affecting groundwater or surface water data usability or quality	Arcadis	see PQAPP Worksheet #3 & 5	see PQAPP Worksheet #3 & 5	Secure same-day verbal approval from Arcadis Regional Lead.

Communication Driver	Organization	Name	Contact Information	Procedure (e.g., timing, pathway, documentation)
Minor field modifications not affecting soil or sediment data usability or quality	Arcadis	see PQAPP Worksheet #3 & 5	see PQAPP Worksheet #3 & 5	Secure same-day verbal approval from Arcadis Regional Lead.
Field modifications affecting groundwater or surface water data usability or quality	Arcadis	see PQAPP Worksheet #3 & 5	see PQAPP Worksheet #3 & 5	Secure same-day verbal approval from Arcadis Regional Lead, PM; Technical Lead. These will also include notification and/or approval form USACE Regional POC. When the USACE POC cannot be reached for approval in a timely matter as to not affect the field schedule, notification may be sufficient via email and voicemail. Regional Lead, DPM or PM will secure approval for modifications to the QAPP addendum as necessary from USACE. All approved modifications will be included in the amendments to the QAPP addendum and approved within seven working days.

Communication Driver	Organization	Name	Contact Information	Procedure (e.g., timing, pathway, documentation)
Field modifications affecting soil or sediment data usability or quality	Arcadis	see PQAPP Worksheet #3 & 5	see PQAPP Worksheet #3 & 5	Secure same-day verbal approval from Arcadis Regional Lead, PM; Technical Lead. These will also include notification and/or approval form USACE Regional POC. When the USACE POC cannot be reached for approval in a timely matter to not affect the field schedule, notification may be sufficient via email and voicemail. Regional Lead, DPM or PM will secure approval for modifications to the QAPP addendum as necessary from USACE. All approved modifications will be included in the amendments to the QAPP addendum and approved within seven working days.
Field progress reports	Arcadis	Regional Team Leads	Varies by Task	Arcadis Field Team Leaders or Regional Team Lead will send field progress reports via email on a daily basis to the Installation, USAEC, and USACE points of contact (POCs).

Communication Driver	Organization	Name	Contact Information	Procedure (e.g., timing, pathway, documentation)
Stop work due to safety issues	Arcadis	Regional Team Leads	Varies by Task	Work may be stopped at any time for any safety concern. Refer to the APP submitted for the USAEC PFAS PA/ SI project for specifics related to health and safety. Persons other than the responsible entity may also stop work for safety concerns. USACE will be notified by the Regional Lead, PM or DPM within one hour of any significant safety-related work stoppages and will be consulted prior to re-starting work.
PQAPP changes prior to field work	Arcadis	Rhonda Stone, PMP / PM	(610) 563-6122	Submit documented amendments within 10 working days for transmittal to USACE and USAEC for approval.
QAPP addendum changes during project execution	Arcadis	Regional Team Leads Rhonda Stone, PMP / PM	Varies by Task (610) 563-6122	Secure same-day approval from Regional Team Lead. Regional Team Lead, DPM or PM will secure approval for modifications to the QAPP addendum as necessary from USACE. All approved modifications will be included in the amendments to the QAPP addendum and approved within seven working days.

Communication Driver	Organization	Name	Contact Information	Procedure (e.g., timing, pathway, documentation)
Field corrective actions	Arcadis	Field Team Leader/Regional Team Leaders Rhonda Stone, PMP / PM Kimberley Schrupp / DPM	Varies by Task (610) 563-6122 (720) 344-3712	The Field Team communicates stop work immediately to the Regional Lead by phone followed by inclusion in daily field progress report. Resolution of the corrective action will be determined by the Regional Lead/PM in consultation with the USACE and may be documented on a non-conformance and/or corrective action report, depending on significance. Work will be allowed to start once all parties have agreed to the resolution.
Sample receipt variances	ELLE GCAL Shealy	Kathy Klinefelter, PM Brenda Martinez, PM Nisreen Saikaly, PM	717-656-2300 Ext 1566 225-769-4900 803-227-2704	All project field samples variance issues will be reported by the laboratory to the Regional Lead within two business days of identification of the technical concern.
Laboratory QC variances	ELLE GCAL Shealy	Kathy Klinefelter, PM Brenda Martinez, PM Nisreen Saikaly, PM	717-656-2300 Ext 1566 225-769-4900 803-227-2704	All QA/QC issues with project field samples will be reported by the laboratory to the Regional Lead within two business days of identification of the technical concern.

Communication Driver	Organization	Name	Contact Information	Procedure (e.g., timing, pathway, documentation)
Analytical corrective actions	ELLE GCAL Shealy	Kathy Klinefelter, PM Brenda Martinez, PM Nisreen Saikaly, PM	717-656-2300 Ext 1566 225-769-4900 803-227-2704	The need for laboratory corrective actions will be determined by the Project Chemist and Assistant PM and/or Laboratory PM, as appropriate, and will be documented in a memorandum to the Regional Lead, PM and Technical QC Manager. The Regional Lead will notify USACE if the changes to the data impact reports/data that have already been submitted. Otherwise, the memorandum will be included with the validated data.
Data verification issues, e.g., incomplete records	ELLE GCAL Shealy	Kathy Klinefelter, PM Brenda Martinez, PM Nisreen Saikaly, PM	717-656-2300 Ext 1566 225-769-4900 803-227-2704	All verification issues will be reported by the laboratory to the Regional Lead, PM and DPM via e-mail within 24 hours of identification of the technical concern. The Technical QC Manager will be notified of the issue by the Regional Lead and will take appropriate action, if necessary.
Data validation issues, e.g., non-compliance with procedures	Arcadis	Lyndi Mott, Data Validator and/or Erika Houtz, Senior Chemist	713-953-4829 937-307-9323 (M) 415-432-6947 (O)	All validation issues will be reported by the Data Validator to the Senior Chemist and Regional Lead via email within 24 hours of identification of the technical concern. The Technical QC Manager will be notified of the issue by the Data Validator and will take appropriate action, if necessary.

Communication Driver	Organization	Name	Contact Information	Procedure (e.g., timing, pathway, documentation)
Data review corrective actions	Arcadis	Lyndi Mott, Data Validator and/or Erika Houtz, Senior Chemist	713-953-4829 937-307-9323 (M) 415-432-6947 (O)	The need for data review corrective actions will be determined by the Senior Chemist and Regional Lead and/or Laboratory PM, as appropriate, and will be documented in a memorandum to the PM. The Technical QC Manager will be notified of the issue by the Regional Lead and will take appropriate action, if necessary.

QAPP Worksheet #9: Project Planning Session Summary

(UFP-QAPP Manual Section 2.5.1 and Figures 9-12)
(EPA 2106-G-05 Section 2.2.5)

Date of planning session: 14-15 December 2017
Location: Arcadis U.S., Inc. Office, Hanover, Maryland
Purpose: Technical Kick-Off Meeting

Participants:

Name	Organization	Title/Role	Email/Phone
Ms. Heather Polinsky, PMP	Arcadis	Program Manager	410-353-7855 Heather.Polinsky@arcadis.com
Ms. Rhonda Stone, PMP	Arcadis	PM	610-563-6122 Rhonda.Stone@arcadis.com
Ms. Kimberley Schrupp	Arcadis	Deputy PM	303-916-1193 Kimberley.Schrupp@arcadis.com
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Mr. Jeffrey McDonough, PE	Arcadis	Technical QC Manager	267-615-1863 Jeffrey.McDonough@arcadis.com
Mr. Mike Madl, PMP	Arcadis	Regional Team Lead	281-827-1754 Mike.Madl@arcadis.com
Ms. Wendy McClellan, PG	Arcadis	Regional Team Lead	510-284-9846 Wendy.McClellan@arcadis.com
Mr. Jeffrey Burdick	Arcadis	Technical Expert, PFAS	215-375-4879 Jeff.Burdick@arcadis.com
Dr. Erika Houtz (via phone)	Arcadis	Sampling and Analytical Quality Control Lead	415-432-6947 Erika.Houtz@arcadis.com
Mr. Joseph Quinnan, PE, PG (via phone)	Arcadis	Technical Expert, PFAS	810-225-1943 Joseph.Quinnan@arcadis.com
Ms. Erica Kalve (via phone)	Arcadis	PA Work Plan Technical Lead	415-491-4530 Erica.Kalve@arcadis.com
Mr. Riadh Hossain	USACE	PM	410-962-2542 Riadh.Hossain@usace.army.mil
Mr. Tim Peck, PG	USACE	COR	410-962-3416 Timothy.J.Peck@usace.army.mil
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Mr. Craig Coombs	USACE	Great Lakes and Ohio River Division PA/SI Regional POC	502-315-6324 Craig.A.Coombs@usace.army.mil

Name	Organization	Title/Role	Email/Phone
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Mr. Richard Smith	USACE	Southwestern Division PA/SI Regional POC	918-669-4956 Richard.P.Smith@usace.army.mil
Mr. Hap Gonser	USAEC	Branch Chief Northeast Division	210-466-1777 kent.r.gonser.civ@mail.mil
Ms. Laurie Haines-Eklund	USAEC	PM	210-466-1873 laurie.b.haines-eklund.civ@mail.mil
Dr. Bonnie Packer (15 December 2017 only)	Army National Guard (ARNG)		703-607-7977 bonnie.m.packer.ctr@mail.mil
Lt. Col. Adel Johnson (15 December 2017 only)	ARNG		adel.m.johnson.mil@mail.mil
Ms. Bridgett Lyons (via phone, 15 December 2017 only)	Army Materiel Command (AMC)		bridgett.e.lyons.civ@mail.mil

Notes/Comments:

Thursday, 14 December 2017

The meeting opened with an overview of meeting objectives and introductions.

- The meeting objectives were to obtain consensus on programmatic communications, concurrence on deliverable matrix, consensus on PA methodology, the definition of quality and concurrence on Arcadis' proposed quality approach, concurrence on USACE / USAEC QA plan, and concurrence on the PA.
- Introductions were brief, and each person provided a summary of their experience working on DoD projects, PFAS issues, and their role on the project.

A high-level summary of the Project Scope was presented, and the following discussion points were noted:

- Currently, there is not an Army-specific PFAS policy but there is pressure from the Navy and Air Force, and related policies that have been developed at the DoD level.
- This nationwide contract is designed to provide a uniform approach for the Army with consistent technical approaches and defensible conclusions.
- Clarification was provided regarding the contract requirement to conduct PAs for perfluorooctane sulfonate (PFOS) / perfluorooctanoic acid (PFOA). Future sampling plans will incorporate a larger suite of PFAS and, therefore, the title for the presentation (and subsequent deliverables) should refer to PFAS rather than PFOS/PFOA.
- Additional clarification was provided regarding reference to CONUS and that the document should refer to OCONUS installations so that it is inclusive of Alaska, Hawaii, and Puerto Rico.
- There was a detailed conversation to define an “installation” to include sub-installations and satellites per the Real Property Database. There was also a discussion about certain installations that have undergone Base Realignment and Closure (BRAC) that are still considered part of the Army’s liabilities including Fort Detrick, Reed, and Forest Glen.
    - For efficiency, USAEC will research whether the installations included have satellite or sub-installations that were not identified for this contract, so that the sites can be identified and discussed on each installation kick-off call. Action Item – Ms. Haines-Eklund
    - The Army would like to see small parcels addressed even if they aren’t “installations” or contiguous with installations.
    - Arcadis confirmed that visual surveys of such parcels would be included, even if not contiguous. However, if there was an issue like a fire response off-property, it was determined that it should be dealt with and discussed with the COR. Regardless, the approach would be consistent if the Army likely used the site, and regardless of property ownership, the site would be captured and evaluated (to the extent possible) as part of the Programmatic PA approach.
- The PFAS PA program will be guided by three white papers and will describe the issues with PFAS in comprehensive documents that could be used and considered during development of Army PFAS policy and how to approach the issues technically. The white papers will be provided in draft and once the text has been reviewed and approved by the Army, the text can be finalized and used in applicable future reports.
- Regarding the SI for Tier 1 Installations, there will not be sampling at the sites designated for SIs prior to conducting the SI (i.e., additional sampling to refine the PA).

Roles and responsibilities were discussed, and the following key items were recorded:

- Dr. Houtz will be the Arcadis Lead Chemist.
- The USACE Center of Expertise (CX) will review final products and the QAPP for AMC installations only. USAEC will find out if there will be one CX reviewer or multiple. Action Item – Ms. Haines-Eklund.
- Regional USACE POCs will foster communications/kickoff discussions with the installations in their regions and may attend the region’s first PA site visit as a test case.
- Arcadis Regional Leads will be leading the installation site visits. USACE Regional POCs will decide whether to attend based on the complexity of the installation, if it’s the first site visit to help facilitate data collection, or to observe progress later in the program. Ms. Stone will also go on some initial site visits.
- Ms. Haines-Eklund will evaluate whether USAEC Environmental Support Managers (ESMs) will attend the site visits. Action Item – Ms. Haines-Eklund.

An overview of the programmatic coordination and communication plan was presented, and the following discussion points were captured:

- USACE Regional POCs should be included in monthly calls, which are intended to be a client-level programmatic check-in, as opposed to detailed installation-specific updates. These calls are currently scheduled bi-weekly but will be moved to monthly as the project progresses towards the data collection phase.
- USAEC will need a status update on each site on the installation tracker. It was noted the tracker should be updated more frequently than monthly with the required status reports. Arcadis proposed that the tracker could be posted on the project SharePoint site, which would facilitate real time updates, to the extent feasible. This approach was agreed to by all. Action Item – Ms. Schrupp.
- Arcadis will coordinate site visits directly with installations as opposed to contacting USACE Regional POCs. To ensure that Arcadis has access to the appropriate senior level installation personnel, USAEC will provide a list of POCs. Mr. Gonser and Ms. Haines-Eklund have agreed to compile that by 15 January 2018. Action Item – Ms. Haines-Eklund.
- The draft Installation Management Command Operations Order (OPORDER) was developed and will be sent to installations. Final comments were sent in by Mr. Gonser a week or two ago and it is expected to be finalized by early January 2018.
- For AMC installations, the AMC POC, Ms. Lyons, will be notified of the site visit. Ms. Haines-Eklund and Mr. Gonser will provide additional Army personnel lists (ESMs, Major Subordinate Command [MSC], ID) of personnel who need to be notified when a visit is happening. Action Item – Ms. Haines-Eklund.
- USAEC Divisions/ESMs need to be informed of the schedule for site visits and reporting, but decisions on AOPIs and PA review and approval will be provided by Mr. Gonser and Ms. Haines-Eklund. To determine AOPIs, Arcadis and USACE will first brief USAEC (Mr. Gonser and Ms. Haines-Eklund) for concurrence, then provide that decision to the installations and ESMs. After installation/ESM concurrence the final path forward on AOPIs will be provided to USAEC (Mr. Gonser and Ms. Haines-Eklund) at which time USAEC (Mr. Gonser and Ms. Haines-Eklund) will provide additional comments or concurrence back to Arcadis for inclusion in the PA Report (see AOPI flow chart in briefing slide 16). The contract COR, Mr. Peck, must be informed and concur with any decisions that may affect contract execution.
- An educational overview for installations will be provided during the in briefing to describe PFAS issues and concerns. Arcadis will capture any installation questions and other program feedback and share any relevant questions/feedback during the scheduled bi-weekly or monthly calls. Action Item - Arcadis
- U.S. Army Reserve Command (USARC) will need to be contacted to determine their level of involvement in the PAs. Bill Rogers is the USARC POC. Ms. Haines-Eklund will talk to Mr. Rogers to make sure he knows that the PA process has started and determine his level of involvement. Action Item – Ms. Haines-Eklund.

Arcadis' plan is to get an agreement of the AOPIs prior to sending out the draft PA report through the post-site visit steps (e.g., trip report and telecon). Once the Draft PA reports are ready for review, they can be sent out to the required reviewers at the same time. However, USAEC (Ms. Haines-Eklund) will make final decisions based on the comments from the reviewers and she will provide Arcadis with the direction needed to resolve conflicting comments. Based on that direction, the document will be updated, and the revised PA Report will ultimately be approved by USAEC and the USACE PM. As part of the initial pilot testing approach, the first few draft reports will be sent to USAEC and USACE prior to the installations.

The following key discussion was captured during the PA Work Plan Discussion:

- Drinking water will be the immediate concern and the Army is interested in documenting everything that could be a potential source of PFAS to the environment, but the initial focus will be on assessing sites with potential and likely aqueous film forming foam (AFFF) releases.
- The documentation of other non-AFFF potential sources will provide context and allow the Army to move forward with other non-AFFF source area assessments during future phases of the PFAS site assessment process. Non-AFFF source areas could include, but are not limited to, metal plating operations (which has been noted during many previous discussions within DoD as a potentially likely source), areas with application of herbicides/insecticides and related staging areas, sludge application sites, landfills, sewer systems, and stormwater.
- The PA report will document what is found such that it can easily be used for internal Army reference and future considerations. Accordingly, the PA reports will have a section and table summarizing potential AFFF source areas and a separate section and table summarizing potential non-AFFF source areas. Similarly, potential off-site sources of PFAS will be noted for future reference as well. These secondary sources could also be added to the Installation Tracker file.
- The PA output will not include recommendations but will provide whether there are likely releases or receptors for those source areas.

The Work Plan discussion continued after the lunch break and the following key points were recorded:

- Arcadis will make arrangements with AMC installations and coordinate site visits far in advance of the site visit. It was suggested that any questionnaires should be sent out in advance to help ensure that the appropriate people will be on site and they will know what records will be needed.
- Arcadis inquired about obtaining common access cards (CACs) to ease the burden on the installations to gain team access for the site visits. Consensus was to get the Arcadis Regional Leads CACs to facilitate site visits. Action Item – Mr. Peck
- There was discussion about access to KCBRS data and READ. Ms. Haines-Eklund to follow up with Susan Elrod on access. Action Item – Ms. Haines-Eklund
- It was noted that the draft PA Work Plan did not include a public communication plan. The Army did develop a communication plan for the 2016 guidance document related to drinking water sampling for PFAS. USAEC will decide if a communication plan should be included in the read-ahead package, or possibly as an informational paper, and to determine if any regulatory agencies need to be notified (with reference to the FFA example). Action Item - Ms. Haines- Eklund
- There was discussion on whether the PFAS PAs should be briefed at the installation Restoration Advisory Boards (RABs). A final decision was reached on Day 2 that no PFAS briefing at RABs would occur at this time.
- Regarding databases to be reviewed as part of the pre-site visit steps, specific discussion points were captured related to Formerly Used Defense Sites (FUDS) and BRAC.
    - FUDS databases will be included in the desktop review, USACE to ask their districts how FUDS sites can be pulled from the FUDS databases. Action Item – Mr. Peck
    - Installations that have been partially BRAC'd will be handled by BRAC, but the BRAC PM should be involved in the process to ensure that appropriate information is exchanged related to those properties. Action Item - Arcadis

- Regarding notification, the plan is that all parties who agree to do the site visit should be notified via email when the site visit is going to proceed. The installation POC will coordinate with Garrison Commanders as necessary. It will not be Arcadis's job to coordinate directly with Garrison Commanders.
- Regarding the personnel interview list, Arcadis will include appropriate managers from pesticide management activities, Range Control, and aviation office. Additionally, Arcadis will interview fire services who supply the foam, if possible. Action Item - Arcadis
- Arcadis clarified that the goal is to gather all information during the visit. If it is not possible, Arcadis will request that data be provided approximately two weeks after completing the site visit.

The Preliminary Assessment QA/QC approach was reviewed, and the following discussion was noted:

Site visits will be audited, and QC will be implemented continuously along with each site visit. USACE will be responsible for overview of QA. Mr. McDonough (as QC lead for Arcadis) will work closely with Dr. Opdyke (as QA lead for USACE) to ensure overall program quality. All parties agreed that quality is defined by consistency, defensibility, and comprehensiveness.

The following summarizes the PA Report Outline Discussion:

- USAEC expressed that they would want to know when we are close to contract capacity for pre-SI sampling (e.g., when the assumed units are above 50 percent [%], 75%). Ms. Schrupp replied that the Monthly Status Reports will contain a table showing percent complete on a sub-contract line item number basis, so it should be easy to track. Action Item – Ms. Schrupp
- If a high priority site is identified, it was discussed that there are not contract mechanisms in place if bottled water is needed as an immediate response action. There was a discussion if groundwater wells figures should be included in the PA report. It was decided that to the extent possible, monitoring well location maps will be included as a main figure. Additionally, installation-specific rules and Operations Security (OPSEC) requirements and restrictions will be discussed as part of the installation kick-off teleconference. Action Item – Arcadis. The potential to cause inconsistencies will be reviewed by Mr. Gonser and he will check with USAEC in Washington D.C. to confirm that they are acceptable. Action Item– Mr. Gonser
- Regarding the designation of sites as they are evaluated during the PA process, it was decided that sites will initially be referred to as AOPIs. No Further Action is a term to be avoided in the PA phase; an alternative term was not formally identified at this time. USAEC legal to review and provide guidance regarding these terms. Action Item – Arcadis and USAEC
- The plan for the PA report is to provide conclusions regarding the possible presence of sites where PFAS could potentially have been released and where there is a receptor that could potentially interact with the releases. No recommendation should be provided in the PA. The approach will follow a Comprehensive Environmental Response, Compensation and Liability Act hybrid. The team will discuss recommendations during the post- site visit call to finalize determinations for sampling.
  - For appendices, it was recommended to include photo logs as an appendix for sites where Arcadis has permission to take photos, and the plan is to incorporate a very simple description and the photos will not have to be geo-tagged.

  - USACE and USAEC would like to see initial read ahead packages prior to distribution. Action Item – Arcadis. The read-ahead package will primarily be distributed electronically with hard copies going to Mr. Gonser and Ms. Haines-Eklund at USAEC. Mr. Lukasko, USACE POC, also requested a hard copy. All other POCs will receive electronic copies. The read-ahead packages will be sent to the installation POC; the rest are just copied. Project coordination and communication will be split into two tables, Deliverables and Approvals.

Regarding deliverable approvals, Mr. Peck is not able to approve anything until Mr. Gonser and Ms. Haines-Eklund have approved it, though the contract says both agencies must approve contract related deliverables.

Day 1 Wrap Up (schedule related):

- The In Progress Review (IPR) is the quarterly contract meeting which does not need to occur every 90 days, rather schedule them whenever is appropriate each quarter.
- Arcadis would like to discuss the white papers at the first quarter IPR meeting. The IPR meeting will be scheduled for February 7th, 2018 in Baltimore.
- USACE Regional POCs should be involved to support quality input on the QAPP.
- The draft QAPP will be reviewed in February and finalized in March so that the sampling program for Tier 1 installations can be initiated in April. The pilot installation (initially planned for at Ft Leavenworth) is currently scheduled for the first week in March. Later discussions indicate the target pilot installation will be Fort Hunter-Liggett.

Friday, 15 December 2017

The meeting opened with an overview of meeting objectives including concurrence on the schedule for pilot installation, location, and sequencing of the project; review of the sampling and analysis methodology; to gain concurrence on the scope of fate and transport and remediation white papers, and to review plans for reviews of the Programmatic Work Plan, white papers, QAPP, and APP-SSHP.

Dr. Packer provided a summary of the ARNG Approach:

- Dr. Packer emphasized that it’s important that something doesn’t hit the press before leadership knows and to keep everyone informed.
- Several points regarding the ARNG approach were noted for consideration and incorporation of the Army PA Program, as follows:
  - ARNG ranked the facilities for PAs and will also do some brief PA reports for hot sites based on information received from questionnaires.
  - They have developed a high-level (generalized) CSM with a graphical Geographical Information System (GIS) image and short narrative and developed the rankings through that review process.
  - She suggested it is good to know nearby potential off-site sources
  - All airfield sites were put on the list for further evaluation no matter what kind of AFFF was used (C6 versus C8 foam).
  - When ARNG proceeds with SIs, they will be site specific, not installation specific.
  - The ARNG has determined that once there is a known release, the regulator should be notified, but there should be no regulator interaction until the PA is complete.
  - The ARNG has determined that conclusions should be stated, but no recommendations are going to be included in the PA summary reports. They use the term “area of interest” when referring to sites that warrant additional consideration.

The ARNG has found that having a good GIS tool is very important for community outreach and that bottled water should be used if a water source is needed.

  - Regarding sample analysis, the labs are instructed to report the typical 16 to 18 analytes, that acceptable recovery limits should be set at 75-130%, and that standardized methods must be used for the modified USEPA 537 method to address issues with reproducible results for soil and groundwater between different labs.
  - The installation commander is the landowner and should be notified prior to results coming out. Rights of entry must be sent to installation commander and needs to be signed off based on Army Regulation 200.
- It appears that investigation derived waste (IDW) guidance will come out in the near future.

AMC – Unique factors and key considerations, Ms. Lyons, AMC representative:

- Escorts will more than likely be needed but may not be needed for some areas. As a warning, it could take up to two hours on the first day to check in to AMC sites. Driver's licenses and safety trainings are necessary. A list of requirements for AMC will be provided. Action Item -Ms. Lyons
- Ms. Stone asked for installation POC's as early as possible. Ms. Lyons suggests planning ahead and contacting them early including MSC, environmental coordinator, and cleanup person. Ms. Lyons can compile list and emails. Anything that is produced (trip report, PA, SI) should go to the installations and copy the AMC and MSC. There should not be an issue with OPSEC and drinking water wells. This includes monitoring wells, but it will still be installation specific. Prior to contacting installations, she requests that these questions are all compiled so they can be discussed on the kick-off calls. Action Item – Arcadis Ms. Lyons will generate an AMC POC list. Action Item – Ms. Lyons
- The CX will also have to review the PA reports and the Programmatic QAPP. Ms. Lyons clarified that the CX just needs to be engaged on the technical aspects of PFAS sampling.
- Ms. Lyons stated that the AMC OPORDER should not be expected in early January.
- She asked for Sierra to be moved up on the schedule because of drinking water issues. Action Item - Arcadis
- Ms. Lyons also requested a copy of the read-ahead package and stated that she will send it out separate from the OPORDER to the AMC installations. Action Item – Ms. Lyons

Programmatic Elements

- Dr. Packer stated that ARNG is also conducting PFAS assessments for ARNG enclaves at Fort Jackson, Fort Irwin, Fort Leonard Wood, and Aberdeen Proving Ground and suggested that the ARNG and USAEC PAs be appended to one another. ARNG legal advised them to conduct ARNG specific PAs for these installations.
- Fort Leavenworth had been planned to be the pilot, but after discussion, it was decided that Fort Hunter Liggett would be the pilot. There is a sub-installation at Hunter Liggett which is four hours away, but that may be able to be completed at a different time.
- Initial contact is expected to take place approximately two weeks before the kick-off call.
- Inventory numbers and columns will be added to the tracker per Ms. Schrupp. Action Item – Ms. Schrupp
- It was decided to replace Picatinny with Sharpe/Presidio of Monterey.
- Ms. McClellan mentioned the scope of Tooele because it is only listed as being one site

but is actually two very large sites. Action Item -Ms. McClellan and Ms. Lyons

Sampling White Paper/QAPP Overview

USAEC, USACE, and ARNG will review the sampling white paper, as well as CX, U.S. Army Public Health Center and USACE Omaha District, because it has to do with sampling. Ms. Haines-Eklund would like Dr. Packer from ARNG to review for consistency and comments. Dr. Anders (USAEC) should be invited to the next IPR (7 February 2018).

Ms. Haines-Eklund asked if high levels of volatile organic compounds (VOCs) could interfere with PFAS results. Dr. Houtz suggested it likely isn't a big issue, but she needs to review the literature. Action Item – Dr. Houtz. PFAS could partition into different type of non-aqueous phase liquid. Dr. Opdyke asked if Arcadis is looking at overall environmental issues where we are testing for PFAS. He also asked if other contaminations in general do not impact PFAS. It will be independent of what else is in there. Results will vary somewhat at a neutral pH vs. lower pH, especially if groundwater is highly acidic. It could give an artificially low result due to preferential partitioning of PFAS to soils at a low pH. Field parameters should be measured along with any sample taken.

There is a distinction between groundwater and drinking water values and state-by-state. Dr. Packer suggested legal counsel reviews it for each state. It should be coordinated between Army and USAEC legal counsel. Action Item - USAEC

There is a link to the guidance and supporting documents that are available. Dr. Opdyke asked if the World Health Organization (WHO) has considered PFAS values with any guidance since USEPA generally follows WHO guidance. (Addendum: no specific WHO values, but PFOA is considered a potential carcinogen by WHO: http://www.myhealthunit.ca/en/livehealthyandprotectyourhealth/resources/PFAS-MOH-Report-and-Recommendations-2017-08-15.pdf).

Data validation was discussed as potentially needing Level 4 with some percentages for some highly sensitive issues, otherwise possibly Level 2. Could defer to DoD. USACE suggested Level 3 which is consistent with the existing contract. Will maintain Level 3 reporting unless otherwise instructed by USAEC/USACE.

Mr. Gonser suggested waiting until the end of the contract for this because it could be years until we go to remediation. If the focus is on drinking water optimization, Mr. McDonough said it may be a scalable issue. Treatment employs the best available technology, but there is no one solution that is the best overall – best practice is a treatment train approach (no silver bullets for PFAS remediation). Ms. Polinsky suggested considerations for carbon in the remediation white page. Mr. Burdick suggested calling the white papers "Version 1.0, 2.0, etc." and change it in the future as needed. Action Item – Arcadis

Day 2 Wrap Up and Meeting Action Items:

In closing, USAEC has to develop a list of all of the contacts/Public Relations people to be notified if sampling is needed. The schedule will be revised to expedite Sierra Army Depot and add Sharpe in place of Picatinny. Hunter Liggett will replace Leavenworth as the pilot. Arcadis will wait for all the comments before revising the work plan. The meeting slide deck will be updated based on the meeting decisions and distributed to all meeting attendees.

Action Items:

Action	Responsible Party	Date Completed
USAEC to provide installation POC list by January 15th	USAEC	1/11/18
USAEC to provide ESMs, MSCs, IDs POCs that need to be notified when a site visit is happening. List to be provided by January 15th	USAEC	1/11/18
USAEC will research whether the installations included have satellite or sub installations that were not identified for this contract, so that the sites can be identified and discussed on each installation kick-off call	USAEC	1/11/18
USAEC to evaluate if USAEC ESMs will attend site visits	USAEC	1/11/18
USAEC to follow up with Susan Elrod on KCBRS data, READ data, and Hopeton Brown’s data	USAEC	Ongoing
USAEC to provide regulatory and public interaction procedures (Public Affairs Office package) to include in read-ahead packages	USAEC	Ongoing
USAEC to find out if there will be one CX reviewer or multiple reviewers	USAEC	1/11/18
Review OPSEC requirements and the potential to cause inconsistencies with PA report	USAEC	Installation specific 1/11/18
USAEC legal to review and provide guidance regarding AOPI, Area of Potential Concern, and other terms that may be included in the PA reports. USAEC legal to review table of advisory and promulgated values for PFAS	USAEC	1/11/18
Follow-up with Mr. Rogers at USARC to determine their level of involvement and to inform them that the PA process has begun	USAEC	1/11/18
Mr. Gonser will read the 2016 guidance document related to drinking water sampling to see if any additional guidance would be needed regarding the programmatic PA approach	USAEC	Do Not include 1/11/18
Contact OPSEC Headquarters for overall guidance on whether well information (both potable and	USAEC	Installation Specific 1/11/18

Action	Responsible Party	Date Completed
monitoring wells) can be included in the body of the PA and SI Reports		
USAEC to determine if PFAS issues are currently being, or should be, discussed at the installation RABs	USAEC	None 1/11/18
USACE technical POCs to participate in the technical work groups that will be a component of the development of the white paper guidance document (Dr. Opdyke), and review Programmatic Work Plan and provide comments (Hossain to work with Regional USACE POCs)	USACE	Prepare Draft Final Work Plan – 2/12/18
COR (Mr. Peck) to facilitate Arcadis Regional Leads to get CACs to facilitate installation access	USACE	Ongoing
Mr. Peck to ask their districts how FUDS sites can be pulled from the FUDS databases	USACE	Ongoing
Arcadis will retool Work Plan based on meeting discussions and reviewer comments, but will not provide a revised copy until all comments are received from the reviewers	Arcadis	Prepare Draft Final Work Plan – 2/12/18
Arcadis to coordinate group discussion with USAEC/USACE regarding proposed nomenclature for PA process outcomes for USAEC legal review	Arcadis	2/12/18
Arcadis will post the tracker on the project SharePoint site which would facilitate real time updates, to the extent feasible. Ms. Schrupp to add inventory numbers and columns to the tracker	Arcadis	Ongoing
Ms. Stone will schedule the first IPR meeting for February 7th in Baltimore	Arcadis	2/14/18
Arcadis to move Sierra up on the schedule per request from AMC	Arcadis	1/11/18
Dr. Houtz to assess if VOCs interfere with PFAS sample results based on literature review	Arcadis	1/11/18
Arcadis to provide table of advisory and promulgated values for USAEC legal review.	Arcadis	2/14/18
Arcadis to contact AMC POCs earlier than usual. Arcadis to compile	Arcadis	2/14/18

Action	Responsible Party	Date Completed
questions to be discussed during kick-off calls with AMC and will send to Ms. Lyons.		
Arcadis to provide initial draft Read-Ahead packages to USACE/USAEC for review and approval prior to distribution and coordination for the first few installations	Arcadis	3/20/18
Arcadis to discuss specific rules and OPSEC requirements during installation kick-off teleconferences	Arcadis	Ongoing
Arcadis to invite BRAC PMs to in-briefing meetings, if applicable	Arcadis	Ongoing
Arcadis to capture questions from those involved in the in-briefing meetings that should be shared with DoD so that policies can be developed/ instituted. These questions will be reported to AEC for their reference	Arcadis	Ongoing
Arcadis to include appropriate managers from pesticide management activities, range control, and aviation office and will plan to interview fire services that supplied foams, if possible, pending availability	Arcadis	Ongoing
Arcadis will identify final versions of white paper by version number, i.e., Version 1.0, 2.0, etc. to account for likely updates in the future	Arcadis	Ongoing
Arcadis to review EQuIS database and reporting format to be used for all sampling data	Arcadis	Ongoing
Provide each installation’s requirements for site access including if and when escorts will be needed	AMC	Ongoing
Provide MSC, environmental coordinator, cleanup personnel, and AMC POC lists and email addresses	AMC	2/14/18
Send Read-Ahead package separate from the OPORDER to the AMC installations	AMC	Ongoing

QAPP Worksheet #10: Conceptual Site Model

(UFP-QAPP Manual Section 2.5.2)
(EPA 2106-G-05 Section 2.2.5)

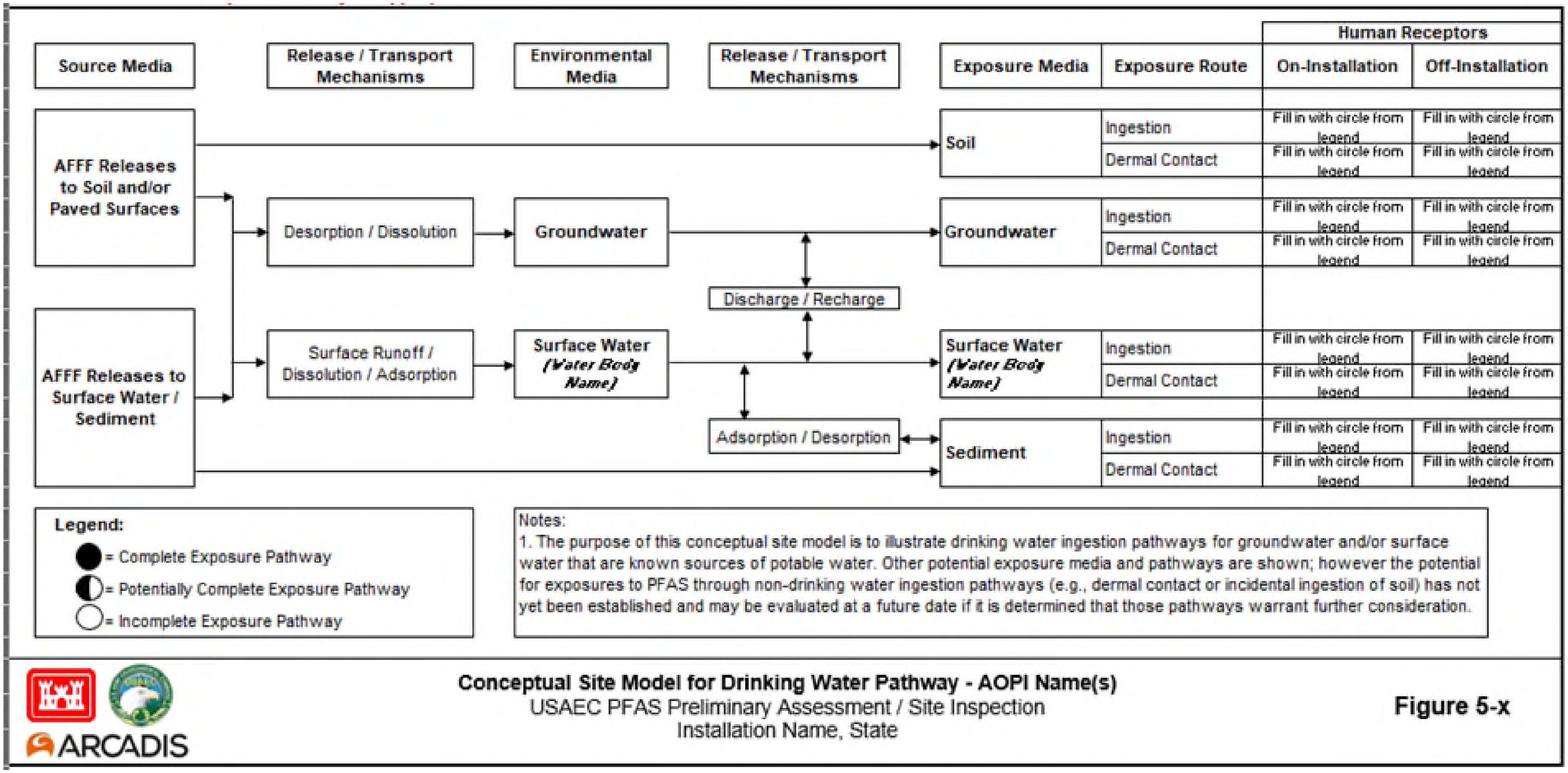
An abbreviated and site-specific CSM will be generated for each AOPI in the installation specific PA Reports. Section 5.2 of the PA Programmatic Workplan has more information on the initial development of the CSMs.

The geologic element of the CSM will include preliminary information on groundwater flow direction, the geologic conditions underlying the AOPI, and other factors that may be used to evaluate PFAS movement. The Fate and Transport white paper will help inform the PFAS geologic element of the CSM for each AOPI. At this time, exposure pathways will focus solely on drinking water pathways. The potential for toxicity from human exposures to PFAS through non-drinking water exposure pathways has not yet been established and may be evaluated at a future date, after it has been determined that those pathways warrant further consideration. Drinking water CSMs will be developed within each installation PA report for each AOPI with a potentially significant source area based on a historical site activities evaluation via existing records, personnel interviews, and site reconnaissance. CSM figures will be developed to illustrate potential sources, release and transport mechanisms, environmental exposure media and human receptors. The drinking water CSMs developed for each AOPI are intended to be “living” CSMs that will be refined through the PA/SI phase, if appropriate. The CSMs may include:

- Background information, i.e., site history (unless this information is presented in an Executive Summary)
- Physical setting information as it relates to each installation, i.e., topography, climate, geology, and hydrogeology
- Known or suspected PFAS contaminants and sources (including various media, activities that contributed to releases, and migration pathways)
- Potential receptors and contaminant exposure pathways as they relate to drinking water only
- Any data gaps to be filled.

The actual CSM figures that will be included in each installation specific QAPP Addendum will only include elements applicable to the primary source and will not necessarily include every element shown on the generic CSM figure below. Both complete and incomplete potential exposure pathways will be documented during the desktop analysis for drinking water pathways only. Sites that move onward to an SI will have a separate section summarizing the analytical results in collected environmental media. The results from site samples will be used to refine the CSM in the final PA/SI Report.

Figure 2: Generic CSM Evaluation Chart



Notes:
1. The purpose of this conceptual site model is to illustrate drinking water ingestion pathways for groundwater and/or surface water that are known sources of potable water. Other potential exposure media and pathways are shown; however the potential for exposures to PFAS through non-drinking water ingestion pathways (e.g., dermal contact or incidental ingestion of soil) has not yet been established and may be evaluated at a future date if it is determined that those pathways warrant further consideration.

QAPP Worksheet #11: Project/Data Quality Objectives

(UFP-QAPP Manual Section 2.6.1)
(EPA 2106-G-05 Section 2.2.6)

Worksheet #11 describes the Data Quality Objectives (DQO) using USEPA's 7-step DQO process, *Guidance on Systematic Planning Using the Data Quality Objectives Process*, USEPA QA/G-4, EPA/240/B-06/001, February 2006. The selected investigation design is presented on **Worksheet #17** in each **QAPP Addendum**. For the purpose of this PQAPP, this worksheet is completed as an example that will be tailored to the specific sampling effort at each installation in its own **QAPP Addendum**. This worksheet will state the problem and identify the goal of the study, the information inputs, and performance or acceptance criteria. Site-specific worksheets will state the boundaries of the sampling, develop the analytical approach, and the developed plan for obtaining data.

Step 1: State the Problem:
Releases of PFAS that may impact human drinking water are known or suspected at multiple Active Army and Reserve installations, posing a potential risk to human health. A PA has identified one or more AOPIs at the installation that may contain PFAS impacts related to the use of AFFF and/or other sources of PFAS.
Step 2: Identify the Goal of the Study:
The primary goals of the sampling activities are to compile sufficient information to determine whether media associated with individual AOPIs on an installation contain detectable levels of PFAS and to refine the AOPI CSMs. For the purpose of this evaluation, any detection above the laboratory limit of detection (LOD) will result in a determination that the compound is present.
Step 3: Identify Information Inputs:
The data needed to accomplish the goals of the sampling activities for this project are: • All information reviewed as part of the PA to identify the AOPIs, including historical use, spill records, existing infrastructure (monitoring wells and remedial systems), and previous analytical data and validation packages; • New analytical data from media applicable to each AOPI (analytes and media to be specified in installation-specific QAPP addenda); • Observations made during the investigation. Parameters and analytical methods are identified in **Worksheets #19/30.** Field sample collection methods are summarized in **Worksheets #17**, **#21**, and **QAPP addenda**.

- Sampling will be limited to areas where AFFF (which likely contained PFOS/PFOA) use is documented, or areas which may have received PFOS/PFOA-impacted material.

Step 4: Define the Boundaries of the Sampling:

The boundaries for sampling will be discussed in the **QAPP addenda.** The media to be potentially sampled are limited to groundwater, surface water, soil, and sediment.

Step 5: Develop the Analytic Approach:

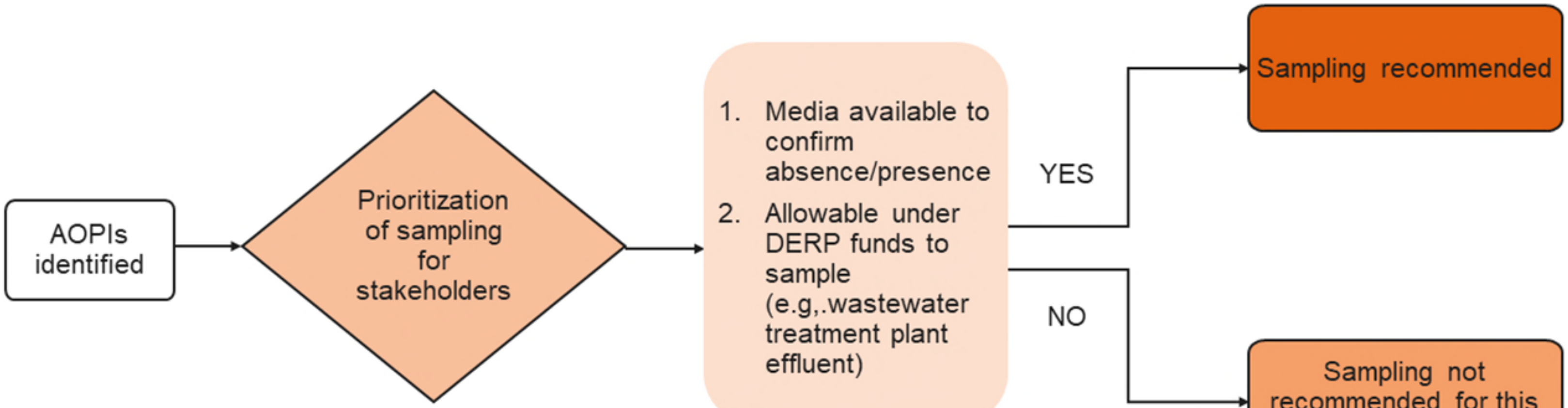
- Samples will be collected in accordance with the technical guidance instruction (TGI) and SOP documents included as **Appendix A**. The samples will be submitted for analysis to Eurofins Lancaster Laboratory Environmental (ELLE) or Gulf Coast Analytical Laboratory (GCAL, which subcontracts grain size analysis to ALS Kelso). Liquid chromatography/tandem mass spectrometry (LC/MS/MS) will be used to analyze samples for PFAS; **Worksheet #15** identifies each laboratory's LODs for PFAS. The LODs are defined as the project screening levels for this sampling effort.
    - If a PFAS concentration is less than the laboratory LOD (i.e., the project screening level), then it is not considered to be present for the purposes of the sampling effort.
    - If a PFAS concentration is above the laboratory LOD, then it is considered to be present.
- The final waste characterization and disposal plan for IDW will be conducted in accordance with Army guidance and state/local regulations. Disposition of IDW is discussed in **Worksheet #17** of each installation-specific **QAPP addendum.**

Controls on precision, reporting, and accuracy are provided in **Worksheets #12** and **#28**. Field monitoring and detection equipment will be routinely calibrated, detailed on **Worksheet #22**, which confirms that equipment used is of the proper type, range, accuracy, and precision to provide data compatible with the specified requirements and desired results. The Data Usability Assessment process is described in **Worksheet #37**.

Step 7: Develop the Plan for Obtaining Data:

The general sampling design will be specified within an Installation-specific **QAPP addendum**.

Figure 3: AOPI Sampling Decision Tree



QAPP Worksheet #12-1 – Measurement Performance Criteria - PFAS in Soil and Sediment

(UFP-QAPP Manual Section 2.6.2)
(EPA 2106-G-05 Section 2.2.6)

Matrix	**Soil/Sediment**
Analytical Group	**PFAS per DoD Quality Systems Manual (QSM) 5.1.1 Table B-15**
Concentration Level	**Low**

Data Quality Indicator (DQI)	**QC Sample or Measurement Performance Activity**	**Measurement Performance Criteria**
Precision	Field Duplicates	Relative Percent Difference (RPD) ≤ 50%
Accuracy/Bias (contamination)	Reagent or Equipment Blanks as appropriate	No target analyte concentrations ≥ ½ limit of quantitation (LOQ) or > 1/10th the amount measured in any sample.
Analytical Accuracy/Bias (laboratory)	Laboratory Control Sample (LCS)	Percent recoveries (%R) 70 to 130% for DoD QSM 5.1.1. %R for DoD QSM 5.2 and later versions, see QSM Table C-45.
Analytical Accuracy/Bias (matrix interference)	Matrix Spike and Matrix Spike Duplicates (MSD)	%R 70 to 130% for DoD QSM 5.1.1. %R for DoD QSM 5.2 and later versions, see QSM Table C-45.
Analytical Precision (laboratory)	LCS Duplicate (LCSD) and MSD	RPD ≤ 30%
Instrument Sensitivity Check	LOQ Verification Sample (spiked at LOQ)	Recovery within ±30% of true value

Note: The above table complies with the requirements of DoD QSM 5.1.1, 5.2, and later versions.

QAPP Worksheet #12-2 – Measurement Performance Criteria - PFAS in Groundwater and Surface Water

(UFP-QAPP Manual Section 2.6.2)
(EPA 2106-G-05 Section 2.2.6)

Matrix	**Groundwater/Surface water**
Analytical Group	**PFAS per DoD QSM 5.1.1 Table B-15**
Concentration Level	**Low**

Data Quality Indicator (DQI)	**QC Sample or Measurement Performance Activity**	**Measurement Performance Criteria**
Precision	Field Duplicates	RPD ≤ 35%
accuracy/bias (contamination)	Reagent or Equipment Blanks as appropriate	No target analyte concentrations ≥ ½ LOQ or > 1/10th the amount measured in any sample
Analytical Accuracy/Bias (laboratory)	LCS	%R 70 to 130% for DoD QSM 5.1.1. %R for DoD QSM 5.2 and later versions, see QSM Table C-44.
Analytical Accuracy/Bias (matrix interference)	Matrix Spike and MSD	%R 70 to 130% for DoD QSM 5.1.1. %R for DoD QSM 5.2 and later versions, see QSM Table C-44.
Analytical Precision (laboratory)	LCSD and MSD	RPD ≤ 30%
Sensitivity Check	LOQ Verification Sample (spiked at LOQ)	Recovery within ±30% of true value

Note: The above table complies with the requirements of DoD QSM 5.1.1, 5.2, and later versions.

QAPP Worksheet #12-3 – Measurement Performance Criteria - Total Organic Carbon in Soil

Matrix	**Soil**
Analytical Group	**Total Organic Carbon (TOC)/SW846 9060A**
Concentration Level	**Low**

Data Quality Indicator (DQI)	**QC Sample or Measurement Performance Activity**	**Measurement Performance Criteria**
Precision	Field Duplicates	RPD ≤ 50%
Accuracy/Bias (contamination)	Method, Reagent and/or Equipment Blanks as appropriate	No TOC concentrations ≥ ½ LOQ
Analytical Accuracy/Bias (laboratory)	LCS and LCSD	%R 80-120%
Analytical Accuracy/Bias (matrix interference)	Matrix Spike and MSD	%R 75-125%
Analytical Precision (laboratory)	LCSD and/or MSD	RPD ≤ 35%
Sensitivity	LOQ Verification Sample (spiked at LOQ)	Recovery within ±30% of true value

QAPP Worksheet #12-4 – Measurement Performance Criteria - pH in Soil

Matrix	**Soil**
Analytical Group	**pH/SW846 9045D**
Concentration Level	**Low**

Data Quality Indicator (DQI)	QC Sample or Measurement Performance Activity	Measurement Performance Criteria
Analytical Accuracy/Bias (laboratory)	LCS (mid-range pH buffer; perform after calibration with 2 pH buffers)	± 0.05 standard pH unit (su) of true value
Analytical Precision (laboratory)	Laboratory Duplicate	Range ≤ 0.1 su

QAPP Worksheet #13: Secondary Data Uses and Limitations

(UFP-QAPP Manual Section 2.7)
(EPA 2106-G-05 Chapter 3: QAPP Elements for Evaluating Existing Data)

See QAPP addenda for secondary data uses and limitations.
Example:

Data type	Source	Data uses relative to current project	Factors affecting the reliability of data and limitations on data use
Meteorological	To Be Determined (TBD)	TBD	TBD
Topographic	TBD	TBD	TBD
Background concentrations	TBD	TBD	TBD
Past site uses	TBD	TBD	TBD

QAPP Worksheet #14/16: Project Tasks & Schedule

(UFP-QAPP Manual Section 2.8.2)
(EPA 2106-G-05 Section 2.2.4)

The schedule for this project is presented in the Project Management Plan. Installation-specific schedules are presented within the site specific **QAPP addendum**. A typical schedule for each installation is summarized below:

- Installation Kick-Off Teleconference Coordination and Preparation: 2 weeks (10 days) before kick-off teleconference
- Installation Kick-Off Teleconference: 6 weeks (28 days) before site visit
- Pre-Site Visit Records Search: 6 weeks (28 days) before site visit
- Read-Ahead Package: 2 weeks (10 days) before site visit
- Site Visit Duration – varies by installation, approximately 1 day to 1 week (5 days)
- Data Compilation and Validation: 3 weeks (20 days) after site visit
- Site Visit Trip Report: 2 weeks (10 days) after site visit
- Data Analysis and Review: 4 weeks (20 days) after site visit
- Post Site Visit Teleconference (to discuss and confirm AOPI identification as well as PA phase sampling): 4 weeks (20 days) after site visit
  - Prepare draft site specific PA Sampling Work Plan to outline sampling activities (30 days after post site visit teleconference
  - Finalize Work Plan (45 days after draft submittal)
  - Perform sampling activities as described in QAPP addenda
  - Prepare draft sampling letter reports
  - Attach as appendices to Final PA report
- If site is a PA only:
  - Draft PA Report: 40 days after site visit
  - Comment Period: 30 calendar days or “edays”
  - Compilation of Comments and Comments Discussion Call with USACE and USAEC: 2 weeks (11 days)
  - Final PA Report: 4 weeks (22 days) after comments discussion call
- If site is moving to SI (schedule is approximate):
  - SI Kickoff teleconference – 30 days after NTP from USACE
  - SI TPP/Scoping teleconference – 30 days after KO teleconference
  - Draft QAPP Addendum submittal – 30 days after TPP/Scoping teleconference
  - Finalize QAPP Addendum – 45 days after draft submittal
  - Perform sampling activities as described in QAPP addenda
  - Compile and validate analytical data, revise CSMs as necessary
  - Secondary TPP meeting (if required) – 60 days after field work completion
  - Prepare draft combined PA/SI report – 120 days after field work completion
  - Finalize PA/SI report – 60 days after draft submittal

QAPP Worksheet #15a: Reference Limits and Evaluation Tables – ELLE (Soil/Sediment)

(UFP-QAPP Manual Section 2.6.2.3)
(EPA 2106-G-05 Section 2.2.6)

Matrix: Soil/Sediment		**Analytical Group: PFAS (ELLE) per DoD QSM 5.1.1 Table B-15**		
Analyte	**CAS Number**	**Project Screening Levels (ng/g)[2]**	**Laboratory Specific Limits[1]**	
			LOQ (ng/g)	**LOD (ng/g)**
Perfluorobutanoic acid (PFBA)	375-22-4	0.6	0.6	0.6
Perfluoropentanoic acid (PFPA)	2706-90-3	0.6	0.6	0.6
Perfluorohexanoic acid (PFHxA)	307-24-4	0.6	0.6	0.6
Perfluoroheptanoic acid (PFHpA)	375-85-9	0.6	0.6	0.6
Perfluorooctanoic acid (PFOA)	335-67-1	0.6	0.6	0.6
Perfluorononanoic acid (PFNA)	375-95-1	0.6	0.6	0.6
Perfluorodecanoic acid (PFDA)	335-76-2	1	1	1
Perfluoroundecanoic acid (PFUnA)	2058-94-8	0.6	0.6	0.6
Perfluorododecanoic acid (PFDoA)	307-55-1	0.6	0.6	0.6
Perfluorotridecanoic acid (PFTrDA)	72629-94-8	0.6	0.6	0.6
Perfluorotetradecanoic acid (PFTA)	376-06-7	0.6	0.6	0.6
Perfluorobutanesulfonic acid (PFBS)	375-73-5	0.6	0.6	0.6
Perfluorohexanesulfonic acid (PFHxS)	355-46-4	0.6	0.6	0.6
Perfluorooctane sulfonate (PFOS)	1763-23-1	0.6	0.6	0.6
N-ethyl perfluorooctane sulfonamidoacetic acid (NEtFOSAA)	2991-50-6	2	2	2
N-methyl perfluorooctane sulfonamidoacetic acid (NMeFOSAA)	2355-31-9	2	2	2
6:2 Fluorotelomer sulfonate	27619-97-2	2	2	2
8:2 Fluorotelomer sulfonate	39108-34-4	2	2	2

Notes: [1] The limits are what ELLE can achieve and were supplied by ELLE. All results to be reported in dry weight.
[2] The Project Screening Levels are set to the compound LODs. ng/g – nanograms per gram

QAPP Worksheet #15b: Reference Limits and Evaluation Tables – ELLE (Groundwater/Surface water)

(UFP-QAPP Manual Section 2.6.2.3)
(EPA 2106-G-05 Section 2.2.6)

Matrix: Groundwater/Surface water		**Analytical Group: PFAS (ELLE) per DoD QSM 5.1.1 Table B-15**		
Analyte	**CAS Number**	**Project Screening Levels[2] (ng/L)**	**Laboratory Specific Limits[1]**	
			LOQ (ng/L)	**LOD (ng/L)**
Perfluorobutanoic acid (PFBA)	375-22-4	6	6	6
Perfluoropentanoic acid (PFPA)	2706-90-3	6	6	6
Perfluorohexanoic acid (PFHxA)	307-24-4	3	3	3
Perfluoroheptanoic acid (PFHpA)	375-85-9	1	1	1
Perfluorooctanoic acid (PFOA)	335-67-1	1	1	1
Perfluorononanoic acid (PFNA)	375-95-1	2	2	2
Perfluorodecanoic acid (PFDA)	335-76-2	3	3	3
Perfluoroundecanoic acid (PFUnA)	2058-94-8	2	2	2
Perfluorododecanoic acid (PFDoA)	307-55-1	1	1	1
Perfluorotridecanoic acid (PFTrDA)	72629-94-8	2	2	2
Perfluorotetradecanoic acid (PFTA)	376-06-7	2	2	2
Perfluorobutanesulfonic acid (PFBS)	375-73-5	1	1	1
Perfluorohexanesulfonic acid (PFHxS)	355-46-4	2	2	2
Perfluorooctane sulfonate (PFOS)	1763-23-1	2	2	2
N-ethyl perfluorooctane sulfonamidoacetic acid (NEtFOSAA)	2991-50-6	3	3	3
N-methyl perfluorooctane sulfonamidoacetic acid (NMeFOSAA)	2355-31-9	3	3	3
6:2 Fluorotelomer sulfonate	27619-97-2	9	9	9
8:2 Fluorotelomer sulfonate	39108-34-4	6	6	6

Notes: [1]These limits are what ELLE can achieve and were supplied by ELLE. [2]The Project Screening Levels are set to the compound LODs. ng/L – nanograms per liter

QAPP Worksheet #15c: Reference Limits and Evaluation Tables – GCAL (Soil/Sediment)

(UFP-QAPP Manual Section 2.6.2.3)
(EPA 2106-G-05 Section 2.2.6)

Matrix: Soil/Sediment		**Analytical Group: PFAS (GCAL) per DoD QSM 5.1.1 Table B-15**		
Analyte	**CAS Number**	**Project Screening Levels[2] (ng/g)**	**Laboratory Specific Limits[1]**	
			LOQ (ng/g)	**LOD (ng/g)**
Perfluorobutanoic acid (PFBA)	375-22-4	0.4	1	0.4
Perfluoropentanoic acid (PFPA)	2706-90-3	0.4	1	0.4
Perfluorohexanoic acid (PFHxA)	307-24-4	0.4	1	0.4
Perfluoroheptanoic acid (PFHpA)	375-85-9	0.4	1	0.4
Perfluorooctanoic acid (PFOA)	335-67-1	0.4	1	0.4
Perfluorononanoic acid (PFNA)	375-95-1	0.4	1	0.4
Perfluorodecanoic acid (PFDA)	335-76-2	0.4	1	0.4
Perfluoroundecanoic acid (PFUnA)	2058-94-8	0.4	1	0.4
Perfluorododecanoic acid (PFDoA)	307-55-1	0.4	1	0.4
Perfluorotridecanoic acid (PFTrDA)	72629-94-8	0.4	1	0.4
Perfluorotetradecanoic acid (PFTA)	376-06-7	0.4	1	0.4
Perfluorobutanesulfonic acid (PFBS)	375-73-5	0.4	1	0.4
Perfluorohexanesulfonic acid (PFHxS)	355-46-4	0.4	1	0.4
Perfluorooctane sulfonate (PFOS)	1763-23-1	0.4	1	0.4
N-ethyl perfluorooctane sulfonamidoacetic acid (NEtFOSAA)	2991-50-6	0.4	1	0.4
N-methyl perfluorooctane sulfonamidoacetic acid (NMeFOSAA)	2355-31-9	0.4	1	0.4
6:2 Fluorotelomer sulfonate	27619-97-2	0.4	1	0.4
8:2 Fluorotelomer sulfonate	39108-34-4	0.4	1	0.4

Notes: [1] The laboratory specific limits are what GCAL can achieve and were supplied by GCAL. All results to be reported in dry weight. [2]The Project Screening Levels are set to the compound LODs. ng/g – nanograms per gram

QAPP Worksheet #15d: Reference Limits and Evaluation Tables – GCAL (Groundwater/ Surface water)

(UFP-QAPP Manual Section 2.6.2.3)
(EPA 2106-G-05 Section 2.2.6)

Matrix: Groundwater/Surface water		**Analytical Group: PFAS (GCAL) per DoD Quality Systems Manual (QSM) 5.1.1 Table B-15**		
Analyte	**CAS Number**	**Project Screening Levels[2] (ng/L)**	**Laboratory Specific Limits[1]**	
			LOQ (ng/L)	**LOD (ng/L)**
Perfluorobutanoic acid (PFBA)	375-22-4	4	10	4
Perfluoropentanoic acid (PFPA)	2706-90-3	4	10	4
Perfluorohexanoic acid (PFHxA)	307-24-4	4	10	4
Perfluoroheptanoic acid (PFHpA)	375-85-9	4	10	4
Perfluorooctanoic acid (PFOA)	335-67-1	4	10	4
Perfluorononanoic acid (PFNA)	375-95-1	4	10	4
Perfluorodecanoic acid (PFDA)	335-76-2	4	10	4
Perfluoroundecanoic acid (PFUnA)	2058-94-8	4	10	4
Perfluorododecanoic acid (PFDoA)	307-55-1	4	10	4
Perfluorotridecanoic acid (PFTrDA)	72629-94-8	4	10	4
Perfluorotetradecanoic acid (PFTA)	376-06-7	4	10	4
Perfluorobutanesulfonic acid (PFBS)	375-73-5	4	10	4
Perfluorohexanesulfonic acid (PFHxS)	355-46-4	4	10	4
Perfluorooctane sulfonate (PFOS)	1763-23-1	4	10	4
N-ethyl perfluorooctane sulfonamidoacetic acid (NEtFOSAA)	2991-50-6	8	10	8
N-methyl perfluorooctane sulfonamidoacetic acid (NMeFOSAA)	2355-31-9	8	10	8
6:2 Fluorotelomer sulfonate	27619-97-2	4	10	4
8:2 Fluorotelomer sulfonate	39108-34-4	4	10	4

Notes:
[1] These are what GCAL can achieve and were supplied by GCAL.
[2] The Project Screening Levels are set to the compound LODs.

QAPP Worksheet #15e: Reference Limits and Evaluation Tables – Shealy (Soil/Sediment)

(UFP-QAPP Manual Section 2.6.2.3)
(EPA 2106-G-05 Section 2.2.6)

Matrix: Soil/Sediment		**Analytical Group: PFAS (Shealy) per DoD QSM 5.1.1 Table B-15**		
Analyte	**CAS Number**	**Project Screening Levels[2] (ng/g)**	**Laboratory Specific Limits[1]**	
			LOQ (ng/g)	**LOD (ng/g)**
Perfluorobutanoic acid (PFBA)	375-22-4	0.5	1	0.5
Perfluoropentanoic acid (PFPA)	2706-90-3	0.5	1	0.5
Perfluorohexanoic acid (PFHxA)	307-24-4	0.5	1	0.5
Perfluoroheptanoic acid (PFHpA)	375-85-9	0.5	1	0.5
Perfluorooctanoic acid (PFOA)	335-67-1	0.5	1	0.5
Perfluorononanoic acid (PFNA)	375-95-1	0.5	1	0.5
Perfluorodecanoic acid (PFDA)	335-76-2	0.5	1	0.5
Perfluoroundecanoic acid (PFUnA)	2058-94-8	0.5	1	0.5
Perfluorododecanoic acid (PFDoA)	307-55-1	0.5	1	0.5
Perfluorotridecanoic acid (PFTrDA)	72629-94-8	0.5	1	0.5
Perfluorotetradecanoic acid (PFTA)	376-06-7	0.5	1	0.5
Perfluorobutanesulfonic acid (PFBS)	375-73-5	0.5	1	0.5
Perfluorohexanesulfonic acid (PFHxS)	355-46-4	0.5	1	0.5
Perfluorooctane sulfonate (PFOS)	1763-23-1	0.5	1	0.5
N-ethyl perfluorooctane sulfonamidoacetic acid (NEtFOSAA)	2991-50-6	0.5	1	0.5
N-methyl perfluorooctane sulfonamidoacetic acid (NMeFOSAA)	2355-31-9	0.5	1	0.5
6:2 Fluorotelomer sulfonate	27619-97-2	0.6	2	0.6
8:2 Fluorotelomer sulfonate	39108-34-4	0.6	2	0.6

Notes: [1] The laboratory specific limits are what Shealy can achieve and were supplied by Shealy. All results to be reported in dry weight.
[2]The Project Screening Levels are set to the compound LODs. ng/g – nanograms per gram.

QAPP Worksheet #15f: Reference Limits and Evaluation Tables – Shealy (Groundwater/ Surface water)

(UFP-QAPP Manual Section 2.6.2.3)
(EPA 2106-G-05 Section 2.2.6)

Matrix: Groundwater/Surface water		**Analytical Group: PFAS (Shealy) per DoD Quality Systems Manual (QSM) 5.1.1 Table B-15**		
Analyte	**CAS Number**	**Project Screening Levels[2] (ng/L)**	**Laboratory Specific Limits[1]**	
			LOQ (ng/L)	**LOD (ng/L)**
Perfluorobutanoic acid (PFBA)	375-22-4	2	4	2
Perfluoropentanoic acid (PFPA)	2706-90-3	2	4	2
Perfluorohexanoic acid (PFHxA)	307-24-4	2	4	2
Perfluoroheptanoic acid (PFHpA)	375-85-9	2	4	2
Perfluorooctanoic acid (PFOA)	335-67-1	2	4	2
Perfluorononanoic acid (PFNA)	375-95-1	2	4	2
Perfluorodecanoic acid (PFDA)	335-76-2	2	4	2
Perfluoroundecanoic acid (PFUnA)	2058-94-8	2	4	2
Perfluorododecanoic acid (PFDoA)	307-55-1	2	4	2
Perfluorotridecanoic acid (PFTrDA)	72629-94-8	2	4	2
Perfluorotetradecanoic acid (PFTA)	376-06-7	4	8	4
Perfluorobutanesulfonic acid (PFBS)	375-73-5	2	4	2
Perfluorohexanesulfonic acid (PFHxS)	355-46-4	2	4	2
Perfluorooctane sulfonate (PFOS)	1763-23-1	2	4	2
N-ethyl perfluorooctane sulfonamidoacetic acid (NEtFOSAA)	2991-50-6	4	8	4
N-methyl perfluorooctane sulfonamidoacetic acid (NMeFOSAA)	2355-31-9	4	8	4
6:2 Fluorotelomer sulfonate	27619-97-2	4	8	4
8:2 Fluorotelomer sulfonate	39108-34-4	4	8	4

Notes: [1] These are what Shealy can achieve and were supplied by Shealy.
[2] The Project Screening Levels are set to the compound LODs.

QAPP Worksheet #15g: Reference Limits and Evaluation Tables – ELLE (Soil)

(UFP-QAPP Manual Section 2.6.2.3)
(EPA 2106-G-05 Section 2.2.6)

Matrix: Soil		**Analytical Group: Other (ELLE)**	
Analyte	**CAS Number**	**Laboratory Specific Limits[1]**	
		LOQ (mg/kg)	**LOD (mg/kg)**
TOC by SW846 9060A	NA	300	300
pH by SW846 9045D	NA	0.1 su	0.1 su
Grain size by ASTM D422	NA	1%	1%

Notes:
[1] The laboratory specific limits are what ELLE can achieve and were supplied by ELLE.
su – standard pH units NA – Not Applicable mg/kg – milligrams per kilogram

QAPP Worksheet #15h: Reference Limits and Evaluation Tables – GCAL (Soil)

(UFP-QAPP Manual Section 2.6.2.3)
(EPA 2106-G-05 Section 2.2.6)

Matrix: Soil		**Analytical Group: Other (GCAL)**	
Analyte	**CAS Number**	**Laboratory Specific Limits[1]**	
		LOQ (mg/kg)	**LOD (mg/kg)**
TOC by SW846 9060A	NA	250	200
pH by SW846 9045D	NA	0.1 su	0.1 su
Grain size by ASTM D422	NA	1%	1%

Notes:
[1] The laboratory specific limits are what GCAL can achieve and were supplied by GCAL.
mg/kg – milligrams per kilogram su – standard pH units NA – Not Applicable

QAPP Worksheet #17a: General Investigation Design and Work Flow

UFP-QAPP, PFAS Sampling Activities

(UFP-QAPP Manual Section 3.1.1)
(EPA 2106-G-05 Section 2.3.1)

This worksheet generally describes Definable Features of Work (DFW) and tasks that will be performed to meet the requirements and objectives of the sampling activities at each installation. Each installation-specific **QAPP addendum** will provide a detailed approach for the sampling.

Table 5: DFWs and Associated Activities

DFW	Associated Activities	Supporting Documents
DFW1: Mobilization/Sampling Preparation	Contact specific Army installations, USAEC, ESM and USACE PM Mobilize staff Installation-specific training Obtain any required permits	Installation-specific QAPP addendum PQAPP APP/SSHP installation-specific addenda
DFW2: Collect Environmental Data	Collect all required samples	PQAPP APP/SSHP QAPP addendum Field SOP-Environmental Media
DFW3: Demobilization	Demobilization of all staff and equipment from the site	PQAPP APP
DFW4: Compile and Report Sampling Data	Compile, analyze, and report documented results from the sampling. CSM refinement if necessary.	PQAPP Installation Specific PA/SI Report

17.1 Overall Approach Rationale

Releases of PFAS that may impact human drinking water are known or suspected at multiple active Army and Reserve installations, posing a potential risk to human health. A PA has identified one or more AOPIs at the Installation that may contain PFAS impacts related to the use of AFFF and/or other sources of PFAS. The objectives of the sampling are to determine whether an AOPI represents a significant source area or directly impacts a receptor as part of the PA, and to refine the CSMs. The QAPP addenda will be developed to ensure the amount, type, and quality of data are sufficient to determine which areas and environmental media are impacted with detectable levels of PFAS.

17.2 DFW1: Mobilization/Sampling Preparation

17.2.1 Mobilization

The mobilization period for the completion of the sampling will include mobilizing staff to include these general activities, not in any particular order:

1. Identify/procure, package, ship, and inventory project equipment.
2. Coordinate communications with installation personnel, USAEC, ESMs, and USACE PM for logistical support.
3. Finalize sampling schedules.
4. Test and inspect field sampling equipment (See **Worksheet #22** for details).
5. Assemble and transport the sampling team.
6. Conduct installation-specific training on the PQAPP and field procedures and hazards specific to PFAS sample collection, as well and installation specific training.
7. Verify that all forms and project documentation are in order and Arcadis personnel understand their responsibilities regarding completion of project reporting requirements.
8. Obtain facility access for all field personnel.
9. Obtain any required permits.

All site-specific mobilization requirements will be documented within a **QAPP addendum**.

17.2.2 Installation Specific Training

Site-specific training is documented in a **QAPP addendum**.

17.3 DFW2: Collect Environmental Data

Environmental data will be collected as presented within a **QAPP addendum**.

17.4 DFW3: Demobilization

The investigation team will demobilize once all field activities are complete. IDW containing PFAS will be handled per the Army guidance (Department of the Army 2018) and the installation specific **QAPP addenda**. All non-IDW wastes will be removed from the site immediately upon completion of each day's field activities. A post-activity inspection will be conducted by the Field Team Lead/Regional Lead and Site Safety and Health Officer identified in the APP/SSHP addenda to ensure the location is left clean.

17.5 DFW4: Compile and Report Sampling Data

Results of the sampling will be compiled and analyzed by Arcadis and presented in the Sampling Letter Report. The Sampling Letter Report will discuss the investigation approach and field effort, present the validated sampling results, including QA/QC, update the CSMs, and provide recommendations for future actions at the site. The Sampling Letter Report will be included as an appendix to the site-specific PA report.

QAPP Worksheet #17b: General Investigation Design and Rationale

UFP-QAPP, PFAS Sampling Activities

This worksheet generally describes the design of the field investigation, if required, to confirm/identify the environmental media containing detectable levels of PFAS. All field activities will be conducted in accordance with the approved Programmatic APP/SSHPs. The sampling media and locations will be identified by USAEC and documented in the **QAPP addenda**, along with APP/SSHP installation-specific addenda.

All samples will be collected in accordance with the field SOPs listed in **Worksheet #21**, which take into consideration PFAS-specific sampling guidelines.

Field SOPs are listed in **Worksheet #21** and provided in **Appendix A**.

Installation specific sampling design and rationale will be presented in detail in installation-specific **QAPP addenda**. Sample locations and their rationale supporting DQOs will be explained in text and shown on figures as applicable, and in the context of the CSM. Some aspects of sampling for PFAS are applicable to all installation-specific efforts.

Soil Sampling

Soil samples will be collected for the analysis of PFAS following the soil sampling protocols (**P-10 – TGI – Poly and Perfluorinated Substances (PFAS) Field Sampling (all media); P-14 – TGI –Vertical Aquifer Profiling for PFAS Analysis**) detailed in **Appendix A**. The sampling method establishes equipment requirements, procedures for equipment and containers before sampling, sampling procedures under various conditions, collecting equipment blank samples (**P-13 – TGI – Equipment and Reagent Blank Sample Collection for PFAS Analysis**), field duplicate requirements, and storing samples to ensure that sample contamination does not occur during collection, transport and analysis. Please see **QAPP addenda** for details concerning individual installation soil sampling locations. All soil samples will be analyzed for PFAS, TOC, pH, and clay content to inform the interpretation of PFAS distribution and update the CSM (**Worksheet #10**).

Sediment Sampling

Sediment samples to be utilized for the analysis of PFAS will be collected following the sediment sampling protocol (**P-10 – TGI – Poly and Perfluorinated Substances (PFAS) Field Sampling (all media); P-15 - TGI – Sediment, Surface Water, and Stormwater Sample Collection for PFAS Analysis**) detailed in **Appendix A**. The sampling method establishes equipment requirements, procedures for equipment and containers before sampling, sampling procedures under various conditions, collecting equipment blank samples (**P-13 – TGI – Equipment and Reagent Blank**

Sample Collection for PFAS Analysis), field duplicate requirements, and storing samples to ensure that sample contamination does not occur during collection, transport and analysis. Please see **QAPP addenda** for details concerning individual installation sediment sampling locations. All sediment samples will be analyzed for PFAS (**Worksheet #20**).

Surface Water Sampling

Surface water samples to be utilized for the analysis of PFAS will be collected following the surface water sampling protocol (**P-10 – TGI – Poly and Perfluorinated Substances (PFAS) Field Sampling (all media); P-15 - TGI – Sediment, Surface Water, and Stormwater Sample Collection for PFAS Analysis**) detailed in **Appendix A**. The sampling method establishes equipment requirements, procedures for equipment and containers before sampling, sampling procedures under various conditions, collecting equipment blank samples (**P-13 – TGI – Equipment and Reagent Blank Sample Collection for PFAS Analysis**), field duplicate requirements, and storing samples to ensure that sample contamination does not occur during collection, transport and analysis. Please see **QAPP addenda** for details concerning individual installation surface water sampling locations. All surface water samples will be analyzed for PFAS (**Worksheet #20**). Additionally, field parameters (temperature, pH, conductivity, dissolved oxygen, turbidity, and oxidation-reduction potential) will be measured during surface water sampling to potentially inform the CSMs.

Groundwater Sampling

Groundwater samples to be utilized for the analysis of PFAS will be collected following the groundwater sampling protocol (**P-10 – TGI – Poly and Perfluorinated Substances (PFAS) Field Sampling (all media); P-11 – TGI – PFAS Sampling Procedures and Low-Flow Groundwater Purging for Monitoring Wells; P14 – TGI – Soil and Groundwater Sampling and Vertical Aquifer Profiling for PFAS Analysis)** detailed in **Appendix A.** The sampling method establishes equipment requirements, procedures for equipment and containers before sampling, sampling procedures under various conditions, collecting equipment blank samples (**P-13 – TGI – Equipment and Reagent Blank Sample Collection for PFAS Analysis**), field duplicate requirements, and storing samples to ensure that sample contamination does not occur during collection, transport and analysis. Please see **QAPP addenda** for details concerning individual installation groundwater sampling locations. All groundwater samples will be analyzed for PFAS (**Worksheet #20**). Additionally, field parameters (temperature, pH, conductivity, dissolved oxygen, turbidity, and oxidation-reduction potential) will be measured during groundwater sampling to ensure a stable sample is collected and, potentially, to inform the CSMs.

Laboratories

ELLE, GCAL, and Shealy will be the primary laboratories for this study. These laboratories will analyze the aforementioned soil, sediment, surface water, and groundwater samples, as required on an individual site basis, with PFAS analysis conducted in accordance with the DoD QSM 5.1.1 Table B-15, or later versions as the laboratories become certified for updated versions of the DoD QSM. Arcadis will validate the data from the laboratory. This information will be included in the Sampling Letter Report.

QAPP Worksheet #18: Sampling Locations and Methods

(UFP-QAPP Manual Section 3.1.1 and 3.1.2)
(EPA 2106-G-05 Section 2.3.1 and 2.3.2)

The sampling locations and associated parameters will be described in the QAPP addenda. PFAS-specific field sampling procedures are specified in the PFAS Sampling TGIs, **P-10 to P-15**. Additional information on PFAS sampling is available in the PFAS Sampling and Analysis White Paper in **Appendix B**. The PFAS list as described in **Worksheet #20** is summarized below for all media.

Compound
Perfluorobutanoic acid (PFBA)
Perfluoropentanoic acid (PFPA)
Perfluorohexanoic acid (PFHxA)
Perfluoroheptanoic acid (PFHpA)
Perfluorooctanoic acid (PFOA)
Perfluorononanoic acid (PFNA)
Perfluorodecanoic acid (PFDA)
Perfluoroundecanoic acid (PFUnA)
Perfluorododecanoic acid (PFDoA)
Perfluorotridecanoic acid (PFTrDA)
Perfluorotetradecanoic acid (PFTA)
Perfluorobutanesulfonic acid (PFBS)
Perfluorohexanesulfonic acid (PFHxS)
Perfluorooctane sulfonate (PFOS)
N-ethyl perfluorooctanesulfonamidoacetic acid (NEtFOSAA)
N-methyl perfluorooctanesulfonamidoacetic acid (NMeFOSAA)
6:2 Fluorotelomer sulfonate
8:2 Fluorotelomer sulfonate

Table 6: Example Sample Summary and Rationale

Sample Location [1]	Matrix	Depth Interval (Approx.)	Sample ID [2]	Sample Type	Phase	# Samples	Analytes [3]	QC Samples	Total Samples	Sampling Rationale [4]
TBD	Sediment	TBD	TBD	Discrete	I	TBD	PFAS group	TBD	TBD	PFAS data: PFAS identification non-PFAS data: supporting data to inform CSM Sampling location is within or downgradient of AOPI
TBD	Soil	TBD	TBD	Discrete	I	TBD	PFAS group, TOC, pH, grain size		TBD	
TBD	Surface Water	TBD	TBD	Discrete	I	TBD	PFAS group, field parameters		TBD	
TBD	Groundwater	TBD	TBD	Discrete	I	TBD	PFAS group, field parameters		TBD	

Notes:

1 – Sampling locations detailed within individual **QAPP addenda**. Additionally, sampling locations subject to change based on conditions encountered in field in consultation with stakeholders.

2 – Sample IDs are detailed within individual **QAPP addenda**.

3 – See **Worksheet #15** for individual compounds within the PFAS group. Field parameters include temperature, pH, conductivity, dissolved oxygen, turbidity, oxidation-reduction potential.

4 – See **QAPP addenda** for narrative.

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

Laboratories:

Eurofins Lancaster Laboratories Environmental (ELLE)
2425 New Holland Pike
Lancaster, PA 17601
Contact: Kathy Klinefelter
Phone: 717.656.2300 ext. 1566
Email: KatherineKlinefelter@eurofinsus.com
DoD Environmental Laboratory Accreditation Program (ELAP) Expiration Date: November 30, 2020

Gulf Coast Analytical Laboratory (GCAL)
7979 Innovation Park Dr.
Baton Rouge, LA 70820
Contact: Brenda Martinez
Phone: 225.769.4900
Email: Brenda.martinez@gcal.com.
DoD ELAP Expiration Date: December 27, 2020

Shealy Environmental Services (Shealy)
106 Vantage Point Drive
West Columbia, SC 29172
Contact: Nisreen Saikaly
Phone: 803.227.2704
Email: nsaikaly@shealylab.com
DoD ELAP Expiration Date: November 18, 2021

List any required accreditations/certifications: DoD ELAP and state associated with the site location. (National ELAP)

Back-up Laboratory: Not identified

Sample Delivery Method: Federal Express Overnight

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

Analyte/ Analyte Group	Method/ SOP	Container(s) (number, size & type per sample)	Preservation	Preparation Holding Time	Analytical Holding Time	Data Package Turnaround
Soil/ Sediment Sampling						
PFAS	PFAS per DoD QSM 5.1.1 Table B-15/ ELLE: T-PFAS-WI12031 GCAL: LCMS-011 Shealy: ME00213-12	High density polyethylene (HDPE) w/ HDPE screw cap 1 x 250 mL	Cool to < 6 degrees Celsius (°C) Sample must not exceed 10°C during first 48 hours after collection	14 days	28 days after extraction	21 calendar days
TOC (Soil Only)	SW846 9060A/ ELLE: T-WC-WI11627 GCAL: WL-057	4-oz wide mouth glass jar	Cool to < 6ºC	NA	28 days	
Soil pH (Soil Only)	SW846 9045D/ ELLE: T-WC-WI11518 GCAL: EXT-032				Within 24 hours of receipt	

Analyte/ Analyte Group	Method/ SOP	Container(s) (number, size & type per sample)	Preservation	Preparation Holding Time	Analytical Holding Time	Data Package Turnaround
Grain Size (Soil Only)	ASTM D422-63/ ELLE: T-WC-WI11514 ALS: GEN-PSP [1]	4-oz wide mouth glass jar	Cool to < 6ºC	NA	NA	
Groundwater/Surface water Sampling						
PFAS	PFAS per DoD QSM 5.1.1 Table B-15/ ELLE: T-PFAS-WI14355 GCAL: LCMS-011 Shealy: ME00213-12	HDPE w/ HDPE screw cap 2 x 500 mL	Cool to < 6°C Sample must not exceed 10°C during first 48 hours after collection	14 days	28 days after extraction	

Note:

1. GCAL will subcontract grain size analysis to ALS Kelso.
2. When soils are submitted to Shealy for PFAS analysis, the field crew will ship the soils collected for soil pH, TOC, and grain size to ELLE for analysis.

QAPP Worksheet #20: Field QC Summary

(UFP-QAPP Section 3.1.1 and 3.1.2)
(EPA 2106-G-05 Section 2.3.5)

The number of field samples will be described in the QAPP addenda. Field QC samples are listed below as frequency per number of field samples.

Matrix	Analyte/Analytical Group	Field Samples	Field Duplicates	Matrix Spikes	MSD	Field Blanks	Equipment Blanks	Total # analyses
Soil	PFAS	TBD	1 per 20	1 per 20	1 per 20	1 per 20 (aqueous)	1 per piece of relevant equipment per sampling event	TBD
	TOC	TBD	1 per 20	1 per 20	1 per 20	N/A	N/A	TBD
	pH	TBD	N/A	N/A	N/A	N/A	N/A	TBD
	Grain size	TBD	N/A	N/A	N/A	N/A	N/A	TBD
Sediment	PFAS	TBD	1 per 20	1 per 20	1 per 20	1 per 20 (aqueous)	1 per piece of relevant equipment per sampling event	TBD

Matrix	Analyte/Analytical Group	Field Samples	Field Duplicates	Matrix Spikes	MSD	Field Blanks	Equipment Blanks	Total # analyses
Groundwater	PFAS	TBD	1 per 20	1 per 20	1 per 20	1 per 20 (aqueous)	1 per piece of relevant equipment per sampling event	TBD
Surface water	PFAS	TBD	1 per 20	1 per 20	1 per 20	1 per 20 (aqueous)	1 per piece of relevant equipment per sampling event	TBD

QAPP Worksheet #21: Field SOPs

(UFP-QAPP Manual Section 3.1.2)
(EPA 2106-G-05 Section 2.3.2)

The Field SOPs listed below may not apply to all sites. Note: SOPs may be field-modified to consider PFAS-specific sampling requirements as discussed in the Sampling and Analysis White Paper.

Procedure # or Reference[1]	Title, Revision, Date, and URL (if available)	Originating Organization	Procedure Option or Equipment Type (if procedure provides different options)[2]	Modified for Project? Y/N
P-01	Quality Procedure (QP) – Field Activities Documentation, Rev. C, November 2016	Arcadis	Applies to all Arcadis field personnel.	N
P-02	SOP – Sample Chain of Custody, Rev. 1, 23 May 2017	Arcadis	Applies to all Arcadis field personnel with 40-hr. Hazardous Waste Operations and Emergency Response and Department of Transportation HazMat #1 training.	N
P-03	Health and Safety Standard - Utility Location and Clearance, Rev. 16, 17 March 2017	Arcadis	Applies to all subsurface intrusive work.	N
P-04	QP – Calibration and Control of measuring and test equipment, Rev. C, November 2016	Arcadis	Applies to all Arcadis field personnel using equipment that is capable of calibration.	N

Procedure # or Reference[1]	Title, Revision, Date, and URL (if available)	Originating Organization	Procedure Option or Equipment Type (if procedure provides different options)[2]	Modified for Project? Y/N
P-05	QP - Field Sampling, Measurement, and Observation, Rev. D, October 2017	Arcadis	Applies to all Arcadis field personnel completing field sampling, measurement, and observations.	N
P-06	TGI - Soil Description, Rev. 2, 16 Feb 2018	Arcadis	Applies to all Arcadis field personnel conducting soil logging.	N
P-07	TGI- Monitoring Well Development, Rev. 0, April 2017	Arcadis	Applies to all Arcadis field personnel developing monitoring wells. See TGI for specific equipment needs.	N
P-08	TGI- Monitoring Well Integrity Survey, Rev. 0, April 2017	Arcadis	See TGI for specific equipment needs.	N
P-09	TGI – Groundwater and Soil Sampling Equipment Decontamination, Rev. 0, 23 February 2017	Arcadis	Applies to soil sampling tools; groundwater, sediment, and surface-water sampling devices; water testing instruments; down-hole instruments; and other activity-specific sampling equipment	N

Procedure # or Reference[1]	Title, Revision, Date, and URL (if available)	Originating Organization	Procedure Option or Equipment Type (if procedure provides different options)[2]	Modified for Project? Y/N
P-10	TGI - Poly- and Perfluorinated Alkyl Substances (PFAS) Field Sampling (all media) Guidance, Rev. 4, 26 March 2019	Arcadis	Applies to all Arcadis field personnel collecting environmental samples for PFAS analysis. See TGI for specific equipment needs.	Y
P-11	TGI – PFAS Sampling Procedures and Low-Flow Groundwater Purging for Monitoring Wells, Rev. 0, 19 June 2018	Arcadis	Applies to low-flow sampling for PFAS.	Y
P-12	PFAS-Specific Drilling and Monitoring Well Installation TGI, Rev. 1, 26 March 2019	Arcadis	Applies to all Arcadis field personnel installing monitoring wells for PFAS analysis. See TGI for specific equipment needs.	Y
P-13	TGI – Equipment and Reagent Blank Sample Collection for PFAS Analysis, Rev. 0, October 2018	Arcadis	Applies to all Arcadis field personnel completing field sampling. See TGI for specific equipment needs.	Y
P-14	TGI – Vertical Aquifer Profiling for PFAS Analysis, Rev. 1, 26 March 2019	Arcadis	Applies to all Arcadis field personnel using Vertical Aquifer Profiling to collecting soil and groundwater samples.	Y

Procedure # or Reference[1]	Title, Revision, Date, and URL (if available)	Originating Organization	Procedure Option or Equipment Type (if procedure provides different options)[2]	Modified for Project? Y/N
			See TGI for specific equipment needs.	
P-15	TGI – Sediment, Surface Water, and Stormwater Sample Collection for PFAS Analysis, Rev. 1, 26 March 2019	Arcadis	Applies to all Arcadis field personnel collecting sediment, surface water, and stormwater samples. See TGI for specific equipment needs.	Y
P-16	TGI – Investigation-Derived Waste Handling and Storage, Rev. 0, 23 February 2017	Arcadis	See TGI for specific equipment needs.	N

Note:

[1] Copies of the field SOPs are included in **Appendix A**.

[2] For all TGIs pertaining to the collection of samples for PFAS analysis, there is concern that sampling for PFAS using sampling equipment manufactured from fluoropolymers could result in sample contamination. The materials of construction of all downhole and surface sampling and monitoring equipment — including pumps, packers, transducers, tubing, liners, valves, and wiring — should be free from polytetrafluorethylene (PTFE) or ethylene tetrafluoroethylene (ETFE) to the maximum extent practicable. In addition, well drilling procedures and completion materials should avoid the use of fluorocarbon-based lubricants, O-rings and pipe thread pastes, tapes and sealants. If possible, a confirmation letter with analytical testing results should be obtained from a manufacturer or service provider certifying that the equipment (or supplies) are free of any PFAS.

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

(UFP-QAPP Manual Section 3.1.2.4)
(EPA 2106-G-05 Section 2.3.6)

The equipment listed below may not apply to all sites.

Instrument or Equipment	Description	Field Calibration Procedure	Performance Criteria	Responsible Personnel
Water Quality Meter – YSI 6-Series Multi-Parameter Instrument or Equivalent	Multi-parameter tool designed for field use with battery operation. Ranges: 0 – 14 pH -999 to +999 millivolt Oxidation-Reduction Potential -5 to 50 °C 0 to 50 mg/L Dissolved Oxygen 0 to 100 mS/cm Conductivity 0 to 1,000 nephelometric turbidity unit (NTU) Turbidity	The unit is factory calibrated. Unit responsiveness will be checked prior to use each day with appropriate standards provided by the supplier.	+/- 10% of included standard solutions with meter	Sample Collection Personnel
		Unit responsiveness is checked against the solution standards provided by each manufacturer.		
Turbidimeter – Hach 2100P or Equivalent	Designed for field use with battery operation. Range: 0 to 1,000 NTU.	Each day prior to use, the turbidimeter is calibrated against the standard solutions provided by each manufacturer.	+/- 10% of included standard solutions with turbidimeter	Sample Collection Personnel
4-Gas Meter – MultiRAE or Equivalent	Designed for field use with battery operation. Ranges: 0 to 100% LEL 0 to 100 ppm H_2S 0 to 30% (by vol.) O_2 0 to 2,000 ppm CO 0 to 20,000 µRem/h Gamma 0.1 to 5,000 ppm VOC	Each day prior to use, the 4-Gas Meter is calibrated against clean (ambient) air and supplier-provided standard (mixed gas cannister).	+/- 10% of included standard gas value	Sample Collection Personnel

QAPP Worksheet #23 Analytical SOP References

SOP Reference Number[1]	Title, Revision Date, and/or Number	Definitive or Screening Data	Matrix/Analytical Group	Instrument	Organization Performing Analysis	Modified for Project Work? (Y/N)
T-PFAS-WI12031 Proprietary SOP available upon request.	Polyfluorinated Alkyl Substances (PFAS) in Solids by Method 537 Revision 1.1 Modified Using LC/MS/MS. Rev. 3. 12/21/2017	Definitive	PFAS/Soil/Sediment	LC/MS/MS	ELLE	N
T-PFAS-WI14355 Proprietary SOP available upon request.	Polyfluorinated Alkyl Substances (PFAS) in Aqueous Samples by Method 537 Revision 1.1 Modified Using LC/MS/MS. Revision 4. 1/3/2018	Definitive	PFAS/Groundwater and Surface water	LC/MS/MS	ELLE	N
T-WC-WI11627	Determination of TOC and TC in Solids and Sludges by Combustion. Rev. 15. 10/30/2013	Definitive	TOC/ Soil	TOC Analyzer	ELLE	N
T-WC-WI11518	pH by EPA 9045C, 9045D, or 150.1, and Corrosivity by SW-846 Chap 7 of Solids, Soils, and Solvents using Electrometric Methods. Rev. 11. 10/13/2016	Definitive	pH/Soil	pH Meter	ELLE	N
T-WC-WI11514	Particle Size Distribution of Soils and Solids/ Grain Size Classification by ASTM D422-63. Rev. 9. 8/18/2014	Definitive	Grain Size/Soil	Sieve and hydrometer	ELLE	N
LCMS-011	Analysis of Per- and Polyfluoroalkyl Substances (PFAS). Revision 02. 10/12/17	Definitive	PFAS/Soil/Sediment, Groundwater and Surface water	LC/MS/MS	GCAL	N
WL-057	SOP for Total Organic Carbon (TOC). Revision 07.1. 09/18/17	Definitive	TOC/Soil	TOC Analyzer	GCAL	N
EXT-032	pH in Aqueous and Soil/Waste Samples. Revision 18. 10/26/17	Definitive	pH/Soil	pH Meter	GCAL	N

QAPP Worksheet #23 Analytical SOP References

SOP Reference Number[1]	Title, Revision Date, and/or Number	Definitive or Screening Data	Matrix/Analytical Group	Instrument	Organization Performing Analysis	Modified for Project Work? (Y/N)
GEN-PSP R8	Particle Size Determination. ASTM D 422 Modified. Revision 8. 3/15/2015	Definitive	Grain Size/Soil	Sieve and hydrometer	ALS Kelso[2]	N
ME00213-12	Determination of Per- and Polyfluoroalkyl Substances (PFAS) by LC/MS/MS (Isotope Dilution) QSM 5.3 Table B-15 Revision 12. 7/11/2019	Definitive	PFAS/Soil/Sediment/ Groundwater and Surface water	LC/MS/MS	Shealy	N

Notes:

[1] Copies of the laboratory SOPs are included in **Appendix C**

[2] GCAL will subcontract grain size analysis to ALS Kelso.

QAPP Worksheet #24 – Analytical Instrument Calibration

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	Standard Operating Procedure (SOP) Reference[1]
LC/MS/MS for PFAS	Mass Calibration	Daily, prior to sample analysis and after performing major maintenance, as required to maintain documented instrument sensitivity and stability performance.	Calibrate the mass scale of the MS with calibration compounds and procedures described by the manufacturer. Mass calibration range must bracket the ion masses of interest. The most recent mass calibration must be used for every acquisition in an analytical run. Mass calibration must be verified to be ±0.5 amu of the true value, by acquiring a full scan continuum mass spectrum of a PFAS stock standard.	Retune instrument and peak check tune. Maintenance may be required.	Analyst, Department Manager	ELLE: T-PFAS-WI12031, T-PFAS-WI14355 GCAL: LCMS-011 Shealy: ME00213-12
	Instrument performance check (tune).	When the masses fall outside of the ±0.5 atomic mass unit of the true value.	Mass assignments of the tuning standard within 0.5 atomic mass unit of true value.	Retune instrument and verify		
	Mass Spectral Acquisition Rate	Each analyte, Extracted Internal Standard Analyte.	A minimum of 10 spectra scans are acquired across each chromatographic peak.	NA		
	Ion Transitions (Parent→Product)	Prior to initial calibration. See more details in DoD QSM 5.1.1, 5.2 or later version, Table B-15.	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	NA		

QAPP Worksheet #24 – Analytical Instrument Calibration

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	Standard Operating Procedure (SOP) Reference[1]
			6:2 FTS: 427 → 407 8:2 FTS: 527 → 507 NEtFOSAA: 584 → 419 NMeFOSAA: 570 → 419			
	Sample PFAS Identification	All analytes detected in a sample	The chemical derivation of the ion transitions must be documented. A minimum of two ion transitions (Precursor → quant ion and precursor → confirmation ion) and the ion transitions ratio per analyte are required for confirmation. Exception is made for analytes where two transitions do not exist (PFBA and PFPeA). Documentation of the primary and confirmation transitions and the ion ratio is required. In-house acceptance criteria for evaluation of ion ratios must be used and must not exceed 50-150%. 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”.		

QAPP Worksheet #24 – Analytical Instrument Calibration

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	Standard Operating Procedure (SOP) Reference[1]
LC/MS/MS for PFAS	Initial Calibration (ICAL) Standards containing both branched and linear isomers must be used when commercially available. Isotope Dilution or Internal Standard Calibration is required. Minimum five-point initial calibration for linear, or six-point calibration for quadratic.	ICAL at instrument set-up and after ICV or CCV failure, prior to sample analysis	Signal to Noise Ratio: ≥ 10:1 for all ions used for quantification. For analytes having a promulgated standard, (e.g., Health Advisory levels for PFOA and PFOS), the qualitative (confirmation) transition ion must have a Signal to Noise Ratio of ≥ 3:1. Average RF: Relative Standard Deviation of the RFs for each analyte ≤ 20% Linear or non-linear Calibration: $r^2 \geq 0.99$. Analytes must be within 70-130% of their true value for each calibration standard.	Verify standard solutions still valid, perform instrument maintenance as needed, then repeat the ICAL		

QAPP Worksheet #24 – Analytical Instrument Calibration

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	Standard Operating Procedure (SOP) Reference[1]
	Retention Time Window Width	Every field sample, standard, blank, and QC sample.	RT of each analyte and EIS analyte must fall within 0.4 minutes of the predicted retention times from the daily calibration verification or, on days when ICAL is performed, from the midpoint standard of the ICAL. Analytes must elute within 0.1 minutes of the associated EIS. This criterion applies only to analyte and labeled analog pairs.	Correct problem and reanalyze samples.		
	Instrument Sensitivity Check (ISC). ISC can serve as initial daily Continuing Calibration Verification (CCV)	Prior to analysis and at least once every 12 hours	Analyte concentrations must be at LOQ; concentrations must be within ±30% of true value.	Correct problem, rerun ISC. If problem persists, repeat ICAL.	Analyst, Department Manager	ELLE: T-PFAS-WI12031, T-PFAS-WI14355 GCAL: LCMS-011 Shealy: ME00213-12
	Initial Calibration Verification (ICV)	Once after each ICAL; analysis of second source standard prior to sample analysis.	Analyte concentrations must be within ±30% of true value.	Correct problem, rerun ICV. If problem persists, repeat ICAL.		
	CCV	Prior to sample analysis, after every 10 field samples, and at end of analytical sequence.	Analyte concentrations must be within ±30% of true value. Concentration of analytes must range from LOQ to mid-level calibration concentrations.	Immediately analyze two additional consecutive CCVs. If both pass, samples may be reported without reanalysis. Otherwise, perform corrective action, repeat CCV (or ICAL) and reanalyze all associated samples since last successful CCV.		

QAPP Worksheet #24 – Analytical Instrument Calibration

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	Standard Operating Procedure (SOP) Reference[1]
LC/MS/MS for PFAS	Instrument Blanks	Immediately following highest standard analyzed and daily prior to sample analysis.	Concentration of each analyte must be ≤ ½ the LOQ Instrument Blank must contain EIS to enable quantitation of contamination.	If acceptance criteria are not met after the highest calibration standard, calibration must be performed using a lower high standard until 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		
TOC Analyzer	Initial calibration — minimum 3 standards and calibration blank.	Daily, or on continuing calibration failure.	Correlation coefficient - ≥ 0.995.	Inspect system, correct problem, rerun calibration and affected samples.	Analyst, Department Manager	ELLE: T-WC-WI11627 GCAL: WL-057
	Continuing calibration – one midpoint standard	Every 10 field samples and QC samples, and at end of analytical run	%R of 90-110%			
pH Meter	Initial calibration — minimum 2 standards	Daily, or on continuing calibration failure.	pH Check Standard within ± 0.05 su of true value	Inspect system, correct problem, rerun calibration and affected samples.	Analyst, Department Manager	ELLE: T-WC-WI11518 GCAL: EXT-032
	Continuing calibration – pH standard near the pH of samples	After every 10 samples, and at end of analytical run	pH Check Standard within ± 0.05 su of true value			

Note:

[1] SOP reference numbers correspond to Laboratory SOPs in **Worksheet #23**.

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

Instrument/ Equipment	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	Standard Operating Procedure Reference[1]
LC/MS/MS	See Laboratory QA Manual and/or SOP	PFAS	See Laboratory QA Manual and/or SOP	See Laboratory QA Manual and/or SOP	See Laboratory QA Manual and/or SOP	See Laboratory QA Manual and/or SOP	Analyst, Department Manager	See Laboratory QA Manual and/or SOP
TOC Analyzer	See Laboratory QA Manual and/or SOP	TOC	See Laboratory QA Manual and/or SOP	See Laboratory QA Manual and/or SOP	See Laboratory QA Manual and/or SOP	See Laboratory QA Manual and/or SOP	Analyst, Department Manager	See Laboratory QA Manual and/or SOP
pH Meter	See Laboratory QA Manual and/or SOP	Soil pH	See Laboratory QA Manual and/or SOP	See Laboratory QA Manual and/or SOP	See Laboratory QA Manual and/or SOP	See Laboratory QA Manual and/or SOP	Analyst, Department Manager	See Laboratory QA Manual and/or SOP

Note:

[1] SOP reference numbers correspond to Laboratory SOPs in **Worksheet #23**.

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

Sampling Organization: Arcadis
Laboratory: ELLE, GCAL, and Shealy
Method of sample delivery (shipper/carrier): Laboratory Courier and/or Federal Express
Number of days from reporting until sample disposal: at least 60 days

Activity	Organization and title or position of person responsible for the activity	SOP reference
Sample labeling	Field Team Leader Arcadis	See Field SOP P-01. Sample identification will be site-specific.
Chain-of-custody (COC) form completion	Field Team Leader Arcadis	See Field SOPs P-01 and P-02.
Packaging	Field Team Leader Arcadis	See Field SOPs P-01 and P-02.
Shipping coordination	Field Team Leader Arcadis	See Field SOPs P-01 and P-02.
Sample receipt, inspection, and log-in	ELLE, GCAL, and Shealy	See “Laboratory Custody Procedures” below.
Sample custody and storage	ELLE, GCAL, and Shealy	See “Laboratory Custody Procedures” and “Final Evidence Files” below.
Sample disposal	ELLE, GCAL, and Shealy	See Laboratory QA Manual and/or Sample Disposal SOP

Laboratory Custody Procedures

A designated sample custodian accepts custody of the samples and verifies that the information on the sample labels matches that on the COC(s). The sample custodian will document any discrepancies and will sign and date all appropriate receiving documents. The sample custodian will also document the condition of the samples upon receipt at the laboratory. If a sample container is missing, a sample container is received broken, the sample is in an inappropriate container, or the sample has not been preserved by appropriate means, Arcadis personnel will be notified as per direction on **Worksheet #6**.

In accordance with laboratory custody and security requirements, the laboratory sample custodian will be responsible for logging the samples in, assigning a unique laboratory identification number to each sample to assure traceability of samples while in possession of the laboratory, labeling the sample bottle with the laboratory identification number, and moving the sample to an appropriate storage location to await analysis. The project name, field sample code, date sampled, date received, analysis required, storage location and date, and action for final disposition will be recorded in the laboratory tracking system. Relevant custody documentation will be placed in the project file.

The following stages of analysis must be documented by the laboratory:

- Sample Extraction/Preparation
- Sample Analysis
- Data Reduction
- Data Reporting

Laboratory personnel are responsible for the custody of the samples until they are returned to the sample custodian.

Final Evidence Files

This is the final phase of sample custody. The COC records and sample analysis request form copies are archived in their respective project files. Laboratory custody forms, sample preparation and analysis logbooks, and data packages will become part of the laboratory final evidence file. Other relevant documentation including records, reports, correspondence, logs, pictures, and data review reports will be archived by Arcadis personnel.

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

(UFP-QAPP Manual Section 3.4 and Tables 4, 5, and 6)
(EPA 2106-G-05 Section 2.3.5)

Matrix	Soil, Sediment, and Water
Analytical Group	PFAS
Analytical Method/SOP Reference[1]	PFAS per DoD QSM 5.1.1, 5.2 or later versions Table B-15/ ELLE SOPs T-PFAS-WI12031/ T-PFAS-WI14355

QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Field Duplicate	1 per 20 field samples	RPD ≤ 50% for soil/sediment; ≤ 35% for water	Qualify data as appropriate	Data Validator	Overall precision	RPD ≤ 50% for soil/sediment; ≤ 35% for water
Method blank	1 per analytical batch of no more than 20 samples	No target analyte concentrations ≥ ½ LOQ or > 1/10th the amount measured in any sample	Correct problem. If required, reprep and reanalyze method blank and all QC samples and field samples processed with the contaminated blank.	Analyst / Section Supervisor	Contamination/ Bias	No target analyte concentrations ≥ ½ LOQ
Equipment blank (per piece of reusable equipment, as needed)	1 per piece of relevant equipment per sampling event	No target analyte concentrations ≥ ½ LOQ or > 1/10th the amount measured in any sample	Qualify data as appropriate	Data Validator	Contamination/ Bias	No target analyte concentrations ≥ ½ LOQ
Field Blank	1 per 20 field samples	No target analyte concentrations ≥ ½ LOQ or > 1/10th the amount	Qualify data as appropriate	Data Validator	Contamination/ Bias	No target analyte concentrations ≥ ½ LOQ

QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
		measured in any sample				

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

(UFP-QAPP Manual Section 3.4 and Tables 4, 5, and 6)
(EPA 2106-G-05 Section 2.3.5)

QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
LCS	1 per analytical batch of no more than 20 samples	DoD QSM 5.1.1: Lab in-house control limits or %R 70 to 130%. DoD QSM 5.2 and later versions, see Tables C-44 and C-45.	Correct problem, then re-prep and reanalyze the LCS and all samples in the associated preparatory batch for failed analytes if sufficient sample material is available.	Analyst / Section Supervisor	Accuracy/Bias	DoD QSM 5.1.1: Lab in-house control limits or %R 70 to 130%. DoD QSM 5.2 and later versions, see Tables C-44 and C-45.

QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Injection Internal Standards (only applies to DoD QSM 5.1.1)	Every field sample, standard, blank, and QC sample.	Added just prior to analysis. Peak areas must be within -50% to +50% of area from ICAL midpoint standard.	If peak areas are unacceptable, analyze a second aliquot of extract if enough remains. If not enough extract, reanalyze the first aliquot. If second analysis meets acceptance criteria, report the second analysis. If it fails, either analysis may be reported with the appropriate flags.	Analyst / Section Supervisor	Accuracy/bias	Peak areas must be within -50% to +50% of area from ICAL midpoint standard

QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Extracted Internal Standards [2]	Every field sample, standard, blank, and QC sample.	Added to solid sample prior to extraction. Added to aqueous samples, into the original container, prior to extraction. For aqueous samples prepared by serial dilution instead of SPE, added to the final dilution of samples prior to analysis. %R 50 to 150% of ICAL midpoint standard area or area measured in the initial CCV on days when ICAL is not performed.	If recoveries are acceptable for QC samples, but not field samples, may indicate matrix effect. If QC samples fail, correct problem; rerun all failed samples, report and narrate	Analyst / Section Supervisor	Accuracy/bias	%R 50 to 150% of ICAL midpoint standard area or area measured in the initial CCV on days when ICAL is not performed.

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

(UFP-QAPP Manual Section 3.4 and Tables 4, 5, and 6)
(EPA 2106-G-05 Section 2.3.5)

QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits[1]	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Matrix spike / MSD	1 per analytical batch of no more than 20 samples. Not required for aqueous samples prepared by serial dilution instead of SPE.	Sample spiked with all analytes at concentration ≥ LOQ and ≤ mid-level calibration concentration. RPD ≤30% DoD QSM 5.1.1: Lab in-house control limits or %R 70 to 130%. DoD QSM 5.2 and later versions, see Tables C-44 and C-45.	If criteria not met, qualify as appropriate.	Analyst / Section Supervisor	Accuracy/bias	RPD ≤30% DoD QSM 5.1.1: Lab in-house control limits or %R 70 to 130%. DoD QSM 5.2 and later versions, see Tables C-44 and C-45.
Post spike sample. Only applies to aqueous samples prepared by serial dilution instead of SPE that have	Spike aliquot(s) of sample at the final dilution(s) reported for sample with all analytes that have reported value of "<LOQ" in the final dilution. The spike must	When analyte concentrations are calculated as "<LOQ," the spike must recover within 70-130%of its true value.	When analyte concentrations are calculated as "<LOQ," and the spike recovery does not meet the 70-130% acceptance criteria, the sample, sample duplicate, and post spike sample must be reanalyzed at consecutively higher dilutions until the criteria is met.	Analyst / Section Supervisor	Accuracy/bias	Post spike recovery must be within 70 to 130% of the true value.

QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits[1]	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
reported value of "<LOQ" for analyte(s).	be at the LOQ concentration to be reported with the sample (the "<LOQ" value).					

Notes:

1. SOP for PFAS from ELLE is proprietary. The SOP will be made available to the client and agency upon request.
2. The isotopically labeled analog of an analyte (Extracted Internal Standard Analyte) must be used for quantitation if commercially available (Isotope Dilution Quantitation). If a labeled analog is not commercially available, the Extracted Internal Standard Analyte with the closest retention time to the analyte must be used for quantitation.

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

(UFP-QAPP Manual Section 3.4 and Tables 4, 5, and 6)
(EPA 2106-G-05 Section 2.3.5)

Matrix	Soil, Sediment, and Water
Analytical Group	PFAS
Analytical Method/SOP Reference	PFAS per DoD QSM 5.1.1, 5.2 or later versions Table B-15/ GCAL SOP LCMS-011

QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Field Duplicate	1 per 20 field samples	RPD ≤ 50% for soil/sediment; ≤ 35% for water	Qualify data as appropriate	Data Validator	Overall precision	RPD ≤ 50% for soil/ sediment; ≤ 35% for water
Method blank	1 per analytical batch of no more than 20 samples	No target analyte concentrations ≥ ½ LOQ or > 1/10th the amount measured in any sample	Correct problem. If required, reprep and reanalyze method blank and all QC samples and field samples processed with the contaminated blank.	Analyst / Section Supervisor	Contamination/ Bias	No target analyte concentrations ≥ ½ LOQ
Equipment blank (per piece of reusable equipment, as needed)	1 per piece of relevant equipment per sampling event	No target analyte concentrations ≥ ½ LOQ or > 1/10th the amount measured in any sample	Qualify data as appropriate	Data Validator	Contamination/ Bias	No target analyte concentrations ≥ ½ LOQ
Field Blank	1 per 20 field samples	No target analyte concentrations ≥ ½ LOQ or > 1/10th the amount	Qualify data as appropriate	Data Validator	Contamination/ Bias	No target analyte concentrations ≥ ½ LOQ

QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
		measured in any sample				

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

(UFP-QAPP Manual Section 3.4 and Tables 4, 5, and 6)
(EPA 2106-G-05 Section 2.3.5)

QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
LCS	1 per analytical batch of no more than 20 samples	DoD QSM 5.1.1: Lab in-house control limits or %R 70 to 130%. DoD QSM 5.2 and later versions, see Tables C-44 and C-45.	Correct problem, then reprep and reanalyze the LCS and all samples in the associated preparatory batch for failed analytes if sufficient sample material is available.	Analyst / Section Supervisor	Accuracy/Bias	DoD QSM 5.1.1: Lab in-house control limits or %R 70 to 130%. DoD QSM 5.2 and later versions, see Tables C-44 and C-45.
Injection Internal Standards (only applies to DoD QSM 5.1.1)	Every field sample, standard, blank, and QC sample.	Added just prior to analysis. Peak areas must be within -50% to +50% of area from ICAL midpoint standard.	If peak areas are unacceptable, analyze a second aliquot of extract if enough remains. If not enough extract, reanalyze the first aliquot. If second analysis meets acceptance criteria, report the second analysis. If it fails, either analysis may be reported with the appropriate flags.	Analyst / Section Supervisor	Accuracy/bias	Peak areas must be within -50% to +50% of area from ICAL midpoint standard

QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Extracted Internal standards [1]	Every field sample, standard, blank, and QC sample.	Added to solid sample prior to extraction. Added to aqueous samples, into the original container, prior to extraction. For aqueous samples prepared by serial dilution instead of SPE, added to the final dilution of samples prior to analysis. %R 50 to 150% of ICAL midpoint standard area or area measured in the initial CCV on days when ICAL is not performed.	If recoveries are acceptable for QC samples, but not field samples, may indicate matrix effect. If QC samples fail, correct problem; rerun all failed samples, report and narrate	Analyst / Section Supervisor	Accuracy/bias	%R 50 to 150% of ICAL midpoint standard area or area measured in the initial CCV on days when ICAL is not performed.

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

(UFP-QAPP Manual Section 3.4 and Tables 4, 5, and 6)
(EPA 2106-G-05 Section 2.3.5)

QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Matrix spike / MSD	1 per analytical batch of no more than 20 samples.	Sample spiked with all analytes at concentration ≥ LOQ and ≤ mid-level calibration concentration. RPD ≤30% DoD QSM 5.1.1: Lab in-house control limits or %R 70 to 130%. DoD QSM 5.2 and later versions, see Tables C-44 and C-45.	If criteria not met, qualify as appropriate.	Analyst / Section Supervisor	Accuracy/bias	RPD ≤30% DoD QSM 5.1.1: Lab in-house control limits or %R 70 to 130%. DoD QSM 5.2 and later versions, see Tables C-44 and C-45.
Post spike sample. Only applies to aqueous samples prepared by serial dilution instead of SPE that have	Spike aliquot(s) of sample at the final dilution(s) reported for sample with all analytes that have reported value of “<LOQ” in the final dilution. The spike must	When analyte concentrations are calculated as “<LOQ,” the spike must recover within 70-130%of its true value.	When analyte concentrations are calculated as “<LOQ,” and the spike recovery does not meet the 70-130% acceptance criteria, the sample, sample duplicate, and post spike sample must be reanalyzed at consecutively higher dilutions until the criteria is met.	Analyst / Section Supervisor	Accuracy/bias	Post spike recovery must be within 70 to 130% of the true value.

QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
reported value of "<LOQ" for analyte(s).	be at the LOQ concentration to be reported with the sample (the "<LOQ" value).					

Notes:

1. The isotopically labeled analog of an analyte (Extracted Internal Standard Analyte) must be used for quantitation if commercially available (Isotope Dilution Quantitation). If a labeled analog is not commercially available, the Extracted Internal Standard Analyte with the closest retention time to the analyte must be used for quantitation.

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

(UFP-QAPP Manual Section 3.4 and Tables 4, 5, and 6)
(EPA 2106-G-05 Section 2.3.5)

Matrix	Soil, Sediment, and Water
Analytical Group	PFAS
Analytical Method/SOP Reference	PFAS per DoD QSM 5.2 or later versions Table B-15/ Shealy SOP ME00213-12

QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Field Duplicate	1 per 20 field samples	RPD ≤ 50% for soil/sediment; ≤ 35% for water	Qualify data as appropriate	Data Validator	Overall precision	RPD ≤ 50% for soil/ sediment; ≤ 35% for water
Method blank	1 per analytical batch of no more than 20 samples	No target analyte concentrations ≥ ½ LOQ or > 1/10th the amount measured in any sample	Correct problem. If required, reprep and reanalyze method blank and all QC samples and field samples processed with the contaminated blank.	Analyst / Section Supervisor	Contamination/ Bias	No target analyte concentrations ≥ ½ LOQ
Equipment blank (per piece of reusable equipment, as needed)	1 per piece of relevant equipment per sampling event	No target analyte concentrations ≥ ½ LOQ or > 1/10th the amount measured in any sample	Qualify data as appropriate	Data Validator	Contamination/ Bias	No target analyte concentrations ≥ ½ LOQ
Field Blank	1 per 20 field samples	No target analyte concentrations ≥ ½ LOQ or > 1/10th the amount	Qualify data as appropriate	Data Validator	Contamination/ Bias	No target analyte concentrations ≥ ½ LOQ

QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
		measured in any sample				

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

(UFP-QAPP Manual Section 3.4 and Tables 4, 5, and 6)
(EPA 2106-G-05 Section 2.3.5)

QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
LCS	1 per analytical batch of no more than 20 samples	DoD QSM 5.2 and later versions, see Tables C-44 and C-45.	Correct problem, then reprep and reanalyze the LCS and all samples in the associated preparatory batch for failed analytes if sufficient sample material is available.	Analyst / Section Supervisor	Accuracy/Bias	DoD QSM 5.2 and later versions, see Tables C-44 and C-45.
Matrix spike / MSD	1 per analytical batch of no more than 20 samples.	Sample spiked with all analytes at concentration ≥ LOQ and ≤ mid-level calibration concentration. RPD ≤30% DoD QSM 5.2 and later versions, see Tables C-44 and C-45.	If criteria not met, qualify as appropriate.	Analyst / Section Supervisor	Accuracy/bias	RPD ≤30% DoD QSM 5.2 and later versions, see Tables C-44 and C-45.
Post spike sample. Only applies to aqueous samples prepared by serial dilution instead of	Spike aliquot(s) of sample at the final dilution(s) reported for sample with all analytes that have reported value of "<LOQ" in the	When analyte concentrations are calculated as "<LOQ," the spike must recover within 70-130%of its true value.	When analyte concentrations are calculated as "<LOQ," and the spike recovery does not meet the 70-130% acceptance criteria, the sample, sample duplicate, and post spike sample must be reanalyzed at consecutively higher dilutions until the criteria is met.	Analyst / Section Supervisor	Accuracy/bias	Post spike recovery must be within 70 to 130% of the true value.

QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
SPE that have reported value of "<LOQ" for analyte(s).	final dilution. The spike must be at the LOQ concentration to be reported with the sample (the "<LOQ" value).					
Extracted Internal standards [1]	Every field sample, standard, blank, and QC sample.	Added to solid sample prior to extraction. Added to aqueous samples, into the original container, prior to extraction. For aqueous samples prepared by serial dilution instead of SPE, added to the final dilution of samples prior to analysis. %R 50 to 150% of ICAL midpoint standard area or area measured in the initial CCV on days when ICAL is not performed.	If recoveries are acceptable for QC samples, but not field samples, may indicate matrix effect. If QC samples fail, correct problem; rerun all failed samples, report and narrate	Analyst / Section Supervisor	Accuracy/bias	%R 50 to 150% of ICAL midpoint standard area or area measured in the initial CCV on days when ICAL is not performed.

Notes:

1. The isotopically labeled analog of an analyte (Extracted Internal Standard Analyte) must be used for quantitation if commercially available (Isotope Dilution Quantitation). If a labeled analog is not commercially available, the Extracted Internal Standard Analyte with the closest retention time to the analyte must be used for quantitation.

QAPP Worksheet #28-4: Analytical Quality Control and Corrective Action

(UFP-QAPP Manual Section 3.4 and Tables 4, 5, and 6)
(EPA 2106-G-05 Section 2.3.5)

Matrix	Soil
Analytical Group	TOC/SW846 9060A
Analytical Method/SOP Reference[1]	ELLE / T-WC-WI11627 GCAL / WL-057

QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits [1]	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Field Duplicate	1 per 20 field samples	RPD ≤ 50% for soil	Qualify data as appropriate	Data Validator	Overall precision	RPD ≤ 50% for soil
Method blank	1 per analytical batch of no more than 20 samples	No TOC concentrations ≥ ½ LOQ	Correct problem. If required, reprep and reanalyze method blank and all QC samples and field samples processed with the contaminated blank.	Analyst / Section Supervisor	Contamination/Bias	No TOC concentrations ≥ ½ LOQ
Reagent or Equipment blank as appropriate	1 per 20 field samples	No TOC concentrations ≥ ½ LOQ	Qualify data as appropriate	Data Validator	Contamination/Bias	No TOC concentrations ≥ ½ LOQ
LCS	1 per analytical batch of no more than 20 samples	%R 80-120%	Correct problem, then reprep and reanalyze the LCS and all samples in the associated preparatory batch for failed analytes if sufficient sample material is available.	Analyst / Section Supervisor	Accuracy/Bias	%R 80-120%

QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits [1]	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
MS / MSD	1 per analytical batch of no more than 20 samples.	Sample spiked at mid-level calibration concentration. %R 75-125% RPD ≤35%	If criteria not met, qualify as appropriate.	Analyst / Section Supervisor	Accuracy/bias	%R 75-125% RPD ≤35%

Notes:
1. SOPs are reviewed/revised on an annual schedule. The current version will be followed at the time of sample receipt.

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

(UFP-QAPP Manual Section 3.4 and Tables 4, 5, and 6)
(EPA 2106-G-05 Section 2.3.5)

Matrix	Soil
Analytical Group	pH/SW846 9045D
Analytical Method/SOP Reference[1]	ELLE / T-WC-WI11518 GCAL / EXT-032

QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits [1]	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
LCS	1 per analytical batch of no more than 20 samples	Within ± 0.05 su of true value	Correct problem, then reanalyze the LCS and all samples in the associated preparatory batch for failed analytes if sufficient sample material is available.	Analyst / Section Supervisor	Accuracy/Bias	± 0.05 su of true value
Laboratory Duplicate	1 per analytical batch of no more than 20 samples.	Range ≤ 0.1 su	If criteria not met, qualify as appropriate.	Analyst / Section Supervisor	Accuracy/bias	Range ≤ 0.1 su

Notes:
1. SOPs are reviewed/revised on an annual schedule. The current version will be followed at the time of sample receipt.

QAPP Worksheet #29: Project Documents and Records Table

(UFP-QAPP Manual Sections 3.5.1)
(EPA 2106-G-05 Sections 2.2.8)

Document	Storage Location
QAPP addenda	Arcadis Project File[1]
PQAPP	
Programmatic Accident Prevention Plan and Site Safety and Health Plan	
Field Data Collection Sheets	
Analytical Data Packages	
Data Validation Reports	
Field Logs, Air Bills, Communication Logs, Non-Conformance Reports, Corrective Action Reports, Documentation of Deviation from Field Methods	
Field Chain-of-Custody Records	
Laboratory QA Plan	Laboratory
Method Detection Limit Study Information	
Environmental Laboratory Accreditation Program (ELAP)	
Sample Receipt and Tracking Records	
Laboratory Chain-of-Custody Records	
Equipment Calibration Logs	
Sample Preparation Logs	
Corrective Action Forms and Reports and Documentation of Corrective Action Results	
Data Summary and Instrument Raw Data for Field Samples, Standards, QC Checks, and QC Samples	
Laboratory Internal Data Package Completeness Checklist	

Document	Storage Location
Standards Traceability Records, Analytical Audit Checklists	
Electronic Copy of Analytical Data Reports	Arcadis Project File[1], and Laboratory Record
Case Narrative, Definition of Laboratory Qualifiers, Documentation of Laboratory Method Deviations, Laboratory Sample Identification Numbers, Signatures for Laboratory Sign-Off	
Electronic Data Deliverables (EDDs)	

Note:
[1] All documents maintained in the Arcadis Project File will be retained for a minimum of 10 years.

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

Assessments					
Assessment Type	**Responsible Party & Organization**	**Number/Frequency**	**Estimated Dates**	**Assessment Deliverable**	**Deliverable Due Date**
Review of QAPP addendum, PQAPP and SOPs with field staff	Arcadis	Prior to sampling start up	Prior to sampling	Documented in field checklist	Completed at beginning of each type/media field activity and as needed during sampling
Daily logbook and field forms	Arcadis	Daily	During field activities	Contained within written report	As part of Draft Report
Laboratory assessment for appropriate certifications and capacity and PQAPP review with laboratory staff	Arcadis	Prior to sampling start up	Prior to sampling	Receipt of copies of certifications. Email traffic concerning laboratory capacity prior to sampling start-up. PQAPP sign-off sheet received from laboratory.	N/A
Field sampling and chain of custody review against QAPP addendum requirements	Arcadis	Daily	During field activities	Communication in the form of an email.	Notify laboratory or field team, as appropriate, of corrections. Last email received no later than 24 hours after last sampling event
Laboratory report deliverables and analytical results review against QAPP addendum requirements	Arcadis	Per sample delivery group (SDG)	Immediately following receipt of laboratory report	Communication in the form of an email.	N/A
Data verification	Arcadis	Per SDG	Immediately following receipt of laboratory report	Communication in the form of an email requesting additional laboratory forms, backup data that may be missing and/or clarification of the analytical report.	Three weeks after receipt of data.

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

Assessments

Assessment Type	Responsible Party & Organization	Number/Frequency	Estimated Dates	Assessment Deliverable	Deliverable Due Date
Data validation	Arcadis	Per SDG	Following receipt of laboratory report	Data Validation Report	Three weeks after receipt of data.

Assessment Response and Corrective Action

Assessment Type	Responsibility for Responding to Assessment Finding	Assessment Response Documentation	Timeframe for Response	Responsibility for Implementing Corrective Action	Responsible for Monitoring Corrective Action Implementation
Review of PQAPP and SOPs with field staff	Rhonda Stone, PMP PM, Arcadis	Field progress report, non-conformance report, or corrective action report dependent on significance of finding	Within 24 hours	Field Team Leader and/or Regional Lead, Arcadis	Rhonda Stone, PMP PM, Arcadis
Daily logbook and field forms	Field Team Leader, Arcadis	Field progress report, non-conformance report, or corrective action report dependent on significance of finding	Within 24 hours	Field Team Leader, Arcadis	Regional Lead, Arcadis
Laboratory assessment for appropriate certifications and capacity and PQAPP review with laboratory staff	Kathy Klinefelter, PM, ELLE Brenda Martinez, PM, GCAL Nisreen Saikaly, PM, Shealy	Response to email	Within 48 hours of notification	Kathy Klinefelter, PM, ELLE Brenda Martinez, PM, GCAL Nisreen Saikaly, PM, Shealy	Project Chemist, Arcadis

Assessment Response and Corrective Action					
Assessment Type	**Responsibility for Responding to Assessment Finding**	**Assessment Response Documentation**	**Timeframe for Response**	**Responsibility for Implementing Corrective Action**	**Responsible for Monitoring Corrective Action Implementation**
Field sampling and chain of custody review against QAPP addendum requirements	Regional Lead Arcadis	Response to email	Within 24 hours after sampling	Field Team Leader, Arcadis	Regional Lead Arcadis
Laboratory report deliverables and analytical results review against QAPP addendum requirements	Kathy Klinefelter, PM, ELLE Brenda Martinez, PM, GCAL Nisreen Saikaly, PM, Shealy	If required, laboratory reports will be amended, and corrections noted in the case narrative.	Within 72 hours after notification	Kathy Klinefelter, PM, ELLE Brenda Martinez, PM, GCAL Nisreen Saikaly, PM, Shealy	Lyndi Mott, Data Validator, Arcadis
Data verification	Kathy Klinefelter, PM, ELLE Brenda Martinez, PM, GCAL Nisreen Saikaly, PM, Shealy	If required, laboratory reports will be amended, and corrections noted in the case narrative and contained within the validation report.	Up to 7 days	Kathy Klinefelter, PM, ELLE Brenda Martinez, PM, GCAL Nisreen Saikaly, PM, Shealy	Lyndi Mott, Data Validator, Arcadis
Data validation	Kathy Klinefelter, PM, ELLE Brenda Martinez, PM, GCAL Nisreen Saikaly, PM, Shealy	If required, laboratory reports will be amended, and corrections noted in the case narrative and contained within the validation report.	Up to 7 days	Kathy Klinefelter, PM, ELLE Brenda Martinez, PM, GCAL Nisreen Saikaly, PM, Shealy	Lyndi Mott, Data Validator, Arcadis

QAPP Worksheet #34 – Data Verification and Validation Inputs

Item	Description	Verification (completeness)	Validation (conformance to specifications)
Planning Documents/Records			
1	Approved QAPP addendum	**X**	
2	Contract	**X**	
4	Field SOPs	**X**	
5	Laboratory SOPs	**X**	
Field Records			
6	Field logbooks	**X**	
7	Equipment calibration records	**X**	
8	COC Forms	**X**	
9	Sampling logs	**X**	
10	Drilling logs	**X**	
13	Change orders/deviations	**X**	
14	Field audit reports	**X**	
15	Field corrective action reports/Field non-conformance reports	**X**	
Analytical Data Package			
16	Cover sheet (laboratory identifying information)	**X**	**X**
17	Case narrative	**X**	**X**
18	Internal laboratory COC	**X**	**X**
19	Sample receipt records	**X**	**X**
20	Sample chronology (i.e. dates and times of receipt, preparation, & analysis)	**X**	**X**
21	Communication records	**X**	**X**
22	LOD/LOQ establishment and verification	**X**	**X**
23	Standards Traceability	**X**	**X**
24	Instrument calibration records	**X**	**X**
25	Definition of laboratory qualifiers	**X**	**X**
26	Results reporting forms	**X**	**X**
27	QC sample results	**X**	**X**
28	Corrective action reports	**X**	**X**
29	Raw data	**X**	**X**
30	EDD	**X**	**X**

QAPP Worksheet #35 – Data Verification Procedures

Worksheet #35 Contains 2 Pages

Records Reviewed	Required Documents	Process Description	Responsible Person, Organization
Field logbook	PQAPP	• 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: Regional Lead/Field Team Leader, Arcadis
COC forms	PQAPP	• All samples to be analyzed by the laboratory will be shipped via overnight delivery or will be sent via the laboratory courier service. • Upon receipt, the laboratory sample custodian will check the integrity of the custody seals and will sign and date the COC to acknowledge sample receipt. • The laboratory is responsible for verifying that the COC and containers agree and that the sample containers are received in good condition. • The sample receipt form will be sent to the Arcadis PM prior to preparation for analysis. • The Laboratory Information Management System will provide evidence of sample custody from receipt by the laboratory until appropriate disposal.	Daily: Regional Lead/Field Team Leader, Arcadis Upon receipt: Kathy Klinefelter, PM, ELLE Upon receipt: Brenda Martinez, PM, GCAL Upon receipt: Nisreen Saikaly, PM, Shealy

QAPP Worksheet #35 – Data Verification Procedures

Worksheet #35 Contains 2 Pages

Records Reviewed	Required Documents	Process Description	Responsible Person, Organization
Laboratory Non-conformance/ corrective action and report procedure	PQAPP	• Routine corrective actions apply to all analytical quality control parameters and analytical system specifications as defined in the laboratory SOPs. • Analysts have full responsibility and authority for performing routine corrective actions, which are documented as part of the analytical record. • Defective processes, holding time violations, systematic errors and quality defects that occur are to be reported by the analyst to the laboratory supervisor and a non-conformance record initiated. The laboratory PM will then notify the Arcadis PM and/or Project Chemist. • All notifications must be made in a timely manner. The non-conformance record must become part of the analytical record.	Before release: Dorothy Love, QA Manager, ELLE Before release: William Perry, QA Manager, GCAL Before release: Stephanie Atkins, QA Manager, Shealy Upon receipt: Erika Houtz, Senior Chemist, or Alternate; Yousof Aly, Arcadis
Analytical Data Package - Laboratory	PQAPP Lab QA Manual Lab SOPs	• All data produced by the laboratory will be required to undergo several levels of review, which will include two levels of management review at the laboratory. • The laboratory will review the data packages internally for completeness and verify that all of the required forms and raw data are included for each data package type. • The Lab QA Manager may also select to review randomly chosen data packages for additional audits.	Before release: Kathy Klinefelter, PM, ELLE Before release: Brenda Martinez, PM, GCAL Before release: Nisreen Saikaly, PM, Shealy
Analytical Data Package/Laboratory Quality Control	PQAPP DoD QSM 5.1.1, 5.2 or later versions Lab SOPs Analytical Methods	• The Data Validator will verify that data have been received for all samples sent to the laboratory. • An evaluation of this data will be performed to determine whether the laboratory met the QC requirements as stated in this PQAPP, DoD QSM 5.1.1, 5.2 or later versions, analytical methods and laboratory SOPs. The QSM version used for data evaluation will be the version the lab is certified for under DoD ELAP at the time of analysis.	Lyndi Mott, Data Validator, Arcadis
Laboratory EDD	PQAPP	• The laboratory will provide EDDs. The database manager or designee will review these files for correctness and completeness.	Ted Wall, Database Manager, Arcadis

Note: All required data deliverables must be present in the data package to proceed to the next step of data validation (**Worksheet # 36**).

QAPP Worksheet #36: Data Validation Procedures

(UFP-QAPP Manual Sections 5.2.2)
(EPA 2106-G-05 Sections 2.5.1)

Data Validator: Arcadis Project Chemist, or designee

Analytical Group/Method:	PFAS, TOC, pH	Grain Size
Data deliverable requirements:	Stage 4 Data Package(pdf); Equis 6 EDD; SEDD Version 5.2 Stage 2a or 2b	Stage 2a Data Package(pdf); Equis 6 EDD
Analytical specifications:	PFAS per DoD QSM 5.1.1 Table B-15 TOC by SW-846 9060A pH by SW-846 9045D	Grain Size by ASTM D422-63
Measurement performance criteria:	DoD QSM 5.1.1, 5.2 or later versions; Worksheets 12 and 28	Laboratory SOPs and QC Control Limits
Percent of data packages to be validated:[1]	100%	0%
Percent of raw data reviewed:	10%	0%
Percent of results to be recalculated:	10%	0%
Validation procedure:	This PQAPP, DoD QSM 5.1, 5.1.1, 5.2 or later versions; USACE Engineer Manual 200-1-10, Analytical Methods, Lab SOPs	N/A

Note:

[1] 100% of the data will be reviewed and verified. Data validation is not required for the geotechnical parameters (i.e., grain size distribution).

QAPP Worksheet #37: Usability Assessment

The Data Usability Assessment will be performed by Arcadis for data associated with the USAEC PFAS PA/SI Program. Documentation generated during the Data Usability Assessment will consist of a Data Usability Summary Report in accordance with the USACE Engineer Manual 200-1-10 and a statement of overall data usability.

After analytical data has been reviewed, verified, and validated in accordance with the procedures described in **Worksheets #34** and **#35**, the data must be further evaluated to determine if the DQOs have been met. Documentation generated during the Data Usability Assessment will consist of data validation checklists with a brief summary of overall data usability.
The DQIs used to evaluate conformance with the project DQOs are presented below.

DQIs are generally defined in terms of six parameters:

1. representativeness
2. comparability
3. completeness
4. precision
5. accuracy
6. sensitivity

Each parameter is defined below. Specific objectives for the site actions are presented in other sections of the QAPP addenda.

Representativeness

Representativeness is the degree to which sampling data accurately and precisely represent site conditions and is dependent on sampling and analytical variability and the variability of environmental media at the site. Actions have been designed to assess the presence of chemical constituents at the time of sampling. The QAPP addendum presents the rationale for sample quantities and location. The QAPP addenda and this PQAPP presents field sampling and laboratory analytical methodologies. Use of the prescribed field and laboratory analytical methods with associated holding times and preservation requirements are intended to provide representative data.

Comparability

Comparability is the degree of confidence with which one data set can be compared to another. Comparability between phases of the actions (if additional phases are required) will be maintained through consistent use of the sampling and analytical methodologies set forth in the QAPP addenda and this PQAPP, established QA/QC procedures and use of appropriately trained personnel.

QAPP Worksheet #37: Usability Assessment

Completeness

Completeness will be determined for Field Sampling and Analytical. Field sampling completeness is defined as the measure of the quantity of samples collected compared to the quantity of samples that were planned to be collected. Field sampling completeness will be calculated as:

$$\text{Field Completeness} = \frac{\text{Number of samples collected}}{\text{Total number of samples planned for collection}} \times 100$$

The field sampling completeness goal for each installation is 100%.

Analytical completeness is defined as a measure of the amount of valid data obtained from an event and/or investigation compared to the total amount that was obtained. This will be determined upon final assessment of the analytical results. Completeness of a laboratory data set will be calculated by comparing the number of valid sample results generated to the total number of results generated.

$$\text{Completeness} = \frac{\text{Number valid results}}{\text{Total number of results generated}} \times 100$$

As a general guideline, the analytical completeness for each installation is expected to be at least 95%. Areas that may require 100% completeness will be addressed in the site specific QAPP Addenda. The assessment of analytical completeness will require professional judgment to determine data usability for intended purposes.

Precision

Precision is a measure of the reproducibility of sample results. The goal is to maintain a level of analytical precision consistent with the objectives of the action. To maximize precision, sampling and analytical procedures will be followed. All work for the site actions will adhere to established protocols presented in the QAPP addendum and this PQAPP. Checks for analytical precision will include the analysis of matrix spike/ MSDs, laboratory duplicates, and field duplicates.

QAPP Worksheet #37: Usability Assessment

The precision of data will be measured by calculating the RPD by the following equation:

$$RPD = \frac{(A-B)}{(A+B)/2} \times 100$$

Where:

A = Analytical result from one of two duplicate measurements.

B = Analytical result from the second measurement.

Accuracy

Accuracy is a measure of how close a measured result is to the true value. Both field and analytical accuracy will be monitored through initial and continuing calibration of instruments. In addition, reference standards, matrix spikes, blank spikes and surrogate standards will be used to assess the accuracy of the analytical data.

Accuracy will be calculated in terms of percent recovery as follows:

$$\%\ Recovery = \frac{A-X}{B} \times 100$$

Where:

A = Value measured in spiked sample or standard.

X = Value measured in original sample.

B = True value of amount added to sample or true value of standard.

QAPP Worksheet #37: Usability Assessment

Sensitivity

Sensitivity is a quantitative measurement to determine if the analytical laboratory's procedures/methodologies and their associated detection limits can satisfy the project requirements. LODs are updated annually by the laboratory. The current LODs for the analytical laboratories are presented in **Worksheet #15**.

Field Data Review

Field data are generated from in-field measurement, which may include a geophysical survey, well development and groundwater sampling. The quality objective for the in-field measurement activities is to obtain accurate measurements of sample characteristics, including aqueous pH, conductivity, temperature, turbidity and dissolved oxygen, using appropriate equipment. Data are recorded in field logbooks or on field sampling sheets and calibration logs. Calibration logs will be reviewed by Arcadis Field Managers with other field documentation to identify any potential impacts to data quality and usability. Field logbooks are reviewed as part of the QC inspections.

Reconciliation with Data Usability Requirements

Data results will be examined to determine the performance that was achieved for each data usability criterion. The performance will then be compared with the project objectives and DQOs. Deviations from objectives will be noted. Data that have been rejected will not be used. Data that have been qualified but not rejected will be considered useable (i.e., qualified as estimated) and definitive data. If there is an instance where further limitations must be placed on qualified data, the data will be additionally qualified with "X." This would indicate that the associated data are non-definitive data and should be used for screening purposes only.

Additional action may be warranted when performance does not meet performance objectives for critical data. Options for corrective action relating to incomplete information, questionable results or inconsistent data may include any or all of the following:

- retrieval of missing information
- request for additional explanation or clarification
- reanalysis of sample from extract (when appropriate)
- recalculation or reinterpretation of results by the laboratory

QAPP Worksheet #37: Usability Assessment

These actions may improve the data quality, reduce uncertainty and eliminate the need to qualify or reject data. If these actions do not improve the data quality to an acceptable level, the following additional actions may be taken:

- extrapolation of missing data from existing data points
- use of historical data
- evaluation of the critical/noncritical nature of the sample

If the data gap cannot be resolved by these actions, the data bias and potential for false negatives and positives can be evaluated. If the resultant uncertainty level is unacceptable, the following action must be taken:

- additional sample collection and analysis

References

Department of Defense. 2018. *Quality Systems Manual,* Version 5.1.1, February 2018; Version 5.2, December 2018, and Version 5.3, May 2019.

Department of the Army. 2018. *MEMORANDUM – Army Guidance for Addressing Releases for Per-and Polyfluorinated Compounds*, September 2018

U.S. Army Corps of Engineers. 2005. *Guidance for Evaluating Performance Based Chemical Data*, USACE EM 200-1-10, June 2005

U.S. Environmental Protection Agency (USEPA). 2001*. Requirements for Quality Assurance Project Plans,* USEPA QA/R-5, March 2001.

USEPA. 2005. *Uniform Federal Policy for Quality Assurance Project Plans,* Final Version, March 2005.

USEPA. 2006*. Guidance on Systematic Planning Using the Data Quality Objectives Process,* USEPA QA/G-4, EPA/240/B-06/001, February 2006.

USEPA. 2012*. USEPA Guidance on Quality Assurance Project Plans,* CIO-2106-G-05, January 2012

Appendix A

Field SOPs

Arcadis ENV Quality Procedure

TOPIC:

FIELD ACTIVITIES DOCUMENTATION

Revision Date: November 2016
Revision Letter: C

QP#: 3.06

STATEMENT OF POLICY:

It is Arcadis Environment Business Line (ENV) policy that field activities must be documented to facilitate the interpretation of data; show compliance with project plans, work plans, and contract terms; and to serve as evidentiary records. Documentation reflecting activities performed must be legible, organized, and complete. Applicable regulatory and client requirements should be considered when documenting field activities. Project-specific requirements for documentation typically should be described in the Work Plan, Field Sampling Plan (FSP), and/or in the Quality Assurance Project Plan (QAPP).

1. Purpose

The purpose of this Quality Procedure (QP) is to provide a standard procedure for the documentation of fieldwork activities. This documentation pertains to site-related projects, but is not limited to the collection of samples, subsurface information, and oversight of construction activities. Field documentation must include, at a minimum, project title and number, date and times of activities, the identification of the employee performing the work, and the specifics of the work being performed.

2. Responsibilities

Certified Project Manager (CPM) – is responsible for the project-related administration of this QP.

Quality Consultant – is responsible for providing quality assurance and quality control guidance to the CPM in implementing this procedure. Note that for federal projects, there are specific requirements and qualifications for the QA Officer assigned to the project.

Project Team Members – who are assigned to document field activities, are responsible for compliance with this procedure.

3. Terms and Definitions

Field Sampling Plan (FSP) – A document that describes the procedures and protocols necessary to complete field sampling and data collection activities.

Work Plan – A document that describes proposed project activities.

Quality Assurance Project Plan (QAPP) – A document that prescribes the quality assurance/quality control (QA/QC) procedures to be followed. Uniform Federal Policy (UFP) QAPPs are now frequently required for environmental projects by most federal regulatory agencies. A UFP QAPP includes Worksheets used to document the entire project plan developed following the systematic planning process. For more details on the UFP QAPP see http://www.epa.gov/fedfac/documents/qualityassurance.htm. Note that if the project QAPP is written following the UFP format, it will also contain a description of the sampling rationale and sampling locations as well as QA/QC requirements. The UFP QAPP format is designed to capture the entire systematic planning process. If a UFP QAPP is written for a project, a separate FSP is generally not required unless specified by the particular client or contract.

Standard Operating Procedure (SOP) and Technical Guidance Instruction (TGI) – Documents that describe a procedure and or protocol necessary to conduct a specific activity.

4. Related Forms

Forms used for documenting field activities may be included as attachments to the FSP or the QAPP and may include the following examples:

- Chain-of-custody (COC) form
- Sample data log
- Field modification form
- Sample receipt form
- Corrective action form
- Field activity log
- Calibration log
- Analysis request and chain-of-custody record
- Daily quality control reports
- Purge log
- Soil boring log.

Examples of SOPs and TGIs with field forms and check-lists can be found in the Arcadis Procedure Library at: https://arcadiso365.sharepoint.com/TEAMS/US_envsoplibrary/SitePages/Home.aspx.

DESCRIPTION OF PROCEDURE:

1. General Requirements

1.1 Documentation Format

Documentation of field activities provides an accurate and comprehensive record of the work performed sufficient for a technical peer to reconstruct the day's activities and confirm that necessary client, regulatory, contract, and work plan requirements were met. General requirements include:

- Use of field books (preferably bound) as the primary source for information collection and recording. Field books should be dedicated to the project and appropriately labeled.
- Use of personal digital assistant (PDA) to document select field sampling and data collection activities using Arcadis’ electronic data gathering system (EDGE); examples include subsurface data, well/piezometer

installation, groundwater sampling, and water-level measurements. Use of PDAs with EDGE is optional but encouraged.
- Use of a Field Activity Log is suggested to formally document activities and events as a supplement to bound field books. The Field Activity Log can be a standard or project-specific form or a bound field book. Preprinted standard forms are available for many activities and should be used whenever possible. These forms will provide prompts and request additional information that may be useful and/or needed. Project-specific field forms may be generated or existing forms may be modified to meet specific project needs. Client-supplied forms may be substituted, as required.
- Appropriate header information is documented on the first page of notes for each day of fieldwork, including project title, project number, date, time, author, and relevant setting information such as weather conditions, topography, surface water conditions, observed site activities/uses, and other persons in field team. In addition, include on every page of notes the page number and date. Project-specific information depends on the nature of work being performed and should be discussed by the project team prior to commencing fieldwork. As appropriate, dedicated field logs/journals or forms should be used. When Field Activity Log Forms are used, information fields that are not applicable should be noted as such with the symbol "N/A" or other appropriate notation.
- Field documentation entries shall be made using indelible ink.
- Data entries shall be legible. A single line should be drawn through incorrect entries and the corrected entry written next to the original strikeout. Strikeouts are to be initialed and dated by the originator.
- Units of measurement shall be specified. The level of accuracy shall be indicated (e.g., observed estimate, quantified census from direct count, and electronic data collection).
- Field records are to be maintained in project files unless otherwise specified by a client or stipulated by a contract.
- Unless addressed specifically by a client or stipulated by a contract, site photographs should be taken to document the general setting and landscape as well as site-specific issues/resources of interest. Photo locations and the compass direction of view should be recorded in the notes with the photo number.

1.2 Documentation Entries

A chronology of field events should be recorded. General entry requirements include:

- Visitors to the site, including owner and regulatory agency representatives
- Summary of pertinent project communications with the client, regulators, or other site visitors during the fieldwork
- Other contractors or entities working on site
- A description of the day's field activities, generally in chronological sequence or in order of significance, using military time notation (e.g., 9:00 a.m. as 0900, and 5:00 p.m. as 1700)
- If applicable, calibration of measuring and test equipment and identification of the calibration standard(s) (use a Calibration Log, if available, with cross-reference entered into the field book)
- Field equipment identification, including information such as the type, manufacturer, model number, or other specific information

- If applicable sampling activities are being performed, weather information such as temperature, wind speed and direction, precipitation, time of measurement, and units
- Documentation of safety meeting (e.g., tailgates and tailboards) topics and attendees
- Verification of subsurface utility clearance in accordance with ENV ivision policy
- Safety and/or monitoring equipment readings, including time of measurements and units
- If applicable, specific forms used for collection of data are referenced in the field notebook
- Subcontractor progress and/or problems encountered
- Changes in the scope of work
- Other unusual events.

2. Specific Requirements

2.1 Sample Collection

Sample collection data are documented in a bound field book, PDA, and/or on a Field Activity Log. Where both are being used, information contained in one is cross-referenced to the other. Entries such as the following examples should be consistent with the requirements in the project-specific Work Plan, FSP, and QAPP:

- Sample identification number, location taken, depth interval, sample media, sample preservative, collection time, and date
- Sample collection method and protocol
- Physical description of the sample (using a standard classification system for soil)
- If a composite sample, include the number, location(s), and depth(s) of grab samples incorporated in the composite
- Quality-related samples (e.g., field duplicates, trip blanks, equipment rinse, blanks matrix spikes, and matrix spike duplicates)
- Container description and sample volume
- Pertinent technical data, such as pH, conductivity, temperature, and head-space readings
- Pertinent technical comments
- Identification of personnel collecting the sample.

2.2 Sample Labeling

Sample labels must be prepared and attached to sample containers. Labels are either provided by the laboratory performing the analyses or are generated internally. Labels should be indelible and securely attached to the container. The information to be provided may include:

- Sample identification number
- Sample date, initials or name of who collected the sample, and collection time
- Physical description of the sample (e.g., water, solid, gas, or other physical medium)
- Analytical parameters and method(s)

- Preservatives, if present
- Sample location and depth, if applicable
- Client.

Although this information is typically written out, it can also be recorded in an electronic tracking system if a bar code is used.

2.3 Analysis Request and Chain-of-Custody Record

A critical component of data collection is the documentation that the samples were obtained from specific locations and received by the laboratory or archive without alteration. Evidence of collection, shipment, laboratory receipt, and laboratory custody until disposal or archive must be properly documented. Documentation will be accomplished through a COC record that documents each sample and identifies the individuals responsible for sample collection, shipment, and receipt. A sample is considered in custody if at least one of the following criteria is met:

- The sample is in a person's actual possession
- The sample is in unobstructed view, after being in the person’s actual possession
- The sample is locked and only accessible by the custodian after having been in the person’s actual possession
- The sample is in a secured area, restricted to authorized personnel (e.g., laboratory).

An example COC form to be used by ENV personnel in collecting and shipping samples can be found on the corporate Intranet. A laboratory typically will not accept samples for analysis without a correctly prepared COC form. The COC must be signed by each individual who has the sample in his/her custody. Each sample shipped to a laboratory for analyses must be documented on the COC. Information on this form correlates with other supporting documentation, including the field log book, sample labels, and sample collection logs.

The COC documents the elapsed time and the custodians of the sample from the time of its collection. The individuals who have physically handled the sample(s) or witnessed initial sample collection and packaging (sample team member) must be identified on the form. A sample team member relinquishes the sample by signing the COC. Individuals who either relinquish or receive samples must include their complete names, company affiliation, and the date and time the sample(s) were relinquished. The times that the samples are relinquished and received by the next custodian should coincide, with the exception of transfer by commercial carriers. These carriers will not be required to sign the COC.

If a sample is to be stored for a period of time (e.g., overnight), measures are taken to secure the sample container in a manner that only provides access to the custodian of record. If samples are relinquished to a commercial carrier (i.e., UPS or Federal Express), the carrier waybill number is recorded, and a copy of the waybill is attached to the COC. These documents are maintained with other field documentation. The original COC is sealed inside a zip-top plastic bag and placed inside the shipping container with the samples.

If corrections are made to the COC, the corrections should be made (single line through the error, initial, and date) by the originator of the change, and, if necessary, an explanation of the change should be provided. The documentation should be of a level of detail that clearly documents the change to a third-party reviewer.

Guidance for choosing a laboratory and completing analyses requests and COC can be found in QP 2.09-Subcontracting Laboratory Services and on the corporate Intranet for the Arcadis Laboratory Program (ALP) and should also be described in the project-specific planning documents (i.e., Work Plan, FSP. or QAPP).

2.4 Subsurface Logs

Test pits, soil borings, monitoring wells or rock coreholes wells, and piezometer installations are to be recorded in bound field books or PDA and may be supplemented with prepared forms. Personnel completing the log are to supply the following information:

- Administrative and technical information included in the header.
- Types of equipment used (e.g., drill rig type, drilling tools used [including diameter and length], or backhoe model).
- Subcontractor/driller used.
- Descriptions of subsurface materials encountered and the number and type of samples collected, if any.
- Subsurface exploration depth and units of measure.
- For drilling, length of recovery.
- Sample type and sample number for geotechnical or analytical samples collected. These data are to be also entered on the sample collection log (if used) and the sample label.
- Classification standard protocol used, if any (e.g., ASTM International Standard Penetration Test).
- Narrative description of the soil, sediment, or bedrock (using standard classification system) and other pertinent information.
- Additional data, such as background and sample vapor/gas readings, observation of sheens, non-aqueous-phase liquid, depth to water (if encountered), presence of (but generally not description of) odors, changes in drilling conditions, and other pertinent information.
- Description of the materials used to seal the boring, unless it is completed as a well or piezometer.

2.5 Monitoring Well/Piezometer Installation

In addition to requirements in Section 2.4, subsequent well or piezometer development activities may involve transcription of field data from the field book onto a computer-based boring log. The field notebook or PDA is to be used to identify the chronology and major events of the installation activity, and the computer-based boring log is to be used to correlate the geologic strata to the major elements of the monitoring well construction. Information to be collected and recorded must meet the regulatory and client requirements and may include the following:

- Location identity
- Screen and riser type, length, diameter, and location

- Diameter
- Total depth
- Sump location and depth and diameter
- Materials of construction (e.g., stainless steel, polyvinyl chloride, or other material)
- Seal type(s) and or depth(s)
- Sand or gravel pack type, including materials (e.g., silica) and gradation
- Depth to water before and after installation.

2.6 Air Sampling Logs

At a minimum, air sampling documentation should include:

- Start and finish time of sampling
- Sampling location
- Sampling method/media
- Volume sampled.

2.7 Construction, Demolition, Abandonment, and Related Activities

Monitoring and documentation of construction and comparable activities shall be documented in bound field books and/or on appropriate company forms and should include similar information as specified above, including information such as:

- Project name and number
- Owner or client name
- Contractor or subcontractors performing the work
- Contractor or subcontractor superintendent(s) and personnel (as available) on site
- Chronological sequence and description of work activities performed, including workday start and completion times
- Reference to contract sections, work plans, or specifications describing work being performed
- Reference to relevant permit conditions and regulatory requirements and/or reference to regulatory guidance documents controlling work approach
- Listing of all trades performing work by contractor and subcontractor
- Hours worked per trade
- Work hours per day per shift, if applicable
- Equipment on site (e.g., description, model number, size, and type) and hours of use
- Listing of equipment on site being left idle
- Description and quantity of materials used or incorporated, with reference to contract or specification item number, if feasible; include simple sketch of excavation with approximate dimension, if applicable
- Calculations with dimensions for quantities of material used or incorporated

- Delineation of the work area and access routes (e.g., fencing, flagging, or staking), confirmation that activities occurred within the work area or description of work occurring outside the delineated work area and justification (as needed), and characterization of impacts outside the designated work area
- Documentation of compliance with speed limits, dust control, erosion control best management practices, and other basic elements of construction activities as dictated by project work plans and applicable permits and regulatory criteria.

2.8 Daily Safety Meeting

A Daily Safety Meeting is to be conducted and documented each workday prior to the initiation of field activities, with on-site ENV personnel, contractors, subcontractors, and visitors if possible. Safety topics discussed are entered on the Daily Safety Meeting Form (available on the corporate Intranet). Topics discussed should include site-specific conditions, procedures to be followed that day, and protective equipment. A printed listing of the attendees at the meeting and their signatures should be included. Other required data are:

- Identification of the individual conducting the meeting and his/her signature
- Identification of the project supervisor and project manager.

2.9 Calibration

Documentation of the calibration and calibration results shall be made for field equipment requiring calibration measuring and test equipment calibration data are recorded in the field book or on the Field Activity Log. Calibration data include the following:

- Unique identification of instrument being calibrated, including type, model, and serial number
- Date and time of calibration
- Standards used in the calibration, including standard identity, concentration, lot number, and manufacturer of the standard
- Instrument reading with respect to each calibration standard
- Comments, as necessary, regarding instrument performance.

2.10 Photographs and Videos

When the client allows, photographs and videos may be used to help document pre-, active, and post-field activities. In sensitive areas (e.g., secured or confidential), the client must be contacted to evaluate security procedures concerning use of photographs or videos. Photographic and video documentation should include project title, project number, date, time, and description of conditions. The time should also be documented if time is important to a sequence of photographs.

Photographs are documented by numbering digital photographs and identifying the number and subject on the Field Activity Log. Individual prints may be marked with a stamp or preprinted self-adhesive labels, or by writing the project number and sequential number of each photograph and referencing the numbers in the field book, the Field Activity Log, or a dedicated photo log. Videos used for field documentation are to be identified by project title, project number, and description.

2.11 Subcontractor Preparedness Checklist

Prior to starting work, a review is to be made and documented of a subcontractor's preparedness to perform specified activities. This review may be documented on the Field Activities Log or on checklists that may be developed according to requirements for subcontracted work activities. Particular emphasis should be on site-specific issues that may require special consideration such as health and safety, access, and unique settings. These should be discussed in advance with the CPM and the client in developing and implementing the Scope of Work.

— END OF PROCEDURE —

ARCADIS Design & Consultancy for natural and built assets

SOP - SAMPLE CHAIN OF CUSTODY

Rev: #1

Rev Date: May 23, 2017

VERSION CONTROL

Revision No	Revision Date	Page No(s)	Description	Reviewed by
0	April 19, 2017	All	Re-write to COC only	Richard Murphy
1	May 23, 2017	4 9 7	Add: Guidance on use of previous version of SOP. Add: Info on COCs for multiple shipping containers Modify: Move letter i. to letter m. and change to “when appropriate”	Peter Frederick

APPROVAL SIGNATURES

Prepared by:		05/23/2017
	Peter C. Frederick	Date:
Technical Expert Reviewed by:		05/23/2017
	Richard J. Murphy	Date:

1 INTRODUCTION

This document describes general and/or specific procedures, methods, actions, steps, and considerations to be used and observed by Arcadis staff when performing work, tasks, or actions under the scope and relevancy of this document. This document may describe expectations, requirements, guidance, recommendations, and/or instructions pertinent to the service, work task, or activity it covers.

It is the responsibility of the Arcadis Certified Project Manager (CPM) to provide this document to the persons conducting services that fall under the scope and purpose of this procedure, instruction, and/or guidance. The Arcadis CPM will also ensure that the persons conducting the work falling under this document are appropriately trained and familiar with its content. The persons conducting the work under this document are required to meet the minimum competency requirements outlined herein, and inquire to the CPM regarding any questions, misunderstanding, or discrepancy related to the work under this document.

This document is not considered to be all inclusive nor does it apply to all projects. It is the CPM's responsibility to determine the proper scope and personnel required for each project. There may be project- and/or client- and/or state-specific requirements that may be more or less stringent than what is described herein. The CPM is responsible for informing Arcadis and/or Subcontractor personnel of omissions and/or deviations from this document that may be required for the project. In turn, project staff are required to inform the CPM if or when there is a deviation or omission from work performed as compared to what is described herein.

In following this document to execute the scope of work for a project, it may be necessary for staff to make professional judgment decisions to meet the project's scope of work based upon site conditions, staffing expertise, regulation-specific requirements, health and safety concerns, etc. Staff are required to consult with the CPM when or if a deviation or omission from this document is required that has not already been previously approved by the CPM. Upon approval by the CPM, the staff can perform the deviation or omission as confirmed by the CPM.

2 SCOPE AND APPLICATION

This Standard Operating Procedure (SOP) describes the general Chain of Custody (COC) procedures and guidance instructions for samples collected from project sites that are relinquished from Arcadis' possession.

COC is defined as the maintenance of an unbroken record of possession of an item from the time of its collection through some analytical or testing procedure. COC is typically documented by a written record of the collection, possession, and handling of samples collected from a project location. Each sample will be tracked by a documented record that efficiently documents the individuals who were responsible for the sample during each successive transfer of that sample to various recipients beyond Arcadis' possession. This information can be used to legally establish the integrity of the samples and therefore the analytical results derived from the samples. This information can be used in addition to other records and documentation regarding the samples, such as field forms, field logs, and photographs.

A sample is considered under custody if:

- It is in your possession; or
- It is in your view, after being in your possession; or
- It was in your possession and then you then locked it up to prevent tampering; or
- It is in a designated secure area.

Continued use of previous version of SOP:

Although not recommended, Arcadis program-, project-, and client-teams may be able to use the previous version of this SOP provided that it meets all of the quality expectations of Arcadis and client, and meets applicable regulatory requirements. It is up to the program, project, and/or client-team leader to determine whether it is appropriate to adopt the current SOP or to continue using the previous version.

However, all new work not associated with the previous version of this SOP must be performed with the current version of the SOP.

When adopting this new SOP, users of the previous versions must be aware that specific handling, packing, and shipping procedures and guidance has been removed and that those should be addressed within program or project plans (e.g. QAPPs, Work Plans, SAPs, etc.) or in a more detailed SOP or TGI specific to that sampling activity, whether related to media, constituent/analyte, client, state, etc.

In addition, adopting this new SOP will require users to refer to the Arcadis DOT Safety Program for procedures and guidance on the determination and handling, packing, and shipping of samples that are or may be considered hazardous materials.

3 PERSONNEL QUALIFICATIONS

Arcadis personnel performing work under the purview of this SOP will have received appropriate training and have field experience regarding the collection of samples from project locations. Arcadis personnel will have all other applicable and appropriate training relevant to the sampling work and project site.

4 EQUIPMENT LIST

The following list provides materials that may be required for each COC. Project reporting and documentation requirements must be reviewed with the CPM prior to execution of work. Additional materials, tools, equipment, etc. may be required, and project staff are required to verify with the CPM and/or Technical Expert what specific equipment is required to complete the COC.

- Indelible ink pen (preferably either black or blue ink);
- COC form https://thesourceus.arcadissource.com/TKI/Documents/COC%20Form.pdf (**Appendix A**) from either Arcadis, laboratory receiving and analyzing the samples, or other applicable and appropriate entity for the work performed;
- When appropriate, such as for litigation or expert testimony work, custody seals or tape.

5 CAUTIONS

One way in which the law tries to ensure the integrity of evidence is by requiring proof of the chain of custody by the party who is seeking to introduce a particular piece of evidence.

A proper chain of custody requires three types of affirmations: (1) affirmation that a sample is what it purports to be (for example, soil collected from a specified location and depth); (2) affirmation of continuous possession by each individual who has had possession of the sample from the time it is collected until the time it is analyzed or held by a laboratory; and (3) affirmation by each person who has had possession that sample remained in substantially the same condition and not contaminated or affected by outside influences from the moment one person took possession until the moment that person released the evidence into the custody of another (for example, affirmation that the sample was stored in a secure location where no one but the person in custody had access to it).

Proving chain of custody is necessary to "lay a foundation" for the samples in question, by showing the absence of alteration, substitution, or change of condition.

Ensure that appropriate sample containers with applicable preservatives, coolers, and packing material are planned for and provided at the site at the time of sample collection.

Understand the offsite transfer requirements of the samples for the facility at which samples are collected.

If overnight courier service is required schedule pick-up or know where the drop-off service center is located and the hours of operation.

An Arcadis employee appropriately trained at the correct level of internal hazardous materials/DOT (Department of Transportation) shipping must complete an Arcadis shipping determination to address applicable DOT and IATA (International Air Transport Association) shipping requirements. Review the applicable Arcadis procedures and guidance instructions for sample packaging, and labeling. Prior to using air transportation, confirm air shipment is acceptable under DOT and IATA regulations.

The person relinquishing possession of the samples or other member of the project team should contact the final recipient of the samples to confirm receipt and review any special provisions on the COC or questions that they may have.

6 HEALTH AND SAFETY CONSIDERATIONS

Follow the health and safety procedures outlined in the project/site Health and Safety Plan (HASP) as well as other applicable H&S requirements, such as:

- Arcadis Hazardous Material/DOT handling, packaging, and shipping training
- Project site-specific H&S training
- Client-specific H&S training
- Constituent-specific H&S training
- Media-specific H&S training

7 PROCEDURE

Collected samples must be uniquely identified, and properly documented, containerized, labeled with unique identifier, possessed in a secure manner during remainder of sampling event, packaged, and shipped to recipient laboratory.

Sample Identification

The method of sample identification depends on the type of measurement or analyses performed. In some cases, in-situ measurements of existing conditions and/or sample location must be made during sample collection. These data will be recorded directly on field forms, logbooks, or other project record data sheets used to permanently retain this information for the project file. Examples of location identification information includes: latitude/longitudinal measurements, compass directions, well number, building number, floor number, room name, or proximity to a site feature unique to the site. Examples of in-situ measurements are pH, temperature, conductivity, flow measurement, or physical condition of the media being sampled. Physical samples collected are identified by a unique identifying number or code on a sample tag or label. These physical samples are removed from the sample location and transported to a laboratory for analyses.

In some cases, before samples are placed into individual containers and labeled as individual samples, samples may be separated into portions depending upon the analytical methods and required duplicate or triplicate analyses to be performed.

When completing a COC for samples, personnel must complete the following:

1. Written COCs must be completed with indelible ink (preferably either black or blue colored ink).
2. Written COCs must be completed using legible printed writing, and not cursive writing.
3. All entry fields on the COC form must be completed. If information is not applicable for a specific entry field, personnel will either put “N/A” or use a strike-out line or dash like “-----------“ to indicate no applicable information is needed for that field.
4. Use of quotation marks or lines/down arrows to represent repetitive/duplicative text in similar fields.
5. Regardless of the type or specific COC form, the following pertinent information must be provided on the COC form:
    a. Arcadis project number
    b. Arcadis project name
    c. Project location, including street address, city, state, building number, providing as much detail as appropriate
    d. Recipient laboratory contact and sample receiving shipping location information
    e. Entities’/persons’ contact information for who will be receiving analytical results
    f. Name of sampler, i.e. person collecting sample and relinquishing possession of samples to the next entity in the chain of custody
    g. Date of sample collection

    h. If appropriate for the sample media, contaminant/constituent of concern, or analytical method, document time of sample collection using standard military time
    i. Sample analytical method(s)
    j. Turnaround time required for analyses and/or reporting
    k. Instructions to laboratory regarding handling, timing, analyses, etc. as applicable and appropriate
    l. Printed name and signature of the individual person who collected the samples and relinquishing possession of the samples
    m. If appropriate or when documentation of the specific sample collection method will influence how the laboratory handles, prepares, or analyzes the samples, document the sample collection methodology used for collecting the samples (e.g. ASTM D5755)

6. The following additional specific information will be entered on the COC form, regardless of what type of COC is being used:
    a. <u>Unique Sample Identifier</u> – The sample identifier (ID) must be unique to the individual sample it is applied to. The information in which the sample ID conveys is determined by the CPM, Technical Expert, and/or other project team members in advance of sample collection so that sample identification is consistently applied for the project. The sample nomenclature may be dictated by a specific client, program, or project database and require unique identification for each sample collected for the project. Consult with the CPM and/or Technical Expert for additional information regarding sample identification.

       The sample ID could convey specific information regarding the sample to aid personnel in recognizing what the sample represents, or they may be arbitrary so as to facilitate the anonymity of the sample location, media, constituent of concern, project site, etc.

       Examples of unique identifiers include:
        1. Well locations, grid points, or soil boring identification numbers (e.g., MW-3, X-20, SB-30). When the depth interval is included, the complete sample ID would be “SB-30 (0.5-1.0) where the depth interval is in feet. Please note it is very important that the use of hyphens in sample names and depth units (i.e., feet or inches) remain consistent for all samples entered on the chain of custody form. DO NOT use the apostrophe or quotes in the sample ID.
        2. Sample names may also use the abbreviations “FB,” “TB,” and “DUP” as prefixes or suffixes to indicate that the sample is a field blank, trip blank, or field duplicate, respectively.
    b. List the date of sample collection. All indicated dates must be formatted using either mm/dd/yy (e.g., 03/07/09) or mm/dd/yyyy (e.g. 03/07/2009).
    c. When appropriate for the analytical procedure used, list the local time that the sample was collected. The time value should be presented using military format. For example, 3:15 P.M. should be entered as 15:15.

d. Samples should be indicated to be either “Grab” or “Composite”. Grab samples are collected from only one unique location at one specific point in time.

e. Composite samples are a group of individual samples that are combined for analysis in their totality. Composite samples need to be documented if they are either collected from a number of different locations over a broader area to be representative of the entire area being sampled, or if they are representative of a single location over an extended period of time.

f. If used, preservatives for the individual sample will be noted.

g. The requested analytical method(s) that the samples are being analyzed for must be indicated. As much detail, as necessary, should be presented to allow the analytical laboratory to properly analyze the samples. For example, polychlorinated biphenyl (PCB) analyses may be represented by entering “EPA Method 8082 – PCBs” or “EPA PLM 600-R93-116.” In cases where multiple analytical methods and/or analytical parameters are required for an individual sample, each method should be indicated for the sample (e.g., EPA 8082/8260/8270 or EPA PLM/400-point count).

h. If there are project-specific sample analytes to be reported, they should be specifically listed for each individual sample (e.g., 40 CFR 264 Appendix IX).

i. The total number of containers for each analytical method requested should be documented. This information may be included under the parameter or as a total for the sample.

j. When necessary, note which samples should be used for site specific matrix spikes.

k. Indicate special project-specific requirements pertinent to the handling, shipping, or analyses. These requirements may be on a per sample basis such as “extract and hold sample until notified,” or may be used to inform the laboratory of special reporting requirements for the entire sample delivery group (SDG).

l. Indicate turnaround time (TAT) required for samples on COC. If individual samples have differing TATs, the different TATs for each sample or groups of samples must be clearly indicated.

m. Provide contact name and phone number in the event that problems are encountered when samples are received at the laboratory. The person relinquishing possession of the samples or other member of the project team should contact the final recipient of the samples to confirm receipt and review any special provisions on the COC or questions that they may have.

n. If available, attach the Laboratory Task Order or Work Authorization forms.

o. The “Relinquished By” field must contain the signature of the Arcadis person who relinquished custody of the samples to the next entity in the chain of custody, which may be another person, the shipping courier, or the analytical laboratory.

p. Dates and times must be indicated using the following format:

   1) Date: either mm/dd/yy e.g., 01/01/17 <u>OR</u> mm/dd/yyyy e.g., 01/01/2017

   2) Time: use military format, e.g. 9:30 a.m. is 0930 and 9:30 p.m. is 2130

   q. The “Received By” section is signed by sample courier or laboratory representative who received the samples from the sampler or it is signed upon laboratory receipt from the overnight courier service.

4. When more than one page of the COC form is required to complete the total number of samples, use as many sheets as necessary to accurately and clearly document the samples and information. Some COCs may have a standard first page/cover page, and subsequent pages may not contain all the detailed fields as the first page/cover page. Ensure that any subsequent pages convey all of the necessary and pertinent information for each individual sample as required in this procedure document.
5. Pages of the COC must retain a page count of the total number of pages; e.g., Page 1 of 3, Page 2 of 3, Page 3 of 3.
6. Upon completing the COC forms, forward the original signed COC with the sample package. Ensure that the original COC form is secured with the sample package so that it remains with the physical samples for the duration of transport and handling to its final destination and ensure that the COC form will not be become damaged or rendered unreadable due to sample breakage/leakage if stored inside the sample shipping container or outside influences if COC is stored in an outside plastic pouch to the container.
7. If you’ve collected enough samples that would require more than one container to ship them all to the same laboratory or location, then each separate/individual container that contains any number of samples must have a separate COC representing only those samples contained within that specific container. For example, if you have 3 total shipping containers for all of your samples, you must have a total of 3 separate, individual COCs for each of the 3 containers representing only those samples in their representative container. Thus, every container holding samples must have its own, individual COC.
8. If electronic chain of custody (eCOC) forms are utilized, ensure that the requirements of this procedure and guidance instructions are followed to the extent possible. Verify that proper signature and COC procedures are maintained with the CPM and/or Technical Expert when using eCOC.

8 WASTE MANAGEMENT

Not Applicable.

9 DATA RECORDING AND MANAGEMENT

The original signed COC shall be submitted with the samples. Copies of COC records will be transmitted to the CPM or designee at the end of each day unless otherwise directed by the CPM. The sampling team leader retains copies of the chain of custody forms for filing in the project file. Record retention shall be in accordance with client- and project-specific requirements and Arcadis policies, the most stringent will apply.

10 QUALITY ASSURANCE

COC forms will be legibly completed in accordance with this procedure and guidance instruction document, as well as other applicable and appropriate project documents such as Sampling and Analysis Plan (SAP), Quality Assurance Project Plan (QAPP), Work Plan, or other project guidance documents.

COC records will be reviewed by the CPM or their appropriate designee for completeness and accuracy to the applicable requirements. Non-conformances will be noted and corrected in a timely manner on the copies retained by Arcadis as well as contacting the ultimate receiving entity for correction to the originally signed COC in their possession.

11 REFERENCES

Arcadis Client Document Retention Guide

Arcadis Transportation Safety Program requirements, procedures, and guidance instructions

EPA Samplers' Guide – Contract Laboratory Program Guidance for Field Samplers, EPA document EPA-540-R014-013 October 2014

EPA Region III – *Sample Submission Procedures for the Office of Analytical Services and Quality Assurance (OASQA) Laboratory Branch* revision 13.0 January 29, 2014

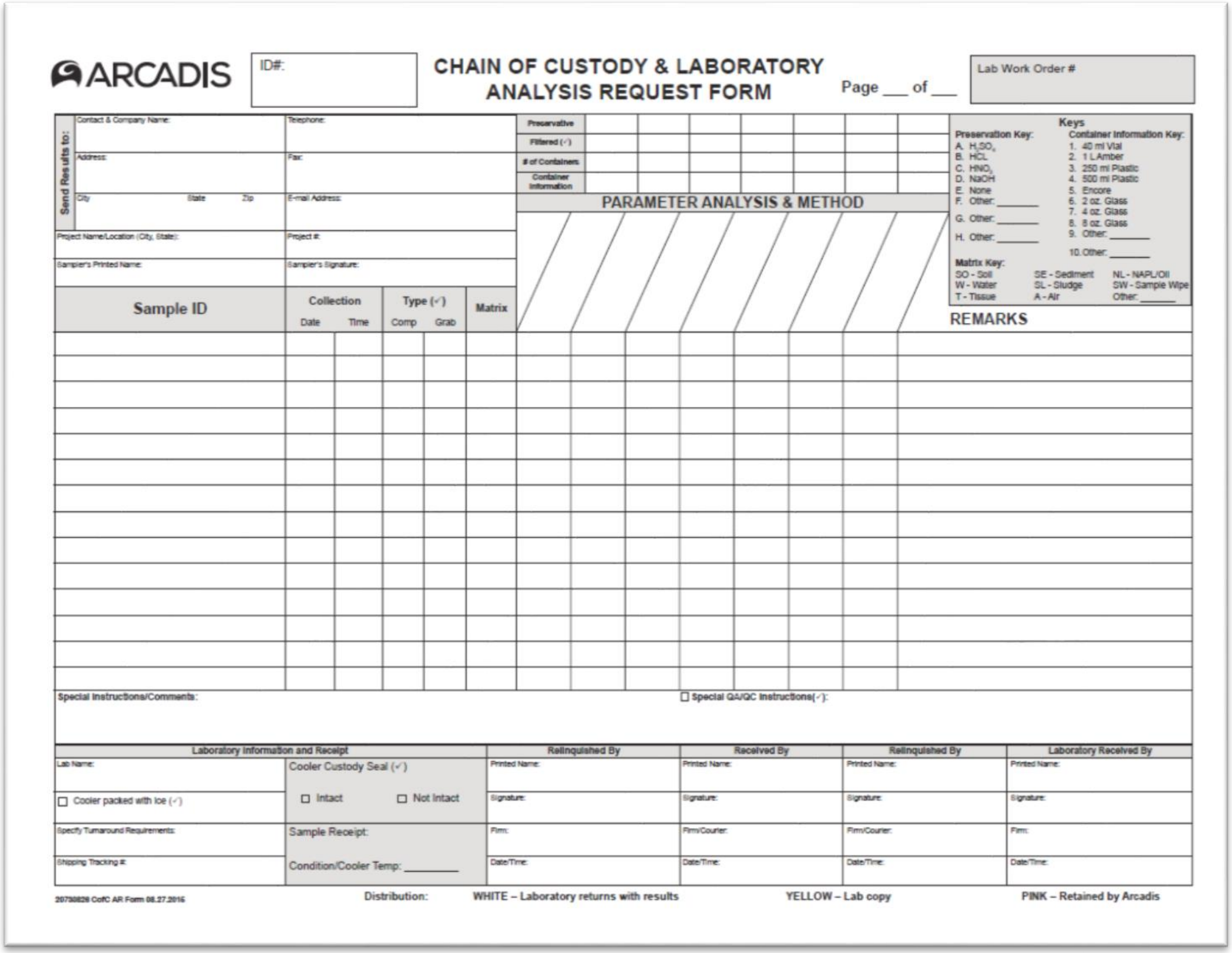
EPA Region I Office Environmental Measurement and Evaluation – *Standard Operating Procedures for Chain of Custody of Samples* revision 1 March 25, 2002

EPA Region IV Science and Ecosystem Support Division *Operating Procedure for Sample and Evidence Management* January 29, 2013

APPENDIX A

Chain of Custody Form

[click image below to access form]



ARCADIS

ID#:

CHAIN OF CUSTODY & LABORATORY ANALYSIS REQUEST FORM

Page ___ of ___

Lab Work Order #

Send Results to:	Contact & Company Name:	Telephone:
	Address:	Fax:
	City State Zip	E-mail Address:
Project Name/Location (City, State):		Project #:
Sampler's Printed Name:		Sampler's Signature:

Preservative							
Filtered (✓)							
# of Containers							
Container Information							

PARAMETER ANALYSIS & METHOD

Keys

Preservation Key:
A. H_2SO_4
B. HCL
C. HNO_3
D. NaOH
E. None
F. Other: _______
G. Other: _______
H. Other: _______

Container Information Key:
1. 40 ml Vial
2. 1 L Amber
3. 250 ml Plastic
4. 500 ml Plastic
5. Encore
6. 2 oz. Glass
7. 4 oz. Glass
8. 8 oz. Glass
9. Other: _______
10. Other: _______

Matrix Key:
SO - Soil
W - Water
T - Tissue
SE - Sediment
SL - Sludge
A - Air
NL - NAPL/Oil
SW - Sample Wipe
Other: _______

Sample ID	Collection		Type (✓)		Matrix								REMARKS
	Date	Time	Comp	Grab									

Special Instructions/Comments:

☐ **Special QA/QC Instructions(✓):**

Laboratory Information and Receipt		Relinquished By	Received By	Relinquished By	Laboratory Received By
Lab Name:	Cooler Custody Seal (✓)	Printed Name:	Printed Name:	Printed Name:	Printed Name:
☐ Cooler packed with ice (✓)	☐ Intact ☐ Not Intact	Signature:	Signature:	Signature:	Signature:
Specify Turnaround Requirements:	Sample Receipt:	Firm:	Firm/Courier:	Firm/Courier:	Firm:
Shipping Tracking #:	Condition/Cooler Temp: _________	Date/Time:	Date/Time:	Date/Time:	Date/Time:

20730826 CofC AR Form 08.27.2016

Distribution: **WHITE – Laboratory returns with results** **YELLOW – Lab copy** **PINK – Retained by Arcadis**

APPENDIX A

Chain of Custody Form

[click image below to access form]

ARCADIS
Design & Consultancy
for natural and
built assets

Implementation Date	Arcadis HS Standard Name	
13 December 2006	Utility Location and Clearance	
Revision Date	Arcadis HS Standard No.	Revision Number
17 March 2017	ARCHSFS019	16

EXECUTIVE SUMMARY

Damaging an underground or aboveground utility can result in serious injury and loss of life, disrupt essential services, and create significant liability to Arcadis, clients, and subcontractors. Therefore, it is Arcadis policy that the following steps be completed prior to beginning any subsurface intrusive work (i.e., any work or activity that breaks the plane of the ground surface):

- The presence of existing or known utilities will be investigated and cleared (to the extent feasible) by locating and marking before the start of any subsurface intrusive work and where appropriate, visually verifying through soft dig methods (referred to as potholing or daylighting) before the start of any subsurface intrusive activity.

- A minimum of **three (3) reliable lines** of evidence are required for an acceptable utility clearance. Each location of subsurface intrusive work must have at least 3 reliable lines of evidence. All lines of evidence used during the utility clearance procedure will be recorded on the Utility and Structures Checklist or equivalent client-provided checklist or permit. If a line of evidence is lost or not apparent, STOP WORK, and re-establish the line of evidence prior to resuming subsurface intrusive work.

- The lines of evidence used will be reasonable and appropriate for the conditions expected to be encountered (soil type, water table, etc.) and the type of utilities expected to be encountered (e.g., gas line versus an irrigation line).

- Contact the State One Call or equivalent service (Nationwide “811”) as required by law. The State One Call or equivalent service (Nationwide “811”) can only be used as a reliable line of evidence when working within the public right-of-way or easement.

- For point clearance (single intrusive point, used as 1 of the 3 required reliable lines of evidence), the borehole must be cleared to 110% of the diameter of the intrusive device (e.g., auger, drill head, etc.) or an additional 2 inches of overall diameter, whichever is greater.

- Utility clearance information will be documented on the Arcadis Utility and Structures Checklist (USC) or equivalent client-provided checklist or permit. The Utility Structures and Checklist is valid for 15 business days from the date of completion. A copy of the completed Utility and Structures Checklist will remain on-site during all subsurface intrusive work.

- Employees overseeing utility clearance activities will:
    - Be familiar with the contents of this standard and ARC HSFS-019 Supplement 2;
    - Have one year of field experience in the visual identification of utilities; and
    - If operating equipment, have training and six months of experience in the proper operation and results interpretation of any clearance equipment, including without limitation, magnetometers and ground penetrating radar.

- A utility strike is an unplanned contact of a utility during the course of work that results in damage requiring repairs, making a report to the utility owner, or requiring further assessment to evaluate the potential for damage. All utility strikes must be reported within 24 hours using the Utility Line Strike Investigation Form. **Do not enter the incident into 4-Sight until approved to do so by Corporate Legal. Refer to** ARC HSFS-019 Supplement 5**, Utility Strike Emergency Action Plan Guidelines.**

Report Utility Incident Now

1. POLICY

It is the practice of Arcadis and its affiliated companies to implement appropriate, reasonable, and practical standards within acceptable and customary industry practices to promote the health and safety of its employees and avoid and mitigate exposure of risk in the performance of their work. In furtherance of this policy, Arcadis promotes and encourages compliance by all employees with this policy and standards relating to work in the vicinity of subsurface, submerged, or aboveground utilities.

2. PURPOSE AND SCOPE

2.1 Purpose

This standard directs general safety standards and best practices associated with the identification and management of subsurface, submerged, and aboveground utilities on project sites. Utility location standard operating procedures (SOP) for submerged utilities can found in ARC HSFS-019 Supplement 6.

2.2 Scope

This standard assigns responsibilities and expectations for proper utility clearance by both Arcadis employees and Arcadis subcontractors at project sites.

3. DEFINITIONS

Definitions relating to Utility Clearance can be found in Exhibit 1.

4. RESPONSIBILITIES

4.1 Project Manager Responsibilities

For every project site having the potential to come into contact with utilities, Project Managers must ensure that:

- The requirements of this standard are followed.
- Local regulations governing utility clearance are followed. This includes ensuring local and/or state laws defining activities or depth of intrusive work/excavation requiring utility clearance are reviewed as they vary by location. For further information, refer to One Call and State Law Directory.
- Efforts are made to work with the client, project site representatives, public utility companies, and subcontractors to identify the nature of any utilities and to determine control processes that need to be implemented by Arcadis and the subcontractors to prevent damage to these utilities and to properly manage the effects in the event there is utility damage.
- Utility clearance activities are only delegated to a Task Manager or other individual meeting the requirements of Section 4.2 below, as appropriate. However, even if the Project Manager delegates certain responsibilities, the Project Manager maintains primary responsibility for a complete utility clearance.

For additional information on Project Manager responsibilities and best practices, refer to ARC HSFS-019 Supplement 1.

- Project Managers or designee must review the Utility and Structures Checklist with staff and Arcadis subcontractors conducting subsurface intrusive work (including “Sub-of-Subs” when conducting subsurface intrusive work) prior to staff beginning subsurface intrusive work. The Project Manager or designee review must be documented on the Utility and Structures Checklist prior to starting subsurface intrusive work.

4.2 Field Personnel Responsibilities

Arcadis field personnel conducting work on a project site having the potential to come into contact with utilities have the responsibility to:

- Read, understand, and follow this standard and ARC HSFS-019 Supplement 2 and complete the appropriate checklists during the on-site utility and structures locate and clearance process.

- Complete a minimum of one year of utility clearance-related experience before accepting responsibility for any utility clearance tasks. This requires on-site training led by another Arcadis employee with detailed knowledge and experience in identifying utilities and structures.

- Complete training and have 6 months of experience in operating and interpreting the results of remote sensing technologies, including without limitation, magnetometers and ground penetrating radar, before operating such technologies. Field staff should understand the technologies being utilized by a private utility locate contractor and how they are operating in comparison with the site conditions. Refer to ARC HSFS-019 Supplement 3 for more information.

- Prior to beginning subsurface intrusive work, the Utility and Structures Checklist must be completed and signed by the staff member completing or overseeing the clearance. Confirm that the Utility and Structures Checklist was reviewed by the Project Manager or designee as discussed in Section 4.1 above. Review the Utility and Structures Checklist daily prior to starting subsurface intrusive activities to ensure all utilities are identified and markings are present. A copy of the completed Utility and Structures Checklist will remain on-site during all subsurface intrusive work (i.e., any work or activity that breaks the plan of the ground surface).

- Use their STOP WORK Authority to eliminate any reasonable concern if utilities cannot be reasonably located and contact the Project Manager to review the STOP WORK situation and confirm the direction of action before moving forward.

- Ensure that Arcadis subcontractors conduct their own reasonable independent utility clearance efforts as required by Arcadis’ standard subcontract and are aware of any Arcadis clearance standards used on-site.

- Be on-site and provide oversight during utility locate activities and any active subsurface intrusive work or activities involving contractor under contract to Arcadis.

- If a utility is damaged and repaired during the course of the field event, field staff must provide oversight and document that the repair appears competent and complete to prevent further damage to the site when the damaged utility is re-activated.

4.3 Arcadis Subcontractor Responsibilities

According to Arcadis' standard subcontract, subcontractors have agreed to take responsibility for any damages resulting from a utility impact caused by their work. Therefore, Arcadis subcontractors are expected to take reasonable time and diligence to conduct their own independent utility clearance using reasonable standards and processes. Subcontractors have the responsibility to stop their work if utility concerns are identified and will report those concerns to the Arcadis employee overseeing their work activities. Arcadis staff should reinforce these responsibilities with subcontractors during job safety briefings.

In jurisdictions where the actual contractor performing the subsurface intrusive work is required to perform utility clearance notifications, the contractor will perform the clearance notification and will provide evidence of the notification to Arcadis (ticket or ticket number, etc.). Refer to ARC HSFS-019 Supplement 4 for Best Practices for State One Call procedures.

- If overhead utilities are present in areas where heavy equipment will be operated, ensure adequate clearance is provided. For heavy equipment that is extendable or telescoping (e.g., excavators, dump trucks, extendable lift trucks), evaluate whether the use of a spotter is necessary prior to operating heavy equipment when in proximity to the overhead utility.

- If a utility is damaged and repaired during the course of the field event, the field subcontractor must verify that the repair is competent and complete to prevent further damage to the site when the damaged utility is re-activated.

5. PROCEDURE

5.1 General

Protocols to be followed during utility and structures location and clearance activities are outlined in:

- Best Practices for Project Managers (or Their Delegates) Concerning Utility Clearance (ARC HSFS-019 Supplement 1).

- Best Practices for Field Personnel Concerning Utility Clearance (ARC HSFS-019 Supplement 2).

- Use and Limitations of Common Underground Locating Technologies and Clearance Methods (ARC HSFS-019 Supplement 3).

- Best Practices for State One Call Procedures (ARC HSFS-019 Supplement 4).
- Emergency Action Plan guidelines for Utility Strikes (HSFS-019 Supplement 5).
- Utility Location Standard Operating Procedure for Aquatic Work Activities (ARC HSFS-019 Supplement 6).

5.2 Lines of Evidence

When locating underground utilities, three (3) reliable “lines of evidence” must be established to help determine where a subsurface utility may be located. A line of evidence may be a site drawing that shows where a utility is located, it could be anecdotal information obtained from owners or employees, it could be established using any number of non-intrusive geophysical methods [e.g., ground penetrating radar (GPR), electromagnetic survey (EM), radio-frequency methods (RF), etc.], or it could involve probing for or exposing the utility by soft dig technologies (i.e., daylighting or potholing). Some lines of evidence will identify utility locations with a high degree of certainty (e.g., direct connect radio-frequency technique, daylighting or potholing, sonde tracing, etc.). Other lines of evidence will identify utilities will less certainty (e.g., anecdotal reports, design drawings, etc.).

Effective utility locate practices must use multiple lines of evidence until there is a high degree of certainty that the underground services have been adequately located. Three (3) reliable lines of evidence are required for an appropriate utility clearance as defined in this standard. All reliable lines of evidence used during the utility clearance procedure will be recorded on the Utility and Structures Checklist or equivalent client-provided checklist or permit. If three (3) reliable lines of evidence have not established certainty in the location of a utility, STOP WORK and do not proceed. Additional reliable lines of evidence must be utilized until the presence or absence of the underground utility can be established. During work activities, if a line of evidence is lost or not apparent (e.g., paint markings have faded), STOP WORK, and re-establish the line of evidence prior to resuming subsurface intrusive work.

Generally, the following lines of evidence may be used to meet this minimum utility clearance requirement:

1. Contacting the State One Call or equivalent service (Nationwide “811”) is REQUIRED BY LAW regardless if it will be used as a line of evidence. Contacting the State One Call or equivalent service (Nationwide “811”) is an acceptable reliable line of evidence when working within the public right of way or easement. Note that the State One Call can provide valuable information regarding locations and types of utilities entering the private property.

   Note: For work on private property or in areas not served by State One Call or equivalent service, consider using a reputable private utility locating company to locate and mark the utilities. **Use of a reputable private utility locator is encouraged for all projects with subsurface or submerged utilities.** When working with a private locater, it is best practice to pre-plan clearance areas, review required clearance equipment and the re-clearing/confirmation of any public utility mark outs (State One Call or equivalent service Nationwide “811”).

2. Use detailed, scaled site utility plans, preferably in the form of an “as-built” or “record” drawing, to identify and/or confirm utility locations. Document request and/or receipt of utility drawings from the property owner/client on the Utilities and Structures Checklist.

3. Interview(s) with knowledgeable site or client personnel. The following questions should be asked during the interview and answers documented on the Utility and Structures Checklist:

   - Employees(s) Name and Affiliation(s) with the site;
   - Types of utilities, including utility composition and location of utilities on-site;
   - Depths of known utilities; and
   - Any other pertinent information regarding utilities on the site.

View the Utilities and Structures Checklist

4. Conduct a detailed visual site inspection of areas around all planned subsurface intrusive work points or areas to identify and/or confirm utility locations. For underground utilities, conduct an inspection for structures that tend to indicate the presence and general location of such utilities, including, but not limited to manholes, vaults, valve covers, valve markers, telephone pedestals, transformer housings, fire hydrants, spigots, sprinkler heads, air relief valves, backflow preventers, meters, downspouts going into the subsurface, power poles with wiring going into the subsurface and line markers. Saw cut lines and concrete/asphalt repairs often yield valuable information regarding utility locations.

   Always discuss the presence of utilities with the site owner, operator, and/or occupant to identify any potential utilities that might not be readily identified by non-intrusive clearing methods or may be:

   - At depths > 5 feet below ground surface; or
   - At very shallow depths (< 2 feet below ground surface), such as communication lines, electrical conduits/wiring, irrigation lines, etc.

If one of the above lines of evidence cannot be utilized or if using the above lines of evidence does not adequately identify utilities with reasonable certainty, one or more additional lines of evidence must be utilized. Commonly used lines of evidence are listed on the Utility and Structures Checklist.

A discussion of use and limitations associated with common utility location and clearance methods is provided in ARC HSFS-019 Supplement 3.

Standard operating procedures for utility location in submerged settings are presented in ARC HSFS-019 Supplement 6.

The lines of evidence will be recorded on the Utility and Structures Checklist or equivalent client-provided checklist or permit.

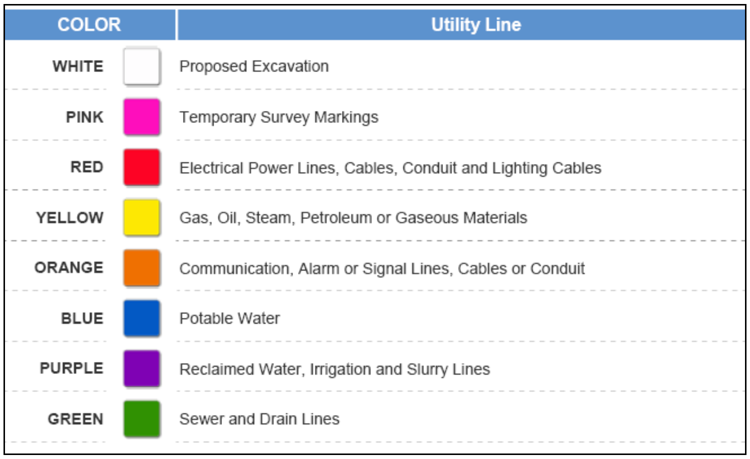
Note: If a line of evidence is lost, utility markings are removed/worn, or area of previous clearance is not confirmed, STOP WORK and re-establish the line(s) of evidence prior to resuming subsurface intrusive work. Each location of subsurface intrusive work must have 3 reliable lines of evidence. All lines of evidence used during the utility clearance procedure will be recorded on the Utility and Structures Checklist of equivalent client-provided checklist or permit. If a line of evidence is lost or not apparent, STOP WORK, and re-establish the line of evidence prior to resuming subsurface intrusive work. The Utility Structures and Checklist is valid for 15 business days from the date of completion.

If and when any line of evidence reveals that planned subsurface work will be located inside the 30-inch Tolerance Zone of known/marked/located/observed utilities, the project team must Stop Work and contact Corporate H&S as early as possible for pre-approval.

5.3 Color Codes used for Utility Markings

The following colors are used for marking utilities. Some government agencies or large industrial facilities may use additional colors not provided below. Arcadis policy is to assume any paint marking or pin flag color not provided below is a subsurface utility marking until proven otherwise.

If utilities or subsurface anomalies are identified but the utility type or anomalies are not classified, it is recommend that a pink (Temporary Survey Marking) marking be used. Once the type of utility is established, the pink marks should be repainted/remarked to represent the correct type of utility.



COLOR		Utility Line
WHITE	⬜	Proposed Excavation
PINK	■	Temporary Survey Markings
RED	🟥	Electrical 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	🟩	Sewer and Drain Lines

APWA and ANSI standard Z-53.1

5.4 Locating Technologies

There are several types of locating technologies that can be used to identify and locate utilities in the subsurface. Project teams need to work closely with private utility locators (PUL) in order to best match locating technology with site conditions. To provide the best results, all possible locating technologies should be available for use and implementation at the project location. Any potential interferences should also be discussed up front and then at the project site during utility location activities. Potential interferences could be soil moisture, soil type, standing water on concrete/asphalt, rebar, fencing, and metal structures that are in the subsurface. Employees overseeing locating technology activities should have an understanding of device operation and limitations. For further information, refer to ARC HSFS-019 Supplement 3, Use and Limitations of Common Utility Location Technologies and Clearance Methods.

5.5 Clearance Methods

In some cases, proposed subsurface intrusive locations may be pre-cleared using other intrusive methods. Determine the clearance or soft dig method based on-site conditions and utilize the least invasive method possible. The number of subsurface intrusive locations and soil type should be taken into consideration. The following clearance methods are listed from least invasive to most:

1. Vacuum Extraction/Potholing (air or water-based),
2. Air knifing,
3. Hydroknifing,
4. Probing,
5. Hand augering,
6. Hand digging, and
7. Posthole digging.

Single-Point clearance must be 110% of the proposed subsurface intrusive area or the diameter plus 2 inches, whichever is greater. Three-Point clearance must be installed in a triangular pattern around the proposed borehole and in a configuration not to allow for utilities to enter the borehole. Three-Point clearance must be 110% of the proposed intrusive area or the diameter of the intrusive area plus 2 inches, whichever is greater. Each method of clearance should be documented on the Utility and Structure Checklist.

Manual clearing methods, such as shoveling, using pick axes, digging bars and other hand tools, should be avoided completely or only used when absolutely necessary and used with caution. Excessive downward force, prying or use in poor/obstructed visibility conditions is prohibited as these tools can damage utilities.

Surface cover (e.g., asphalt) removal methods within the 30-inch Tolerance Zone that pose excessive downward force, such as jackhammering, should be used with extreme caution. Methods that only cut the surface cover (coring or saw cutting) present less risk due to the absence of the downward force, which could cause collateral damage to shallow subsurface utilities. Note that utilities are often present at the concrete or pavement/soil interface or encased within the concrete or pavement and are easily damaged during concrete coring or pavement removal. Always work slowly, methodically and frequently STOP WORK to evaluate conditions during these work activities.

For borings and excavations, if the utility is known to be at depths where hand clearing is not feasible or creates additional safety concerns, no work will be performed within the 30-inch Tolerance Zone vertically or horizontally of the utility unless manual clearing is performed under the oversight of an Excavation Competent Person as defined in ARC HSCS005 Arcadis Excavation and Trenching.

5.5.1 Temporary Backfilling of Pre-Cleared Boreholes

In some cases, it may be necessary to temporarily backfill a pre-cleared location until the remaining subsurface activities are performed. At these locations where subsurface intrusive work does not immediately follow pre-clearance, it is important to properly backfill and mark the pre-cleared location in order to relocate the pre-cleared location. In general, wooden stakes, survey markers, whiskers, paint marking or other surficial markings alone are inadequate because these markings can be easily removed, damaged or otherwise lost leading to uncertainty regarding the pre-cleared location. Although the specific steps for backfilling a pre-cleared location will depend on site-specific conditions, use the following additional steps to prevent loss of the pre-cleared location:

- Backfill a pre-cleared location with clean sand or other granular material that is significantly different than the surrounding subsurface native material. Native soil should not be used to backfill a pre-cleared location that may require further subsurface work.

- Backfill the top 2 feet of a pre-cleared location with dyed sand or gravel to facilitate re-location.

- Use hammered wooden stakes or delineators to mark locations as an additional measure, if practical.

- In the event that the pre-cleared borehole is located on asphalt or concrete and an asphalt cold patch is required, use white paint to mark the intrusive location with a circle over the asphalt cold patch.

- In some instances, such as projects potentially affected by unexploded ordinance (UXO), the pre-cleared borehole may require that a PVC of matching diameter pipe be inserted into the pre-cleared borehole, filled with clean sand and affixed with a matching cap. Contact the project manager to identify any client-specific requirements.

- Always use a physical subsurface marker such as described above to identify the pre-cleared borehole location. Never rely solely on field measurements or GPS coordinates.

- If a utility or anomaly/obstruction is encountered during the pre-clearing process, backfill the hole with the native soil and mark the location with a pink-painted X and/or NO.

In the event that a previously pre-cleared location cannot be located, the location must be re-cleared prior to performing subsurface intrusive work.

5.6 Clearance for Working in Vicinity of Subsurface Utilities

Prior to the start of subsurface intrusive activities (i.e., excavations, vertical drilling, installing grounding rod, and soil sampling), all utilities must be located and measures must be instituted to avoid subsurface utility hazards. See exemptions for subsurface intrusive work in Exhibit 1 (Definitions). Do not conduct subsurface work within 30 inches of a line marking in all directions. If the centerline of the utility is marked, the diameter of the utility or utility bank (Exhibit 1) must be incorporated into the 30-inch Tolerance Zone, see Figure 1 located in Exhibit 2 for further instructions.

If and when any line of evidence reveals that planned subsurface work will be located inside the 30-inch Tolerance Zone of known/marked/located/observed utilities, the project team must Stop Work and contact Corporate H&S as early as possible for pre-approval.

If subsurface work must take place within the 30-inch Tolerance Zone of the line marking, the utility must be exposed (potholed) by soft dig/clearance methods prior to starting subsurface intrusive activities (see Section 5.5 for options); **no mechanized equipment is permitted for the exposing of the utility**.

Once the utility has been exposed, if mechanized equipment is planned for use within the 30-inch Tolerance Zone of the utility, such activity must receive pre-approval by Corporate H&S, as necessary, to mitigate or accept the risk associated with the planned work. Additional excavation safety procedures may have to be developed as part of the approval to proceed. It should be noted that any disturbance within the 30 inches or disruption of the bedding materials could affect the integrity of the utility.

For horizontal borings, to avoid striking a utility, damage from vibration, damage by pressure of the advancing boring, do not drill within 30 inches in all directions (3-Dimensional cylinder) of a line marking. Make sure to factor the diameter of the line or utility bank when computing 30-inch Tolerance Zone. When crossing a utility during horizontal drilling, it is recommend that the utility be exposed 30 inches in a 360°-direction. When exposing utilities for horizontal borings, the utility must be exposed (potholed) by soft dig/clearance methods. This recommendation applies even if the operating contractor has technology that places the location to within a few inches. Make sure to factor the diameter of the utility when determining the 30-inch Tolerance Zone. If subsurface work must take place within the 30-inch Tolerance Zone of the line marking, the utility must be exposed (potholed) by soft dig/clearance methods prior to starting subsurface intrusive work (see Section 5.5 for options); **no mechanized equipment is permitted for the exposing of the utility**. Once the utility has been exposed, if mechanized equipment is planned for use within the 30-inch Tolerance Zone of the utility, such activity must receive pre-approval by Corporate H&S, as necessary, to mitigate or accept the risk associated with the planned work. Additional excavation safety procedures may have to be developed as part of the approval to proceed. It should be noted that any disturbance within the 30 inches or disruption of the bedding materials could affect the integrity of the utility.

Additional cautions for horizontal borings include gravity utilities, such as sewers and storm drains, as the depth of these utilities will change (sometimes significantly) as they run across the project site. Always obtain the utility depth at the location where the boring will actually cross the line by collecting sewer depth inverts from identified manholes and interpolating those depths to the area of the subsurface intrusive work.

During well installations and well abandonment via mechanical equipment, the 30-inch Tolerance Zone rule applies outward from the outside edge of the largest diameter auger or tool to be used for installation and abandonment (over drilling). In cases where wells have been previously installed and the 30-inch rule has not been followed, work proposed using mechanized equipment to work within the 30-inch Tolerance Zone will require approval from Corporate H&S. For more information, see Exhibit 2 for further instructions.

5.6.1 Aboveground Activities causing Subsurface Disturbance in the Vicinity of Underground Utilities

Aboveground activities can cause damage to shallow underground utilities or structures. Plan the intended path/mobilization/operation of Heavy Equipment is cleared to ensure that shallow utilities are not damaged. If Heavy Equipment must cross over shallow utilities, the utilities will be protected. Other subsurface disturbances may lead to damage such as clearing trees/shrubs/vegetation as roots may be entangled with underground piping or structures. For more information, see Best Practices for Field Personnel Concerning Utility Clearance (ARC HSFS-019 Supplement 2).

5.7 Acceptable Clearance for Working in Vicinity of Overhead Power Lines and Other Overhead Lines and Structures

No work will be performed by Arcadis or our subcontractor near overhead power lines where any Unqualified Person or equipment is within the limits specified below unless the power line has been properly covered or de-energized by the owner or operator of the power line. Qualified Person approach distances are defined in Exhibit 5A and 5B of ARC HSFS0006 Electrical Safety Standard.

Power Line Voltage Phase to phase (kV)	Minimum Safe Clearance (feet)
50 or below	10
Above 50 to 200	15
Above 200 to 350	20
Above 350 to 500	25
Above 500 to 750	35
Above 750 to 1,000	45

ANSI standard B30.5-1994, 5-3.4.5

5.7.1 Reducing Vehicle and Mechanical Equipment Clearance Requirements

Any vehicle or mechanical equipment capable of having parts of its structure elevated near energized overhead lines shall be operated so that a clearance of 10 feet (305 centimeters (cm)) is maintained. If the voltage is higher than 50 kilovolts (kV), the clearance shall be increased 4 inches (10 cm) for every 10 kV over that voltage. However, under any of the following conditions, the clearance may be reduced:

- If the vehicle is in transit with its structure lowered, the clearance may be reduced to 4 feet (122 cm). If the voltage is higher than 50 kV, the clearance shall be increased 4 inches (10 cm) for every 10 kV over that voltage.

- If insulating barriers are installed to prevent contact with the lines and if the barriers are rated for the voltage of the line being guarded and are not a part of or an attachment to the vehicle or its raised structure, the clearance may be reduced to a distance within the designed working dimensions of the insulating barrier.

- If the equipment is an aerial lift that is insulated for the voltage involved and if the work is performed by a qualified person, the clearance (between the uninsulated portion of the aerial lift and the power line) may be reduced to the distance given in OSHA 1910.333(c)(3)(ii)(C) Table S-5. Reference information from OSHA 1910.333 Table S-5 and NFPA 70E Table 130.4(C)(a) for alternating-current systems and 130.4(C)(b) for the distances associated with direct-current voltage systems is included as Exhibit 5 of ARC HSFS0006 Electrical Safety Standard.

Employees standing on the ground may not contact the vehicle or mechanical equipment or any of its attachments unless:

- The employee is using protective equipment rated for the voltage; or

- The equipment is located so that no uninsulated part of its structure (that portion of the structure that provides a conductive path to employees on the ground) can come closer to the line than permitted in this section of this standard.

If any vehicle or mechanical equipment capable of having parts of its structure elevated near energized overhead lines is intentionally grounded, employees working on the ground near the point of grounding may not stand at the grounding location whenever there is a possibility of overhead line contact. Additional precautions, such as the use of barricades or insulation, shall be taken to protect employees from hazardous ground potentials, depending on earth resistivity and fault currents, which can develop within the first few feet or more outward from the grounding point.

When a machine is in contact with an overhead power line, do not allow anyone to come near or touch the machine. Stay away from the machine and summon outside assistance.

5.7.2 Acceptable Clearance for Working in Vicinity of Non-Electrical Overhead Utilities and Structures

Arcadis field personnel will identify non-electrical overhead utilities and structures and where possible, work is not be conducted within the 30-inch Tolerance Zone of these overhead utilities and structures. It is recommended that if work will be completed in the vicinity of non-electric overhead utilities, the overhead utilities should be labeled with warning signs, protective barricades, and/or flags. Non-electrical overhead utilities and structures may include, but is not limited to, pipe chases, water lines, ceilings in buildings, etc. Arcadis field personnel will notify its site workers (employees, subcontractors, vendors, etc.) of known overhead utilities and structures during the tailgate safety meeting. See Exhibit 2 for additional details.

5.8 Reporting Utility Incidents

Arcadis field personnel involved with any subsurface, submerged, and aboveground utility strikes should immediately STOP WORK and contact the Project Manager to discuss the incident unless there are injuries, then call 911 or the available emergency services number for the area and then the Project Manager. The utility strike must be reported to Corporate Health and Safety and Legal Departments immediately and no later than 24 hours. Use the Utility Line Strike Investigation Form as part of the notification process.

Selected utility strike incidents may also utilize a conference call with operations management to review findings and lessons learned. The Business Line Health and Safety Director will make the determination concerning the need to have the incident review call and will arrange the call, if deemed necessary.

5.9 Relationship of this standard to the Project Specific HASP

With the exception of the Utility and Structures Checklist, this standard, including most supplements, are not designed to be printed off and attached to project HASPs. During project health and safety planning, this standard will be reviewed and applicable clearance technologies and methods will be documented on the Utility and Structures Checklist.

Additionally, emergency action standards specific to utility strikes should be addressed. ARC HSFS-019 Supplement 5 provides general guidelines for emergency response to utility strikes. Applicable information may be attached to the Utility and Structures Checklist to facilitate communication of response expectations.

5.10 Required Contract Terms and Conditions

Arcadis’ standard client and subcontractor contracts contain required terms and conditions defining responsibility for utility clearance and the allocation of risk associated with an impacted utility. These terms and conditions have prescribed language concerning subsurface work that is presented in Arcadis client contracts and Arcadis’ subcontractor contracts, which can be found on the Legal Source site. If such provisions cannot be agreed upon, the reasons are documented and other risk-management actions should be identified, such as limits of liability, add additional physical investigations, additional lines of evidence or utility location, assignment of risk to subcontractors, etc. In addition, any changes to these terms and conditions require approval by Legal Services.

6. TRAINING

Employees responsible for coordinating or conducting utility clearance activities will be familiar with the requirements of this standard. Arcadis in-house 8-hour Hazardous Waste Operations and Emergency Response (HAZWOPER) refresher may provide awareness-level training regarding this utility location and clearance standard.

7. REFERENCES (regulation citation, technical links, publications, etc.)

- Utility and Structures Checklist
- Utility Line Strike Investigation Form
- ARC HSFS-019 Supplement 1, Best Practices for Project Managers (or Their Delegates) Concerning Utility Clearance
- ARC HSFS-019 Supplement 2, Best Practices for Field Personnel Concerning Utility Clearance
- ARC HSFS-019 Supplement 3, Use and Limitations Associated with Location Technologies and Common Utility Clearance Methods
- ARC HSFS-019 Supplement 4, Best Practices for State One Call Procedures and Notifications
- ARC HSFS-019 Supplement 5, Emergency Action Plan guidelines for Utility Strikes
- ARC HSFS-019 Supplement 6, Utility Location SOP for Aquatic Work Activities
- Figure 1 – 30-Inch Tolerance Zone
- ARC HSCS005 Excavation and Trenching
- ARC HSFS0006 Electrical Safety Standard
- One Call and State Law Directory

8. RECORDS - DATA RECORDING AND MANAGEMENT

8.1 Utility Clearance Records

All records (maps, checklists and documentation of communications) used to determine the location of utilities should be retained and kept in the project file.

9. APPROVALS AND HISTORY OF CHANGE

Approved By: Julie Santaniello, CSP – Corporate H&S, Manager of Technical Programs

Julie

History of Change

Revision Date	Revision Number	Standard Developed/Reviewed By or Revised By	Reason for change
13 December 2006	01	Mike Thomas/Pat Vollertsen	Original document
26 March 2007	02	Mike Thomas/Pat Vollertsen	Put in new company format
15 May 2007	03	Mike Thomas/Pat Vollertsen	Added nation-wide 811 number
6 September 2007	04	Mike Thomas/Pat Vollertsen	Changing over to new template format
22 February 2008	05	Mija Coppola	Changing over to new template format
13 January 2009	06	Mija Coppola	Define lines of evidence
4 October 2010	07	Sam Moyers/Mija Coppola	Reformatting and addition of utility clearance information
13 February 2012	08	Sam Moyers/Mija Coppola	Modified link information for utility strike reporting, clarified local/state requirements in section 4.1 and 4.3
28 January 2013	09	Tony Tremblay	Utility and Structures Checklist revised; hyperlink updated
12 February 2013	10	Amanda Tine/Tony Tremblay	Clarified clearance boundaries for Unqualified staff in Section 5.7 and added information about vehicles and equipment being used near power lines in Section 5.7.1

Revision Date	**Revision Number**	**Standard Developed/Reviewed By or Revised By**	**Reason for change**
15 March 2013	11	Kurt Merkle, Rebecca Lindeman / Tony Tremblay	Added additional text to standard for recent lessons learned, added section 5.4 (Locating Technologies) and 5.5 (Clearance Methodologies), added additional details to section 5.6 when working in close proximity to subsurface utilities, and added Supplement 6 - Utility Location SOP for Aquatic Work Activities.
07 July 2013	12	Andrew McDonald/ Tony Tremblay	Removed HSFS-019 Supplement 1, Utility Definitions. Added hyperlink for One Call and State Law Directory. Segregated evidence of sewer or storm drains in USC list. Removed Sam Moyers and added Andrew McDonald as author.
26 September 2014	13	Andrew McDonald/Tony Tremblay	Added Exhibit 1. Definitions and 30 inch tolerance zone. Clarified use of 811 or state one call as a reliable line of evidence. Added best practice to cover backfilling of pre-cleared boreholes. Updated USC list to cover soft dig termination depths and PM review.
23 February 2015	14	Tony Tremblay	Page number correction

Revision Date	Revision Number	Standard Developed/Reviewed By or Revised By	Reason for change
10 May 2016	15	Denis Balcer/Sharon Lingle/Alec MacAdam/Andrew McDonald/Tony Tremblay/Julie Santaniello	ES and Section 4.2 - define subsurface intrusive work; clarify employees providing oversight of utility contractors, Arcadis requirements of operating and interpreting results of utility clearance equipment, and utility clearance before all subsurface intrusive work. Sections 1 and 5.8- changed submarine to submerged. Section 4.1 – added contacting public utility companies to help clear utilities. Section 4.2 – Clarified requirement to complete one year of utility clearance-related experience. Section 4.2 and 4.3 - Added discussion on aboveground activities causing subsurface disturbances. Added responsibility to clear overhead utilities when heavy equipment will be used and to evaluate use of a spotter. Added that repairs to damaged utilities need to be verified as competent and complete. Section 5.2 – Clarified reliable lines of evidence for each subsurface intrusive work point and degrees of certainty. Added all work within 30-inch Tolerance Zone needs Corp H&S preapproval. Section 5.6 and Exhibit 1- Clarify subsurface intrusive work and activity and exemptions for subsurface intrusive work. Section 5.6.1 – Add requirement to evaluate aboveground activities that may lead to subsurface disturbances that may cause damage to shallow underground utilities or structures.

Revision Date	**Revision Number**	**Standard Developed/Reviewed By or Revised By**	**Reason for change**
10 May 2016	15	Denis Balcer/Sharon Lingle/Alec MacAdam/Andrew McDonald/Tony Tremblay/Julie Santaniello	Section 5.7.2 – added non-electric overhead utilities and structures other than power lines need to be identified and marked if working in that area. Section 9 – Changed reviewer from Tony Tremblay to Julie Santaniello. Exhibit 1 – added definitions of Utility Strike, Daylighting, Potholing, Subsurface Intrusive Work, Subsurface Intrusive Activities, and Utility Bank. Standard and Supplements placed on new Arcadis headers. Updated Supplement revision numbers to be consistent with standard. Supplement 2 revised. Utility Clearance and Structures Checklist and Utility Strike Investigation Form revised.
17 March 2017	16	Alec MacAdam/Julie Santaniello	Hyperlink updates; minor formatting; Utility Clearance and Structures Checklist revised.

EXHIBIT 1 – DEFINITIONS

Aboveground Utilities - For the purpose of this procedure, aboveground utilities include, but are not limited to: any aboveground line, pipe, conduit, system, or facility used for producing, storing, conveying, transmitting or distributing communication or telecommunications signals, electricity, gas, liquid, petroleum and petroleum products, coal slurry, hazardous liquids or gases, water under pressure, steam, sanitary sewage, storm water, or other materials, liquids, or gases.

Daylighting – exposing underground utilities or structures through soft dig technology/clearance prior to completing subsurface intrusive activities.

Excavation - Any man-made cut, cavity, trench, or depression, in an earth surface formed by earth removal into which a person can bodily enter.

Overhead Utilities and Structures – Overhead water lines, overhead pipe chases, ceilings in buildings.

Potholing – exposing underground utilities or structures through soft dig technology/clearance prior to completing subsurface intrusive activities.

Subsurface Intrusive Activities – For the purposes of this procedure, subsurface intrusive activities include, but are not limited to: excavations, vertical drilling, installing grounding rod, soil sampling, etc,

Subsurface Intrusive Work – Is any work or activity that breaks the plane of the ground surface. Exemptions include soil sampling using a non-conductive sampling tool to a depth of 6 inches below ground surface (bgs), placement of survey flagging to a depth of 6 inches bgs, and placement of non-conductive survey stake(s) to a depth of 6 inches bgs).

Subsurface Utilities - For the purposes of this procedure, subsurface utilities include, but are not limited to: any underground line, pipe, conduit, system, or facility used for producing, storing, conveying, transmitting or distributing communication or telecommunications signals, electricity, gas, liquid, petroleum and petroleum products, coal slurry, hazardous liquids or gases, water under pressure, steam, storm water, or sanitary sewage; underground storage tanks; tunnels and cisterns; and septic tanks and lines.

Tolerance Zone – The area within 30 inches in all directions from the outside diameter of a located/marked utility in which special care is to be taken. If the centerline of the utility is marked, the diameter of the utility or utility bank/trench must be incorporated into the 30 inches. This area must be hand cleared with non-mechanized equipment. Once the utility has been exposed, if mechanized equipment is planned for use within the 30-inch Tolerance Zone of the utility, such activity must receive pre-approval by Corporate H&S, to mitigate or accept the risk associated with the planned work. See Figure 1 – 30-inch Tolerance Zone.

Utility Bank – a structure containing two or more conduits. A conduit is a single enclosure containing one or more facilities.

Utility Strike – An unplanned contact of a utility (i.e., overhead and structures, aboveground, underground or submerged) during the course of work that results in damage requiring repairs, making a report to the utility owner or requiring further assessment to evaluate the potential for damage

EXHIBIT 2 – FIGURE 1 – TOLERANCE ZONE

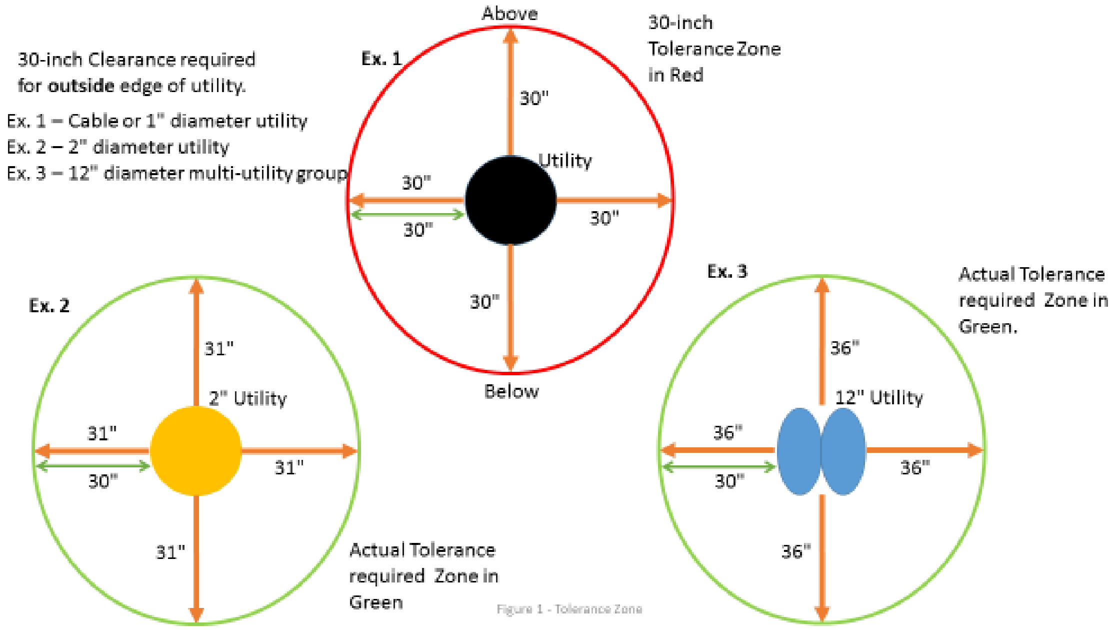


Figure 1 - Tolerance Zone

Arcadis ENV Quality Procedure

TOPIC:

CALIBRATION AND CONTROL OF MEASURING AND TEST EQUIPMENT

Revision Date: November 2016
Revision Letter: C

QP#: 3.07

STATEMENT OF POLICY:

The Arcadis Environment Business Line (ENV) uses measuring and test equipment in the course of its activities. Equipment used by ENV and their subcontractors must be in the condition required for the performance of specified activities. A procedure for performing and documenting calibration and for the preventive maintenance of measuring and test equipment will be followed to provide necessary controls.

1. Purpose

The objective of this Quality Procedure (QP) is to provide a standard procedure for the calibration and control of measuring and test equipment, including establishing the correct equipment type, range, accuracy, and precision to meet data collection needs. Equipment must be uniquely identified, calibrated against recognized standards that are clearly identified and documented, and maintained to provide reliable performance and to meet ENV quality requirements.

2. Responsibilities

Certified Project Manager – responsible for implementation of this procedure.

Field Supervisor – responsible for field equipment and for communicating calibration and maintenance procedures for equipment used by ENV staff. Similar requirements for field equipment calibration and maintenance should also be communicated to subcontractors using field equipment. Subcontractors are responsible for following those requirements and are subject to performance audits.

Quality Consultant – responsible for providing quality assurance and quality control guidance to the CPM in implementing this procedure.

Project Team Members – project team members are responsible for verifying calibration status prior to using the equipment, and for operating equipment by approved procedures, documenting information, and reporting equipment malfunctions.

3. Terms and Definitions

Accuracy – a qualitative evaluation of the agreement between an individual value (or the central tendency of a set of values) and the correct value or the accepted reference value.

Calibration – the process of evaluating and standardizing an instrument by determining the deviation from a known standard.

Measuring and Test Equipment – devices or systems used to calibrate, measure, gauge, test, or inspect in order to acquire data.

Precision – a qualitative evaluation of measurement data used to describe the dispersion of a set of numbers with respect to its central tendency.

4. Related Forms

Not applicable.

DESCRIPTION OF PROCEDURE:

Measuring and test equipment will be controlled by a calibration and preventive maintenance program. Instruments that measure a quantity or whose performance must meet stated criteria will be subject to calibration. Calibration of equipment may be performed internally using reference equipment and standards, or externally by agencies or manufacturers. Two types of calibration are presented in this procedure:

- Operational calibration, which is routinely performed as part of instrument usage.
- Periodic calibration, which is performed at prescribed intervals for equipment such as water-level indicators, pressure recording devices, and thermometers. In general, equipment that can be calibrated periodically is relatively stable in performance.

Preventive maintenance is an organized and documented program of equipment cleaning, lubricating, reconditioning, adjusting, and/or testing intended to maintain proper performance, prevent equipment from failing during use, and maintain reliability.

1. Calibration Procedures

Documented procedures must be used for calibrating measuring and test equipment and reference equipment. Procedures such as those published by ASTM International (formerly known as the American Society for Testing and Materials), U.S. Environmental Protection Agency (USEPA), or procedures provided by manufacturers will be used whenever possible.

Where pre-established procedures are not available, procedures will be developed. Factors such as the type of equipment, stability characteristics of the equipment, required accuracy and precision, and the effect of error on the quantities measured must be taken into account. Calibration procedures must include:

- Type of equipment to be calibrated
- Reference equipment and standards to be used
- Calibration method and specific procedure

- Acceptance tolerances
- Frequency of calibration
- Data recording form.

2. Equipment Identification

Measuring and test equipment owned by Arcadis must be uniquely identified using the manufacturer's serial number, a calibration system identification number, or an inventory control tag number. This identification must be attached to the equipment. In addition to the identification number, equipment requiring periodic calibration must bear a label indicating when the next calibration is due. Equipment that is rented or leased for the purposes of measuring and testing must also be uniquely identified.

Personnel are responsible for verifying calibration status from due date labels or instrument records prior to using the equipment. Measuring and test equipment that is not properly calibrated must not be used.

3. Calibration Frequency

Measuring and test equipment and reference equipment will be calibrated at prescribed intervals and/or as part of operational use. The calibration frequency will depend on the type of equipment, inherent stability, manufacturer's recommendations, intended use, effect of error on the measurement process, and experience. Calibration frequencies may be defined in project-specific plans or in calibration procedures. The CPM or Field Supervisor is responsible for specifying the procedures to be followed to meet project data quality objectives.

Scheduled periodic calibration may not be performed for infrequently used equipment; such equipment will be calibrated on an "as needed" basis prior to use, and then at the required frequencies for the duration of its use.

Field equipment will require an operational check per the applicable procedure and or the equipment manual prior to use, and then again at the end of the working day. Pre-use calibration should be completed under conditions of anticipated use (e.g., temperature, humidity, and atmospheric pressure) if these parameters may influence results.

4. Reference Equipment and Standards

Whenever possible, equipment must be calibrated using reference equipment (i.e., physical standards) and chemical and radioactive standards having known relationships to nationally recognized standards (e.g., National Institute of Standards and Technology [NIST]) or accepted values of natural physical constants. If national standards or constants do not exist, the basis for the calibration must be documented.

Physical standards may include calibration weights, certified thermometers, standard measurement tapes, gauge blocks, and reference gauges. These are generally used for periodic calibrations. Physical standards must be used only for calibration.

Chemical and radioactive standards may include reagents, solvents, and gases. These may be Standard Reference Materials (SRM) provided by NIST or USEPA, or they may be vendor-certified materials traceable to NIST or USEPA SRMs. Chemical and radioactive standards will primarily be used for operational calibrations.

The date of receipt and expiration date must be clearly labeled on the container of each standard. If calibration standards are transferred to additional containers, these containers must be labeled with the name of the standard, the lot number, and the shelf life. Calibration standards that exceed shelf life must not be used and must be discarded.

If equipment is sent to the manufacturer or calibration laboratory for calibration, adequate documentation must be maintained to establish the calibration method, reference standard source, or traceability to recognized standards.

5. Calibration Failure

Equipment failing calibration or becoming inoperable during use will be removed from service and segregated to prevent inadvertent use, or tagged to indicate it is out of service. The equipment must be repaired and properly recalibrated; equipment that cannot be repaired will be replaced.

The results of activities involving equipment that has failed recalibration will be evaluated by the CPM. If the results are adversely affected, the findings of the evaluation will be documented and appropriate personnel will be notified.

Periodic calibration of measuring and test equipment does not replace the user’s responsibility for verifying proper function of equipment. If an equipment malfunction is suspected, the device must be tagged or removed from service, and recalibrated. If it fails recalibration, it must be repaired or replaced.

6. Documentation of Calibration

Records must be maintained for each piece of calibrated measuring and test equipment and each piece of reference equipment. The records must indicate that established calibration procedures have been followed, and that the accuracy of reference chemical and radioactive standards has been verified.

Records for periodically calibrated equipment must include the following minimum information:

- Type and identification number of equipment
- Calibration frequency and acceptance tolerances

- Calibration dates
- Name of individual and organization performing the calibration
- Reference equipment and/or standards used for calibration
- Calibration data
- Certificates or statements of calibration provided by manufacturers and external organizations
- Documentation of calibration acceptance or failure, and of repair of failed equipment.

For equipment requiring calibration, information should be maintained in a project or equipment database regarding the calibration and maintenance history for that equipment. Equipment that does not have a calibration sticker or that has an expired calibration sticker should be tagged inoperable and sent for calibration. The equipment information file should contain periodic calibration files, as well as equipment calibration and maintenance records, calibration data forms, and/or certification of calibration provided by manufacturers or external organizations, and notice of equipment calibration failure.

Measuring and test equipment used for field investigations will typically be calibrated as part of operational use. For this equipment, records of the calibrations or checks will be documented as part of the test data (e.g., in the field notebook or on a Field Activity Log). Equipment-specific forms may also be developed. These records should include information similar to that required for periodically calibrated equipment. Documentation related to malfunctioning equipment or equipment that fails calibration should also be included in the individual equipment file.

Calibration files for equipment requiring periodic calibration should be sent with equipment that is transferred to allow a continuously updated record to be maintained. Recalibration of sensitive equipment should be performed following the transfer.

When measuring and test equipment is rented or leased, procurement documents must specify that a current certificate of calibration must accompany the equipment. This certificate must be maintained with the project documentation calibration records.

7. Operational Checks

Certain equipment may require periodic operability tests or checks to verify that operating systems are within the allowed range. These tests are in addition to formal calibration. Like calibrations, these tests will be performed at specified frequencies, or as part of operational use using reference equipment and standards.

If an instrument fails an operability test, and corrective action cannot bring the instrument into tolerance, it must be removed from service and segregated to prevent inadvertent use, or tagged to indicate it is out of service. Such equipment will be repaired and/or recalibrated.

Operability tests will generally be performed in conjunction with data acquisition. Information recorded must include:

- Type and identification number of equipment (e.g., model and serial numbers)
- Test date
- Name of individual and organization performing the test
- Reference equipment and standards used
- Test data
- Documentation of acceptance or failure.

Documentation may be in the field notebook or on a Field Activity Log.

8. Preventive Maintenance

Preventive maintenance is an organized program of equipment cleaning, lubricating, reconditioning, adjusting, and/or testing intended to maintain proper performance, prevent equipment from failing during use, and maintain reliability. Specific maintenance details may be supplied in project-specific plans. A typical preventive maintenance program includes:

- A listing of the equipment that is included in the program
- The frequency of maintenance (manufacturer's recommendations or previous experience with the equipment)
- Service contracts
- Identification of spare parts
- Items to be checked and specific protocols to be followed
- Documentation of maintenance.

Maintenance records of measuring and test equipment must be maintained at the location that is the host for the equipment. Documentation of subcontractor and Arcadis equipment that is used for an individual project will be included in the project files. Records for multi-project equipment will be maintained by the location that controls the equipment.

Measuring and test equipment must be controlled through the use of sign-out/sign-in records or other suitable method. Equipment that is returned from field use must be free of contamination, packaged in a manner suitable for storage, and returned to its designated area. Support personnel should be notified of performance problems with equipment.

— END OF PROCEDURE —

Arcadis ENV Quality Procedure

TOPIC:

FIELD SAMPLING, MEASUREMENT, AND OBSERVATIONS

Revision Date: October 2017
Revision Letter: D

QP#: 3.08

STATEMENT OF POLICY:

It is Arcadis Environment Business Line (ENV) policy that field sampling, measurements, and observations must be conducted and documented to facilitate later data interpretation, provide an evidentiary record and to demonstrate that field activities have been performed consistently and in accordance with approved site-specific project planning documents. Site-specific documents describing field sampling activities may include, but are not limited to, work plans, the Project Quality Plan (PQP), Quality Assurance Project Plan (QAPP), Field Sampling Plan (FSP), applicable Standard Operating Procedures (SOPs) and Technical Guidance Instructions (TGIs), Quality Procedures (QPs), Health and Safety Plan (HASP), and/or other appropriate project documents associated with the sampling program.

1. Purpose

The objective of this Quality Procedure (QP) is to provide a consistent process for the execution of activities associated with field sampling, measurements, and observations. This QP, while focused on field sampling activities, should be performed in conjunction with QP 3.06 Field Activities Documentation.

2. Responsibilities

Certified Project Manager (CPM) – is responsible for implementation of this QP, including verification that site-specific project planning documents are followed (including approved deviation decisions, if necessary). Although a Field Supervisor may lead the sampling activities, the CPM is ultimately responsible for staff's adherence to this QP.

Quality Consultant – responsible for providing quality assurance and quality control (QA/QC) guidance to the CPM in implementing this procedure. Note that for Federal projects there are specific requirements for the QA officer assigned to a project.

Project Team Members – project participants who are involved in sampling activities are responsible for compliance with this procedure. Individuals involved in the sampling program will read and adhere to the site-specific project planning documents that direct their field activities.

3. Terms and Definitions

Work Plan – a document that describes proposed project activities.

Quality Assurance Project Plan (QAPP) – a document that prescribes the quality assurance/quality control procedures to be followed. Uniform Federal Policy (UFP)-QAPPs are now frequently required for environmental projects by most federal regulatory agencies. UFP-QAPP includes Worksheets used to document the entire project plan developed following the systematic planning process. For more details on the UFP-QAPP see: http://www.epa.gov/fedfac/documents/qualityassurance.htm. Note that if the project QAPP is written following the

Uniform Federal Policy (UFP) that it will also contain a description of the sampling rationale and sampling locations as well as quality assurance/quality control requirements. The UFP-QAPP format is designed to capture the entire systematic planning process. If a UFP-QAPP is written for a project, a separate FSP may not be required unless specified by the particular regulatory agency, client or contract.

Field Sampling Plan (FSP) – a document that describes the procedures and protocols necessary to complete field sampling and data collection activities.

Health and Safety Plan (HASP) – a document that describes the hazards of planned activities and the controls to be implemented to protect site personnel.

Data Quality Objective (DQO) – a statement that specifies the quality of data required to support the purposes and intent of the sampling and analysis activity. DQOs are based on the intended use of the data; as such, different data uses and needs may require different levels of data quality.

Standard Operating Procedures (SOP) and Technical Guidance Instruction (TGI) – Documents that describe a procedure and/or protocol necessary to conduct a specific field activity. SOPs/TGIs may also be created or revised on a program or project specific basis. An SOP/TGI library is available on The Source.

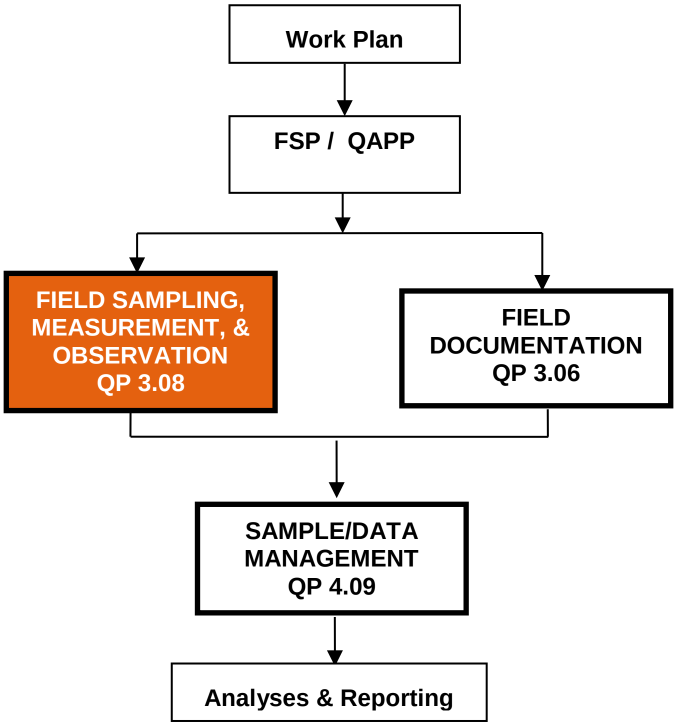
4. Related Forms

Forms such as purge logs, soil boring logs appropriate for the field sampling activity and observations.

DESCRIPTION OF PROCEDURE:

Sampling and data quality directly affect overall project success because sampling and other field activities are a critical and fundamental component of projects. Errors, mistakes, missed communications, or out-of-scope or out-of-compliance actions may have an adverse effect on a project. Because field conditions cannot be anticipated absolutely, procedures for a particular sampling program must include a formal process for making decisions and obtaining appropriate approvals for deviations necessitated by conditions. Within this context, the basic procedures and requirements for sampling and other field measurements and observations are outlined in the project documents (FSP, QAAP or Work Plan) and the associated procedures. Sample collection, data collection, and drilling locations should be documented (i.e., tape measurements with respect to site features, GPS measurements, and or survey by a licensed land surveyor). It is also recommended taking to the field site maps showing pre-existing and proposed sampling, drilling, data collection, and well locations. It is also recommended the field staff be aware of previous data measurements so field staff can note and communicate any significant changes.

The following flow chart provides the major components of a typical field characterization program and highlights where field sampling activities fit in.



1. Field Sampling, Measurement, and Observation Activities

Field operations are conducted to provide reliable information, data, and/or samples that meet the project and data quality objectives. It is essential that field sampling, measurement, and observation activities begin with the field team having a detailed familiarity with appropriate site-specific project planning documents, most notably the FSP. Time should be scheduled and budgeted for the field team members to review the plan(s) and ask questions. With a good understanding of what samples or data are to be collected, as well as where and why they are to be collected, field personnel will perform the following activities during the implementation of field characterization activities.

1.1 Briefing and Preparation

Before field activity begins, a kick-off meeting should be held to ensure that the project team understands the project objectives and the procedures that will be followed. The CPM and appropriate project office and field personnel (e.g., Field Supervisor, Crew Leader, or entire crew) should engage in a briefing via telephone discussion or in person to review (in summary fashion) the following:

- Project objectives and project plans
- DQOs
- Sampling locations
- SOPs/TGIs

- Chain of command
- HASP
- Provisions for addressing deviations
- Other special circumstances or information critical to the success of the sampling event and integrity of the data and documentation.

When possible, the CPM and/or Field Supervisor should perform a reconnaissance site visit prior to initiation of the sampling or other field activities to review sample locations and consider health and safety or other logistical challenges the site may present. The CPM must also ensure that any utility clearance requirements have been met. Finally, the CPM and/or Field Supervisor must verify that the necessary subcontracts, notifications, and approvals are in place, including coordination with client personnel, agency oversight personnel, access to private or public property (i.e., legal), and coordination with utility companies/agencies regarding the potential of buried, overhead, or other sensitive infrastructure that may affect project implementation and/or health and safety.

1.2 Standard Operating Procedures and Technical Guidance Instructions

Applicable SOPs and TGIs must be followed to ensure consistency and quality in method and resulting data. An SOP/TGI library is available on The Source. SOPs and TGIs may also be created or revised on a program or project specific basis. Deviation from established procedure(s) during a data collection activity must be documented. Where plans and SOPs allow discretion (do A or B) or choice (exact sampling location) these decisions should be documented in the field notebook. In cases where the integrity of the data being collected may be jeopardized, field personnel must consider stopping associated work activities until the CPM or other project authority can be consulted as to what corrective action is warranted before work can recommence. Follow the hierarchy of regulatory, client, ENV in selecting and modifying methods and procedures.

1.3 Equipment and Instrumentation

The site-specific project planning documents will be reviewed to identify the types of equipment, instrumentation, and supplies that are needed for the sampling, measurement, observation, or other data collection activities. The selected equipment and instrumentation will meet the requirements of the specifications, methods, and procedures provided in the FSP, QAPP, HASP, or other planning document(s). Further, the Field Supervisor/Crew Leader is responsible for verifying that the equipment and instrumentation are in good working order, clean and, if necessary, properly calibrated and maintained before, during, and after use in the field. (See QP 3.07 Calibration and Control of Measuring and Test Equipment).

1.4 Physical Sample Management

It is extremely important that proper procedures be followed in the sample identification system employed for collected samples, the chain-of-custody procedures, and the manner in which the samples are tracked from collection point, through handling and shipment, and to receipt by the laboratory (including sampling techniques, sample volumes, holding times, preservation, packaging, and shipping procedures). Field personnel are responsible for obtaining the proper number and type of quality control samples, including but not necessarily limited to trip blanks, duplicates, matrix spikes, matrix spike duplicates, and equipment rinse blanks (these requirements should be specified in the site-specific project planning documents and reviewed prior to commencing the field program). These procedures are specified in the Work Plans, FSP, QAPP, and or HASP, or other project planning documents and shall be reviewed by field personnel prior to initiation of field activities. Deviation from established procedures could impact the integrity of the sample or activity; and must be justified, approved by the CPM, and be appropriately documented.

1.5 Qualitative Data Management

Based on requirements specified in site-specific project planning documents, field activities should adhere to applicable SOPs and WTGIs and be carried out in a consistent manner that is well documented in accordance with QP 3.06 Field Activities Documentation. This includes care in making and recording accurate and precise measurements and observations in a timely manner.

1.6 Decontamination

Field personnel will review and be familiar with required decontamination procedures, including those for cleaning field equipment, proper storage of cleaned field equipment, and for properly disposing of waste generated from decontamination procedures. If decontamination is conducted on site, the activities will be performed in a designated, controlled location that will not impact collected samples. Decontamination activities will be appropriately documented in the field notes, following the protocols specified in the FSP/QAPP or SOP/TGI and QP 3.06 Field Activities Documentation. Wastes generated in the field will be collected, stored, and properly disposed in accordance with FSP/QAPP protocols.

It is important to note that decontamination includes personal protective equipment as well as vehicles and equipment. It is critical that equipment used in one area not serve as a source of contamination of another. This may include weeds or affected soil/water (e.g., carried-in tires or equipment) that could be transported outside the designated work area. In particular, work in surface waters potentially supporting amphibians and other ecological resources may require specific decontamination procedures between sampling events even if no pollutants are anticipated in the waters.

1.7 Corrective Action

The CPM and field personnel will be familiar with site-specific project planning procedures designed to address deficiencies or deviations quickly and efficiently, so as not to unnecessarily hold up progress or compromise the integrity of the field effort. Based on the procedures established in the site-specific project planning documents, specific steps are taken as soon as a potential problem is identified. At a minimum, deficiencies or deviations must be reported to the CPM (through pre-established chain of command) and then fully documented to include the nature of the problem, the corrective action taken, and the person(s) responsible for correcting or otherwise addressing the problem. Site-specific project planning documents should contain site-specific corrective action procedures.

— END OF PROCEDURE —

TGI - SOIL DESCRIPTION

Rev: #2

Rev Date: February 16, 2018

VERSION CONTROL

Revision No	Revision Date	Page No(s)	Description	Reviewed by
0	May 20, 2008	17	Original SOP	Joe Quinnan Joel Hunt
1	September 2016	15	Updated to TGI	Nick Welty Patrick Curry
2	February 16, 2018	15	Updated descriptions, attachments and references in text	Nick Welty Patrick Curry

APPROVAL SIGNATURES

Prepared by:

Patrick Curry, PG

Date: June 30, 2017

Technical Expert Reviewed by: Niklaus R.H. Welty

Nicklaus Welty, PG

Date: June 30, 2017

1 INTRODUCTION

This document describes general and/or specific procedures, methods, actions, steps, and considerations to be used and observed by Arcadis staff when performing work, tasks, or actions under the scope and relevancy of this document. This document may describe expectations, requirements, guidance, recommendations, and/or instructions pertinent to the service, work task, or activity it covers.

It is the responsibility of the Arcadis Certified Project Manager (CPM) to provide this document to the persons conducting services that fall under the scope and purpose of this procedure, instruction, and/or guidance. The Arcadis CPM will also ensure that the persons conducting the work falling under this document are appropriately trained and familiar with its content. The persons conducting the work under this document are required to meet the minimum competency requirements outlined herein, and inquire to the CPM regarding any questions, misunderstanding, or discrepancy related to the work under this document.

This document is not considered to be all inclusive nor does it apply to all projects. It is the CPM's responsibility to determine the proper scope and personnel required for each project. There may be project- and/or client- and/or state-specific requirements that may be more or less stringent than what is described herein. The CPM is responsible for informing Arcadis and/or Subcontractor personnel of omissions and/or deviations from this document that may be required for the project. In turn, project staff are required to inform the CPM if or when there is a deviation or omission from work performed as compared to what is described herein.

In following this document to execute the scope of work for a project, it may be necessary for staff to make professional judgment decisions to meet the project's scope of work based upon site conditions, staffing expertise, regulation-specific requirements, health and safety concerns, etc. Staff are required to consult with the CPM when or if a deviation or omission from this document is required that has not already been previously approved by the CPM. Upon approval by the CPM, the staff can perform the deviation or omission as confirmed by the CPM.

2 SCOPE AND APPLICATION

This Arcadis Technical Guidance Instruction (TGI) describes proper soil description procedures. This TGI should be followed for unconsolidated material unless there is an established client-required specific procedure or regulatory-required specific procedure. In cases where there is a required specific procedure, it should be followed and should be referenced and/or provided as an appendix to reports that include soil classifications and/or boring logs. When following a required non-Arcadis procedure, additional information required by this TGI should be included in field notes with client approval.

This TGI has been developed to emphasize field observation and documentation of details required to:

- make hydrostratigraphic interpretations guided by depositional environment/geologic settings;
- provide information needed to understand the distribution of constituents of concern; properly design wells, piezometers, and/or additional field investigations; and develop appropriate remedial strategies.

This TGI incorporates elements from various standard systems such as ASTM D2488-06, Unified Soil Classification System, Burmister and Wentworth. However, none of these standard systems focus specifically on contaminant hydrogeology and remedial design. Therefore, although each of these systems contain valuable guidance and information related to correct descriptions, strict application of these systems can omit information critical to our clients and the projects that we perform.

This TGI does not address details of health and safety; drilling method selection; boring log preparation; sample collection; or laboratory analysis. Refer to other Arcadis procedure, guidance, and instructional documents, the project work plans including the quality assurance project plan, sampling plan, and health and safety plan (HASP), as appropriate.

3 PERSONNEL QUALIFICATIONS

Soil descriptions should only be performed by Arcadis personnel or authorized sub-contractors with a degree in geology or a geology-related discipline. Field personnel will complete training on the Arcadis soil description TGI in the office and/or in the field under the guidance of an experienced field geologist with at least 2 years of prior experience applying the Arcadis soil description method.

4 EQUIPMENT LIST

The following equipment should be taken to the field to facilitate soil descriptions:

- field book, field forms or PDA to record soil descriptions;
- field book for supplemental notes;
- this TGI for Soil Descriptions and any project-specific procedure, guidance, and/or instructional documents (if required);
- field card showing Wentworth scale;
- Munsell® soil color chart;
- tape measure divided into tenths of a foot;
- stainless steel knife or spatula;
- hand lens;
- water squirt bottle;
- jar with lid;
- personal protective equipment (PPE), as required by the HASP; and
- digital camera

5 CAUTIONS

Drilling and drilling-related hazards including subsurface utilities are discussed in other procedure documents and site-specific HASPs and are not discussed herein.

Soil samples may contain hazardous substances that can result in exposure to persons describing soils. Routes for exposure may include dermal contact, inhalation and ingestion. Refer to the project specific HASP for guidance in these situations.

6 HEALTH AND SAFETY CONSIDERATIONS

Field activities associated with soil sampling and description will be performed in accordance with a site-specific HASP, a copy of which will be present on site during such activities. Know what hazardous substances may be present in the soil and understand their hazards. Always avoid the temptation to touch soils with bare hands, detect odors by placing soils close to your nose, or tasting soils.

7 PROCEDURE

1. Select the appropriate sampling method to obtain representative samples in accordance with the selected sub-surface exploration method, e.g. split-spoon or Shelby sample for hollow-stem drilling, acetate sleeves for direct push, bagged core for sonic drilling, etc.
2. Proceed with field activities in required sequence. Although completion of soil descriptions is often not the first activity after opening sampler, identification of stratigraphic changes is often necessary to select appropriate intervals for field screening and/or selection of laboratory samples.
3. Set up boring log field sheet.
    - Drillers in both the US and Canada generally work in feet due to equipment specifications. Use the Arcadis standard boring log form (**Attachment A**).
    - The preferred boring log includes a graphic log of the principal soil component to support quick visual evaluation of grain size. The purpose of the graphic log is to quickly assess relative soil permeability. Note, for poorly sorted soils (e.g. glacial till), the principal component may not correlate to permeability of the sample. In this case, the geologist should use best judgement to graph overall soil type consistent with relative soil permeability. For example, for a dense sand/silt/clay till, the graphic log would reflect the silt/clay, rather than sand.
    - Record depths along the left-hand side at a standard scale to aid in the use of this tool. See an example completed boring log (**Attachment B**).
4. Examine each soil core (this is different than examining each sample selected for laboratory analysis), and record the following for each stratum:
    - depth interval;
    - principal component with descriptors, as appropriate;
    - amount and identification of minor component(s) with descriptors as appropriate;
    - moisture;
    - consistency/density;
    - color; and
    - additional description or comments (recorded as notes).
5. At the end of the boring, record the amount of drilling fluid used (if applicable) and the total depth logged.

The above is described more fully below.

DEPTH

To measure and record the depth below ground surface (bgs) of top and bottom of each stratum, the following information should be recorded.

1. Measured depth to the top and bottom of sampled interval. Use starting depth of sample based upon measured tool length information and the length of sample interval.
2. Length of sample recovered, not including slough (material that has fallen into hole from previous interval), expressed as fraction with length of recovered sample as numerator over length of sampled interval as denominator (e.g. 14/24 for 14 inches recovered from 24-inch sampling interval that had 2 inches of slough discarded).
3. Thickness of each stratum measured sequentially from the top of recovery to the bottom of recovery.
4. Any observations of sample condition or drilling activity that would help identify whether there was loss from the top of the sampling interval, loss from the bottom of the sampling interval, or compression of the sampling interval. Examples: 14/24, gravel in nose of spoon; or 10/18 bottom 6 inches of spoon empty.

DETERMINATION OF COMPONENTS

Obtain a representative sample of soil from a single stratum. If multiple strata are present in a single sample interval, each stratum should be described separately. More specifically, if the sample is from a 2-foot long split-spoon where strata of coarse sand, fine sand and clay are present, then the resultant description should be of the three individual strata unless a combined description can clearly describe the interbedded nature of the three strata. Example: Fine Sand with interbedded lenses of Silt and Clay, ranging between 1 and 3 inches thick.

Identify principal component and express volume estimates for minor components on logs using the following standard modifiers.

Modifier	Percent of Total Sample (by volume)
and	36 - 50
some	21 - 35
little	10 - 20
trace	<10

Determination of components is based on using the Udden-Wentworth particle size classification (see below) and measurement of the average grain size diameter. Each size grade or class differs from the next larger grade or class by a constant ratio of ½. Due to visual limitations, the finer classifications of Wentworth's scale cannot be distinguished in the field and the subgroups are not included. Visual determinations in the field should be made carefully by comparing the sample to the Soil Description Field Guide (**Attachment C**) that shows Udden-Wentworth scale or by measuring with a ruler. Use of field sieves is encouraged to assist in estimating percentage of coarse grain sizes. Settling test or wash method (Appendix X4 of ASTM D2488) is encouraged for determining presence and estimating percentage of clay and silt. Note that "gravel" is not an Udden-Wentworth size class.

Udden-Wenworth Scale
Modified Arcadis, 2008

Size Class	Millimeters	Inches	Standard Sieve #
Boulder	256 – 4096	10.08+	
Large cobble	128 - 256	5.04 -10.08	
Small cobble	64 - 128	2.52 – 5.04	
Very large pebble	32 – 64	0.16 - 2.52	
Large pebble	16 – 32	0.63 – 1.26	
Medium pebble	8 – 16	0.31 – 0.63	
Small pebble	4 – 8	0.16 – 0.31	No. 5 +
Granule	2 – 4	0.08 – 0.16	No.5 – No.10
Very coarse sand	1 -2	0.04 – 0.08	No.10 – No.18
Coarse sand	½ - 1	0.02 – 0.04	No.18 - No.35
Medium sand	¼ - ½	0.01 – 0.02	No.35 - No.60
Fine sand	1/8 -¼	0.005 – 0.1	No.60 - No.120
Very fine sand	1/16 – 1/8	0.002 – 0.005	No. 120 – No. 230
Silt (subgroups not included)	1/256 – 1/16	0.0002 – 0.002	Not applicable (analyze by pipette or hydrometer)
Clay (subgroups not included	1/2048 – 1/256	.00002 – 0.0002	

Identify components as follows. Remove particles greater than very large pebbles (64-mm diameter) from the soil sample. Record the volume estimate of the greater than very large pebbles. Examine the sample fraction of very large pebbles and smaller particles and estimate the volume percentage of the pebbles, granules, sand, silt and clay. Use the jar method, visual method, and/or wash method (Appendix X4 of ASTM D2488) to estimate the volume percentages of each category.

Determination of actual dry weight of each Udden-Wentworth fraction requires laboratory grain-size analysis using sieve sizes corresponding to Udden-Wentworth fractions and is highly recommended to determine grain-size distributions for each hydrostratigraphic unit.

Lab or field sieve analysis is advisable to characterize the variability and facies trends within each hydrostratigraphic unit. Field sieve-analysis can be performed on selected samples to estimate dry weight fraction of each category using ASTM D2488 Standard Practice for Classification of Soils for Engineering Purposes as guidance, but replace required sieve sizes with the following Udden-Wentworth set: U.S. Standard sieve mesh sizes 6; 12; 20; 40; 70; 140; and 270 to retain pebbles; granules; very coarse sand; coarse sand; medium sand; fine sand; and very fine sand, respectively.

PRINCIPAL COMPONENT

The principal component is the size fraction or range of size fractions containing the majority of the volume. Examples: the principal component in a sample that contained 55% pebbles would be “Pebbles”; or the principal component in a sample that was 20% fine sand, 30% medium sand and 25% coarse sand would be “Sand, fine to coarse” or for a sample that was 40% silt and 45% clay the principal component would be “Clay and Silt”. Shade the boxes on the graphic log (**Attachment A**) up to and including the box with the principal component. The purpose of the graphical log is to provide a relative estimate of permeability. As noted above, for poorly sorted soils such as glacial till, the principal component may not correlate to permeability of the sample. In this case, the geologist should use best judgement to graph overall soil type consistent with relative soil permeability.

Include appropriate descriptors with the principal component. These descriptors vary for different particle sizes as follows.

Angularity – Describe the angularity for very coarse sand and larger particles in accordance with the table below (ASTM D-2488-06). Figures showing examples of angularity are available in ASTM D-2488-06 and the Arcadis Soil Description Field Guide.

Description	**Criteria**
Angular	Particles have sharp edges and relatively plane sides with unpolished surfaces.
Sub-angular	Particles are similar to angular description but have rounded edges.
Sub-rounded	Particles have nearly plane sides but have well-rounded corners and edges.
Rounded	Particles have smoothly curved sides and no edges.

Plasticity – Describe the plasticity for silt and clay based on observations made during the following test method (ASTM D-2488-06).

- As in the dilatancy test below, select enough material to mold into a ball about ½ inch (12 mm) in diameter. Mold the material, adding water if necessary, until it has a soft, but not sticky, consistency.
- Shape the test specimen into an elongated pat and roll by hand on a smooth surface or between the palms into a thread about 1/8 inch (3 mm) in diameter. If the sample is too wet to roll easily, it should be spread into a thin layer and allowed to lose some water by evaporation. Fold the sample threads and reroll repeatedly until the thread crumbles at a diameter of about 1/8 inch. The thread will crumble when the soil is near the plastic limit.

Description	Criteria
Non-plastic	A 1/8-inch (3 mm) thread cannot be rolled at any water content.
Low	The thread can barely be rolled, and the lump cannot be formed when drier than the plastic limit.
Medium	The thread is easy to roll and not much time is required to reach the plastic limit. The thread cannot be rerolled after reaching the plastic limit. The lump crumbles when drier than the plastic limit.
High	It takes considerable time rolling and kneading to reach the plastic limit. The thread can be rolled several times after reaching the plastic limit. The lump can be formed without crumbling when drier than the plastic limit.

Dilatancy – Describe the dilatancy for silt and silt-sand mixtures using the following field test method (ASTM D-2488-06).

- From the specimen select enough material to mold into a ball about ½ inch (12 mm) in diameter. Mold the material adding water if necessary, until it has a soft, but not sticky, consistency.
- Smooth the ball in the palm of one hand with a small spatula.
- Shake horizontally, striking the side of the hand vigorously with the other hand several times.
- Note the reaction of water appearing on the surface of the soil.
- Squeeze the sample by closing the hand or pinching the soil between the fingers, and not the reaction as none, slow, or rapid in accordance with the table below. The reaction is the speed with which water appears while shaking and disappears while squeezing.

Description	Criteria
None	No visible change in the specimen.
Slow	Water appears slowly on the surface of the specimen during shaking and does not disappear or disappears slowly upon squeezing.
Rapid	Water appears quickly on the surface of the specimen during shaking and disappears quickly upon squeezing.

Note that silt and silt-sand mixtures will be non-plastic and display dilatancy. Clay mixtures will have some degree of plasticity but do not typically react to dilatancy testing. Therefore, the tests outlined above can be used to differentiate between silt dominated and clay dominated soils.

MINOR COMPONENT(S)

The minor component(s) are the size fraction(s) containing less than 50% volume. Example: the identified components are estimated to be 60% medium sand to granules, 25% silt and clay; 15 % pebbles – there are two identified minor components: silt and clay; and pebbles.

Include a standard modifier to indicate percentage of minor components (see Table on Page 6) and the same descriptors that would be used for a principal component. Plasticity should be provided as a descriptor for clay and clay mixtures. Dilatancy should be provided for silt and silt mixtures. Angularity should be provided as a descriptor for pebbles and coarse sand. For the example above, the minor constituents with modifiers could be: some silt and clay, low plasticity; little medium to large pebbles, sub-round.

SORTING

Sorting is the opposite of grading, which is a commonly used term in the USCS or ASTM methods to describe the uniformity of the particle size distribution in a sample. Well-sorted samples are poorly graded and poorly sorted samples are well graded. Arcadis prefers the use of sorting for particle size distributions and grading to describe particle size distribution trends in the vertical profile of a sample or hydrostratigraphic unit because of the relationship between sorting and the energy of the depositional process. For soils with sand-sized or larger particles, sorting should be determined as follows:

Well sorted – the range of particle sizes is limited (e.g. the sample is comprised of predominantly one or two grain sizes).

Poorly sorted – a wide range of particle sizes are present.

You can also use sieve analysis to estimate sorting from a sedimentological perspective; sorting is the statistical equivalent of standard deviation. Smaller standard deviations correspond to higher degree of sorting (see Remediation Hydraulics, 2008).

MOISTURE

Moisture content should be described for every sample since increases or decreases in water content is critical information. Moisture should be described in accordance with the table below (percentages should not be used unless determined in the laboratory).

Description	Criteria
Dry	Absence of moisture, dry to touch, dusty.
Moist	Damp but no visible water.
Wet (Saturated)	Visible free water, soil is usually below the water table.

CONSISTENCY or DENSITY

This can be determined by standard penetration test (SPT) blow counts (ASTM D-1586) or field tests in accordance with the tables below. When drilling with hollow-stem augers and split-spoon sampling, the SPT blow counts and N-value is used to estimate density. The N-value is the blows per foot for the 6” to 18” interval. Example: for 24-inch spoon, recorded blows per 6-inch interval are: 4/6/9/22. Since the second interval is 6” to12”, the third interval is 12” to 18”, the N value is 6+9, or 15. Fifty blow counts for less than 6 inches is considered refusal. In recent years, more common drilling methods include rotary-sonic or direct push. When blow counts are not available, density is determined using a thumb test. Note however, the thumb test only applies to fine-grained soils.

Fine-grained soil – Consistency

Description	Criteria
Very soft	N-value < 2 or easily penetrated several inches by thumb.
Soft	N-value 2-4 or easily penetrated one inch by thumb.
Medium stiff	N-value 9-15 or indented about ¼ inch by thumb with great effort.
Very stiff	N-value 16-30 or readily indented by thumb nail.
Hard	N-value > than 30 or indented by thumbnail with difficulty

Coarse-grained soil – Density

Description	Criteria
Very loose	N-value 1- 4
Loose	N-value 5-10
Medium dense	N-value 11-30
Dense	N-value 31- 50
Very dense	N-value >50

COLOR

Color should be described using simple basic terminology and modifiers based on the Munsell system. Munsell alpha-numeric codes are required for all samples. If the sample contains layers or patches of varying colors this should be noted and all representative colors should be described. The colors should be described for moist samples. If the sample is dry it should be wetted prior to comparing the sample to the Munsell chart.

ADDITIONAL COMMENTS (NOTES)

Additional comments should be made where observed and should be presented as notes with reference to a specific depth interval(s) to which they apply. Some of the significant information that may be observed includes the following.

- Odor - You should not make an effort to smell samples by placing near your nose since this can result in unnecessary exposure to hazardous materials. However, odors should be noted if they are detected during the normal sampling procedures. Odors should be based upon descriptors such as those used in NIOSH “Pocket Guide to Chemical Hazards”, e.g. “pungent” or “sweet” and should not indicate specific chemicals such as “phenol-like” odor or “BTEX” odor.
- Structure
- Bedding planes (laminated, banded, geologic contacts).
- Presence of roots, root holes, organic material, man-made materials, minerals, etc.
- Mineralogy
- Cementation
- NAPL presence/characteristics, including sheen (based on client-specific guidance).
- Reaction with HCl - typically only used for special soil conditions, such as caliche environments.
- Origin, if known (Lacustrine; Fill; etc.).

EXAMPLE DESCRIPTIONS

51.4 to 54.0’ CLAY, some silt, medium to high plasticity; trace small to large pebbles, sub-round to sub-angular up to 2” diameter; moist, stiff, dark grayish brown (10 YR 4/2) NOTE: Lacustrine; laminated 0.1 to 0.2” thick, laminations brownish yellow (10 YR 4/3).

32.5 to 38.0’ SAND, medium to very coarse, sub-round to sub-angular; little granule and pebble, trace silt; poorly sorted, wet, grayish brown (10 YR 5/2).

Unlike the first example where a density of cohesive soils could be estimated, this rotary-sonic sand and pebble sample was disturbed during drilling (due to vibrations in a loose sand and pebble matrix) so no density description could be provided. Neither sample had noticeable odor so odor comments were not included.

The standard generic description order is presented below.

- Depth
- Principal Components
    - Angularity for very coarse sand and larger particles
    - Plasticity for silt and clay
    - Dilatancy for silt and silt-sand mixtures
- Minor Components
- Sorting
- Moisture
- Consistency or Density
- Color
- Additional Comments

8 WASTE MANAGEMENT

Project-specific requirements should be identified and followed. The following procedures, or similar waste management procedures are generally required.

Water generated during cleaning procedures will be collected and contained onsite in appropriate containers for future analysis and appropriate disposal. PPE (such as gloves, disposable clothing, and other disposable equipment) resulting from personnel cleaning procedures and soil sampling/handling activities will be placed in plastic bags. These bags will be transferred into appropriately labeled 55-gallon drums or a covered roll-off box for appropriate disposal.

Soil materials will be placed in sealed 55-gallon steel drums or covered roll-off boxes and stored in a secured area. Once full, the material will be analyzed to determine the appropriate disposal method.

9 DATA RECORDING AND MANAGEMENT

Upon collection of soil samples, the soil sample should be logged on a standard boring log and/or in the field log book depending on Data Quality Objectives (DQOs) for the task/project. The preferred standard boring log is presented below and is included as **Attachment A**.

The general scheme for soil logging entries is presented above; however, depending on task/project DQOs, specific logging entries that are not applicable to task/project goals may be omitted at the project manager's discretion. In any case, use of a consistent logging procedure is required.

Completed logs and/or logbook will be maintained in the task/project field records file. Digital photographs of typical soil types observed at the site and any unusual features should be obtained whenever possible. All photographs should include a ruler or common object for scale. Photo location, depth and orientation must be recorded in the daily log or log book and a label showing this information in the photo is useful.

10 QUALITY ASSURANCE

Soil descriptions should be completed only by appropriately trained personnel. Descriptions should be reviewed by an experienced field geologist for content, format and consistency. Edited boring logs should be reviewed by the original author to assure that content has not changed.

11 REFERENCES

Arcadis Soil Description Field Guide, 2008.

Munsell® Color Chart – available from Forestry Suppliers, Inc.- Item 77341 "Munsell® Color Soil Color Charts.

Field Gauge Card that Shows Udden-Wentworth scale – available from Forestry Suppliers, Inc. – Item 77332 "Sand Grain Sizing Folder."

ASTM D-1586, Test Method for Penetration Test and Split-Barrel Sampling of Soils.

ASTM D-2488-00, Standard Practice for Description and Identification of Soils (Visual-Manual Procedure)

United States Bureau of Reclamation. Engineering Geology Field Manual. United States Department of Interior, Bureau of Reclamation. http://www.usbr.gov/pmts/geology/fieldmap.htm.

Petrology of Sedimentary Rocks, Robert L. Folk, 1980, p. 1-48.

NIOSH Pocket Guide to Chemical Hazards.

Remediation Hydraulics, Fred C. Payne, Joseph A. Quinnan, and Scott T. Potter, 2008, p 59-63.

ATTACHMENT A

Arcadis Standard Soil Boring Log Form

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SOIL BORING LOG

Boring/Well ________ Project ________ Page ____ of ____

Site Location ________ Drilling Started ________

Total Depth Drilled ________ Feet Hole Diameter ________ inches Drilling Completed ________

Type of Sample or Coring Device ________ Length and Diameter of Coring Device ________ Sampling Interval ________ feet

Drilling Method ________ Drilling Fluid Used ________

Drilling Contractor ________ Driller ________

Prepared By ________ Helper ________

Core Recovery (feet)	PID Reading (ppm)	Sample Depth (ft bgs)	MUD		SAND					GRAVEL				**Udden-Wentworth Description:** principal components, (angularity, plasticity, dilatency); minor components, (angularity, plasticity, dilatency); sorting, moisture content, consistency/density, color, additional comments
			clay	silt	very fine	fine	medium	coarse	very coarse	granular	pebble	cobble	boulder	

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SOIL BORING LOG (CONT'D)

Boring/Well ______________________ Prepared By ______________________ Page ____ of ____

Core Recovery (feet)	PID Reading (ppm)	Sample Depth (ft bgs)	MUD		SAND					GRAVEL				Udden-Wentworth Description: principal components, (angularity, plasticity, dilatency); minor components, (angularity, plasticity, dilatency); sorting, moisture content, consistency/density, color, addtl. Comments
			clay	silt	very fine	fine	medium	coarse	very coarse	granular	pebble	cobble	boulder	

ATTACHMENT B

Example of Completed Arcadis Soil Boring Log

ARCADIS Design & Consultancy for natural and built assets

SOIL BORING LOG

Boring/Well SB-01 Project Example Page 1 of 1
Site Location Anytown, North America Drilling Started 6/26/17
Total Depth Drilled 20 Feet Hole Diameter 4.5 inches Drilling Completed 6/26/17
Type of Sample or Coring Device Continuous Length and Diameter of Coring Device 5', 2.25" macrocore Sampling Interval 5 feet
Drilling Method Geoprobe Drilling Fluid Used NA
Drilling Contractor Fibertec Driller Ryan Brown
Prepared By A. DeGrandis Helper Grant Berger

Core Recovery (feet)	PID Reading (ppm)	Sample Depth (ft bgs)	MUD clay	MUD silt	SAND very fine	SAND fine	SAND medium	SAND coarse	SAND very coarse	GRAVEL granular	GRAVEL pebble	GRAVEL cobble	GRAVEL boulder	Udden-Wentworth Description: principal components, (angularity, plasticity, dilatency); minor components, (angularity, plasticity, dilatency); sorting, moisture content, consistency/density, color, additional comments
	0.3	1	X	X	X	X	X							(0.0-4.0) SAND, fine to medium, sub-rounded;
	0.1	2	X	X	X	X	X							little granules to small pebbles, sub-rounded
60"	0.0	3	X	X	X	X	X							to sub-angular; trace silt; poorly sorted, dry
(HA)	0.0	4	X	X	X	X	X							to moist, dark grayish brown (10YR 4/2).
	1.4	5	X	X										NOTE: Ablation till.
	1.7	6	X	X										
	0.9	7	X	X										(4.0-10.0) SILT, non-plastic, rapid dilatancy;
52"	1.2	8	X	X										dry to moist, soft to medium stiff,
	0.6	9	X	X										gray (10YR 5/1).
	0.2	10	X	X										
	0.0	11	X	X	X	X								(10.0-15.5) SAND, fine, sub-rounded; trace
	0.0	12	X	X	X	X								silt; well sorted, moist to wet, pale
60"	0.1	13	X	X	X	X								brown (10YR 6/3).
	0.0	14	X	X	X	X								
	0.0	15	X	X	X	X								NOTE: Wet at 12.0'
	0.2	16	X	X	X	X								
	0.0	17	X											(15.5-20.0) CLAY, high plasticity, no dilatancy;
58"	0.0	18	X											little silt; moist, soft to medium stiff,
	0.0	19	X											light gray (10YR 7/1) to dark gray (10YR 4/1).
	0.0	20	X											NOTE: Lacustrine, minor 0.1-0.25" lamination.
														End of boring - 20.0'

ATTACHMENT C

Arcadis Soil Description Field Guide

ON THE ORIGINAL DRAWING.
USE TO VERIFY FIGURE
REPRODUCTION SCALE

SOIL DESCRIPTION FIELD GUIDE (JUNE 30, 2017; REV. 2.0)

ARCADIS Design & Consultancy for natural and built assets

FINE-GRAINED SOILS

Description	Criteria
	Descriptor - Plasticity
Nonplastic	A 1/8-inch (3mm) thread cannot be rolled at any moisture content.
Low	Thread can barely be rolled, and lump cannot be formed when drier than plastic limit.
Medium	Takes considerable time and rolling to reach plastic limit. Thread cannot be rolled after reaching plastic limit. Lump crumbles when drier than plastic limit.
High	Thread is easy to roll and quickly reaches plastic limit. Thread can be rerolled several times after reaching plastic limit. Lump can be formed without crumbling when drier than plastic limit.
	Descriptor - Dilatancy
No Dilatancy	No visible change when shaken or squeezed.
Slow	Water appears slowly on the surface of soil during shaking and does not disappear or disappears slowly when squeezed.
Rapid	Water appears quickly on surface of soil during shaking and disappears quickly when squeezed.
Minor Components with Descriptors	
	Moisture
Dry	Absence of moisture, dry to touch, dusty.
Moist	Damp but no visible water.
Wet	Visible free water; soil is usually below the water table. (Saturated)
	Consistency
Very soft	N-value < 2 or easily penetrated several inches by thumb.
Soft	N-value 2-4 or easily penetrated 1 inch by thumb.
Medium stiff	N-value 5-8 or indented about 1/2 inch by thumb with great effort.
Stiff	N-value 9-15 or indented about 1/4 inch by thumb with great effort.
Very stiff	N-value 16-30 or readily indented by thumb nail.
Hard	N-value > than 30 or indented by thumbnail with difficulty.
Color using Munsell	
Geologic Origin (if known)	
Other	

EXAMPLE OF SOIL DESCRIPTION AND PHOTO

10-15 feet CLAY, medium to high plasticity; trace silt; trace small to very large pebbles, subround to subangular up to 2" diameter; moist, stiff, dark grayish brown (10YR 4/2). NOTE: Lacustrine; laminated 0.1 to 0.2" thick, laminations brownish yellow (10YR 4/3).

DESCRIPTION ORDER

Depth Interval
Principal Components with Descriptors
Minor Components with Descriptors
Sorting
Field Moisture Condition
Density/Consistency
Color using Munsell
Geologic Origin (if known)
Other descriptions as NOTES:
- Odor
- Stratigraphy
- Structure
- Sphericity
- Cementation
- Reaction to acid

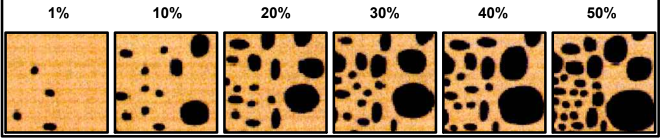
MINOR COMPONENTS % MODIFIERS

Modifier	Percent of Total Sample (by volume)
and	36 - 50
some	21 - 35
little	10 - 20
trace	<10

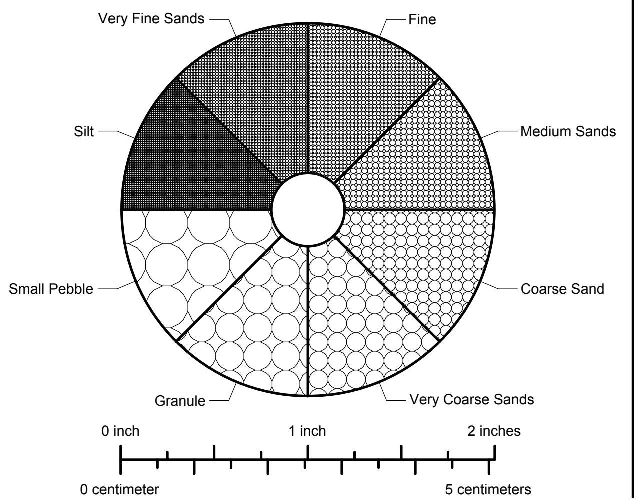
UDDEN-WENTWORTH SCALE

Fraction	Sieve Size	Grain Size	Approximate Scale
Boulder		256 - 4096 mm	Larger than volleyball
Large Cobble		128 - 256 mm	Softball to volleyball
Small Cobble		64 - 128 mm	Pool ball to softball
Very Large Pebble		32 - 64 mm	Pinball to pool ball
Large Pebble		16 - 32 mm	Dime size to pinball
Medium Pebble		8 - 16 mm	Pencil eraser to dime size
Small Pebble	No. 5+	4 - 8 mm	Pea size to pencil eraser
Granule	No. 10 - 5	2 - 4 mm	Rock salt to pea size
Very Coarse Sand	No. 18 - 10	1 - 2 mm	See field gauge card
Coarse Sand	No. 35 -18	0.5 - 1 mm	See field gauge card
Medium Sand	No. 60 - 35	0.25 - 0.5 mm	See field gauge card
Fine Sand	No. 120 - 60	0.125 - 0.25 mm	See field gauge card
Very Fine Sand	No. 230 - 120	0.0625 - 0.125 mm	See field gauge card
Silt and Clay. See SOP for description of fines	Not Applicable	<0.0625 mm	Analyze by pipette or hydrometer

PARTICLE PERCENT COMPOSITION ESTIMATION



GRAPH FOR DETERMINING SIZE OF PARTICLES



FOR COARSE-GRAINED SOILS

Description	Criteria
	Descriptor - Angularity
Angular	Particles have sharp edges and relatively planar sides withunpolished surfaces.
Subangular	Particles are similar to angular but have rounded edges.
Subround	Particles have nearly planar sides but have well-roundedcorners and edges.
Round	Particles have smoothly curved sides and no edges.
Minor Components with Descriptors	
	Sorting **Cu= d60/d10**
Well Sorted	Near uniform grain-size distribution Cu= 1 to 3.
Poorly Sorted	Wide range of grain size Cu= 4 to 6.
	Moisture
Dry	Absence of moisture, dry to touch, dusty.
Moist	Damp but no visible water.
Wet	Visible free water; soil is usually below the water table. (Saturated)
	Density
Very loose	N-value 1 - 4
Loose	N-value 5 - 10
Medium Dense	N-value 11 - 30
Dense	N-value 31 - 50
Very dense	N-value >50
Color using Munsell	
Geologic Origin (if known)	
Other	
	Cementation
Weak Cementation	Crumbles or breaks with handling or little finger pressure.
Moderate Cementation	Crumbles or breaks with considerable finger pressure.
Strong Cementation	Will not crumble with finger pressure.
	Reaction with Dilute HCl Solution (10%)
No Reaction	No visible reaction.
Weak Reaction	Some reaction, with bubbles forming slowly.
Strong Reaction	Violent reaction, with bubbles forming immediately.

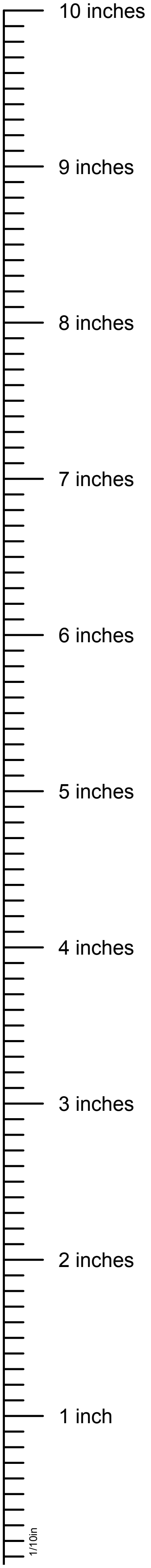
EXAMPLE OF SOIL DESCRIPTION AND PHOTO

10 -15 feet SAND, medium to very coarse; little granules to medium pebbles, subround to subangular; trace silt; poorly sorted, wet, grayish brown (10YR5/2).

ON THE ORIGINAL DRAWING.
USE TO VERIFY FIGURE
REPRODUCTION SCALE

SOIL DESCRIPTION FIELD GUIDE (JUNE 30, 2017; REV. 2.0)

ARCADIS Design & Consultancy for natural and built assets



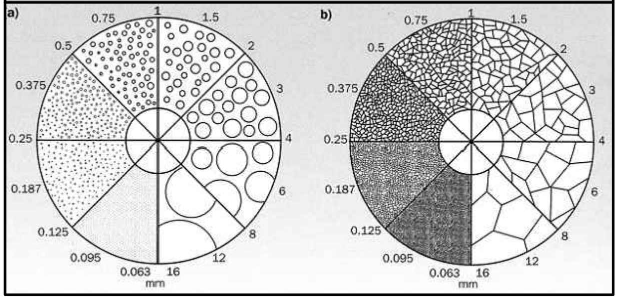
VARIATIONS IN SOIL STRATIGRAPHY

Term	Thickness of Configuration
Parting	0 - to 1/16-inch thickness.
Seam	1/16 - to 1/2-inch thickness.
Layer	1/2 - to 12-inch thickness.
Stratum	> 12-inch thickness.
Pocket	Small erratic deposit, usually less than 1 foot in size.
Varved Clay	Alternating seams or layers of sand, silt, and clay (laminated).
Occasional	≤ 1 foot thick.
Frequent	> 1 foot thick.

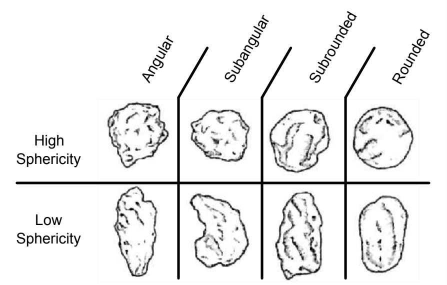
SOIL STRUCTURE DESCRIPTIONS

Term	Description
Homogeneous	Same color and appearance throughout.
Laminated	Alternating layers < 1/4 inch thick.
Stratified	Alternating layers ≥ 1/4 inch thick.
Lensed	Inclusions of small pockets of different materials, such as lenses of sand scattered through a mass of clay; note thickness.
Blocky	Cohesive soil can be broken down into small angular lumps, which resist further breakdown.
Fissured	Breaks along definite planes of fracture with little resistance to fracturing.
Slickensided	Fracture planes appear to be polished or glossy, sometimes striated.

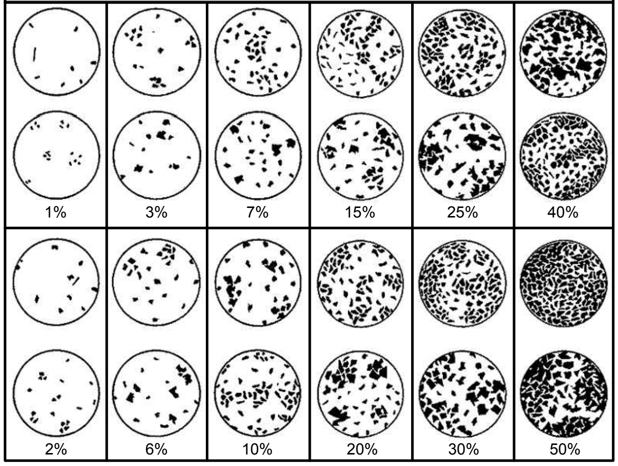
GRAPH FOR DETERMINING SIZE OF PARTICLES



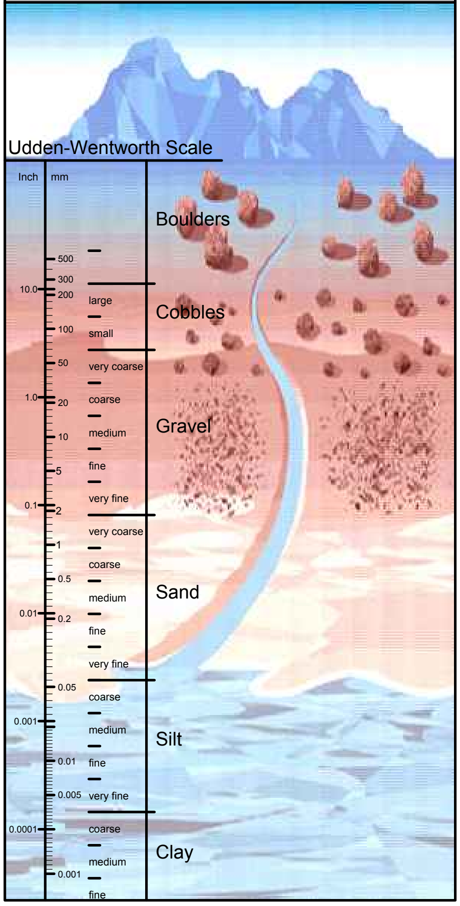
ANGULARITY CHART



PARTICLE PERCENT COMPOSITION ESTIMATION

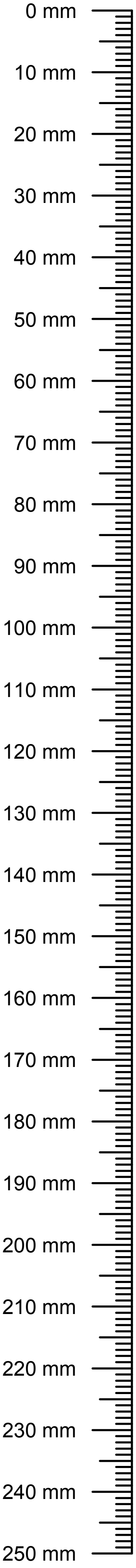


SORTING



SETTLING TABLE (SILT/CLAY)

Diameter of Particle (mm)	<0.625	<0.031	<0.016	<0.008	<0.004	<0.002	<0.0005
Depth of Withdrawal (cm)	10	10	10	10	5	5	3
Time of Withdrawal	hr:min:sec	hr:min:sec	hr:min:sec	hr:min:sec	hr:min:sec	hr:min:sec	hr:min:sec
Temperature (Celsius)							
20	00:00:29	00:01:55	00:07:40	00:30:40	00:61:19	04:05:00	37:21:00
21	00:00:28	00:01:52	00:07:29	00:29:58	00:59:50	04:00:00	
22	00:00:27	00:01:50	00:07:18	00:29:13	00:58:22	03:54:00	
23	00:00:27	00:01:47	00:07:08	00:28:34	00:57:05	03:48:00	
24	00:00:26	00:01:45	00:06:58	00:27:52	00:55:41	03:43:00	33:56:00
25	00:00:25	00:01:42	00:06:48	00:27:14	00:54:25	03:38:00	
26	00:00:25	00:01:40	00:06:39	00:26:38	00:53:12	03:33:00	
27	00:00:24	00:01:38	00:06:31	00:26:02	00:52:02	03:28:00	
28	00:00:24	00:01:35	00:06:22	00:25:28	00:50:52	03:24:00	31:00:00
29	00:00:23	00:01:33	00:06:13	00:24:53	00:49:42	03:10:00	
30	00:00:23	00:01:31	00:06:06	00:24:22	00:48:42	03:05:00	



TECHNICAL GUIDANCE INSTRUCTION - MONITORING WELL DEVELOPMENT

Rev: #0

Rev Date: April 24, 2017

VERSION CONTROL

Revision No	Revision Date	Page No(s)	Description	Reviewed by
0	4/24/2017	All	Re-written as TGI	Marc Killingstad

APPROVAL SIGNATURES

Prepared by: Jay Erickson
Date: 4/24/2017

Technical Expert Reviewed by: Marc Killingstad
Date: 4/24/2017

1 INTRODUCTION

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In following this document to execute the scope of work for a project, it may be necessary for staff to make professional judgment decisions to meet the project's scope of work based upon site conditions, staffing expertise, regulation-specific requirements, health and safety concerns, etc. Staff are required to consult with the CPM when or if a deviation or omission from this document is required that has not already been previously approved by the CPM. Upon approval by the CPM, the staff can perform the deviation or omission as confirmed by the CPM.

2 SCOPE AND APPLICATION

This Technical Guidance Instruction (TGI) covers the development of screened wells used for obtaining representative groundwater information and samples from granular aquifers (i.e., monitoring wells). Note that this TGI only applies to monitoring well development and not remediation (injection/extraction) well development.

The purposes of Monitoring Well Development are:

1. Repair damage to the borehole wall from drilling that can include clogging, smearing or compaction of aquifer materials;
2. Remove fine grained sediment from the formation and filter pack that may result in high turbidity levels in groundwater samples;
3. To re-sort formation and filter pack material adjacent to the well screen;

4. To recover any drilling fluids (if used) that may affect the permeability of the formation and filter pack or alter the water quality around the well; and
5. To optimize the well efficiency and hydraulic communication between the well screen and the formation.

Successful monitoring well development is dependent on the following:

1. Hydrostratigraphy – Permeable formations containing primarily sand and gravel are more easily developed due to lower percentages of silt and clay material. Water in permeable formations can be moved in and out of the screen and/or through the formation easier than in less permeable deposits
2. Well Diameter – Development tooling including brushes, surge blocks, pumps and jetting tools are more readily available for wells 4 inches in diameter and greater.
3. Well Design – Wells with filter packs and screens designed to match the formation through the analysis of formation sieve samples are easier to develop. An important aspect to well design is to minimize the size of the annular space between the formation and well screen. Adequate room must be allowed for the proper installation of well materials, but not too large as to prevent/reduce communication with the surrounding formation.
4. Drilling Methods – Different drilling methods result in varying amount of borehole damage and, therefore, impact the degree to which development will be successful.

Well development methods for monitoring wells include the following:

1. Bailing – use of a bailer to remove water and sediment from the well casing. This technique does little to remove fines from the filter pack and may lead to bridging of sediment since the flow in only in one direction, toward the well screen.
2. Pumping/overpumping – use of a pump to remove water and sediment from the well casing, overpumping involves pumping the well at a rate that exceeds the design capacity of the well. Similar to bailing, this technique does little to remove fines from the filter pack and may lead to bridging of sediment since the flow in only in one direction, toward the well screen. Small diameter monitoring wells have the additional constraint on pump size and flow rates.
3. Backwashing (rawhiding) – consists of starting and stopping a pump intermittently to produce rapid pressure changes in a well. This method can produce better results than pumping alone since the procedure involves movement of the water in and out of the screen and formation. However, in many cases the surging action is not rigorous enough to fully develop the well.
4. Surging/swabbing – use of a mechanical surge block or swabbing tool to operate like a piston with an up and down motion. The downstroke causes a backwash action that breaks up bridged sediment and the upstroke pulls the dislodged sediment into the well. This method works well for small and large diameter wells. Care should be taken on the downstroke so as not to force fines back into the formation, frequent pumping/purging during surging help to keep fines out of the well. Double surge blocks are recommended.
5. Jetting – use of a tool fitted with nozzles that direct streams of water horizontally into well screens at high velocity. Due to the size of the tooling, this method is better suited for wells 4 inch in diameter and larger. The method is also more effective with wire-wrapped/continuous slot screens due to the

increased open area. Jetting requires specialized equipment and concurrent pumping to prevent reintroducing fines into the filter pack. Additionally, jetting requires subsequent surging to remove fines dislodged in the filter pack and formation.

For most situations, gentle surging coupled with bailing or pumping to remove dislodged materials is recommended.

Well development for properly designed and constructed monitoring wells may begin after the annular seal materials have been installed and allowed to cure, since these wells are designed to retain 90-99% of the filter pack material. This cure time is typically at least 24 to 48 hours after the sealing materials have been installed.

This TGI is meant to provide a general guide for proper monitoring well development. A site-specific field implementation plan for well installation and development detailing the specific methods and tools should be developed to provide site-specific instruction and guidance.

3 PERSONNEL QUALIFICATIONS

Monitoring well development activities will be performed by persons who have been trained in proper well development procedures under the guidance of an experienced field geologist, engineer, or technician.

4 EQUIPMENT LIST

Required equipment depends on the selected method and should be detailed in the site-specific field implementation plan. However, the following are typically required.

- Health and safety equipment, as required by the site Health and Safety Plan (HASP):
- Cleaning equipment
- Field notebook and/or personal digital assistant (PDA)
- Monitoring well keys
- Water level indicator
- Field parameter meter (YSI)
- Well Development Logs
- Well construction logs/diagrams
- Weighted tape (measure depth)
- Turbidity meter
- Camera
- Watch/timing device.

5 CAUTIONS

Where surging is performed to assist in removing fine-grained material from the sand pack, surging must be performed in a gentle manner. Excessive suction could promote fine-grained sediment entry into the outside of the sand pack from the formation.

Avoid using development fluids or materials that could impact groundwater or soil quality, or could be incompatible with the subsurface conditions.

In some cases, it may be necessary to add potable water to a well to allow surging and development, especially for new monitoring wells installed in low permeability formations. Before adding potable water to a well, the Certified Project Manager (CPM) and/or Project Hydrogeologist must be notified and the CPM shall make the decision regarding the appropriateness and applicability of adding potable water to a well during well development procedures. If potable water is to be added to a well as part of development, the potable water source should be sampled and analyzed for constituents of concern, and the results evaluated by the CPM prior to adding the potable water to the well. If potable water is added to a well for development purposes, at the end of development the well will be purged dry to remove the potable water, or if the well no longer goes dry then the well will be purged to remove at least three times the volume of potable water that was added.

6 HEALTH AND SAFETY CONSIDERATIONS

Field activities associated with monitoring well development will be performed in accordance with a site-specific HASP, a copy of which will be present on site during such activities.

7 PROCEDURE

As indicated above, for most monitoring wells, gentle surging coupled with bailing or pumping to remove dislodged sediment is recommended.

1 Ensure sufficient time has passed to allow for proper curing of the well seal.

2 Don appropriate PPE (as required by the site-specific HASP).

3 Place plastic sheeting around the well.

4 Clean all equipment entering each monitoring well, except for new, disposable materials that have not been previously used.

5 Open the well cover while standing upwind of the well, remove well cap. Insert PID probe approximately 4 to 6 inches into the casing or the well headspace and cover with gloved hand. Record the PID reading in the field notebook. If the well headspace reading is less than 5 PID units, proceed; if the headspace reading is greater than 5 PID units, screen the air within the breathing zone. If the PID reading in the breathing zone is below 5 PID units, proceed. If the PID reading is above 5 PID units, move upwind from well for 5 minutes to allow the volatiles to dissipate. Repeat the breathing zone test. If the reading is still above 5 PID units, don the appropriate respiratory protection in accordance with the requirements of the HASP. Record all PID readings.

6 Obtain an initial measurement of the depth to water and the total well depth from the reference point at the top of the well casing. Record these measurements in the field log book. It is recommended to use a weighted tape for the total well depth measurement.

7 The depth to the bottom of the well should be sounded and then compared to the completion form or construction diagram for the well. Any discrepancies should be reported immediately to the CPM and/or Project Hydrogeologist. If sand or sediment is present inside the well, it should first be removed by bailing. Do not insert bailers, pumps, or surge blocks into the well if obstructions, parting of the casing, or other damage to the well is suspected. Instead report the conditions to the CPM and/or Project Hydrogeologist and obtain approval to continue or cease well development activities.

8 Lower a double surge block into the screened portion of the well. Starting from the bottom of the screen using 2 foot throws, gently raise and lower the surge block to force water in and out of the screen slots and sand pack. Continue surging for 15 to 30 minutes.

9 Lower a bottom-loading bailer, submersible pump, or inertia pump tubing with check valve to the bottom of the well and gently bounce on the bottom of the well to collect/remove accumulated sediment, if any. Remove and empty the bailer, if used. Repeat until the bailed/pumped water is free of excessive sediment and contact at the bottom of the well feels solid. Alternatively, measurement of the well depth with a weighted tape can be used to verify that sediment and/or silt has been removed to the extent practicable, based on a comparison with the well installation log or previous measurement of total well depth.

10 After surging the well for a minimum of two cycles and removing excess accumulated sediment from the bottom of the well, re-measure the depth-to-water and the total well depth from the reference point at the top of the well casing. Record these measurements in the field log book.

11 Remove formation water by pumping/bailing. Where pumping is used, measure and record the pre-pumping water level. Operate the pump at a relatively constant rate. Measure the pumping rate using a calibrated container and stop watch, and record the pumping rate in the field log book. Measure and record the water level in the well at least once every 5 minutes during pumping. Note any relevant observations in terms of water color, visual level of turbidity, sheen, odors, etc. Pump or bail until termination criteria specified in the Site-Specific Field Implementation plan are reached. Note: the project-specific field implementation plan may also specify a maximum turbidity requirement for completion of development. Unless otherwise specified the maximum turbidity should be 50 NTUs or less. Record the total volume of water purged from the well.

12 While developing, take periodic water level measurements (at least one every five minutes) to determine if drawdown is occurring and record the measurements on the Well Development Log.

13 While developing, calculate the rate at which water is being removed from the well. Record the volume on the Well Development Log.

14 While developing, water is also periodically collected directly from the well or bailer discharge and readings taken of the indicator parameters: pH, specific conductance, and temperature. Development is considered complete when the indicator parameters have stabilized (i.e., three consecutive pH, specific conductance, and temperature readings are within tolerances specified in the project work plans or within 10% if not otherwise specified), the extracted water is clear and free

of fine sediment and most importantly, when acceptable volume of water has been removed and/or a sufficient amount of surging has been performed.

15 In certain instances, for slow recharging wells, the parameters may not stabilize. In this case, well development is considered complete when minimal amounts of fine-grained sediments are recovered and acceptable volume of water has been removed.

16 If the well goes dry, stop pumping or bailing. Note the time that the well went dry. After allowing the well to recover, note the time and depth to water. Resume pumping or bailing when sufficient water has recharged the well.

17 Contain all development water in appropriate containers.

18 When complete, secure the lid back on the well.

19 Place disposable materials in plastic bags for appropriate disposal and decontaminate reusable, downhole pump components and/or bailer

8 WASTE MANAGEMENT

Materials generated during monitoring well installation and development will be placed in appropriate labeled containers and disposed of as described in the Work Plan/Field Implementation Plan or Field Sampling Plan.

9 DATA RECORDING AND MANAGEMENT

All well development activities should be documented on appropriate log forms as well as in a proper field notebook and/or PDA. Additionally, all documents (and photographs) should be scanned and electronically filed in the appropriate project directory for easy access. Pertinent information will include personnel present on site; times of arrival and departure; significant weather conditions; timing of well development activities; development method(s); observations of purge water color, turbidity, odor, sheen, etc.; purge rate; and water levels before, during, and after pumping.

10 QUALITY ASSURANCE

All reused, non-disposable, downhole well development equipment should be cleaned in accordance with the procedures outlined in the project documents.

11 REFERENCES

American Society for Testing Materials (ASTM), Designation D5521-05. *Standard Guide for Development of Ground-Water Monitoring Wells in Granular Aquifers*. American Society for Testing Materials. West Conshohocken, Pennsylvania.

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TGI – MONITORING WELL INTEGRITY SURVEY

Rev #: 0

Rev Date: April 19, 2017

VERSION CONTROL

Revision No	Revision Date	Page No(s)	Description	Reviewed by
0	4/19/2017	All	Re-written as a TGI	Matthew McCaughey

APPROVAL SIGNATURES

Prepared by: 4/19/2017

Patrick J. Nolan Date:

Technical Expert Reviewed by: Matthew C. McCaughey 4/19/2017

Matthew McCaughey (Technical Expert) Date:

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2 SCOPE AND APPLICATION

This Technical Guidance Instruction (TGI) specifies the procedures for performing inspections/inventories of existing monitoring wells. This TGI also applies to piezometers that are constructed analogous to monitoring wells. For simplicity, such piezometers are also referred to as monitoring wells for the remainder of this document. For all other types of wells (e.g., remediation wells such as injection, extraction, sparge, etc.), please refer to the appropriate guidance document regarding procedures for conducting inspections on those specific wells.

Monitoring well inventories are periodically conducted to assess the integrity of existing monitoring wells and to identify the need for repairs, replacement of parts, or replacement of wells that are determined to no longer be usable. A well inventory involves an inspection of the overall condition of the well, comparison of measurable quantities (e.g., riser stickup relative to grade and total depth), general verification of survey coordinates and elevation, and measurement of depth to water in the well.

3 PERSONNEL QUALIFICATIONS

All personnel shall meet the requirements of the site-specific Health and Safety Plan (HASP).

The CPM is responsible for ensuring that the activities described herein are conducted in accordance with this TGI and any other appropriate procedures. This will be accomplished through staff training and by maintaining quality assurance/quality control (QA/QC).

The Field Manager is responsible for periodic observation of field activities and review of field generated documentation associated with this TGI. The Field Manager is also responsible for implementation of corrective action if well conditions necessitate them.

4 EQUIPMENT LIST

The following materials will be available, as required, during performance of a monitoring well inventory:

- Health and safety equipment (as required by the site-specific Health and Safety Plan)
- Ruler or tape measure
- Water level indicator and/or interface probe
- Bailer
- Metal detector
- Indelible ink pen
- Paint pen
- Well keys
- Wrenches or ratchet set for accessing flush-mount well covers
- Cleaning equipment
- Well construction information (e.g., construction log, as-built, summary table, etc.)
- Digital camera (or phone with camera)
- Field notebook or Personal Digital Assistant (PDA)
- Appropriate field form(s) (see Attachment A)

If feasible, a supply of typical replacement parts (e.g., locks, bolts, well caps) should be available to enable immediate usage as necessary.

5 CAUTIONS

It is important to confirm the correct identity of wells, particularly when they are installed in a cluster. In these cases, however, the wells usually differ significantly in terms of depth below grade. During the well integrity survey, verify that all wells are properly labeled by comparing their measured depth to the reported depth as installed. If the well identity is incorrectly labeled or not labeled, provide a clear, correct label using an indelible ink pen on the inside of the steel protective cover for the well, or on the outside of the steel protective cover using a paint pen. Take photos to document as necessary.

One of the routine challenges encountered in performing this task is actually locating monitoring wells in the field. Oftentimes, field teams create an electronic file for new sites that will include a photo of the well head and a map image (e.g., Google Earth image) showing the well location. If such files exist, ensure that they are used as part of this task. Note that the Well Integrity Assessment Form (Attachment A) includes a sketch area to help locate wells in future surveys.

If present, remove standing water from the curb box using a bailer before opening the monitoring well. Refer to project waste management plan for proper disposal of water.

6 HEALTH AND SAFETY CONSIDERATIONS

Field activities associated with monitoring well installation will be performed in accordance with a site-specific HASP, a copy of which will be present on site during such activities. Care should be taken using tools to access flush-mount curb boxes. Wells in or near roadways must not be accessed without proper traffic cones and flagging. Access to wells containing chemicals of concern may pose a chemical exposure and biological hazard.

7 PROCEDURE

The typical procedure for assessing the integrity of a monitoring well is outlined below.

Step 1. Prior to mobilizing in the field, obtain a list of wells/piezometers to be inventoried and available information concerning their location and physical characteristics.

Step 2. Identify site and well identification number on the Well Integrity Assessment Form **(Attachment A).** Record all observations on this form, supplemented by notes in the field notebook if necessary.

Step 3. Locate the monitoring well using site maps and, if needed, a metal detector.

Step 4. Examine the well for the presence of an identification label. If absent, label the well with the appropriate well number after measuring the total depth of the well to verify that the depth matches the well number (see Step 8 below). If the well identity is incorrectly labeled or not labeled, provide a clear, correct label using an indelible ink pen on the inside of the steel protective cover for the well, and on the outside of the steel protective cover using a paint pen.

Step 5. Examine the surface condition of the well. Record the type of well (i.e., flush mount or above-grade stickup), condition of the well cover and surface seal. Confirm the protective casing is not bent or rusted through, the PVC casing is not broken or chipped, there is no evidence of frost heaving or subsidence.

Step 6. Unlock and open the well. Record the type (e.g., PVC or stainless steel), dimensions (i.e., casing diameter and riser stickup relative to grade), condition of the well casing, and type of well cap. Record any observations of recent modifications of the well casing. If the well cap is missing, replace with available parts or record the type of cap required.

Step 7. Measure the above-grade portion of the well riser stickup and compare to the known length of the stickup measured during well installation (surveyed top of inner casing elevation minus ground surface elevation). If the difference between the observed stickup length and the known stickup length is greater than 0.1 foot, the monitoring well location and elevation should be re-surveyed.

Step 8. Locate the marked measuring point along the top of the well casing. If no mark is visible, add a mark at the highest point of the casing using an indelible ink pen.

Step 9. Measure the depth to water, total depth of the well and any non-aqueous phase liquids (NAPL) thicknesses. For total depth measurements, account for any difference in calibration of the measuring tape on the probe (i.e., distance from part of probe that measures depth to water and the physical bottom of the probe that will measure total depth of the well). Record any obstructions encountered and a description of the feel of the well bottom (i.e., soft due to sediment or hard).

Step 10. Compare all observations concerning the measured dimensions of the well with the listed values. Based on these results as well as other observations concerning the condition of the well, record any appropriate recommendations on the Monitoring Well Integrity Assessment form **(Attachment A).** Perform any recommended maintenance activities that can be accomplished with available equipment.

Step 11. Remove all equipment from the well. If no additional maintenance activities are to be performed, close the well and collect all personal protection equipment (PPE) and other wastes generated for disposal (see Section 8 below).

Depending on the results of the well inventory, several additional activities may be warranted prior to future usage of the well. Typical follow-up activities include replacement of missing parts, removal of sediment from the base of the well, re-surveying of the well, or complete replacement if the well is determined to be unusable.

As stated above, a supply of locks, bolts, and well caps should be available for immediate usage during performance of the well inventories. However, it may not be feasible to maintain a supply of all potential replacement parts due to the variety of well types in use. Therefore, a list of required replacement parts should be compiled during the performance of a well inventory event. At the conclusion of the event, the necessary replacement parts for all wells should be obtained and installed.

8 WASTE MANAGEMENT

Materials generated during well inventory activities, including disposable equipment, will be disposed in appropriate containers.

9 DATA RECORDING AND MANAGEMENT

Field observations will be recorded on the Well Integrity Assessment Form (Attachment A), and/or in an appropriate Field Notebook or PDA. Well integrity inventory results will be retained in the project file.

10 QUALITY ASSURANCE

To verify accurate measurements of well stickup, depth to bottom, depth to groundwater, etc., measurements must be double-checked periodically (e.g., at least one of these measurements per well should be repeated to verify accuracy).

11 REFERENCES

No references apply to this TGI.

12 ATTACHMENTS

A. Well Integrity Assessment Form

ARCADIS

Monitoring Well Integrity Assessment Form

(For each item, check appropriate response or fill in the blank)

Date ____________________

Well ID ________ ID Clearly Marked? ________

Project Name ____________________

Photo filename ____________________

Project Number ____________________

Weather ____________________

Field Personnel ____________________

General Description of Surroundings ____

Well Condition:

Damaged? ☐ Abandoned? ☐

(Describe Below)

Stick Up ☐ Flush Mount ☐

Lockable cover? ____________________

Lock present? ____________________

Key number: ____________________

Stick up height ____________________

Casing material ____________________

Well diameter ____________________

Protective casing material: ____________________

Protective casing diameter: ____________________

Cap present? Type? ____________________

Vented? If so, how? ____________________

Measuring point clearly marked? ____________________

Total depth reported: ____________________

Total depth measured: ____________________

DTW: ____________________

Well obstructed? If so, depth? ____________________

Well bottom soft (sediment) or firm? ____________________

Flush Mount Wells Only

Gasket present? ____________________

Bolts present? ____________________

Teflon washers present?

Surface Condition:

Damaged? ☐

(Describe Below)

Pad/cement intact? ____________________

Curb box/well cover present? ____________________

Intact? ____________________

Seal condition ____________________

All bolts present? ____________________

Ground surface slopes away from well? ____________________

Location Sketch

Comments/Recommendations:

ARCADIS Design & Consultancy for natural and built assets

TGI – GROUNDWATER AND SOIL SAMPLING EQUIPMENT DECONTAMINATION

Rev: 0

Rev Date: February 23, 2017

VERSION CONTROL

Revision No	Revision Date	Page No(s)	Description	Reviewed by
0	February 23, 2017	ALL	Conversion from SOP to TGI	Cassandra McCloud / Pete Frederick

APPROVAL SIGNATURES

Prepared by: Derrick Maurer Date: 02/23/2017

Derrick Maurer

Technical Expert Reviewed by: Date: 02/23/2017

Cassandra McCloud (Technical Expert)

1 INTRODUCTION

This document describes general and/or specific procedures, methods, actions, steps, and considerations to be used and observed by Arcadis staff when performing work, tasks, or actions under the scope and relevancy of this document. This document may describe expectations, requirements, guidance, recommendations, and/or instructions pertinent to the service, work task, or activity it covers.

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2 SCOPE AND APPLICATION

Decontamination is performed on sampling equipment prior to sample collection to ensure that the sampling equipment that contacts a sample, or monitoring equipment that is brought into contact with environmental media to be sampled, is free from analytes of interest and/or constituents that could interfere with laboratory analysis for analytes of interest. Sampling equipment must be appropriately cleaned prior to use for sampling or coming into contact with environmental media to be sampled, and following completion of the sampling event prior to shipment or storage. The effectiveness of the decontamination procedure should be verified by collecting and analyzing equipment blank samples.

The sampling equipment cleaning procedures described herein includes pre-field, in the field, and post-field cleaning of sampling equipment which may be conducted at an established equipment decontamination area (EDA) on site, as appropriate and necessary. Sampling equipment that may require decontamination at a given site includes: soil sampling tools; groundwater, sediment, and surface-water sampling devices; water testing instruments; down-hole instruments; and other activity-specific sampling equipment. Non-disposable equipment will be cleaned before collecting each sample, between each sample collected, and prior to placing sampling equipment in protective cases, or containers for transport. Cleaning procedures for sampling equipment should be monitored by collecting equipment blank samples as required in project work plans, field sampling plans, quality assurance project plans (QAPP), or other pertinent project documents. Dedicated and/or single-use (i.e., not to be re-used) sampling equipment will not require decontamination.

3 PERSONNEL QUALIFICATIONS

Arcadis field sampling personnel will have completed or are in the process of completing site-specific training as well as having current health and safety training as required by Arcadis, client, or regulations, such as 40-hour HAZWOPER training and/or OSHA HAZWOPER site supervisor training. Arcadis personnel will also have current training as specified in the Health and Safety Plan (HASP) which may include first aid, cardiopulmonary resuscitation (CPR), Blood Borne Pathogens (BBP) as needed. In addition, Arcadis field sampling personnel will be knowledgeable in the relevant processes, procedures, and Technical Guidance Instructions (TGIs) and possess the demonstrated required skills and experience necessary to successfully complete the desired field work. The project health and safety plan (HASP) and other documents will identify other training requirements or access control requirements.

4 EQUIPMENT LIST

The equipment required for equipment decontamination is presented below:

- Health and safety equipment, including appropriate PPE, as required in the site Health and Safety Plan (HASP)
- Deionized water that meets that analytical criteria for deionized water with no detectable constituents above the reporting limits for the methods to be used and analytes being analyzed for. Deionized water is used for inorganics, and organic-free water for VOCs, SVOCs, pesticides, etc.
- Non-phosphate detergent such as Alconox or, if sampling for phosphorus or phosphorus-containing compounds, Liquinox (or equivalent).
- Tap water
- Rinsate collection plastic containers
- DOT-approved waste shipping container(s), as specified in the work plan, field sampling plan, or regulatory requirements if decontamination waste is to be shipped for disposal
- Brushes
- Large heavy-duty garbage bags
- Spray bottles
- (Optional) – Isopropyl alcohol (free of ketones) or methanol. These can be wipes or diluted with water (usually 1part isopropyl/methanol to 10 parts water) if a spray is needed.
- Airtight, sealable plastic baggies, such as Ziploc-type
- Plastic sheeting

5 CAUTIONS

Rinse equipment thoroughly and allow the equipment to dry before re-use or storage to prevent introducing solvent into sample medium. If manual drying of equipment is required, use clean lint-free material to wipe the equipment dry. Ensure all rinsate materials do not adversely affect sample collection efficiency or analytical results.

Store decontaminated equipment in a clean, dry environment. Do not store near combustion engine exhausts. Properly containerize equipment to ensure cross-contamination doesn't happen from other uncontaminated surfaces or equipment.

If equipment is damaged to the extent that decontamination is uncertain due to cracks, gouges, crevices, or dents, the equipment should not be used and should be discarded or submitted for repair prior to use for sample collection.

A proper shipping determination regarding hazardous materials will be performed by a DOT-trained individual for cleaning materials shipped by Arcadis.

Caution should be exercised to avoid contact with the pump casing and water in the container while the pump is running (do not use metal drums or garbage cans) to avoid electric shock.

6 HEALTH AND SAFETY CONSIDERATIONS

Review the safety data sheets (SDS) for the cleaning agents and materials used in decontamination. If solvent is used during decontamination, use appropriate PPE and work in a well-ventilated area and stand upwind while applying solvent to equipment. Apply solvent in a manner that minimizes potential for exposure to workers and bystanders. Follow health and safety procedures outlined in the HASP.

7 PROCEDURE

A designated area will be established to clean sampling equipment in the field prior to and following sample collection. Equipment cleaning areas will be set up within or adjacent to the specific work area, but not at a location that expose equipment to contamination (i.e. exposed to combustion engine exhaust). Detergent solutions will be prepared in clean containers for use in equipment decontamination. Decontaminated equipment should be handled by workers wearing clean gloves, properly changed to prevent cross-contamination.

Cleaning Sampling Equipment

1. Wash the equipment/pump with potable water.
2. Wash with detergent solution (Alconox, Liquinox or equivalent) to remove all visible particulate matter and any residual oils or grease.
3. If equipment is very dirty, precleaning gross debris with a brush and tap water may be necessary.
4. If non-aqueous phase liquids are present, the use of isopropyl alcohol (free of ketones) or methanol is recommended. Cloth wipes or diluted solution can be used to remove the non-aqueous phase liquids that are hard to remove with detergent solution in step 2. Consult with project manager if

non-aqueous phase liquids are present onsite and design an appropriate decontamination procedure that includes step 4.

5. Rinse with deionized water.

Decontaminating Submersible Pumps

Submersible pumps may be used during well development, groundwater sampling, or other investigative activities. The pumps must be cleaned and flushed before and between uses. This cleaning process will consist of an external detergent solution wash and tap water rinse, a flush of detergent solution through the pump, followed by a flush of potable water through the pump. Flushing will be accomplished by using an appropriate container filled with detergent solution and another container filled with potable water. The pump should be flushed with deionized water as the last step prior to use. The pump will run long enough to effectively flush the pump housing and hose (unless new, disposable hose is used). Disconnect the pump from the power source before handling. The pump and hose should be placed on or in clean polyethylene sheeting to avoid contact with the ground surface.

8 WASTE MANAGEMENT

Equipment decontamination rinsate will be managed in conjunction with all other waste produced during the field sampling effort. Waste management procedures are outlined in the work plan or Waste Management Plan (WMP).

9 DATA RECORDING AND MANAGEMENT

Equipment cleaning and decontamination will be noted in the field notebook for project documentation. Information will include the type of equipment cleaned, the decontamination location, specific procedures utilized, solvents and/or cleaning agents used, source of water, and deviations or omissions from this TGI.

Unusual field conditions should be noted if there is potential to impact the efficacy of the decontamination or subsequent sample collection.

An inventory of the solvents brought on site and used and removed from the site will be maintained in the project documentation. Records will be maintained for solvents used in decontamination, including lot number and expiration date.

Containers with decontamination fluids will be labeled.

10 QUALITY ASSURANCE

Equipment blanks should be collected to verify that the decontamination procedures are effective in minimizing potential for cross contamination. The equipment blank is prepared by pouring deionized water (or organic-free water, for organic analyses) over the clean and dry tools and collecting the water into appropriate sample containers. Equipment blanks should be analyzed for the same set of parameters that are performed on the field samples collected with the equipment that was cleaned as specified in the sampling and analysis plan. Equipment blanks are collected per equipment set, which represents all of the tools needed to collect a specific sample.

11 REFERENCES

USEPA Region 9 - Field Sampling Guidance #1230, Sampling Equipment Decontamination.

USEPA Region 1 - Low Stress (low flow) Purging and Sampling Procedure for the Collection of Groundwater Samples from Monitoring Wells.

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POLY- AND PERFLUORINATED ALKYL SUBSTANCES (PFAS) FIELD SAMPLING GUIDANCE

Rev: 4

Rev Date: March 26, 2019

VERSION CONTROL

Revision No	Revision Date	Page No(s)	Description	Reviewed by
0	April 27, 2017	All	Initial Release	Erica Kalve Erika Houtz Sue Tauro
1	June 19, 2018	1 through 4 and 17	Updated Information on Sampling Materials	Erica Kalve Erika Houtz
2	October 15, 2018	6 to 16	Minor updates on laboratory elements, updates to decontamination procedures, and clarification on equipment and reagent blank collection	Erika Houtz Erica Kalve
3	December 17, 2018	4, 6, 17	Removed Sharpies from acceptable field writing implements; Changed language in Section 3.2 and Section 10.5 to provide stricter guidance for DoD projects.	Erika Houtz, Erica Kalve
4	March 26, 2019	4,5	Removed Citranox from acceptable Decon solutions in Table 1a, added all fluoropolymer containing materials to prohibited items in Table 1b. Made a correction that Liquinox contains trace levels of 1,4 Dioxane, not Alconox.	Erika Houtz

APPROVAL SIGNATURES

Prepared by:

Erika F. Houtz

3/26/2019

Erika F. Houtz, PhD, PE
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Date:

Reviewed by:

Erica Kalve

12/17/2018

Erica Kalve, PG-CA
Emerging Contaminants Focus Group Leader

Date:

1 INTRODUCTION

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2 SCOPE AND APPLICATION

The purpose of this Technical Guidance Instructions (TGI) is to provide guidance on field sampling to be used for poly-and perfluorinated alkyl substances (PFASs). This protocol was adapted from various sources including Arcadis Australia, Transport Canada, and the U.S Army Corp of Engineers (USACE) Omaha. In general, sampling techniques used for PFAS site characterization are consistent with conventional sampling techniques used in the environmental industry, but special consideration is made regarding PFAS-containing materials and cross-contamination potential. **Table 1a** provides a summary of materials that have been approved for site investigation; this list is expected to grow longer as industry experience increases. **Table 1b** provides a summary of field equipment and materials that have available testing information and/or industry knowledge regarding PFAS cross-contamination potential and it is recommended that these materials be prohibited for sample collection; for materials that are suspected of containing PFASs and/or to retain PFASs, these recommendations are considered preliminary and subject to change.

Table 1a: Summary of Acceptable Sampling Equipment and Materials for PFAS Site Investigations

Sampling Materials	Additional Considerations	References
Water Sampling Materials		
High density polyethylene (HDPE) or silicone tubing materials	--	DER 2016; USACE 2016; NHDES 2016; MassDEP 2017
HDPE HydraSleeves^{TM}	Low density polyethylene (LDPE) HydraSleeves^{TM} are not recommended	USACE 2016; MassDEP 2017
Drilling and Soil Sampling Materials		
PFAS-free drilling fluids	--	DER 2016
PFAS-free makeup water	Confirm PFAS-free water source via laboratory analysis prior to investigation	--
Acetate liners	For use in soil sampling	USACE 2016
Sample Containers and Storage		
HDPE sample containers with HDPE lined lids for soil and water samples	Laboratory should provide; whole bottle analysis of aqueous samples combined with a solvent rinse of bottle is recommended	DER 2016, MassDEP 2017
Ice contained in plastic (polyethylene) bags (double bagged)	--	DER 2016; USACE 2016; NHDES 2016; MassDEP 2017
Field Documentation		
Ball point pens	--	MassDEP 2017
Standard paper and paper labels	--	DER 2016; USACE 2016; NHDES 2016; MassDEP 2017
Decontamination		
Water-only decontamination	Confirm PFAS-free water source via laboratory analysis prior to investigation	DER 2016
Alconox® or Liquinox® followed by deionized water or PFAS-free water rinse	Liquinox® known to contain trace levels of 1,4-dioxane	NHDES 2016; USACE 2016; MassDEP 2017
Methanol, isopropanol, or acetone	Special health and safety precautions are necessary	UNEP 2015; USACE 2016

Note: This list is considered preliminary and additional materials may be added as additional information becomes available. Project teams are expected to follow a methodical evaluation process of materials to be used and confirm acceptance prior to implementation of field activities.

Table 1b: Summary of Sampling Equipment and Materials Not Recommended for PFAS Site Investigations.

Sampling Materials	Known PFAS-Containing Materials	Suspected PFAS-Containing Materials	Materials with Potential to Retain PFASs	References
Water Sampling Materials				
Teflon®, PTFE-containing or other fluoropolymer coated or containing field equipment (e.g., tubing, bailers, liners, tape, plumbing paste, pump parts)	x			DER 2016; USACE 2016; NHDES 2016; MassDEP 2017
Passive diffusion bags			x	MassDEP 2017
LDPE HydraSleeves ™			x	USACE 2016; MassDEP 2017
Water particle filters			x	MassDEP 2017
Drilling and Soil Sampling Materials				
Aluminum foil			x	DER 2016; USACE 2016; NHDES 2016; MassDEP 2017
Drilling fluid containing PFASs	x	x		DER 2016
Sample Containers and Storage				
Glass sample containers with lined lids			x	DER 2016; USACE 2016; NHDES 2016; MassDEP 2017
LDPE containers and lined lids			x	USACE 2016
Teflon® or PTFE- lined lids on containers (e.g., sample containers, rinsate water storage containers)	x			DER 2016; USACE 2016; NHDES 2016; MassDEP 2017
Reusable chemical or gel ice packs (e.g., BlueIce®)		x		DER 2016; USACE 2016; NHDES 2016; MassDEP 2017
Field Documentation				
Self-sticking notes and similar office products (e.g., 3M Post-it-notes)		x		DER 2016; USACE 2016; NHDES 2016; MassDEP 2017
Waterproof paper, notebooks, and labels	x			DER 2016, MassDEP 2017
Non-Sharpie® markers		x		NHDES 2016
Decontamination				
[Some] detergents and decontamination solutions (e.g., Decon 90® Decontamination Solution)	x	x		DER 2016; NHDES 2016; MassDEP 2017

Note: For materials that are suspected of containing PFASs, or have the potential to retain PFASs, project specific considerations may provide adequate justification for use during the field event. For example, further evaluation may be conducted in the form of pre-field equipment blank sample analysis.

Given the extremely low detection limits associated with PFAS analysis and the many potential sources of trace levels of PFASs, field personnel are advised to err on the side of caution by strictly following these protocols, frequently replacing nitrile gloves, and rinsing field equipment to help mitigate the potential for false detections of PFASs. A summary of other specific items related to field sampling for PFASs are discussed in the sections below.

This TGI applies to all Arcadis and subcontractor personnel involved in field sampling for PFAS.

3 PERSONNEL QUALIFICATIONS

3.1 Sampling Personnel

Field personnel must have current health and safety training, including 40-hour HAZWOPER training, site supervisor training, and site-specific training, as needed. In addition, field personnel will be versed in the other relevant SOPs (e.g., low flow sampling) and will possess the skills and experience necessary to successfully complete the desired field work. The site Health and Safety Plan (HASP) and other documents will identify any other training requirements such as site-specific safety training or access control requirements.

3.2 Laboratories

These laboratories are example laboratories that could be used to analyze environmental media for PFASs, pending project approval:

- United States: TestAmerica, SGS, Vista, ALS, and Eurofins
- Canada: Axys-SGS and Maxxam Laboratories

Other laboratories may be used if they are appropriately accredited for PFAS analysis according to any project requirements. It is recommended that a laboratory is Environmental Laboratory Accreditation Program (ELAP)-accredited for PFAS analysis in accordance with the Department of Defense (DoD) Quality Systems Manual (QSM) 5.1 Table B-15 or any subsequent updates. **For all data collection efforts at DoD sites, PFAS data must be obtained using a method that is DoD ELAP-accredited under QSM 5.1 or later.**

4 EQUIPMENT LIST

The following equipment and materials must be available for sampling:

- Site plan of sampling locations, relevant work plan (or equivalent), and this TGI;
- Appropriate health and safety equipment, as specified in the site HASP;
- Dedicated plastic sheeting (preferably high-density polyethylene [HDPE]) or other clean surface to prevent sample contact with the ground;
- Conductivity/temperature/pH meter;
- Dissolved oxygen meter, oxidation reduction potential meter, and turbidity meter;
- Depth to water meter;

- If using low-flow groundwater sampling techniques, peristaltic pump (groundwater sampling)/bladder pump (with PFAS free bladder/ HDPE bladder), flow through cell, and accompanying HDPE and silicone tubing;
- Hydrasleeves, if using Hydrasleeves for groundwater sampling;
- Metal trowel for soil samples; specialized soil/sediment sampling equipment as required;
- Brushes for scrubbing sampling equipment;
- Pens, pencils, and/or Sharpies for writing;
- Clipboards, field binders, and field note pages that are not waterproof;
- Labeled sample bottles:
    - Water: HDPE bottles fitted with polypropylene screw cap only; some types of PFAS samples (primarily drinking water) may require preservative, which will be indicated by the laboratory conducting the analysis. The laboratory will specify the sample bottle volume.
    - Soil and sediment: HDPE bottles fitted with polypropylene screw cap only; no preservatives. The laboratory will specify the sample bottle volume.
- If high concentrations of PFASs related to class B firefighting foams are expected, bring additional small vials to conduct field-based shaker tests for foaming;
- Ziploc® bags to hold ice and samples;
- Bottles containing “PFAS-free” water used for reagent blanks;
- Labeled coolers for samples with ice; Blue ice is not permitted;
- Deionized or distilled water for initial decontamination rinsing;
- “PFAS-free” water provided by the laboratory for final decontamination rinsing;
- Methanol, isopropanol, or acetone if able to be brought safely to field site; especially important for decontamination during soil sampling;
- Alconox or Liquinox®;
- Packing and shipping materials;
- Groundwater Sampling Log; and
- Chain-of-Custody (COC) Forms.

5 CAUTIONS

5.1 Food Packaging

Some food packaging may be treated with PFAS-containing chemicals to prevent permeation of oil and water in the food outside of the packaging. To avoid potential food packaging-related PFAS contact:

- Do not bring any food outside of the field vehicles onsite and eat snacks and meals offsite.
- Wash hands after eating.
- Remove any field garments or outer layers prior to eating. Do not put them back on until done eating and hands are washed.

5.2 Field Gear

5.2.1 Clothing

Many types of clothing are treated with PFASs for stain and water resistance, in particular outdoor performance wear under brand names such as Gore-Tex®. To avoid potential clothing-related PFAS contact:

- Do not wear any outdoor performance wear that is water or stain resistant, or appears to be. Err on the side of caution.
- Wear pre-laundered (multiple washings, i.e. 6+) clothing that is not stain resistant or water proof.
- Natural fabrics such as cotton are preferred. Synthetic fabrics may also be acceptable if there is no indication on the label that the fabric is water and stain resistant.
- Most importantly, avoid contacting your clothing with sampling equipment, bottles, and samples.

5.2.2 Personal Protective Equipment

Safety Footwear

Some safety footwear has been treated to provide a degree of waterproofing and increased durability and may represent a source of trace PFASs. For the health and safety of field personnel, footwear must be protected at all times to avoid potential PFAS contamination. To do this:

- Do not contact your footwear with equipment, bottles, or samples in any way.
- Do not allow gloves used for sampling to come in contact with safety footwear.

Nitrile Gloves

Wear disposable nitrile gloves at all times. Don a new pair of nitrile gloves **before** the following activities at each sample location:

- Decontamination of re-usable sampling equipment;
- Contact with sample bottles or “PFAS-free” water bottles;
- Insertion of anything into the sample ports (e.g., HDPE tubing); and
- Handling of any quality assurance/quality control (QA/QC) samples including field blanks and equipment blanks.

Don a new pair of nitrile gloves **after** the following activities:

- Handling of any non-dedicated sampling equipment;
- Contact with contaminated surfaces; or
- When judged necessary by field personnel.

5.3 Personal Hygiene

- Shower at night.
- Do not use personal care products after showering such as lotions, makeup, and perfumes, UNLESS medically necessary.
- Use sunscreen and insect repellent ONLY if necessary for health and safety. If they are necessary, apply sunscreen and repellant prior to initiating field sampling. If sunscreen and/or repellant need to

be reapplied, ensure a safe distance away from the sampling locations and equipment (i.e., more than 10 meters (m) away). Wash hands after application.

5.4 Visitors

Visitors to the site are asked to remain at least 10 m from sampling areas.

5.5 Rain Events

Special care should be taken when rain is falling at the project site:

- Do not perform field sampling when rain fall is persistent at a consistent rate that saturates the ground (i.e., formation of puddles) because rain gear is not permitted while sampling. Intermittent showers or fog are acceptable conditions to proceed. If rain showers occur; field gear must be removed from the monitoring well location until the rain subsides.
- If project timelines are tight, consider the use of a gazebo tent that can be erected over the top of the monitoring well to provide shelter from the rain. The canopy material is possibly a PFAS-treated surface and should be managed as such; therefore, wear gloves when moving the tent, change them immediately after moving the tent, and avoid further contact with the tent until all sampling activities have been finished and the team is ready to move on to the next site.

6 HEALTH AND SAFETY CONSIDERATIONS

- The ability to safely access the surface water sampling locations must be verified before sampling.
- Field activities must be performed in accordance with the site HASP, a copy of which will be present onsite during such activities.
- Safety hazards associated with sampling surface water include fast-moving water, deep water, and steep slopes close to sampling sites. Use extreme caution when approaching sampling sites.
- If thunder or lighting is present, discontinue sampling and take cover until 30 minutes have passed after the last occurrence of thunder or lighting.
- Use caution when removing well caps as well may be under pressure, cap can dislodge forcefully and cause injury.

7 PROCEDURE

7.1 Field Equipment Cleaning

Reusable field sampling equipment will require cleaning between uses. For groundwater sampling, between uses, decontaminate the flow-through cell and any non-dedicated equipment (i.e., interface probe of depth to water meter) that comes into contact with well water. Trowels and other materials used to sample soil samples will also require decontamination, although dedicated, single use equipment such as liners should be used where possible.

After donning a new pair of nitrile gloves:

- Rinse sampling equipment with Alconox or Liquinox® cleaning solution; Scrub equipment with a plastic brush if needed;
- Rinse two times with distilled water or deionized water;

- Rinse one time with “PFAS-free” water or once with methanol/isopropanol/acetone, if it is available, and once with “PFAS-free” water; organic solvents are especially useful for decontaminating soil sampling equipment. If organic cleaning solvents cannot be brought to site, scrub equipment a second time after a single distilled or deionized water rinse, then rinse two times with distilled or deionized water and once with “PFAS-free” water (i.e., two scrubbings and four water rinsings total).
- Collect all rinsate in a sealed pail for disposal. Do not reuse decontamination solutions between sampling locations.

7.2 Borehole/Monitoring Well Development

If a drill rig is being used to drill for soil cores or to install monitoring wells, wear clean nitrile gloves before collecting each continuous soil sample. Additional requirements include the following:

- Verify in writing with the manufacturer that single-use liners used to collect each sample are made of a material that does not contain PFASs;
- Collect soil samples in laboratory-supplied HDPE bottles.
- Store the sample bottles in coolers and keep at a temperature of 0 to 6ºC until transported to the laboratory.

7.2.1 Well Condition Survey/ Water Level Monitoring

Using equipment that has been thoroughly decontaminated according to the procedures in Section 7.1, conduct the well condition surveys and water level monitoring:

- Conduct monitoring well inspections and record water levels.
- Use an interface probe to evaluate presence/absence of non-aqueous phase liquid (NAPL).
- Measure the depth to water from the top of the polyvinyl chloride (PVC) riser and the total depth of the well.
- Record information in the field notes.

7.2.2 Monitoring Well Development and Purging

Follow these requirements for monitoring well development and purging:

- Do not use Teflon™ tubing for purging or sample collection. HDPE tubing is acceptable.
- Do not re-use materials between wells. Upon completion of use, remove all disposable materials (such as HDPE and/or silicone tubing) and place in heavy duty garbage bags for disposal.
- During development of the well, create sufficient energy to agitate the water column and create flow reversals in the well screen, filter pack and formation to loosen fine-grained materials and draw them into the well. The pumping or bailing action should then draw all drilling fluids and fine-grained material out of the borehole and adjacent formation and then out of the well. Review the Arcadis Monitoring Well Development guidance (Arcadis 2010) for more detailed information.
- Follow the low-flow purge and sampling techniques per the U.S. Protection Agency’s (EPA’s) guidance document titled *Low Stress (Low Flow) purging and Sampling Procedure for the Collection of Ground Water Samples from Monitoring Wells* (2010) and ASTM’s standard titled *Standard Practice for Low-Flow Purging and Sampling for Wells and Devices Used for Ground-Water Quality Investigations* (2002). Also available for review is the Arcadis Low-Flow Groundwater Purging and Sampling Procedures for Monitoring Wells (Arcadis 2011).

- To purge the well, if using HDPE tubing and a peristaltic pump, insert the end of the tubing to the approximate depth of the midpoint of the screened section of the monitoring wells. Measure the length of HDPE tubing to be inserted into each monitoring well and pre-cut it to approximate lengths (such as the previously measured arm span of a field technician) to avoid contact with any materials other than the monitoring well and peristaltic pump. Flow rates should be as low as can be reasonably achieved. Collect and appropriately dispose of purge water.
- Silicone tubing should direct the purge water through a flow-through cell for field parameter measurements of pH, conductivity, temperature, dissolved oxygen, and turbidity. Calibrate the instrument in the field prior to use. Decontaminate the instrument and flow-through cell at each monitoring well location before purging.
- Record field parameters in intervals (generally of 3-minute duration) to ensure purge water has cycled through the flow-through cell. Sample the wells after field parameter measurements indicate stabilization, which allows collection of representative formation water (generally acceptable standards are three consecutive pH readings to within ±0.1 units, and three consecutive conductivity, temperature and dissolved oxygen measurements to within 3%). Turbidity must be monitored, but does not need to be used as a stabilization indicator of purge completion. Record field parameter measurements at each well. Drawdown should be monitored throughout the purge.
- If wells are suspected to be dewatering throughout the purge (i.e., reduced flow rate/difficulty pumping water or bubbles begin to come through the flow through cell), turn off the pump and allow the water level to recover for ½ hour, followed by sample collection. Document these activities in the field notes.

7.3 Sample Collection

Different laboratories may supply sample collection bottles of varying sizes depending on the type of media to be sampled.

7.3.1 Sample Containers

- Collect samples in HDPE bottles fitted with an unlined (no Teflon™), polypropylene screw cap.
- Complete bottle labels after the caps have been placed back on each bottle.
- Do not use glass bottles due to potential loss of analyte through adsorption. This is particularly important for aqueous samples.
- Review with analytical lab the sample size, sample container, etc. depending upon the type of PFAS analysis that is being requested.

7.3.2 Soil Sampling

Before Sample Collection

- Place plastic sheeting adjacent to the sample port for use as a clean work area, if conditions allow. Otherwise, prevent sampling equipment from contacting the ground or other surface that could compromise sample integrity.
- Trowels or drilling equipment that will come into contact with a sample should be decontaminated prior to sample collection, preferably with methanol/isopropanol/acetone;
- Don a new set of nitrile gloves. Do not use gloved hands to subsequently handle papers, pens, clothes, etc., before collecting samples.
- Use the HDPE bottles that are supplied by the laboratory. Make sure that the caps remain on the bottle until immediately prior to sample collection.

During Sample Collection

- Collect soil samples using a clean stainless steel trowel or with single-use PFAS-free liners;
- Place soil samples in labeled HDPE bottles supplied by the laboratory.
- Note the time on the sample label.
- Collect any necessary duplicates/co-located samples and matrix spikes – verify with laboratory whether they need to be collected in separate sample bottles.
- Collect any necessary equipment blanks. The best timing to collect equipment blanks is immediately after the collection of a sample likely to contain high concentrations of PFASs, after the sampling equipment has been appropriately decontaminated.
- Collect any necessary field reagent blanks. This sample should be collected after field staff return from an offsite break (e.g., lunch) to capture any potential cross-contamination from field personnel.

After Sample Collection

- Place soil sample bottles in a sealed Ziploc© bag (optional).
- Record the label information and time of sampling in the field notes.
- Place soil sample bottles in coolers that are durable in transportation and keep the temperature between 0 and 6ºC until transported to the laboratory. Do not use blue ice.

7.3.3 Groundwater Sampling

Before Sample Collection

- Place plastic sheeting adjacent to the sample port for use as a clean work area, if conditions allow. Otherwise, prevent sampling equipment from contacting the ground or other surface that could compromise sample integrity.
- Don a new set of nitrile gloves. Do not use gloved hands to subsequently handle papers, pens, clothes, etc., before collecting samples.
- Use the labeled HDPE bottles that are supplied by the laboratory. Make sure that the caps remain on the bottle until immediately prior to sample collection.
- Measure depth to water and field parameters. Turbidity and the physical appearance of the purged water should be noted on the Groundwater Sampling Log.

During Sample Collection

- Start groundwater sample collection upon stabilization of field parameters.
- If low-flow groundwater sampling techniques are being used, disconnect the silicone tubing from the flow-through cell, enabling collection of groundwater samples prior to passing through the cell.
- Hydrasleeves are also considered acceptable for sampling of PFAS in groundwater – consult the project manager to determine which technique should be used. In general, low flow sampling is preferable.
- Collect groundwater samples (to the neck of the bottle, some headspace is acceptable) from the dedicated sampling ports at the center of the well screen. While collecting the sample, make sure the bottle cap remains in the other hand of the sampler, until replaced on the bottle.
- To mitigate cross contamination, collect groundwater samples in a pre-determined order from least impacted to greater impacted based on previous analytical data or knowledge about past activities at the site. If no analytical data are available, samples are to be collected in the following order:
    1. First sample the upgradient well(s).

2. Next, sample the well located furthest downgradient of the interpreted or known source.
3. The remaining wells should be progressively sampled in order from downgradient to upgradient, such that the wells closest to the interpreted or known source are sampled last.

- NOTE: If high concentrations of PFASs related to class B firefighting foams are expected in a groundwater sample, conduct a Shaker test by collecting and shaking a small portion of the sample (~10 to 25 mL) on site in a small disposable vial. If foaming is noted within the sample, document the foaming when samples are submitted for analysis; the 'shaker test' vial can then be disposed. This shaker test provides information about how each of the samples should be handled analytically.
- After collecting the sample, tightly screw on the polypropylene cap (snug, but not too tight). This will minimize leaking or cross contamination of the sample. Most PFASs, including all analytes measured by USEPA Method 537, are not volatile at environmental pH.
- Note the time on the sample label.
- Collect any necessary duplicates and matrix spikes. As the laboratory should be analyzing the entire aqueous sample rather than sub-sampling, separate bottles will be required for these samples.
- Collect any necessary equipment blanks. The best timing to collect equipment blanks is immediately after the collection of a sample likely to contain high concentrations of PFASs, after the sampling equipment has been appropriately decontaminated.
- Collect any necessary field reagent blanks. This sample should be collected after field staff return from an offsite break (e.g., lunch) to capture any potential cross-contamination from field personnel.
- Do not rinse PFAS sample bottles during sampling. Do not filter samples.

After Sample Collection

- Place groundwater sample bottles in a sealed Ziploc© bag (optional).
- Record the label information and time of sampling in the field notes and COC. Note ‘shake test’ results if appropriate.
- Place groundwater samples in coolers that are durable in transportation and keep the temperature between 0 and 6ºC until transported to the laboratory. **Do not use blue ice. Store PFAS samples in a separate cooler from other types of samples.**
- Treat all disposable sampling materials as single use and dispose of them appropriately after sampling at each monitoring well.

7.3.4 Sediment Sampling

Before Sample Collection

- Place plastic sheeting (preferably HDPE) adjacent to the sample port for use as a clean work area, if conditions allow. Otherwise, prevent sampling equipment from contacting the ground or other surface that could compromise sample integrity.
- Don a new set of nitrile gloves. Do not use gloved hands to subsequently handle papers, pens, clothes, etc., before collecting samples.
- Use the HDPE bottles that are supplied by the laboratory. Make sure that the caps remain on the bottle until immediately prior to sample collection.

During Sample Collection

- Where surface water samples and sediment samples are collected at the same location, collect surface water samples first to minimize siltation.

- Collect sediment samples either manually using a stainless steel trowel or using a petite ponar grab sampler, depending on field conditions at each sampling location during sampling program.
- Collect sediment samples from the upper 10 cm of sediment.
- For a sample to be acceptable overlying, low turbidity water must be present.
- Decant the overlying water and use a stainless steel trowel to collect only the upper 5 centimeters (cm) of sediment.
- Collect sediment samples directly into laboratory-supplied bottles that are suitable in both material and size.
- Do not overfill the sample bottle.
- Make sure that the sample does not contain vegetation, that the sediment is undisturbed, and that the sampler shows no signs of winnowing or leaking.
- Make sure bottle caps remain in the gloved hand of the sampler until sampling is complete and caps are replaced on the bottle.
- Note the time on the sample label.
- Collect any necessary duplicates and matrix spikes.
- Collect any necessary equipment blanks. The best timing to collect equipment blanks is immediately after the collection of a sample likely to contain high concentrations of PFASs, after the sampling equipment has been appropriately decontaminated.
- Collect any necessary field reagent blanks. This sample should be collected after field staff return from an offsite break (e.g., lunch) to capture any potential cross-contamination from field personnel.

After Sample Collection

- Place sample bottles in a sealed Ziploc© bag (optional).
- Record the label information and time of sampling in the field notes.
- Place samples in coolers that are durable in transportation and keep the temperature between 0 and 6ºC until transported to the laboratory. **Do not use blue ice. Store PFAS samples in a separate cooler from other types of samples.**
- Measure surface water pH, conductivity, temperature, and total dissolved solids (TDS) at each location **after** both surface water and sediment sampling is completed.

7.3.5 Surface Water Sampling

Before Sample Collection

- Place plastic sheeting (preferably HDPE) adjacent to the sample port for use as a clean work area, if conditions allow. Otherwise, prevent sampling equipment from contacting the ground or other surface that could compromise sample integrity.
- Don a new set of nitrile gloves. Do not use gloved hands to subsequently handle papers, pens, clothes, etc., before collecting samples.
- Use the HDPE bottles that are supplied by the laboratory. Make sure that the caps remain on the bottle until immediately prior to sample collection.

During Sample Collection

- Avoid sampling the surface.
- Where surface water samples and sediment samples are collected at the same location, collect surface water samples first to minimize siltation.

- Collect surface water samples directly into laboratory-supplied bottles; wide-mouth bottles may be preferable to narrow mouth bottles for ease of surface water collection.
- Make sure bottle caps remain in the gloved hand of the sampler until sampling is complete and caps are replaced on the bottle.
- Note the time on the sample bottle.
- Collect any necessary duplicates and matrix spikes. As the laboratory should be analyzing the entire aqueous sample rather than sub-sampling, separate bottles will be required for these samples.
- Collect any necessary equipment blanks. The best timing to collect equipment blanks is immediately after the collection of a sample likely to contain high concentrations of PFASs, after the sampling equipment has been appropriately decontaminated.
- Collect any necessary field reagent blanks. This sample should be collected after field staff return from an offsite break (e.g., lunch) to capture any potential cross-contamination from field personnel.

After Sample Collection

- Place sample bottles in a sealed Ziploc© bag (optional).
- Record the label information and time of sampling in the field notes.
- Place samples in coolers that are durable in transportation and keep the temperature between 0 and 6ºC until transported to the laboratory. **Do not use blue ice. Store PFAS samples in a separate cooler from other types of samples.**
- Measure surface water pH, conductivity, temperature, and TDS at each location **after** both surface water and sediment sampling.

7.4 Shipping

- If samples cannot be shipped the same day as collected, arrange an appropriate means of keeping the samples cool overnight and maintain the temperature between 0 and 10°C for the first 48 hours after collection, and then between 0 and 6°C thereafter.
- Store samples in appropriate transport bottles (coolers) with ice (Ziploc© bags for use as ice containers) with appropriate labeling. **Do not use blue ice. Store PFAS samples in a separate cooler from other types of samples.**
- Complete the appropriate procedures for COC, handling, packing, and shipping.
- Fill out and check COC Forms against the labels on the sample bottles progressively after each sample is collected.
- Place all disposable sampling materials (such as plastic sheeting, and health and safety equipment) in appropriate containers.
- Ship samples via courier service with priority overnight delivery. Tracking numbers for all shipments should be provided and recorded after they have been sent out to ensure their timely delivery.
- Do not ship samples via Fed Ex for Saturday delivery.

8 WASTE MANAGEMENT

All rinsate should be collected in a sealed pail for disposal. Drill cuttings and purge water will be managed as specified in the Field Sampling Plan (FSP) or Work Plan, and according to state and/or federal requirements. PPE and decontaminated fluids will be contained separately and staged at the sampling location. Containers must be labeled at the time of collection. Labels will include date, location(s), site name, city, state, and description of matrix contained (e.g., soil, groundwater, PPE). General guidelines for investigation derived waste (IDW) handling and storage are set forth in a separate IDW guidance document (Arcadis 2009).

Typical waste characterization procedures include collection of a composite sample of the drill cutting material and a composite sample of the purge water for laboratory analysis. Samples are typically analyzed for disposal toxicity characteristic leaching procedure (TCLP) analysis for metals and VOCs. For PFASs, a simple leach test with neutral pH water may be more indicative of actual risk. Additionally, generators of waste are required to include analysis of other constituents that are reasonably believed to be present including (in this case) PFASs.

Emerging contaminants pose a unique challenge for disposal because acceptance of such waste will be based on the local facility and their permit restrictions. Project teams will be required to identify appropriate facilities based on the facility's legal ability to accept the waste and the team should confirm that the facility is meeting the regulatory requirements for accepting waste containing PFASs. In general, facilities that provide solidification and/or incineration will be likely to meet the necessary requirements to accept PFAS-containing waste. The facility will then provide the definitive laboratory analysis requirements needed to meet their permit requirements for waste classification.

9 DATA RECORDING AND MANAGEMENT

9.1 Field Notes

Waterproof field books must not be used for field notes. Instead, field notes should be on loose paper on Masonite, plastic, or aluminum clip boards. Other requirements for field notes include:

- Pens, pencils, and Sharpies may be used.
- Keep field notes and writing implements away from samples and sampling materials.
- One person should conduct sampling while another records field notes.
- Do not write on sampling bottles unless they are closed.

9.2 Other Project Documentation

- Complete Groundwater Sampling Logs.
- Make sure COC Forms are properly completed. Verify which PFAS analytes (e.g., just PFOS and PFOA, some or all of the 537 list, etc.) are required for analysis and note on the COC.

10 QUALITY CONTROL

Refer to quality control requirements for the project to ensure that appropriate quality assurance and quality control (QA/QC) samples are collected. When collecting QA/QC samples, the same guidelines apply as when collecting regular samples – specifically that:

- Samples should be collected in laboratory-supplied HDPE bottles;
- Bottle caps must remain in the hand of the sampler until replaced on the bottle;
- Labels must be completed after the caps have been placed back on each bottle; and

- Samples must be stored in appropriate transport bottles (coolers) with ice (Ziploc$^{©}$ bags for use as ice containers) with appropriate labeling. **Do not use blue ice. Store PFAS samples in a separate cooler from other types of samples.**

10.1 Equipment Blanks (if relevant)

QA/QC sampling typically includes daily collection of equipment blanks using the laboratory-supplied “PFAS-free” water. For peristaltic pump tubing, laboratory supplied “PFAS-free” water should be poured into a clean HDPE sample bottle and then pumped through new HDPE tubing using the peristaltic pump (with new silicone tubing). The best timing to collect equipment blanks is immediately after the collection of a sample likely to contain high concentrations of PFASs, after the sampling equipment has been appropriately decontaminated.

10.2 Field Duplicates

QA/QC sampling typically includes the collection of one field duplicate for every 10 or 20 samples collected. Each duplicate sample will be collected immediately after the initial sample of which it is a duplicate into a separate laboratory-provided sample bottle. Do not indicate to the laboratory which sample the duplicate replicates, i.e. it should be given a blind reference on the COC and sample name such as “duplicate”.

10.3 Field Reagent Blanks

QA/QC sampling for PFASs typically includes the submission of one laboratory supplied field reagent blank per day. The field reagent blank sample is brought to the site in a laboratory-supplied sample bottle. Field staff transfer the laboratory-supplied reagent blank to an empty sample bottle. This sample should be collected after field staff return from an offsite break (e.g., lunch) to capture any potential cross-contamination from field personnel and should be placed in the same cooler as the other PFAS samples.

10.4 Matrix Spikes (optional in some cases)

QA/QC sampling includes submitting a sample to be used as a matrix spike if the project requires it. If a separate sample bottle is required, an additional sample will be collected immediately after the initial sample of which it is a duplicate into a separate laboratory-supplied sample bottle.

10.5 Laboratory Analytical QA/QC

- Arcadis recommends that any request for PFAS analysis in groundwater or soil should be conducted by an ELAP-accredited method compliant with QSM 5.1 Table B-15. Requirements laid out in Table B-15 strictly govern acceptable laboratory data quality for PFAS analysis in environmental samples. **For all data collection efforts at DoD sites, PFAS data must be obtained using a method that is DoD ELAP-accredited under QSM 5.1 or later.**
- Laboratory QA/QC should consist of one laboratory blank and one laboratory control sample (or blank spike) per batch of samples, and additional QA/QCs as indicated by the laboratory QA/QC procedures.
- Isotope dilution should be used for quantification with isotope-labeled surrogate standards, as available, according to the guidelines of QSM 5.1 Table B-15. USEPA Method 537 does not allow for isotope dilution in their PFAS drinking water method.

- For drinking water, groundwater, and surface water samples, laboratories must extract the entire sample and include a solvent rinse of the bottle for analysis. Aqueous samples should generally not be sub-sampled prior to analysis, unless they are high concentration and require serial dilution (US DoD 2017).
- Soil samples should be analyzed in their entirety or thoroughly homogenized before extraction and analysis.
- As part of the internal QA/QC of laboratory results, relative percent difference (RPD) should be calculated between samples and corresponding field or laboratory duplicates. The laboratory quality assurance portion of the laboratory certificates should be reviewed to verify that all calculations/recoveries were within acceptable limits as established by the laboratory method and guidelines in Table B-15 of QSM 5.1 or later (USDoD 2017).

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United States Army Corps of Engineers

PFAS SAMPLING PROCEDURES AND LOW-FLOW GROUNDWATER PURGING FOR MONITORING WELLS

Rev. # 0

Date 6/19/2018

PFAS SAMPLING PROCEDURES AND LOW-FLOW GROUNDWATER PURGING FOR MONITORING WELLS

REV. # 0

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CONTENTS

1 SCOPE AND APPLICATION

The protocol presented in this methods and procedures document describes the procedures recommended to purge monitoring wells and collect groundwater samples for per- and polyfluoroalkyl substances (PFASs) using low flow sampling with a peristaltic pump. Samples will be analyzed for a specified list of PFASs using a modified version of United States (U.S.) Environmental Protection Agency (USEPA) method 537 following the U.S. Department of Defense and U.S. Department of Energy Quality Systems Manual 5.1 methods and procedures set forth in Table B-15.

This protocol has been developed in accordance with the USEPA Region I Low Stress (Low-Flow) Purging and Sampling Procedures for the Collection of Groundwater Samples from Monitoring Wells (EQASOP-GW4; September 19, 2017). PFAS sampling guidelines are incorporated from various guidance documents including the United States Army Corps of Engineers (2016), Department of Environment Regulation, Western Australia (2016), New Hampshire Department of Environmental Services (2016), and Massachusetts Department of Environmental Protection (2017). Staff should also review the Arcadis Technical Guidance Instruction (TGI) titled, Poly- and Perfluorinated Alkyl Substances (PFAS) Field Sampling Guidance (Arcadis 2018).

The project team should determine the last time the wells were developed and if additional development is necessary prior to sample collection. Groundwater samples should not be collected within one week following well development.

2 PERSONNEL QUALIFICATIONS

Arcadis personnel providing assistance to groundwater sample collection and associated activities should have a minimum of six months of related experience or an advanced degree in environmental sciences, engineering, hydrogeology, or geology. The supervisor of the groundwater sampling team should have at least one year of previous supervised groundwater sampling experience, preferably with PFAS related experience. Prior to mobilizing to the field, the groundwater sampling team should review and be thoroughly familiar with relevant site-specific documents including but not limited to the site work plan, field sampling plan, Health and Safety Plan (HASP), historical information, and site relevant documents. Additionally, the groundwater sampling team should review and be thoroughly familiar with documentation provided by equipment manufacturers for all equipment that will be used in the field prior to mobilization, in particular to confirm the sample materials that will be in contact with the water sample are compatibile with PFAS sample collection**.**

3 EQUIPMENT LIST

Specific to this activity, the following materials (or equivalent) should be available:

- Health and safety documents and equipment (as identified in the Programmatic Accident Prevention Plan and Site Safety and Health Plan)
- Site Plan, well construction records, prior groundwater sampling records (if available)

- Peristaltic pump (e.g., ISCO Model 150) or bladder pump (e.g., Geotech PFC-Free Portable Bladder Pumps)
- A power supply for the peristaltic pump; peristaltic pumps require electric power from either a generator or a deep cell battery.
- High Density Polyethylene (HDPE) tubing and/or silicon tubing of an appropriate size for the pump being used. When collecting samples for PFASs, Teflon® or polytetrafluoroethylene-containing or coated components or tubing are prohibited.
- HDPE bailers (if necessary)
- Water-level probe with fluorine-free materials (e.g., Geotech ET 3/8” with Delrin tip and Buna-N O-ring)
- Water-quality (temperature/pH/specific conductivity/oxidation reduction potential [ORP]/turbidity/dissolved oxygen [DO]) meter, flow-through measurement cell, and appropriate calibration standards. Several brands may be used, including:
    - YSI 6-Series Multi-Parameter Instrument
    - Horiba U-22 Multi-Parameter Instrument
    - Hydrolab Series 3 or Series 4a Multiprobe and Display
- Supplemental turbidity meter (e.g., Horiba U-10, Hach 2100P, LaMotte 2020). Turbidity measurements collected with multi-parameter meters have sometimes been shown to be unreliable due to fouling of the optic lens of the turbidity meter within the flow-through cell. A supplemental turbidity meter should be used to verify turbidity data during purging if such fouling is suspected. An in-line tee and valve should allow for collection of water for turbidity measurements before the pump discharge enters the flow-through cell. Note that industry improvements may eliminate the need for these supplemental measurements in the future.
- HDPE water sample containers (supplied by the laboratory) fitted with an unlined (no Teflon™), polypropylene screw cap. Sample bottles for standard groundwater sampling should not contain Trizma® preservative. If sample bottles with Trizma® are provided by the laboratory, request new sample bottles prior to sample collection.
- Appropriate blanks (field reagent blanks supplied by the laboratory)
- Fluorine-free cleaning equipment
- Groundwater sampling log
- Dedicated plastic sheeting (preferably HDPE) or other clean surface to prevent sample contact with the ground
- Clipboards, field binders, and field note pages that are not waterproof and are fluorine-free
- If high concentrations of PFAS related to class B firefighting foams are expected, bring ‘shaker test’ vials
- Ziploc® bags to hold ice and samples

- Appropriate blanks (field reagent blanks supplied by the laboratory)
- Appropriate transport containers (coolers) with ice and appropriate labeling, no blue ice should be used
- "PFAS-free" water provided by the laboratory for decontamination rinsing
- Alconox® or Liquinox®; note that Alconox® is known to contain trace levels of 1,4-dioxane
- Packing and shipping materials
- Chain-of-Custody (COC) Forms

Note the specific make/model of the equipment used during each sampling event on the groundwater sampling log. The maintenance requirements for the above equipment generally involve decontamination or periodic cleaning, battery charging, calibration, and proper storage, as specified by the manufacturer. For operational difficulties, the equipment should be serviced by a qualified technician.

4 CAUTIONS

- Do not perform field sampling when rain fall is persistent at a consistent rate that saturates the ground (i.e., formation of puddles) because rain gear is not permitted while sampling. Intermittent showers or fog are acceptable conditions to proceed. If rain showers occur; field gear must be removed from the monitoring well location until the rain subsides. If project timelines are tight, consider the use of a gazebo tent that can be erected over the top of the monitoring well to provide shelter from the rain. The canopy material is possibly a PFAS-treated surface and should be managed as such; therefore, wear gloves when moving the tent, change them immediately after moving the tent, and avoid further contact with the tent until all sampling activities have been finished and the team is ready to move on to the next sample location. Ensure that the canopy will not leak into the sampling area prior to use.
- Do not wear any outdoor performance wear that is water or stain resistant or appears to be. Performance wear such as Gore-Tex® or eVent™ are examples of clothing brands to avoid. Natural fabrics such as cotton are preferred. Synthetic fabrics may also be acceptable if there is no indication on the label that the fabric is water and stain resistant. Avoid contacting clothing with sampling equipment, bottles, and samples.
- Waterproof field books must not be used for field notes. Use loose paper on Masonite, plastic, or aluminum clip boards. Pens, pencils, and Sharpies may be used but should be kept away from sampling materials. One person should conduct the sampling while another records the field notes.
- To avoid potential food packaging-related PFAS contact, do not bring any food outside of the field vehicles onsite. Wash your hands after eating and remove any field garments or outer layers prior to eating.
- Safety footwear is often treated to provide a degree of waterproofing and increased durability and may represent a source of trace PFAS. For the health and safety of field personnel, footwear must be protected at all times to avoid potential PFAS contamination. To do this, do not touch your safety footwear in the immediate vicinity of the sampling location and do not allow gloves used for sampling to come in contact with safety footwear.

- Wear disposable nitrile gloves at all times.
  - Don a new pair of nitrile gloves before the following activities at each sample location:
    - Decontamination of re-usable sampling equipment;
    - Contact with sample bottles or “PFAS-free” water bottles;
    - Insertion of anything into the sample ports (e.g., HDPE tubing); and
    - Handling of any quality assurance/quality control samples including field blanks and equipment blanks.
  - Don a new pair of nitrile gloves after the following activities:
    - Handling of any non-dedicated sampling equipment;
    - Contact with contaminated surfaces; or
    - When judged necessary by field personnel.
- Shower at night. Do not use personal care products after showering such as lotions, makeup, and perfumes, UNLESS medically necessary.
- Use sunscreen and insect repellent ONLY if necessary for health and safety. If they are necessary, apply sunscreen and repellant prior to initiating field sampling. If sunscreen and/or repellant need to be reapplied, ensure a safe distance away from the sampling locations and equipment (i.e., more than 10 meters away). Wash hands after application. Don a new pair of gloves as noted above.
- Visitors are asked to remain at least 30 feet from sampling areas.

5 HEALTH AND SAFETY CONSIDERATIONS

Review all site-specific and procedural hazards as they are provided in the HASP, and review Job Safety Analysis (JSA) documents in the field each day prior to beginning work. The HASP and JSA documents should be present onsite during all field activities. Generators and cord and plug equipment should employ an overcurrent protection device such as an integrated ground fault circuit interrupter cord. If thunder or lighting is present, discontinue sampling and take cover until 30 minutes have passed after the last occurrence of thunder or lighting. Use caution when removing well caps as the well may be under pressure and the cap can dislodge forcefully and cause injury.

6 PROCEDURE

If a round of water level measurements for all site monitoring wells are planned as part of the project scope, the site-wide water level measurements should be collected in such a manner to avoid potential cross-contamination between the wells. Follow appropriate decontamination procedures for collection of water level measurements.

Peristaltic pumps are preferred when sampling for PFASs to minimize potential cross-contamination. If the depth to water is below the sampling range of a peristaltic pump (approximately 25 feet), a PFAS-free bladder pump is acceptable. Purge water should be collected and containerized according to the direction of the project team.

1. Calibrate field instruments according to manufacturer procedures for calibration and document.
2. Place plastic sheeting (preferably HDPE) adjacent to the sample port for use as a clean work area, if conditions allow. Otherwise, prevent sampling equipment from contacting the ground or other surface that could compromise sample integrity.
3. If required in the HASP, use a photoionization detector (PID) to measure the headspace before sampling. Open the well cover while standing upwind of the well. Remove the well cap and place it on the plastic sheeting. Insert the PID probe approximately 4 to 6 inches into the casing or the well headspace and cover it with a gloved hand. Record the PID reading in the field log. Perform air monitoring in the breathing zone according to the HASP and/or JSA.
4. Measure the initial depth to groundwater prior to placing the HDPE tubing.
5. Prepare and install the pump in the well: when using a peristaltic pump, slowly lower the HDPE sampling tubing into the well to a depth corresponding to the approximate center of the saturated screen section of the well. Any dedicated tubing in the well should be replaced with new HDPE tubing. The sampling tube must be kept at least 2 feet above the bottom of the well to prevent mobilization of any sediment present in the bottom of the well. If using a weight on the tubing ensure the material is PFAS free and has been deconned according to the procedures described in this document.
6. Measure the water level again with the pump in the well before starting the pump to ensure that it has stabilized. Start pumping the well at 200 to 500 milliliters (mL) per minute (or at a lower site-specific rate if specified). Adjust the pump rate to cause little or no water level drawdown in the well (less than 0.3 foot below the initial static depth to water measurement), and the water level should stabilize; however, this is not always possible. If the recovery rate is less than 50 mL per minute, or the well is being essentially dewatered during purging, the well should be sampled as soon as the water level has recovered sufficiently to collect the volume needed for all anticipated samples. Contact the project manager or other appropriate personnel to discuss.

   The water level should be monitored every 3 to 5 minutes (or as appropriate, lower flow rates may require longer time between readings) during pumping if the well diameter is of sufficient size to allow such monitoring. Do not break pump suction or cause entrainment of air in the sample. Record pumping rate adjustments and depths to water. If necessary, reduce pumping rates to the minimum capabilities of the pump to avoid pumping the well dry and/or to stabilize indicator parameters. Maintain a steady flow rate to the extent practicable. Review groundwater sampling records from previous sampling events (if available) prior to mobilization to estimate the optimum pumping rate and anticipated drawdown for the well in order to more efficiently reach a stabilized pumping condition.

   If the recharge rate of the well is very low, use approved alternative purging techniques, which will vary based on the well construction and screen position. For wells screened across the water table, the well may be pumped dry and sampling can commence as soon as the volume in the well has recovered sufficiently to permit collection of samples. For wells screened entirely below the water table, the well can be pumped until a stabilized level (which may be greater than the maximum displacement goal of 0.3 foot) is maintained and monitoring for stabilization of field indicator parameters can commence. If a lower stabilization level cannot be maintained, the well may be pumped until the drawdown is at a level slightly higher than top of the well screen. Sampling may commence after one well volume has been removed and the well has recovered sufficiently to permit collection of samples.

During purging, monitor the field indicator parameters (e.g., turbidity, temperature, specific conductance, pH, ORP, and DO) every 3 to 5 minutes (or after each volume of the flow-through cell has been purged). Measure field indicator parameters using a flow-through analytical cell or a clean container such as a glass beaker. Record field indicator parameters on the groundwater sampling log. The well is considered stabilized and ready for sample collection when turbidity values remain within 10% (or within 1 nephelometric turbidity unit [NTU] if the turbidity reading is less than 5 NTU), the specific conductance and temperature values remain within 3%, ORP readings remain within ± 10 mV, DO values remain within 10%, and pH remains within 0.1 unit for three consecutive readings collected at 3- to 5-minute intervals (or other appropriate interval, alternate stabilization goals may exist in different geographic regions, consult the site-specific Work Plan for stabilization criteria). If the field indicator parameters do not stabilize within 1 hour of the start of purging, but the groundwater turbidity is below the goal of 10 NTU and the values for all other parameters are within 10%, the well can be sampled. If the parameters have stabilized but the turbidity is not in the range of the 5 NTU goal, the pump flow rate may be decreased to a minimum rate of 100 mL/min to reduce turbidity levels as low as possible.

DO is extremely susceptible to various external influences (including temperature or the presence of bubbles on the DO meter); care should be taken to minimize the agitation or other disturbance of water within the flow-through cell while collecting these measurements. If air bubbles are present on the DO probe or in the discharge tubing, remove them before taking a measurement. If DO values are not within acceptable range for the temperature of groundwater then again check for and remove air bubbles on the probe before re-measuring. If the DO value is 0.00 or less, then the meter should be serviced and re-calibrated. If the DO values are above possible results, then the meter should be serviced and re-calibrated.

During extreme weather conditions, stabilization of field indicator parameters may be difficult to attain. Modifications to the sampling procedures to alleviate these conditions (e.g., measuring the water temperature in the well adjacent to the pump intake) should be documented in the field notes. If other field conditions preclude stabilization of certain parameters, an explanation of why the parameters did not stabilize should also be documented on the groundwater sampling log.

7. After the indicator parameters have stabilized, collect groundwater samples by diverting flow out of the unfiltered discharge tubing into the appropriate labeled sample container. If a flow-through analytical cell is being used to measure field parameters, the flow-through cell should be disconnected after stabilization of the field indicator parameters and prior to groundwater sample collection. Under no circumstances should analytical samples be collected from the discharge of the flow-through cell.

8. Make sure the sample bottle caps have remained on the bottle until immediately prior to sample collection.

9. Don a new set of nitrile gloves prior to sample collection. While collecting the sample, make sure the bottle cap remains in the other hand of the sampler until replaced on the bottle. When the container is full (fill to the neck of the bottle, some headspace is acceptable), firmly screw on the cap (snug but

not too tight so that the screw cap is stripped). Do not use gloved hands to subsequently handle papers, pens, clothes, etc. before collecting the sample.

10. Collect any necessary duplicates and matrix spikes. As the laboratory should be analyzing the entire aqueous sample rather than sub-sampling, separate bottles will be required for these samples.
11. Do not rinse PFAS sample bottles during sampling. Do not filter samples.
12. Complete and attach the sample label(s) after sample collection and after the caps have been placed back on each container. Pre-printed labels are preferred, but pens and Sharpies® may be used.
13. Place sample bottles in a sealed Ziploc® bag. Place samples in coolers that are durable in transportation and keep the temperature between 0 and 4ºC until transported to the laboratory.
14. Record the sample name and time of sampling on the sample bottle label, in the field notes and note observations (e.g., physical appearance and the presence or lack of odors or sheens), and record on the COC form.
15. NOTE: If high concentrations of PFAS related to class B firefighting foams are expected in a groundwater sample, collect and shake a small portion of the sample (~10 to 25 mL) on site. If foaming is noted within the sample, document the foaming when samples are submitted for analysis; the 'shaker test' vial can then be disposed. This shaker test provides information about how each of the samples should be handled analytically. Therefore, note ‘shake test’ results on the COC form if appropriate.
16. Turn off the pump. Slowly remove the tubing from the well. If the tubing will be dedicated, store the tubing in an appropriate storage container. Do not allow the tubing or lines to touch the ground or any other surfaces which could contaminate them.
17. Complete the procedures for packaging, shipping, and handling with the associated COC.
18. Between uses, complete decontamination procedures for flow-through analytical cell and water level meter, and any equipment that comes into contact with well water (see decontamination procedures described in Section 9 below).
19. At the end of the day, perform a calibration check of field instruments.
20. The general procedures listed in this document can be used for collection of samples from groundwater treatment systems or other similar sampling of water. In order to collect samples from a sampling port on a groundwater treatment system or for a similar situation follow the safety and quality procedures listed in this document. As a general note on sampling ports, ensure that there is no indication of Teflon™ tape or other Teflon™ containing material.

7 WASTE MANAGEMENT

Materials generated during groundwater sampling activities, including disposable equipment, should be placed in appropriate containers. PFAS containing waste requires special considerations and containerized waste will be stored onsite for future management by the responsible party.

8 DATA RECORDING AND MANAGEMENT

Initial field logs and COC records should be transmitted to the Arcadis Project Manager at the end of each day unless otherwise directed. The groundwater team leader retains copies of the groundwater sampling logs until they are relinquished to the project file.

9 QUALITY ASSURANCE

In addition to the quality control samples to be collected in accordance with these methods and procedures, the following quality control procedures should be observed in the field:

- Collect samples from monitoring wells, in order of increasing concentration, to the extent known based on review of historical site information if available. If no analytical data are available, collect samples in order of upgradient, then furthest downgradient to source area locations.
- Bottle caps must remain in the hand of the sampler until replaced on the bottle.
- Labels must be completed after the caps have been placed back on each bottle.
- Equipment blanks should be collected from various sampling equipment including the pump, water level meter (following decontamination procedures), disposable tubing, and nitrile gloves.
- Collect equipment blanks using laboratory supplied “PFAS-free” water after wells with higher concentrations (if known) have been sampled.
- Field duplicates, matrix spike, and matrix spike duplicates will be collected at a frequency in accordance with the QAPP and applicable QAPP Addenda.
- Samples must be stored in appropriate transport containers (coolers) with ice (Ziploc© bags for use as ice containers) with appropriate labeling. Do not use blue ice. Store PFAS samples in a separate cooler from other types of samples. Samples should be maintained at temperatures between 0 and 4ºC until transported to the laboratory.
- Operate all monitoring instrumentation in accordance with manufacturer’s instructions and calibration procedures. Calibrate instruments at the beginning of each day and verify the calibration at the end of each day. Record all calibration activities on calibration log sheets.
- Clean all groundwater sampling equipment prior to use in the first well and after each subsequent well following the procedure for PFAS equipment decontamination noted below. Clean all field equipment used at locations that are suspected of containing class B firefighting foam (i.e., those that foam during shaking or are known to be near a class B firefighting foam source zone) using each of the below steps repeated twice.
- The steps for PFAS equipment decontamination are as follows:
    - Donning a new pair of nitrile gloves;
    - Rinse sampling equipment with Alconox or Liquinox® cleaning solution; Scrub equipment with a plastic brush if needed;
    - Rinse two times with distilled water or deionized water;

- Rinse one time with “PFAS-free” water; and
- Collect all rinsate in a sealed pail for disposal. Do not reuse decontamination solutions between sampling locations

10 REFERENCES

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TGI - INVESTIGATION-DERIVED WASTE HANDLING AND STORAGE

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1 INTRODUCTION

This document describes general and/or specific procedures, methods, actions, steps, and considerations to be used and observed by Arcadis staff when performing work, tasks, or actions under the scope and relevancy of this document. This document may describe expectations, requirements, guidance, recommendations, and/or instructions pertinent to the service, work task, or activity it covers.

It is the responsibility of the Arcadis Certified Project Manager (CPM) to provide this document to the persons conducting services that fall under the scope and purpose of this procedure, instruction, and/or guidance. The Arcadis CPM will also ensure that the persons conducting the work falling under this document are appropriately trained and familiar with its content. The persons conducting the work under this document are required to meet the minimum competency requirements outlined herein, and inquire to the CPM regarding any questions, misunderstanding, or discrepancy related to the work under this document.

This document is not considered to be all inclusive nor does it apply to any and all projects. It is the CPM's responsibility to determine the proper scope and personnel required for each project. There may be project- and/or client- and/or state-specific requirements that may be more or less stringent than what is described herein. The CPM is responsible for informing Arcadis and/or Subcontractor personnel of omissions and/or deviations from this document that may be required for the project. In turn, project staff are required to inform the CPM if or when there is a deviation or omission from work performed as compared to what is described herein.

In following this document to execute the scope of work for a project, it may be necessary for staff to make professional judgment decisions to meet the project's scope of work based upon site conditions, staffing expertise, state-specific requirements, health and safety concerns, etc. Staff are required to consult with the CPM when or if a deviation or omission from this document is required that has not already been previously approved by the CPM. Upon approval by the CPM, the staff can perform the deviation or omission as confirmed by the CPM.

2 SCOPE AND APPLICATION

The objective of this Technical Guidance Instruction (TGI) is to describe the procedures to manage investigation-derived wastes (IDW), both hazardous and nonhazardous, generated during site activities, which may include, but are not limited to: drilling, trenching/excavation, construction, demolition, monitoring well sampling, soil sampling, decontamination and remediation. For the purposes of this TGI, IDW is considered to be discarded materials which are defined as solid waste by United States Environmental Protection Agency (EPA) standard 40 CFR § 261.2 (which may include liquids, solids, or sludges). IDW may include soil, groundwater, drilling fluids, decontamination liquids, as well as contaminated personal protective equipment (PPE), sorbent materials, construction and demolition debris, and disposable sampling materials. Hazardous or uncharacterized IDW will be collected and staged at the point of generation. Quantities small enough to be containerized in 55-gallon drums will be taken to a designated temporary onsite storage area (discussed in further detail under Drum Storage) pending characterization and disposal. IDW materials will be characterized using process knowledge and appropriate laboratory analyses to determine the waste classification and evaluate proper safe handling and disposal methods.

This TGI describes the necessary equipment, field procedures, materials, regulatory references, and documentation procedures necessary for proper handling and storage of IDW up to the time it is properly transported from the project site and disposed. The procedures included in this TGI for handling and temporary storage of IDW are based on the EPA's guidance document *Guide to Management of Investigation Derived Wastes* (USEPA, 1992). IDW is assumed to be contaminated with the site constituents of concern (COCs) until analytical evidence indicates otherwise. IDW will be managed to ensure the protection of human health and the environment and will comply with all applicable or relevant and appropriate requirements (ARAR). Although not comprehensive, the following laws and regulations on Hazardous Waste Management should be considered as potential ARAR. It is the Arcadis Certified Project Manager (CPM) and/or designated Technical Expert to determine which laws and regulations, at all levels of government, are applicable to each project site and activity falling under this TGI.

Federal Laws and Regulations

- Resource Conservation and Recovery Act (RCRA) 42 USC § 6901-6987.
- Federal Hazardous Waste Regulations 40 CFR § 260-265

Department of Transportation (DOT) Hazardous Materials Transportation 49 CFR

Occupational Safety and Health Administration (OSHA) Regulations 29 CFR

State Laws and Regulations

- To be determined based on location of site and location of treatment, storage, and/or disposal facility (TSDF) to be utilized.

Regional, County, Municipal, and Local Regulations

- To be determined based on location of site and location of treatment, storage, and/or disposal facility (TSDF) to be utilized.

Initial Storage

Pending characterization, IDW will be temporarily stored appropriately within each area of contamination (AOC). Under RCRA, "storage" is defined as the "holding of hazardous waste for a temporary period, at the end of which the hazardous waste is treated, disposed of, or stored elsewhere" (40 CFR § 260.10). The onsite waste staging area will be in a secure and controlled area. Uncharacterized wastes are considered potentially hazardous wastes and must be stored in DOT approved packaging. Liquid wastes must be stored in DOT approved closed head drums or other approved containers (e.g., portable tank containers) that are compatible with the type of material stored therein. Solid materials must be stored in DOT approved open head drums where practicable. Larger quantities of solid IDW can be containerized in bulk containers (such as in a roll-off box). Soil from large excavation projects may be managed in stockpiles with within the AOC and does not need to be containerized until exiting the AOC.

Characterization

Waste characterization can either be based on generator knowledge, such as using historical process knowledge and safety data sheets (SDS), or can be based upon characterization sampling analytical results. IDW typically is not characterized using SDS as it is a mixture of aged chemicals and environmental media. Historical process knowledge should be used to determine if the IDW is a listed hazardous waste (40 CFR § 261.31-33). If the IDW is not a listed hazardous waste, waste characterization can be completed by laboratory analysis of representative samples of the IDW. The laboratory used for waste characterization analysis must have the appropriate state and federal accreditations and may be required to be pre-approved by the Client. IDW will be classified as RCRA hazardous or non-regulated under RCRA based on the waste characterization determination.

If IDW is characterized as RCRA hazardous waste, RCRA and DOT requirements must be followed for packaging, labeling, transporting, storing, and record keeping as described in 40 CFR § 262 and 49 CFR § 171-178. Waste material classified as RCRA nonhazardous may be handled and disposed of as nonhazardous waste in accordance with applicable federal, state, and local regulations.

Storage Time Limitations

Containerized hazardous wastes can be temporarily stored for a maximum of 90 calendar days from the accumulation start date for a large quantity generator or a maximum of 180 calendar days from the accumulation start date for a small quantity generator. Wastes classified as nonhazardous may be handled and disposed of as nonhazardous waste and are not subject to storage time limitations.

This is TGI may be modified by the CPM and/or Technical Expert for a specific project or client program, as required, dependent upon client requirements, site conditions, equipment limitations, or limitations imposed by the procedure. The resulting procedure employed to execute the work will be documented in the project work plans or reports. If changes to the sampling procedures are required due to unanticipated field conditions, the changes will be discussed with the CPM and/or Technical Expert as soon as practicable, and if approved to be performed, be documented.

3 PERSONNEL QUALIFICATIONS

Arcadis field sampling personnel will have current regulatory- and Arcadis-required health and safety training including 40-hour HAZWOPER training, site supervisor training, site-specific training, first aid, and cardiopulmonary resuscitation (CPR), as needed. Personnel handling and packaging hazardous waste and performing hazardous waste characterizations must have RCRA hazardous waste management training per 40 CFR § 264.16.

Although not common practice, in certain situations Arcadis personnel may sign waste profiles and/or waste manifests on a case by case basis for clients, provided the appropriate agreement is in place between Arcadis and the client documenting that Arcadis is not the generator, but is acting as an authorized representative of the generator. Arcadis personnel who sign waste profiles and/or waste manifests will have both current RCRA hazardous waste management training per 40 CFR § 264.16 and current DOT hazardous materials transportation training per 49 CFR § 172.704. Arcadis field personnel will also comply with client-specific training. In addition, Arcadis field sampling personnel will be knowledgeable in the relevant processes, procedures, and Technical Guidance Instructions (TGIs) and possess the demonstrated required skills and experience necessary to successfully complete the desired field work. The project health and safety plan (HASP) and other documents will identify other training requirements or access control requirements.

4 EQUIPMENT LIST

The Following Materials, as required, will be available for IDW handling and Storage:

- Appropriate personal protective equipment as specified in the Site Health and Safety Plan (HASP)
- DOT approved containers
- Hammer
- Leather gloves
- Drum dolly
- Appropriate drum labels (outdoor waterproof self-adhesive)
- Portable tank container
- Appropriate labeling, packing, chain-of-custody forms, and shipping materials as determined by the CPM and/or Technical Expert.
- Indelible ink and/or permanent marking pens
- Plastic sheeting
- Appropriate sample containers, labels, and forms
- Stainless-steel bucket auger
- Stainless steel spatula or knife
- Stainless steel hand spade
- Stainless steel scoop
- Digital camera
- Field logbook

5 CAUTIONS

Filled drums can be very heavy, become unbalanced, or spill its contents. Therefore, use appropriate moving techniques and equipment for safe handling. Similar media (e.g. soils with other soils; or liquids with other liquids) will be stored in the same drums to aid in sample analysis and disposal. Drum lids must be secured to prevent rainwater from entering the drums and leakage during movement. Drums containing solid material may not contain any free liquids. Waste containers stored for extended periods of time may be subject to deterioration. Drum Over Packs may be used as secondary containment. All drums must be visually inspected for condition to ensure that they are in good condition without visible evidence of rusting, holes, breakage, etc., to prevent potential leakage and facilitate subsequent disposal. All drum lids must be verified as having a properly functioning secured lid prior to use.

6 HEALTH AND SAFETY CONSIDERATIONS

Click here and enter text] As determined by the site's known and suspected hazards, appropriate PPE must be worn by all field personnel within the designated work area. Exposure air monitoring may be required during certain field activities as required in the Site Health and Safety Plan. If soil excavation in areas with potentially hazardous contaminants is possible, contingency plans will be developed to address the potential for encountering gross contamination or non-aqueous phase liquids. All excavation activities shall be in compliance with OSHA standard 29 CFR 1926.651 Excavations, and any other applicable regulations.

Arcadis field personnel and subcontractors will be trained in and perform their work in compliance with all applicable federal, state, and local health and safety regulations as well as Arcadis' HASP and applicable Client health and safety requirements.

7 PROCEDURE

Specific waste temporary storage and handling procedures to be used are dependent upon the type of generated waste, including type of media (e.g. soils or free liquids) and constituents of concern. For this reason, IDW can be stored in a secure location onsite in separate 55-gallon storage drums, where solids can be stockpiled onsite (if nonhazardous) and purge water may be stored in portable tank containers. Waste materials such as broken sample bottles or equipment containers and wrappings will be stored in 55-gallon drums unless they were not in contact with sample media.

Management of IDW

Minimization of IDW should be considered by the project team during all phases of the project. Site managers may want to consider techniques such as replacing solvent based cleaners with aqueous-based cleaners for decontamination of equipment, reuse of equipment (where it can be properly decontaminated), limitation of traffic between exclusion and support zones, and drilling methods and sampling techniques that minimize the generation of waste. Alternative drilling and subsurface sampling methods may include the use of small diameter boreholes, as well as borehole testing methods such as a core penetrometer or direct push technique instead of coring.

Drum Storage

Drums containing hazardous waste will be stored in accordance with the requirements of 40 CFR 265 Subpart I (for containers) and 265 Subpart DD (for containment buildings). All 55-gallon drums will be stored at a secure, centralized onsite location that is readily accessible for vehicular pick-up. Drums confirmed as, or assumed to contain hazardous waste will be stored over an impervious surface provided with secondary spill containment. The storage location will, for drums containing liquid, have a containment system that can contain at least the larger of 10% of the aggregate volume of staged materials or 100% of the volume of the largest container. Drums will be closed during storage and be in good condition in accordance with the Guide to Management of Investigation-Derived Wastes (USEPA, 1992).

Hazardous Waste Determination

Waste material must be characterized to determine if it meets any of the federal definitions of hazardous waste as required by 40 CFR § 262.11. If the waste does not meet any of the federal definitions, it must then be established if any state-specific or local-specific hazardous waste criteria exist/apply.

Generator Status

Once hazardous waste determination has been made, the generator status will be determined. Large quantity generators (LQG) are generators who generate more than 1,000 kilograms of hazardous waste in a calendar month. Small quantity generators (SQG) of hazardous waste are generators who generate greater than 100 kilograms but less than 1,000 kilograms of hazardous waste in a calendar month. Conditionally exempt small quantity generators (CESQG) are generators who generate less than 100 kilograms of hazardous waste per month. Please note that a generator status may change from month to month and that a notice of this change is usually required by the generator's state agency.

Accumulation Time for Hazardous Waste

A LQG may accumulate hazardous waste on site for 90 calendar days or less without a permit and without having interim status, provided that such accumulation is in compliance with requirements in 40 CFR § 262.34. A SQG may accumulate hazardous waste on site for 180 calendar days or less without a permit or without having interim status, subject to the requirements of 40 CFR § 262.34(d). CESQG requirements are found in 40 CFR § 261.5. NOTE: The CESQG and SQG provisions of 40 CFR § 261.5, 262.20(e), 262.42(b) and 262.44 may not be recognized by some states (e.g., California and Rhode Island). State-specific and local-specific regulations must be reviewed and understood prior to the generation of hazardous waste.

Satellite Accumulation of Hazardous Waste Satellite accumulation (SAA) will mean the accumulation of as much as fifty-five (55) gallons of hazardous waste, or the accumulation of as much as one quart of acutely hazardous waste, in containers at or near any point of generation where the waste initially accumulates, which is under the control of the operator of the process generating the waste, without a permit or interim status and without complying with the requirements of 40 CFR § 262.34(a) and without any storage time limit, provided that the generator complies with 40 CFR § 262.34(c)(1)(i).

Once more than 55 gallons of hazardous waste accumulates in SAA, the generator has three days to move this waste into storage.

Storage recommendations for hazardous waste include:

- Ignitable Hazardous wastes must be >50 feet from the property line per 40 CFR § 265.176 (LQG generators only).
- Hazardous waste must be stored on a concrete slab (asphalt is acceptable if there are no free liquids in the waste) per 40 CFR § 265.176.
- Drainage must be directed away from the accumulation area.
- Area must be properly vented.
- Area must be secure.

Drum/Container Labeling

Drums will be labeled on both the side and lid of the drum using a permanent marking pen. Old drum labels must be removed to the extent possible, descriptions crossed out should any information remain, and new labels affixed on top of the old labels. Other containers used to store various types of waste (e.g., polyethylene tanks, roll-off boxes, end-dump trailers, etc.) will be labeled with an appropriate "Waste Container" or "Testing in Progress" label pending characterization. Drums and containers will be labeled as follows:

- Appropriate waste characterization label (Pending Analysis, Hazardous, or Nonhazardous)
- Waste generator's name (e.g., client name)
- Project Name
- Name and telephone number of Arcadis project manager

- Composition of contents (e.g., used oil, acetone 40%, toluene 60%)
- Media (e.g., solid, liquid)
- Accumulation start date
- Drum number of total drums as reconciled with the Drum Inventory maintained in the field log book.

IDW containers will remain closed except when adding or removing waste. Immediately upon beginning to place waste into the drum/container, a “Waste Container” or “Pending Analysis” label will be filled out to include the information specified above, and affixed to the container. Once the contents of the container are identified as either non-hazardous or hazardous, the following additional labels will be applied.

- Containers with waste determined to be non-hazardous will be labeled with a green and white "Nonhazardous Waste" label over the "Waste Container" label.
- Containers with waste determined to be hazardous will be stored in an onsite storage area and will be labeled with the "Hazardous Waste" label and affixed over the "Waste Container" label.

The ACCUMULATION DATE for the hazardous waste is the date the waste is first placed in the container and is the same date as the date on the "Waste Container" label. DOT hazardous class labels must be applied to all hazardous waste containers for shipment offsite to an approved disposal or recycling facility. In addition, a DOT proper shipping name will be included on the hazardous waste label. The transporter should be equipped with the appropriate DOT placards. However, placarding or offering placards to the initial transporter is the responsibility of the generator per 40 CFR § 262.33.

Inspections and Documentation

All IDW will be documented as generated on a Drum Inventory Log maintained in the field log book. The Drum Inventory will record the generation date, type, quantity, matrix and origin (e.g., Boring-1, Test Pit 3, etc.) of materials in every drum, as well as a unique identification number for each drum. The drum inventory will be used during drum pickup to assist with labeling of drums. The drum storage area and any other areas of temporarily staged waste, such as soil/debris piles, will be inspected weekly. The weekly inspections will be recorded in the field notebook or on a Weekly Inspection Log. Digital photographs will be taken upon the initial generation and drumming/staging of waste, and final labeling after characterization to document compliance with labeling and storage protocols, and condition of the container. Evidence of damage, tampering or other discrepancy should be documented photographically.

Emergency Response and Notifications

Specific procedures for responding to site emergencies will be detailed in the HASP. If the generator is designated as a LQG, a Contingency Plan will need to be prepared to include emergency response and notification procedures per 40 CFR § 265 Subpart D. In the event of a fire, explosion, or other release which could threaten human health outside of the site or when Client or ARCADIS has knowledge of a spill that has reached surface water, Client or ARCADIS must immediately notify the National Response Center (800-424-8802) in accordance with 40 CFR § 262.34. Other notifications to state and/or other local regulatory agencies may also be necessary.

Drilling Soil Cuttings and Muds

Soil cuttings are solid to semi-solid soils generated during trenching activities, subsurface soil sampling, or installation of monitoring wells. Depending on the drilling method, drilling fluids known as "muds" may be used to remove soil cuttings. Drilling fluids flushed from the borehole must be directed into a settling section of a mud pit. This allows reuse of the decanted fluids after removal of the settled sediments. Soil cuttings will be labeled and stored in 55-gallon drums with bolt-sealed lids.

Excavated Solids

Excavated solids may include, but are not limited to: soil, fill, and construction and demolition debris. Prior to permitted treatment or offsite disposal, potentially hazardous excavated solids may be temporarily stockpiled onsite as long as the stockpile remains in the same AOC from where it was excavated. Potentially hazardous excavated solids removed from the AOC must be immediately containerized in labeled drums or closable top roll-offs lined with 9-mil polyvinyl chloride (PVC) sheeting and are subject to LQG storage time limits. Nonhazardous excavated solids can be stockpiled either inside or outside of the AOC, do not have to be containerized and are not subject to hazardous waste regulations. Potentially hazardous excavated solids must not be mixed with nonhazardous excavated solids. All classes of excavated solid stockpiles should be maintained in a secure area onsite. At a minimum, the floor of the stockpile area will be covered with a 20-mil high density polyethylene liner that is supported by a foundation or at least a 60-mil high density polyethylene liner that is not supported by a foundation. The excavated material will not contain free liquids. The owner/operator will provide controls for windblown dispersion, run-on control, and precipitation runoff. The run-on control system will prevent flow onto the active portion of the pile during peak discharge from at least a 25-year storm and the run-off management system will collect and control at least the water volume resulting from a 24-hour, 25-year storm (USEPA, 1992). Additionally, the stockpile area will be inspected on a weekly basis and after storm events. Individual states may require that the stockpile be inspected/certified by a licensed professional engineer. Stockpiled material will be covered with a 6-mil polyvinyl chloride (PVC) liner or sprayed dust control product. The stockpile cover will be secured in place with appropriate material (concrete blocks, weights, etc.) to prevent the movement of the cover.

Decontamination Solutions

Decontamination solutions are generated during the decontamination of personal protective equipment and sampling equipment. Decontamination solutions may range from detergents, organic solvents and acids used to decontaminate small field sampling equipment to steam cleaning rinsate used to wash heavy field equipment. These solutions are to be labeled and stored in closed head drums compatible with the decontamination solution. Decontamination procedures, including personnel and field sampling equipment, must comply with applicable Arcadis procedural documents.

Disposable Equipment

Disposable equipment includes personal protective equipment (e.g., tyvek coveralls, gloves, booties and APR cartridges) and disposable sampling equipment such as trowels or disposable bailers. If the media sampled exhibits hazardous characteristics per results of waste characterization sampling, contaminated disposable equipment will also be disposed of as a hazardous waste. If compatible with the original IDW waste stream (i.e., the IDW is a solid and the disposal equipment is a solid), the disposable equipment can be combined with the IDW. If these materials are not compatible (i.e., the IDW is a liquid and the disposal equipment is a solid), the disposable equipment will be stored onsite in separate labeled 55-gallon drums. Uncontaminated or decontaminated disposable equipment can be considered nonhazardous waste.

Purge Water

Purge water includes groundwater generated during well development, groundwater sampling, or aquifer testing. The volume of groundwater generated will dictate the appropriate storage procedure. Monitoring well development and groundwater sampling may generate three well volumes of groundwater or more. This volume will be stored in labeled 55-gallon drums. Aquifer tests may generate significantly greater volumes of groundwater depending on the well yield and the duration of the test. Therefore, large-volume portable polyethylene tanks will be considered for temporary storage pending groundwater-waste characterization.

Purged Water Storage Tank Decontamination and Removal

The following procedures will be used for inspection, cleaning, and offsite removal of storage tanks used for temporary storage of purge water. These procedures are intended to be used for rented portable tanks such as Baker Tanks or Rain for Rent containers. Storage tanks will be made of inert plastic materials. The major steps for preparing a rented tank for return to a vendor include characterizing the purge water, disposing of the purge water, decontaminating the tank, final tank inspection, and mobilization. Decontamination and inspection procedures are described in further detail below.

- Tank Cleaning: Most vendors require that tanks be free of any visible sediment and water before returning, a professional cleaning service may be required. Each specific vendor should be consulted concerning specific requirements for returning tanks.
- Tank Inspection: After emptying the tank, purged water storage tanks should be inspected for debris, chemical staining, and physical damage. The vendors require that tanks be returned in the original condition (i.e., free of sediment, staining and no physical damage).

8 WASTE MANAGEMENT

Soil/Solids Characterization

Waste characterization will be conducted in accordance with waste hauler, waste handling facility, and local/state/federal requirements. In general, RCRA hazardous wastes are those solid wastes determined by a Toxicity Characteristic Leaching Procedure (TCLP) test or to contain levels of certain toxic metals, pesticides, or other organic chemicals above specific applicable regulatory agency thresholds. If the one or more of 40 toxic compounds listed in Table I of 40 CFR § 261.24 are detected in the sample at levels above the maximum unregulated concentrations, the waste must be characterized as a toxic hazardous waste. Wastes can also be considered “listed” hazardous waste depending on site-specific processes.

Composite soil samples will be collected at a frequency of one sample per 10 cubic yard basis for stockpiled soil or one per 55-gallon drum for containerized. A four-point composite sample will be collected per 10 cubic yards of stockpiled material and for each drum. Sample and composite frequencies may be adjusted in accordance with the waste handling facility’s requirements. Waste characterization samples may be analyzed for the TCLP volatile organic compounds (VOCs), TCLP semi-volatile organic compounds (SVOCs), TCLP RCRA metals, and polychlorinated biphenyls (PCBs), as well as reactivity and flammability (flashpoint). Additional samples may be collected and analyzed by the laboratory on a contingency basis. Site-specific constituents of concern including pesticides may require additional sampling. Please note that state- or local-specific regulations may require a different or additional sampling approaches.

Wastewater Characterization

Waste characterization will be conducted in accordance with the requirements of the waste hauler, waste handling facility, and local/state/federal governments. In general, purge water should be analyzed by methods appropriate for the known contaminants, if any, that have been historically detected in the monitoring wells. Samples will be collected and analyzed in accordance with the requirements of the waste disposal facility. Wastewater characterization samples may be analyzed for TCLP volatile organic compounds (VOCs), TCLP semi-volatile organic compounds (SVOCs), TCLP RCRA metals, and polychlorinated biphenyls, as well as corrosivity (pH), reactivity and flammability (flashpoint). Additional samples may be collected and analyzed by the laboratory on a contingency basis. Site-specific constituents of concern including pesticides may require additional sampling. Please note that state- and/or local-specific regulations may require different or additional sampling approaches.

Sample Handling and Shipping

All samples will be appropriately labeled, packed, and shipped, and the chain-of-custody will be filled out in accordance with current Arcadis sample chain of custody, handling, packing, and shipping procedures and guidance instructions.

It should be noted that additional training is required for packaging and shipping of hazardous and/or dangerous materials. Please refer to the current Arcadis training requirements related to handling and shipping of samples, shipping determinations, and hazardous materials.

Preparing Waste Shipment Documentation (Hazardous and Nonhazardous)

Waste profiles will be prepared by the Arcadis CPM and forwarded, along with laboratory analytical data to the Client for approval/signature. The Client will then return the profile to Arcadis who will then forward to the waste removal contractor for preparation of a manifest. The manifest will be reviewed by Arcadis prior to forwarding to the Client for approval. Upon approval of the manifest, the Client will return the original signed manifest directly to the waste contractor or to the Arcadis CPM for forwarding to the waste contractor. Arcadis personnel may sign waste profiles and/or waste manifests on a case by case basis for clients, provided the appropriate agreement is in place between Arcadis and the client documenting that Arcadis is not the generator, but is acting as an authorized representative of the generator.

Final drum labeling and pickup will be supervised by an Arcadis representative who is trained and experienced with applicable waste labeling procedures. The Arcadis representative will have a copy of the drum inventory maintained in the field book and will reconcile the drum inventory with the profile numbers on the labels and on the manifest. Different profile numbers will be generated for different matrices or materials in the drums. For example, the profile number for drill cuttings will be different than the profile number for purge water. When there are multiple profiles it is critical that the proper label, with the profile number appropriate to a specific material be affixed to the proper drums. A copy of the Arcadis drum inventory will be provided to the waste transporter during drum pickup and to the facility receiving the waste.

9 DATA RECORDING AND MANAGEMENT

Waste characterization sample handling, packing, and shipping procedures will be documented in accordance with relevant Arcadis procedures and guidance instructions as well as applicable client and/or project requirements, such as a Quality Assurance Project Plan or Sampling and Analysis Plan. Copies of the chain-of-custody forms will be maintained in the project file. Arcadis should photograph or maintain a copy of any hazardous waste manifest signed on behalf of Client in the corresponding office DOT record file.

10 QUALITY ASSURANCE

The CPM or APM will review all field documentation once per week for errors or omissions as compared to applicable project requirements including but not limited to: the proposal/scope of work, QAPP, SAP, HASP, etc. Deficiencies will be noted, tracked, and resolved. Upon correction, they will be noted for project documentation.

11 REFERENCES

United States Environmental Protection Agency (USEPA). 1992. Guide to Management of Investigation-Derived Wastes. Office of Remedial and Emergency Response. Hazardous Site Control Division. January 1992.

PFAS-SPECIFIC DRILLING AND MONITORING WELL INSTALLATION TECHNICAL GUIDANCE INSTRUCTION

Rev: #1

Rev Date: 3/26/2019

VERSION CONTROL

Revision No	Revision Date	Page No(s)	Description	Reviewed by
0	10/12/2018	All	Generated from generic Well Installation TGI (Rev 0, April 24, 2017). Revised to be PFAS-specific, provide more instruction on soil sample collection, and only include DPT and Sonic methods	Ankit Gupta
1	3/26/2019	Attachments	Added a restriction against all fluoropolymer materials in Table 2 for sampling; Removed Citranox as an appropriate decon solution in Table 1. Made a correction that Liquinox contains trace levels of 1,4 Dioxane, not Alconox.	Erika Houtz

APPROVAL SIGNATURES

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10/12/2018

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1 INTRODUCTION

This document describes general and/or specific procedures, methods, actions, steps, and considerations to be used and observed by Arcadis staff when performing work, tasks, or actions under the scope and relevancy of this document. This document may describe expectations, requirements, guidance, recommendations, and/or instructions pertinent to the service, work task, or activity it covers.

It is the responsibility of the Arcadis Certified Project Manager (CPM) to provide this document to the persons conducting services that fall under the scope and purpose of this procedure, instruction, and/or guidance. The Arcadis CPM will also ensure that the persons conducting the work falling under this document are appropriately trained and familiar with its content. The persons conducting the work under this document are required to meet the minimum competency requirements outlined herein, and inquire to the CPM regarding any questions, misunderstanding, or discrepancy related to the work under this document.

This document is not considered to be all inclusive nor does it apply to any and all projects. It is the CPM's responsibility to determine the proper scope and personnel required for each project. There may be project- and/or client- and/or state-specific requirements that may be more or less stringent than what is described herein. The CPM is responsible for informing Arcadis and/or Subcontractor personnel of omissions and/or deviations from this document that may be required for the project. In turn, project staff are required to inform the CPM if or when there is a deviation or omission from work performed as compared to what is described herein.

In following this document to execute the scope of work for a project, it may be necessary for staff to make professional judgment decisions to meet the project's scope of work based upon site conditions, staffing expertise, state-specific requirements, health and safety concerns, etc. Staff are required to consult with the CPM when or if a deviation or omission from this document is required that has not already been previously approved by the CPM. Upon approval by the CPM, the staff can perform the deviation or omission as confirmed by the CPM.

2 SCOPE AND APPLICATION

This Technical Guidance Instruction (TGI) describes methods used to advance soil borings via direct push technology (DPT) or rotosonic drilling techniques, collect single or multiple depth-discrete dry and/or saturated soil samples, and install groundwater monitoring wells in unconsolidated aquifers (as necessary) at sites impacted by per- and polyfluoroalkyl substances (PFASs). It covers specific considerations relevant for PFASs due to their unique chemical and physical properties, low detection limits, and low regulatory standards. A more detailed discussion of general PFAS sampling procedures is provided in PFAS Field Sampling Guidance TGI (Arcadis 2018a).

If monitoring wells are to be installed upon completion of borehole drilling and soil sampling, it is assumed that the monitoring well has been designed consistent with the approach and methods presented in the American Society of Testing and Materials (ASTM) D5092 – *Standard Practice for Design and Installation of Groundwater Monitoring Wells* (ASTM D5092). This includes sizing of the filter pack and screen slot size, the length of the screen, total depth of the well, material strength and compatibility and surface completion. Typical monitoring wells are constructed of manufactured screen and engineered filter pack and are generally suitable for formations with granular materials having a grain size distribution with up to 50% passing a #200 sieve and up to 20% clay-sized material. Monitoring wells installed in formations finer than this may not be able to produce turbidity free water.

The procedures set out herein are designed to produce standard groundwater monitoring wells suitable for: (1) groundwater sampling; (2) water level measurement; and (3) hydraulic conductivity testing of formation sediments immediately adjacent to the open interval of the well (e.g., slug testing).

This TGI will focus specifically on two drilling methods most likely to be utilized during drilling and soil sampling activities: DPT and rotosonic techniques. The drilling method to be used at a given site will be selected based on site-specific consideration of anticipated drilling depths, site or regional geologic knowledge, type of sampling to be conducted, project objectives, and cost.

No oils or grease will be used on equipment introduced into the boring (e.g., drill rod, casing, or sampling tools). No polyvinyl chloride (PVC) glue/cement will be used in constructing or retrofitting monitoring wells that will be used for water-quality monitoring. No coated bentonite pellets will be used in the well drilling or construction process. Specifications of materials to be installed in the borehole will be obtained prior to mobilizing onsite; these materials generally include:

- Well casing (length, material, and diameter);
- Well screen (length, material, diameter, and slot size);
- Bentonite (type, as applicable, chips, non-coated and granular bentonite are acceptable);
- Filter pack (filter pack type and fine sand seal type, as applicable); and
- Grout (type, as applicable).

Well materials will be inspected and, if needed, cleaned or replaced prior to installation.

3 PERSONNEL QUALIFICATIONS

Drilling and soil sampling activities will be performed by persons who have been trained in proper procedures under the guidance of an experienced field geologist, engineer, or technician, with particular emphasis on PFAS sampling procedures outlined in PFAS Field Sampling Guidance TGI (Arcadis 2018a). Field personnel will have undergone in-field training in soil description methods, as described in Soil Description TGI (Arcadis 2018b).

4 EQUIPMENT LIST

The following materials will be available during soil boring and monitoring well installation activities, as required:

- Site Plan with proposed soil boring/well locations;
- Work Plan (or equivalent) and Site Safety and Health Plan (SSHP);

- Personal protective equipment (PPE), as required by the SSHP;

- Traffic cones, delineators, caution tape, and/or fencing as appropriate for securing the work area, if not provided by drillers;

- Drilling/Sampling

    - Stainless-steel spatulas, spoons, and trowels
    - Stainless-steel hand auger with at least 10-ft of extension rods
    - PVC piping of larger diameter than hand auger, if necessary, to keep hand auger borings open
    - Soil logging equipment as specified in the appropriate project documents;
    - Dedicated low-density polyethylene (LDPE) plastic sheeting to prevent sample contact with the ground.
    - Photoionization detector (PID) or flame ionization detector (FID) with calibration gas;
    - 4-gas meter with calibration gas
    - Water level meter with fluorine-free materials (Geotech ET 3/8" with Delrin tip and Buna-N O-ring);
    - Laboratory provided PFAS-free water for field and equipment blank QC samples

- Appropriate sample containers and labels:

    - Laboratory-supplied sample bottles: see the Poly- and Perfluorinated Alkyl Substances (PFAS) Field Sampling Guidance (Arcadis 2018a) for PFAS-specific considerations;
    - 1-qt and 1-gal polyethylene bags (Ziploc® brand only) to hold ice and samples;
    - Appropriate blanks (field reagent blanks supplied by the laboratory);
    - Packing and shipping materials;
    - Chain-of-Custody (COC) Forms; see the Sample Chain of Custody Standard Operating Procedure (SOP) for reference (Arcadis 2017a);
    - Appropriate transport containers (coolers) with ice and appropriate labeling, no blue ice;

- Decontamination/Waste Management:
    - PFAS-free decontamination fluids and equipment
        - HDPE or PVC brushes and squirt bottles, stainless steel bowl
        - HDPE buckets to hold decontamination fluids
        - Alconox or Liquinox (other detergents prohibited)
        - Methanol or isopropyl alcohol, if necessary
        - Distilled or laboratory-supplied deionized water
        - Laboratory provided PFAS-free water

    - See the Poly- and Perfluorinated Alkyl Substances (PFAS) Field Sampling Guidance (Arcadis 2018a) or the Groundwater and Soil Sampling Equipment Decontamination TGI (Arcadis 2017b) for additional guidance;
    - Portable field hand washing setup;
    - Non-hazardous drum labels as required for investigation-derived waste handling: see the Investigation-Derived Waste Handling and Storage TGI for details (Arcadis 2017c).
- Field Notes:
    - Pens, pencils, and/or Sharpies® for writing;
    - Appropriate field forms; consider including a photo of the well head and a Google Earth map showing the well location.
    - Clipboards, field binders, field notebook, and field note pages that are not waterproof;
    - Digital camera.
- Other:
    - Field clothing made of cotton or other natural fibers that is well laundered (i.e., washed at least 6 times)
    - Well laundered cotton blankets for covering field vehicle seats
    - PFAS-free sunscreen and insect repellant
    - Garbage bags;
    - Paper towels;
- Locks and keys for securing the well after installation;
- Engineer's tape/measuring wheel;

Prior to mobilizing to the site, ARCADIS personnel will contact the drilling subcontractor or in-house driller (as appropriate) to confirm that appropriate sampling and well installation equipment will be provided. Specifications of the sampling and well installation equipment are expected to vary by project, and so communication with the driller is necessary to ensure that the materials provided will meet the project objectives. Equipment/materials typically provided by the driller could include:

- Disposable acetate (or Lexan ™) liners (when drilling with direct-push equipment);
- Drums for investigation derived waste;
- Drilling and sampling equipment decontamination materials;
- Decontamination pad materials;
- Well construction materials.

5 CAUTIONS

5.1 Utility Clearance

The appropriate drilling authorities will be contacted and a site visit for public utility line clearance at the proposed boring locations will be conducted at least 72 hours prior to work commencing. As applicable, utility maps will be reviewed during field reconnaissance of the proposed inspection locations to determine if any are co-located with public utility lines. Arcadis will also contract an independent geophysical survey company to verify that proposed boring locations are not co-located with existing underground utility/substructure features, as necessary. Arcadis will clear locations with soft dig methods to assess the presence of underground utilities as necessary. See the Utility Location and Clearance Arcadis Health and Safety Standard (Arcadis 2017d) for reference.

5.2 General Drilling and Well Construction Considerations

Prior to beginning field work, contact the project technical team to ensure that all field logistics (e.g., access issues, health and safety issues, communication network, schedules, etc.) and task objectives are clearly understood by all team members.

Some regulatory agencies require a minimum annular space between the well or permanent casing and the borehole wall. When specified, the minimum clearance is typically 2 inches on all sides (e.g., a 2-inch diameter well requires a 6-inch diameter borehole). In addition, some regulatory agencies have specific requirements regarding grout mixtures. Determine whether the oversight agency has any such requirements prior to finalizing the drilling and well installation plan.

If dense non-aqueous phase liquids (DNAPL) are known or expected to exist at the site, refer to the project specific documents for additional details regarding drilling and well installation to reduce the potential for inadvertent DNAPL remobilization.

Similarly, if light non-aqueous phase liquids (LNAPLs) are known or expected to be present as “perched” layers above the water table, refer to the DNAPL Contingency Plan. Follow the general provisions and concepts in the DNAPL contingency plan during drilling above the water table at known or expected LNAPL sites.

Consider the compatibility between the well materials and the surrounding environment. For example, PVC well materials are not preferred when DNAPL is present. In addition, some groundwater conditions leach metals from stainless steel or are corrosive to metal well materials. If questions arise, contact the CPM and/or project technical lead to discuss.

Specifications of materials used for backfilling the borehole will be obtained, reviewed and approved to meet project quality objectives. Bentonite is not recommended where DNAPLs are likely to be present or in groundwater with high salinity. In these situations, neat cement grout is preferred.

As noted above, coated bentonite pellets will not be used in monitoring well construction, as the coating could impact the water quality in the completed well.

Heat of hydration during neat cement grout curing must be considered to avoid damage to PVC well materials. The annular space for a typical monitoring well is small enough that heat of hydration should not create excessive temperature increases which may damage PVC well material. However, washouts in the borehole can lead to thick accumulations of grout which can produce enough heat during curing to weaken and potentially damage PVC casing. If heat of hydration is a concern, contact the project technical lead to address the issue.

5.3 PFAS-Specific General Sampling Considerations

This section provides a summary of methods and procedures applicable to the collection of environmental samples for field screening or laboratory analysis during PFAS site characterization activities. In general, sampling techniques used for PFAS site characterization are consistent with conventional sampling techniques used in the environmental industry, but special consideration is made regarding PFAS-containing materials and cross-contamination potential. For example, Teflon™ and other fluoropolymer containing materials are found in pumps, tubing, and sample storage containers and therefore should be avoided (Department of Environment Regulation [DER], Western Australia 2016; New Hampshire Department of Environmental Services [NHDES] 2016). Certain field documentation materials such as waterproof paper or field books, adhesive paper products, and some writing utensils (grouped as non-Sharpie® markers) are also prohibited items during PFAS sampling (DER 2016; NHDES 2016).

New nitrile gloves should be donned before any of the following activities:

- Decontamination of re-usable sampling equipment;
- Contact with sample bottles or PFAS-free water bottles;
- Handling clean sample tubing/down-well equipment or connecting tubing;
- Handling QC samples including field blanks and equipment blanks.

Additionally, new nitrile gloves should also be donned after handling of any non-dedicated sampling equipment; contact with contaminated surfaces; and whenever judged necessary by field personnel. **When in doubt change your gloves.**

Prior to initiating field activities, water sources to be used during drilling activities (e.g., rotosonic drilling, should be sampled to verify those sources are PFAS-free. While not part of the PQAPP, this is considered best practice and should be completed to the extent possible.

Waterproof field books must not be used for field notes. Instead, field notes should be on loose paper on Masonite, plastic, or aluminum clip boards. Other requirements for field notes include:

- Keep field notes, writing implements, and electronic data collection tablets away from samples and sampling materials; and,
- Do not write on sampling bottles unless they are closed.

Tables 1 and **2** in **Attachment 1** provide recommendations for PFAS Site Inspection equipment. **Table 1** provides a summary of materials that have been approved for site inspection; this list is expected to grow longer as industry experience increases. **Table 2** provides a summary of field equipment and materials that have available testing information and/or industry knowledge regarding PFAS cross-contamination potential and it is recommended that these materials be prohibited for sample collection. For materials that are suspected of containing PFASs and/or retaining PFASs, these recommendations are considered preliminary and subject to change.

Given the extremely low detection limits associated with PFAS analysis and the many potential sources of trace levels of PFASs, field personnel are typically advised to err on the side of caution by strictly following field wear guidelines and decontamination procedures as specified in the Poly- and Perfluorinated Alkyl Substances (PFAS) Field Sampling Guidance (Arcadis 2018a). **The most important consideration during PFAS related drilling and soil sampling is to prevent contact between sample media and suspect PFAS sources.**

5.4 PFAS-Specific Soil Sampling

Equipment that contacts soil cuttings during sampling activities should be carefully considered and selected. PFAS-containing materials are potentially present in some of the equipment typically used for soil sampling. This includes any lubricants, connections, fittings, etc. used on the cutting shoe on the head of a direct push drill string. Additionally, no materials that pose a cross-contamination risk should be introduced to the bucket of a hand auger. **To minimize the risk of cross-contamination, all hand augering activities (i.e. augering, sample collection, decontamination) should be performed by Arcadis personnel (as opposed to drilling subcontractor) when surface soil samples will be collected**. Each piece of reusable drilling/sampling equipment that comes into direct contact with soil cuttings or groundwater must be inspected before use to confirm that PFAS-containing materials are not present, which could be a source of cross-contamination and cause false positives, and that PFASs will not adhere to the material, which has the potential to cause low bias sample results. If equipment cannot be verified as being PFAS-free and there is a concern that it could potentially introduce contamination, a conservative number of equipment blanks should be collected to confirm that materials in the sample equipment do not cause false positives by introducing PFASs. Other quality assurance methods may be implemented to avoid materials that could result in potential losses associated with PFASs adhering to surfaces. For example, collecting soil samples for laboratory analysis from an “undisturbed” portion of a large diameter soil core is a good practice.

The following additional notes are provided regarding soil sampling materials:

- Where drilling or decontamination water is needed, a sample of the source water must be collected and analyzed for PFAS before drilling begins to ensure that background PFASs will not be introduced. Some water systems may be constructed with PFAS-containing thread and gasket sealants; therefore, an inspection of the source water distribution system may provide an additional level of assurance for identifying a source of PFAS-free water for site inspections.
- It is often standard practice to cover the ends of sample sleeves and protect the sample from potential cross-contamination from the plastic end caps with Teflon™ or other PTFE tape (Geotechnical Services, Inc. 2018); this practice is prohibited for PFAS sample collection (DER 2016).
- Lexan™ liner sleeves are made of polycarbonate and they are not expected to contain PFASs based on review of the Safety Data Sheet (Sabic 2016).
- Acetate (i.e., cellulose acetate butyrate) liners are commonly used as sleeves and are not expected to contain PFASs.

- Studies evaluating the use of stainless steel indicate that PFASs do not strongly sorb to stainless-steel (Obal et al. 2012). Therefore, stainless-steel sleeves and equipment should be acceptable for collection of soil samples for PFAS analysis.

6 HEALTH AND SAFETY CONSIDERATIONS

Field activities associated with drilling, soil sampling, and monitoring well installation will be performed in accordance with the SSHP, a copy of which will be present on site during such activities.

7 PROCEDURE

The procedures for drilling, soil sampling, and installing groundwater monitoring wells (if necessary), are presented below. All field sampling should be completed by a two-person team, with one collecting the samples, and the other handling documentation and providing support. This will help to limit the potential for accidental cross-contamination of the sample media.

7.1 Direct Push Technology (DPT) Method

Direct-push drilling may be used to complete soil borings and install monitoring wells. Examples of this technique include the Diedrich ESP vibratory probe system, GeoProbe®, or AMS Power Probe® dual-tube system. Environmental probe systems typically use a hydraulically operated percussion hammer. Depending on the equipment used, the hammer delivers 140- to 350-foot pounds of energy with each blow. The hammer provides the force needed to penetrate very stiff to medium dense soil formations. The hammer simultaneously advances an outer steel casing that contains a dual-tube liner for sampling soil. The outside diameter (OD) of the outer casing ranges from 1.75 to 2.4 inches and the OD of the inner sampling tube ranges from 1.1 to 1.8 inches. The outer casing isolates shallow layers and permits the unit to continue to probe at depth. The double-rod system provides a borehole that may be tremie-grouted from the bottom up. Alternatively, the inside diameter (ID) of the steel casing provides clearance for the installation of small-diameter (e.g., 0.75- to 1-inch ID) micro-wells. The procedures for drilling, soil sampling, and installing monitoring wells (if necessary) in soil using the direct-push method are described below.

1. Place LDPE plastic sheeting over core/sampling processing area to create a clean working surface, if conditions allow. Otherwise, prevent sampling equipment from contacting the ground or other surface that could compromise sample integrity.
2. Clear the ground surface of brush, root mat, grass, leaves, or other debris prior to sampling.
3. Decontaminate all non-disposable sampling equipment/tooling that will or may to come into direct contact with soil prior to first use. Disposable sampling equipment must be kept in sealed PFAS-free packaging until it is used.
4. Use stainless-steel hand auger to collect samples from 0 - 5 ft bgs surface interval, if applicable. All hand auguring to collect soil samples will be completed by Arcadis personnel, not the drilling subcontractor. These samples can be collected either during other Utility Clearance activities (e.g., third party clearance) or immediately prior to drilling.
    a. The sample should be collected manually directly from the hand auger bucket (using stainless steel scoop, spatula, or trowel as necessary) and placed directly into the sample

   jar, following Steps 7 – 15 below. The sample should not contact the ground or LDPE sheeting.
   b. If collecting multiple samples from the same boring, after collecting sample from the surface or shallowest depth interval examine the stability of the soil in the boring sidewalls. If sidewalls appear to be at risk of collapsing into the borehole insert a length of polyvinyl chloride (PVC) pipe into the boring to maintain the opening and prevent collapse prior to augering to the next deeper sampling interval.

5. If using direct push drilling method, use dual tube rod system and collect soil cores in acetate or Lexan ™ liners. The cutting shoe and core extractor must be stainless steel with no PFAS-containing materials present (e.g., gaskets, coatings).
6. After each drilling run, drillers extract and cut open liners and provide to Arcadis personnel for characterization and sampling. Drillers must not touch soil inside of liners during this process. Arcadis personnel decontaminate cutter between uses (see below).
7. Don a new set of nitrile gloves prior to handling sample core, then characterize soils in accordance with P-04 TGI - Soil Description (Arcadis 2018b). Record descriptions in the field notes, boring logs, and/or personal digital assistant (PDA). It is also beneficial to photo document the samples. It should be noted that PDA logs must be electronically backed up and transferred to a location accessible to other project team members as soon as feasible to retain and protect the field data.
8. Don a new set of nitrile gloves prior collecting soil samples for analysis. Do not use gloved hands to handle papers, pens, clothes, etc., before collecting samples. Do not touch outside of sample liner with gloved hands.
9. Collect field samples and any required QC samples from recovered soil cores using a clean stainless-steel trowel and place in clean, labeled bottles supplied by the laboratory for the required analyses. If collecting samples for multiple analyses, collect PFAS samples first. Make sure caps remain on PFAS sample bottles until immediately prior to filling. Caps must remain in the hand of the sampler until replacing on the bottle.
10. Once the sample has been placed in the bottle, and the bottle cap has been completely tightened, label the sample with sample identification number, date, and time of collection. Labels must be completed only after the caps have been placed back on each bottle. (See P-01 QP#3.06 Field Activities documentation for sample label information).
11. Place soil sample bottles in a sealed Ziploc© bag, and then into sample coolers. Store PFAS samples in separate cooler from other samples.
12. Record the label information and time of sampling in the field notes and sampling forms.
13. Fill out laboratory COC and check against the labels on the sample bottles progressively after each sample is collected.
14. Decontaminate all reusable sampling equipment between sample intervals and borings as described in Section 10.
15. Repeat Steps 7 – 14 until all samples have been collected from the boring location.
16. Abandon soil boring to grade in accordance with the site-specific work plan upon completion and before moving to the next boring location. **If well is to be installed, see Section 7.1.1 for well construction procedure**.
17. Mark boring location with wooden stake that identifies boring ID for subsequent surveying, as necessary.

18. Manage investigation-derived-waste (IDW) as specified in Section 8 and in accordance with the site-specific work plan.
19. If samples are not shipped the same day as collected, add fresh ice to sample coolers at the end of the day to maintain the temperature between 0 and 6°C. Place ice in sealed Ziplock® bags. Do not use blue ice. Sample coolers must remain in the possession of the sampling team at all times or secured under lock and key until shipment to the laboratory.

7.1.1 DPT Monitoring-Well Construction

1. Upon advancing the borehole to the desired depth, install the well through the inner drill casing. The well will consist of 2-inch ID PVC or stainless-steel slotted screen and blank riser. Screen length and construction will be specified in the Work Plan or discussed with the Arcadis PM.

2. When the monitoring well assembly has been set in place, place a washed silica filter pack in the annular space from the bottom of the boring to a height of 1 to 2 feet above the top of the well screen (following specifications in the Work Plan) using a tremie pipe. The filter pack is placed, and drilling equipment (i.e., rods) extracted in increments until the top of the sand pack is at the appropriate depth. Verify that the expected volume of filter pack matches with the actual amount installed. There can be differences due to irregularities in the borehole. Washout of the borehole will result in the need for greater than calculated well materials. If a difference of more than 10% is noted, consult with the project technical team. The filter pack will be consistent with the screen slot size and the soil particle size in the screened interval, as specified in the Work Plan. The well should be gently surged to prevent filter pack material bridging and to settle the filter pack prior to well seal installation.

    a. Alternately, a monitoring well assembly with a pre-packed screen can be installed. The monitoring well assembly (i.e., regular PVC or pre-packed) should be discussed and decided prior to beginning field work and specified in the QAPP addendum. Pre-packed filters should be verified as PFAS-free prior to use.

3. A hydrated bentonite seal (a minimum of 2 feet thick) will then be placed in the annular space above the sand pack (alternatively, in some cases a fine sand seal may be installed instead of bentonite—follow the specifications in the Work Plan). Use of a tremie pipe is not required for placement of the bentonite seal (though may be required if a well is very deep and borehole bridging is reasonably anticipated). However, bentonite should be poured into the annular space slowly enough to ensure borehole bridging does not occur. If non-hydrated bentonite is used, the bentonite should be permitted to hydrate in place for a minimum of 30 minutes before proceeding. *No coated bentonite pellets will be used in monitoring well drilling or construction*. PFAS-free water (verified by laboratory analysis of source water) should be added to hydrate the bentonite if the seal is above the water table. Continuously monitor the placement of the sand pack and bentonite with a weighted tape measure.

4. During the extraction of the augers or casing, a cement/bentonite or neat cement grout will be placed in the annular space from the bentonite seal to a depth approximately 2 ft bgs or as

specified in the Work Plan. As with the filter pack, it is recommended that seal material be placed with a tremie pipe. Ensure that seal materials are mixed at the proper ratios with PFAS-free water (verified by laboratory analysis of source water) following manufacturer's recommendations.

5. Install the monitoring well completion as specified in the Work Plan. Typical completions are a locking, steel protective casing (extended at least 1.5 feet below grade and 2 feet above grade) over the riser casing set within a neat cement pad at grade. Alternatively, for flush-mount completions, place a steel curb box with a bolt-down lid over the riser casing set within a neat cement pad. In either case, the cement pad will extend approximately 1.5 to 2.0 feet below grade and laterally at least 1 foot in all directions from the protective casing and should slope gently away to promote drainage away from the well.

6. During well installation, record construction details and tabulate materials used in field notebook as well as appropriate field forms.

7. After completing the well installation, lock the well, clean the area, and dispose of materials in accordance with the procedures outlined in Section 8 below.

7.2 Rotosonic Drilling Methods

Rotosonic drilling produces soil cores that, for the most part, are relatively undisturbed, but note that when drilling in consolidated or finer-grained sediment the vibratory action during core barrel advancement may create secondary fractures or breaks.

1. Place LDPE plastic sheeting over core/sampling processing area to create a clean working surface, if conditions allow. Otherwise, prevent sampling equipment from contacting the ground or other surface that could compromise sample integrity.
2. Clear the ground surface of brush, root mat, grass, leaves, or other debris prior to sampling.
3. Decontaminate all non-disposable sampling equipment/tooling that will or may to come into direct contact with soil prior to first use. Disposable sampling equipment must be kept in sealed PFAS-free packaging until it is used.
4. Use stainless-steel hand auger to collect samples from 0 - 5 ft bgs surface interval, if applicable. All hand augering to collect soil samples will be completed by Arcadis personnel, not the drilling subcontractor. These samples can be collected either during other Utility Clearance activities (e.g., third party clearance) or immediately prior to drilling.
    a. Hand auger soil sample should be collected manually from the hand auger bucket (using stainless steel scoop, spatula, or trowel as necessary) and placed directly into the sample jar. The sample should not contact the ground or LDPE sheeting.
    b. If sampling by hand auger, after collecting sample from the surface or shallowest depth interval examine the stability of the soil in the boring sidewalls. If sidewalls appear to be at risk of collapsing into the borehole insert a length of polyvinyl chloride (PVC) pipe into the boring to maintain the opening and prevent collapse prior to augering to the next deeper sampling interval.

5. During rotosonic drilling, drillers extract soil core bags after each drilling run, place the core bag onto LDPE sheeting, and cut open bags so Arcadis personnel can perform characterization and sampling. Arcadis personnel should confirm with drilling subcontractor that core bags are constructed of PFAS-free material. Drillers must not touch soil inside of bags during this process. Arcadis personnel decontaminate cutter between uses (see below).
6. Don a new set of nitrile gloves prior to collecting each sample. Do not use gloved hands to handle papers, pens, clothes, etc., before collecting samples. Do not touch outside of sample bag with gloved hands.
7. During sampling, characterize soils in accordance with P-04 TGI - Soil Description (Arcadis 2018b). Record descriptions in the field notes, boring logs, and/or personal digital assistant (PDA). It is also beneficial to photo document the samples. It should be noted that PDA logs must be electronically backed up and transferred to a location accessible to other project team members as soon as feasible to retain and protect the field data.
8. Collect sample volumes from recovered soil cores using a clean stainless-steel trowel and place in clean, labeled bottles supplied by the laboratory for the required analyses (see sample container list in PQAPP Worksheets #19&30). Make sure caps remain on PFAS sample bottles until immediately prior to filling. Caps must remain in the hand of the sampler until replacing on the bottle.
9. Once the sample has been placed in the bottle, and the bottle cap has been completely tightened, label the sample with sample identification number, date, and time of collection. Labels must be completed only after the caps have been placed back on each bottle. (See P-01 QP#3.06 Field Activities documentation for sample label information).
10. Collect QC samples at frequency specified in PQAPP Worksheet #20. QC sample locations to be selected based on consultation with Arcadis RL.
11. Place soil sample bottles in a sealed Ziploc© bag, and then into sample coolers. Store PFAS samples in separate cooler from other samples.
12. Record the label information and time of sampling in the field notes and sampling forms.
13. Fill out laboratory COC and check against the labels on the sample bottles progressively after each sample is collected.
14. Abandon all soil borings to grade as specified in the QAPP Addendum upon completion and before moving to the next boring location. **If well is to be installed, see Section 7.2.1 for well construction procedure**.
15. Mark boring location with wooden stake that identifies boring ID for subsequent surveying, as necessary.
16. Manage investigation-derived-waste (IDW) as specified in site-specific work plan.
17. If samples are not shipped the same day as collected, add fresh ice to sample coolers at the end of the day to maintain the temperature between 0 and 6°C. Place ice in sealed polyethylene bags (Ziplock). Do not use blue ice. See QAPP worksheet #19 and 30 for sample containers, preservation and hold times. Sample coolers must remain in the possession of the sampling team at all times or secured under lock and key until shipment to the laboratory.

7.2.1 Monitoring Well Construction

1. If it is necessary to install a monitor well into a permeable zone below a confining layer, particularly if the deeper zone is believed to have water quality that differs significantly from the zone above the confining layer, then a telescopic well construction will be considered. In this case, the borehole is advanced approximately 3 to 5 feet into the top of the confining layer, and a permanent casing (typically PVC, black steel or stainless steel) is installed into the socket drilled into the top of the confining layer. The casing is then grouted in place. Grout should be mixed with PFAS-free water (verified by laboratory analysis of source water). The preferred methods of grouting telescoping casings include: pressure-injection grouting using an inflatable packer installed temporarily into the base of the casing, such that grout is injected out the bottom of the casing until it is observed at ground surface outside the casing; displacement-method grouting (also known as the Halliburton method), which entails filling the casing with grout and displacing the grout out the bottom of the casing by pushing a drillable plug, typically made of wood to the bottom of the casing, following by tremie grouting the remainder of the annulus outside the casing; or tremie grouting the annulus surrounding the casing using a tremie pipe installed to the base of the borehole. In all three cases, the casing is grouted to the ground surface, and the grout is allowed to set prior to drilling deeper through the casing. Site-specific criteria and work plans should be created for the completion of non-standard monitoring wells, including telescopic wells.

2. Before installing a screened well, it is important to confirm that the borehole has been advanced into the targeted saturated zone. This is particularly important for wells installed to monitor the water table and/or the shallow saturated zone, as the capillary fringe may cause soils above the water table to appear saturated. If one or more previously installed monitoring wells exist nearby, use the depth to water at such well(s) to estimate the water-table depth at the new borehole location.

   To verify that the borehole has been advanced into the saturated zone, it is necessary to measure the water level in the borehole. For boreholes drilled using water (e.g., Rotosonic), monitor the water level in the borehole as it re-equilibrates to the static level. In low-permeability units like clay, fine-grained glacial tills, shale and other bedrock formations, it may be necessary to wait overnight to allow the water level to equilibrate. Document depth to water in the borehole on the appropriate field forms and field notebook. If there are questions concerning the depth of the well/screen interval, consult with the project technical lead or PM prior to finalizing well depth/screen interval. To the extent practicable, ensure that the depth of the well below the apparent water table is deep enough so that the installed well can monitor groundwater year-round, accounting for seasonal water-table fluctuations. When in doubt, err on the side of slightly deeper well installation.

3. Upon completing the borehole to the desired depth, if a screened well construction is desired, install the monitoring well by lowering the screen and solid PVC risers through the augers or casing. Monitoring wells typically will be constructed of 2-inch-diameter (although sometimes 4-inch), flush-threaded PVC or stainless steel slotted or wire wrapped well screen and blank riser

casing. Smaller diameters may be used if multiple wells are to be installed in a single borehole. The screen length will be specified in the Work Plan (or equivalent) based on regulatory requirements and specific monitoring objectives. Monitoring well screens should be limited to 5 to 10 feet long. The screen length will depend on the purpose for the well and the objectives of the groundwater investigation and will (in most cases) be determined prior to the field mobilization.

The slot size and filter pack gradation should be predetermined in the Work Plan (or equivalent) based on site-specific grain-size analysis (sieve analysis) or other geologic considerations or monitoring objectives. Typically, slot sizes for monitoring wells will range from 0.010 inches to 0.020 inches while the filter pack will be 20-40, Morie No. 0, or equivalent. In very fine-grained formations where sample turbidity needs to be minimized, it may be preferred to use a 0.006-inch slot size and 30-65, Morie No. 00, or equivalent filter pack. Alternatively, where monitoring wells are installed in coarse-grained deposits and higher well yield is required, a 0.020-inch slot size and 10-20, Morie No. 1, or equivalent filter pack may be preferred. If the screen slot size and filter pack have not been based on site-specific grain-size analysis, consider collecting soil samples during well installation so future wells can be properly designed.

Alternately, a monitoring well assembly with a pre-packed screen can be installed. The monitoring well assembly (i.e., regular PVC or pre-packed) should be discussed and decided prior to beginning field work and specified in the QAPP addendum. Pre-packed filters should be verified as PFAS-free prior to use.

A blank riser will extend from the top of the screen to approximately 2.5 feet above grade or, if necessary, just below grade where conditions warrant a flush-mounted monitoring well. For wells greater than 50 feet deep, centralizers may be desired to assist in centering the monitoring well in the borehole during construction.

4. When the monitoring well assembly has been set in place, place a washed silica filter pack in the annular space from the bottom of the boring to a height of 1 to 2 feet above the top of the well screen (following specifications in the Work Plan) using a tremie. The filter pack is placed, and drilling equipment extracted in increments until the top of the sand pack is at the appropriate depth. Verify that the expected volume of filter pack matches with the actual amount installed. There can be differences due to irregularities in the borehole. Washout of the borehole will result in the need for greater than calculated well materials. If a difference of more than 10% is noted, consult with the project technical team. The filter pack will be consistent with the screen slot size and the soil particle size in the screened interval, as specified in the Work Plan (or equivalent). The well should be gently surged to prevent filter pack material bridging and to settle the filter pack prior to well seal installation.

5. A hydrated bentonite seal (a minimum of 2 feet thick) will then be placed in the annular space above the sand pack (alternatively, in some cases a fine sand seal may be installed instead of bentonite—follow the specifications in the Work Plan). Use of a tremie pipe is not required for placement of the bentonite seal (though may be required if a well is very deep and borehole

bridging is reasonably anticipated). However, bentonite should be poured into the annular space slowly enough to ensure borehole bridging does not occur. If non-hydrated bentonite is used, the bentonite should be permitted to hydrate in place for a minimum of 30 minutes before proceeding. *No coated bentonite pellets will be used in monitoring well drilling or construction*. PFAS-free water (verified by laboratory analysis of source water) should be added to hydrate the bentonite if the seal is above the water table. Continuously monitor the placement of the sand pack and bentonite with a weighted tape measure.

6. During the extraction of the augers or casing, a cement/bentonite or neat cement grout will be placed in the annular space from the bentonite seal to a depth approximately 2 ft bgs or as specified in the Work Plan (or equivalent). As with the filter pack, it is recommended that seal material be placed with a tremie pipe. Ensure that seal materials are mixed at the proper ratios with PFAS-free water (verified by laboratory analysis of source water) following manufacturer's recommendations.

7. Install the monitoring well completion as specified Work Plan (or equivalent). Typical completions are a locking, steel protective casing (extended at least 1.5 feet below grade and 2 feet above grade) over the riser casing and secure with a neat cement seal. Alternatively, for flush-mount completions, place a steel curb box with a bolt-down lid over the riser casing and secure with a neat cement seal. In either case, the cement seal will extend approximately 1.5 to 2.0 feet below grade and laterally at least 1 foot in all directions from the protective casing and should slope gently away to promote drainage away from the well.

8. Monitoring wells should be labeled using indelible ink or paint with the appropriate designation on both the inner and outer well casings or inside of the curb box lid. Use caution when labeling the well as paint or indelible ink could potentially contain PFAS materials.

9. When an above-grade completion is used, the riser will be sealed using an expandable locking plug and the top of the well will be vented by drilling a small-diameter (1/8 inch) hole near the top of the well casing or through the locking plug, or by cutting a vertical slot in the top of the well casing. When a flush-mount installation is used, the riser will be sealed using an unvented, expandable locking plug.

10. During well installation, record construction details and actual measurements relayed by the drilling contractor and tabulate materials used (e.g., screen and riser footages; bags of bentonite, cement, and sand) in the field notebook as well as appropriate field forms.

11. After completing the well installation, lock the well, clean the area, and dispose of materials in accordance with the procedures outlined in Section 8 below.

8 WASTE MANAGEMENT

Investigation-derived waste (IDW) including soil cuttings, purge water, and decontamination water generated during cleaning procedures will be collected and placed in Department of Transportation approved containers, segregated by waste streams: see the Investigation-Derived Waste Handling and Storage TGI for details (Arcadis 2017c). All containers will be labeled as non-hazardous unless otherwise instructed by the project manager. Containerized IDW will be stored on site until it is profiled and subsequently transported to an approved facility for disposal or recycling. Waste manifests for all IDW suspected to have come into contact with PFAS should clearly note the presence of PFAS. Additional IDW sampling and management details will be provided in the site-specific Work Plan (QAPP addendum) and will be consistent with applicable Army policies and Army post requirements. Personal protective equipment (e.g., gloves, disposable clothing, disposable equipment) resulting from personnel cleaning procedures and soil sampling activities will be placed in plastic bags. These bags will be transferred into appropriately labeled waste containers for appropriate disposal.

9 DATA RECORDING AND MANAGEMENT

The supervising field lead will be responsible for documenting drilling events to record all relevant information in a clear and concise format. The record of drilling events should include:

- Start and finish drilling dates;
- Project name and location;
- Project number, client, and site location;
- Boring number and depths;
- Soil descriptions;
- Depth to water;
- Well construction specifications, if applicable (screen and riser material and diameter, sump length, screen length and slot size, riser length, sand pack type);
- Quantities of materials used (e.g., bentonite, grout);
- Type of drilling tools used (e.g., rig type);
- Core barrel size;
- Names of contractor’s drillers, inspectors, or other people onsite; and,
- Weather conditions.

Field staff should ensure COC Forms are properly completed, and verify which PFAS analytes (e.g., just PFOS and PFOA, some or all of the modified method 537 target analyte list) are required for analysis and note on the COC.

All documents (and photographs) should be scanned and electronically filed in the appropriate project directory for easy access. In addition, the locations of newly-installed wells will be documented photographically or in a site sketch. If appropriate, a measuring wheel or engineer's tape will be used to determine approximate distances between important site features.

The well location, ground surface elevation, and inner and outer casing elevations will be surveyed using the method specified in the site Work Plan. Generally, a local baseline control will be set up. This local baseline control can then be tied into the appropriate vertical and horizontal datum, such as the National Geodetic Vertical Datum of 1929 or 1988 and the State Plane Coordinate System. At a minimum, the elevation of the top of the inner casing used for water-level measurements should be measured to the nearest 0.01 foot. Elevations will be established in relation to the National Geodetic Vertical Datum of 1929. A permanent mark will be placed on top of the inner casing to mark the point for water-level measurements.

10 DECONTAMINATION

To avoid cross-contamination during drilling and sampling, all reusable groundwater sampling equipment that has or is suspected to have come into contact with groundwater or soil will be decontaminated between each sample using the following steps. If Class B firefighting foam is a suspected PFAS source at any sampling location, then these steps should be performed twice.

- Don new pair of Nitrile gloves prior to decontamination
- Scrub using a plastic brush and a non-phosphate soap free of VOCs (e.g., Liquinox, Alconox) and plastic brush;
- Double-rinse in potable deionized or distilled water;
- Rinse once with methanol or isopropyl alcohol;
- Rinse once with laboratory-certified PFAS-free water;
- Collect all rinsate in a sealed pail for disposal
- Allow time for equipment to air dry prior to re-use.

While strongly recommended, the use of solvents may be excluded for project-specific H&S concerns. If solvents are prohibited after DQO development, then additional procedures should be evaluated by the project team. Contingencies could include the use of dedicated sampling equipment at each sampling location or amending laboratory procedures to mitigate the increased risk of cross-contamination.

Additionally, the following decontamination procedure could be utilized when organic solvent use is not possible.

- Don new pair of Nitrile gloves prior to decontamination
- Scrub using a plastic brush and a non-phosphate soap free of VOCs (e.g., Liquinox, Alconox) and plastic brush;
- Single-rinse in potable deionized or distilled water;
- Scrub using a plastic brush and a non-phosphate soap free of VOCs (e.g., Liquinox, Alconox) and plastic brush;

- Rinse twice with deionized water and once with PFAS-free water;
- Collect all rinsate in a sealed pail for disposal
- Allow time for equipment to air dry prior to re-use.

Drive casings and other drilling tooling will be steam cleaned or replaced with new equipment between boreholes. Steam cleaning will be performed by the drillers within a temporary decontamination or other containment area designated by the supervising engineer or geologist that is located outside of the work zone. All decontamination water will be collected and containerized for disposal.

See additional specifics in P-04, TGI - Groundwater and Soil Sampling Equipment Decontamination in PQAPP Appendix A.

11QUALITY ASSURANCE

In general, the following quality assurance and quality control (QA/QC) samples should be collected:

- Equipment blanks
- Field (i.e., reagent) blanks
- Field duplicates
- Matrix spike/matrix spike duplicate

Details on QC sampling requirements (e.g., frequency of collection, types of QA/QC samples) are provided in the PQAPP and will be outlined in various Site-specific sampling scopes of work in the QAPP Addendum. Additionally, detailed procedures related to equipment and field (i.e., reagent) blank sample collection are outlined in the Equipment and Reagent Blank Sample Collection TGI (Arcadis 2018c). In general, equipment blanks should be collected from every piece of downhole equipment that could come in contact with soil or groundwater during sample collection. This includes all downhole tooling (e.g., drill bits, drill rods).

Prior to initiating field activities, water sources to be used during drilling and well construction activities should be sampled to verify those sources are PFAS-free. While not part of the PQAPP, this is considered best practice and should be completed to the extent possible.

Refer to quality control requirements for the project to ensure that appropriate quality assurance and quality control (QA/QC) samples are collected. When collecting QA/QC samples, the same guidelines apply as when collecting regular samples – specifically that:

- Samples should be collected in laboratory-supplied HDPE bottles;
- Bottle caps must remain in the hand of the sampler until replaced on the bottle;
- Labels must be completed after the caps have been placed back on each bottle; and,
- Samples must be stored in appropriate transport containers (coolers) with ice (Ziploc®-type bags for use as ice containers) with appropriate labeling. **Do not use blue ice. Store PFAS samples in a separate cooler from other types of samples.**

12 REFERENCES

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Massachusetts Department of Environmental Protection (MassDEP). 2017. DRAFT Fact Sheet, Guidance on Sampling and Analysis for PFAS at Disposal Sites Regulated under the Massachusetts Contingency Plan. January.

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ATTACHMENT 1

Table 1 and Table 2: PFAS Inspection Material Recommendations

Table 1: Summary of Acceptable Sampling Equipment and Materials for PFAS Site Inspections

Sampling Materials	Additional Considerations	References
Water Sampling Materials		
High density polyethylene (HDPE) or silicone tubing materials	--	DER 2016; USACE 2016; NHDES 2016; MassDEP 2017
HDPE HydraSleeves™	Low density polyethylene (LDPE) HydraSleeves™ are not recommended	USACE 2016; MassDEP 2017
Drilling and Soil Sampling Materials		
PFAS-free drilling fluids	--	DER 2016
PFAS-free makeup water	Confirm PFAS-free water source via laboratory analysis prior to inspections	--
Acetate liners	For use in soil sampling	USACE 2016
Sample Containers and Storage		
HDPE sample containers with HDPE lined lids for soil and water samples	Laboratory should provide; whole bottle analysis of aqueous samples combined with a solvent rinse of bottle is recommended	DER 2016, MassDEP 2017
Ice contained in plastic (polyethylene) bags (double bagged)	--	DER 2016; USACE 2016; NHDES 2016; MassDEP 2017
Field Documentation		
Sharpie®	--	NHDES 2016; USACE 2016; MassDEP 2017
Ball point pens	--	MassDEP 2017
Standard paper and paper labels	--	DER 2016; USACE 2016; NHDES 2016; MassDEP 2017
Decontamination		
Water-only decontamination	Confirm PFAS-free water source via laboratory analysis prior to inspections	DER 2016
Alconox® or Liquinox® followed by deionized water or PFAS-free water rinse	Liquinox® known to contain trace levels of 1,4-dioxane	NHDES 2016; USACE 2016; MassDEP 2017
Methanol, isopropanol, or acetone	Special health and safety precautions are necessary	UNEP 2015; USACE 2016

Note: This list is considered preliminary and additional materials may be added as additional information becomes available. Project teams are expected to follow a methodical evaluation process of materials to be used and confirm acceptance prior to implementation of field activities.

Table 2: Summary of Equipment and Materials Not Recommended for PFAS Site Inspections

Sampling Materials	Known PFAS-Containing Materials	Suspected PFAS-Containing Materials	Materials with Potential to Retain PFASs	References
Water Sampling Materials				
Teflon®, PTFE-containing or other fluoropolymer coated or containing field equipment (e.g., tubing, bailers, liners, tape, plumbing paste, pump parts)	x			DER 2016; USACE 2016; NHDES 2016; MassDEP 2017
Passive diffusion bags			x	MassDEP 2017
LDPE HydraSleeves ™			x	USACE 2016; MassDEP 2017
Water particle filters			x	MassDEP 2017
Drilling and Soil Sampling Materials				
Aluminum foil			x	DER 2016; USACE 2016; NHDES 2016; MassDEP 2017
Drilling fluid containing PFASs	x	x		DER 2016
Sample Containers and Storage				
Glass sample containers with lined lids			x	DER 2016; USACE 2016; NHDES 2016; MassDEP 2017
LDPE containers and lined lids			x	USACE 2016
Teflon® or PTFE- lined lids on containers (e.g., sample containers, rinsate water storage containers)	x			DER 2016; USACE 2016; NHDES 2016; MassDEP 2017
Reusable chemical or gel ice packs (e.g., BlueIce®)		x		DER 2016; USACE 2016; NHDES 2016; MassDEP 2017
Field Documentation				
Self-sticking notes and similar office products (e.g., 3M Post-it-notes)		x		DER 2016; USACE 2016; NHDES 2016; MassDEP 2017
Waterproof paper, notebooks, and labels	x			DER 2016, MassDEP 2017
Non-Sharpie® markers		x		NHDES 2016
Decontamination				
Some detergents and decontamination solutions (e.g., Decon 90® Decontamination Solution)	x	x		DER 2016; NHDES 2016; MassDEP 2017

Note: For materials that are suspected of containing PFASs, or have the potential to retain PFASs, project specific considerations may provide adequate justification for use during the field event. For example, further evaluation may be conducted in the form of pre-field equipment blank sample analysis.

TECHNICAL GUIDANCE INSTRUCTION - EQUIPMENT AND REAGENT BLANK SAMPLE COLLECTION FOR PFAS ANALYSIS

USAEC PFAS PA/SI

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1 INTRODUCTION

This document describes general and/or specific procedures, methods, actions, steps, and considerations to be used and observed by Arcadis staff when performing work, tasks, or actions under the scope and relevancy of this document. This document may describe expectations, requirements, guidance, recommendations, and/or instructions pertinent to the service, work task, or activity it covers.

It is the responsibility of the Arcadis Certified Project Manager (CPM) to provide this document to the persons conducting services that fall under the scope and purpose of this procedure, instruction, and/or guidance. The Arcadis CPM will also ensure that the persons conducting the work falling under this document are appropriately trained and familiar with its content. The persons conducting the work under this document are required to meet the minimum competency requirements outlined herein, and inquire to the CPM regarding any questions, misunderstanding, or discrepancy related to the work under this document.

This document is not considered to be all inclusive nor does it apply to all projects. It is the CPM's responsibility to determine the proper scope and personnel required for each project. There may be project- and/or client- and/or state-specific requirements that may be more or less stringent than what is described herein. The CPM is responsible for informing Arcadis and/or Subcontractor personnel of omissions and/or deviations from this document that may be required for the project. In turn, project staff are required to inform the CPM if or when there is a deviation or omission from work performed as compared to what is described herein.

In following this document to execute the scope of work for a project, it may be necessary for staff to make professional judgment decisions to meet the project's scope of work based upon site conditions, staffing expertise, regulation-specific requirements, health and safety concerns, etc. Staff are required to consult with the CPM when or if a deviation or omission from this document is required that has not already been previously approved by the CPM. Upon approval by the CPM, the staff can perform the deviation or omission as confirmed by the CPM.

2 SCOPE AND APPLICATION

Equipment and reagent blanks will be collected in the field during sampling activities and submitted for laboratory analysis. These samples are primarily intended to verify that sampling and decontamination practices are effectively preventing cross-contamination caused by reusable sample equipment or other per- and polyfluoroalkyl substances (PFAS)-containing materials.

The intent of this Technical Guidance Instruction (TGI) is to provide instructions for collection of equipment and reagent blanks during United States Army Environmental Command (USAEC) PFAS Preliminary Assessment and Site Inspection (PA/SI) at various installations More detailed instructions related to general PFAS sampling considerations is provided in the Poly- and Perfluorinated Alkyl Substances (PFAS) Field Sampling Guidance (Arcadis 2018).

3 PERSONNEL QUALIFICATIONS

Equipment and reagent samples will be collected by persons who have been trained in proper sampling procedures under the guidance of an experienced field geologist, engineer, or technician. Blank sampling should be completed with a two-person sampling team.

4 EQUIPMENT LIST

The following equipment and materials must be available for equipment and reagent blank sampling:

- Site plan which specifies frequency/quantity of blank sampling;
- Relevant work plan (e.g., PQAPP);
- Site Safety and Health Plan (SSHP);
- Appropriate health and safety equipment, as specified in the SSHP;
- Laboratory-provided “PFAS-free” water;
- Nitrile gloves;
- Dedicated plastic sheeting (preferably low-density polyethylene) or other clean surface to prevent sample contact with the ground;
- Pail or bucket with closable lid for excess rinse water;
- Garbage bags;
- Appropriate sample containers and labels;
    - Labeled high density polypropylene (HDPE) sample bottles: see the Poly- and Perfluorinated Alkyl Substances (PFAS) Field Sampling Guidance (Arcadis 2018) for PFAS-specific considerations;
    - Ziploc®-style bags to hold ice and samples;
    - Packing and shipping materials;
    - Chain-of-Custody (COC) Forms; see the Sample Chain of Custody Standard Operating Procedure (SOP) for reference (Arcadis 2017a);
    - Appropriate transport containers (coolers) with ice and appropriate labeling; no blue ice is to be used.
- Decontamination:
    - Equipment cleaning materials: see the Poly- and Perfluorinated Alkyl Substances (PFAS) Field Sampling Guidance (Arcadis 2018) or the Groundwater and Soil Sampling Equipment Decontamination TGI (Arcadis 2017b) as applicable;
    - An organic solvent such as isopropanol, methanol, or acetone should be used to decontaminate reusable equipment if it can be brought to the site safely. While strongly recommended, the use

of solvents may be excluded for project-specific health and safety concerns. Refer to Section 7.1.1 for more details.

  - Drum labels as required for investigation-derived waste handling: see the Investigation-Derived Waste Handling and Storage TGI for details (Arcadis 2017c);

- Field Notes:
  - Pens, pencils, and/or Sharpies® for writing;
  - Appropriate field forms;
  - Clipboards, field binders, field notebook, and field note pages that are not waterproof.

5 CAUTIONS

In general, sampling techniques used for PFAS sample collection are consistent with conventional sampling techniques used in the environmental industry, but special consideration is made regarding PFAS-containing materials and cross-contamination potential. The most important consideration during PFAS-related sampling is to prevent contact between sample media and suspect PFAS sources. During collection of equipment and reagent blanks, the sampled media (i.e., PFAS-free water) should not contact anything but the sample container. New nitrile gloves should be donned after handling of any non-dedicated sampling equipment; contact with contaminated surfaces; and whenever judged necessary by field personnel. **When in doubt change your gloves.** More detailed instructions related to general PFAS sampling considerations is provided in the TGI - Poly- and Perfluorinated Alkyl Substances (PFAS) Field Sampling Guidance (Arcadis 2018).

6 HEALTH AND SAFETY CONSIDERATIONS

Field activities associated with equipment and reagent blank sampling will be performed in accordance with the SSHP, a copy of which will be present on site during such activities.

7 PROCEDURE

The specific procedure for equipment and reagent blank sampling was developed after careful review and consideration of project data quality objectives. Procedures for equipment blank sampling and reagent blank sampling are further described in this section. **Note: the laboratory has to analyze the entire sample bottle for aqueous solutions of PFASs. When collecting each blank, fill two sample bottles and instruct the lab to hold one of them in reserve. If an unacceptable detection occurs in a blank, the second bottle of sample may be analyzed.**

7.1 Equipment Blank Sampling

7.1.1 Decontamination

Prior to collecting blank samples, the applicable piece of equipment should be properly decontaminated following these steps:

- Hand Tools and Sampling Devices (including hand augers and bladder pumps)
  1. Don new pair of nitrile gloves prior to decontamination
  2. Remove o-rings and bladder (applies only to bladder pump)
  3. Scrub using a plastic brush and a non-phosphate soap free of volatile organic compounds (VOCs) (e.g., Liquinox, Alconox);
  4. Double-rinse in deionized or distilled water;
  5. Rinse once with the site-approved organic rinsing solvent (e.g., isopropanol, methanol, acetone);
  6. Rinse once with PFAS-free water;
  7. Collect all rinsate in a sealed pail for disposal;
  8. Allowed time to air dry prior to re-use.
  9. Insert new o-rings and bladder (applies only to bladder pump)

See additional specifics in P-04, TGI - Groundwater and Soil Sampling Equipment Decontamination in the PQAPP Appendix A.

While strongly recommended, the use of solvents may be excluded for project-specific health and safety concerns. If solvents are prohibited, then additional procedures should be evaluated by the project team. Contingencies could include the use of dedicated sampling equipment at each sampling location or amending laboratory procedures to mitigate the increased risk of cross-contamination.

The following decontamination procedure could be utilized when organic solvent use is not possible:

1. Don new pair of nitrile gloves prior to decontamination
2. Remove o-rings and bladder (applies only to bladder pump)
3. Scrub using a plastic brush and a non-phosphate soap free of VOCs (e.g., Liquinox, Alconox);
4. Single-rinse in deionized or distilled water;
5. Scrub using a plastic brush and a non-phosphate soap free of VOCs (e.g., Liquinox, Alconox);
6. Rinse twice with deionized water and once with PFAS-free water;
7. Collect all rinsate in a sealed pail for disposal;
8. Allowed time to air dry prior to re-use.
9. Insert new o-rings and bladder (applies only to bladder pump)

- Drilling Rods
  - Drive casings and other drilling equipment will be steam cleaned or replaced with new equipment between boreholes.
  - The drilling equipment will be cleaned in an area designated by the supervising engineer or geologist that is located outside of the work zone.

After verifying the piece of equipment is properly decontaminated, and after determining an equipment blank is warranted per the sampling quality assurance / quality control (QA/QC) plan, follow the specific procedures for the relevant type of equipment found in the following sections.

7.1.2 Drilling Equipment (Hand Auger or Cutting Shoe/Drill Rod)

- Two field personnel should participate in the collection of the equipment blank. One person ("Field Personnel #1") should hold the sampling bottle and collect the sample, and the second person ("Field Personnel #2") should pour the rinse water.
- The best timing to collect equipment blanks is immediately after the collection of a sample likely to contain high concentrations of PFASs, after the sampling equipment has been appropriately decontaminated.

1. Label the laboratory-provided HDPE bottles with applicable information (e.g., sample ID, date, time, analysis required). Keep bottle lid on until immediately prior to sample collection.
2. Lay down dedicated plastic sheeting or other clean surface to prevent sample contact with the ground.
3. Place the sealable bucket or pail on top of plastic sheeting.
4. Don a new pair of nitrile gloves prior to blank collection (Field Personnel #1 and #2). Do not use gloved hands to handle other objects (e.g., papers, pens, clothes, equipment) before collecting samples.
5. Open the sample container and position the piece of clean, decontaminated sample equipment (i.e., hand auger or drilling rod/cutting shoe) above the container (Field Personnel #1). Keep the sample cap in the hand of the sampler (Field Personnel #1) until it is replaced on the bottle.
    - The bucket of the hand auger can be removed from the rods/handle and held manually.
    - The drillers should assist the field staff with removing the cutting shoe from the drill string and positioning it for sampling.
6. Slowly pour laboratory-provided "PFAS-free" water over any surface of the decontaminated sampling device that previously contacted sampled material (Field Personnel #2).
    - Pour water through the inside of the hand auger bucket while manually rotating the bucket so that "PFAS-free" water contacts all sides of the sampling device. Collect runoff in the sample container (Field Personnel #1), making sure that any excess "PFAS-free" water is contained in the sealable bucket or pail.
    - Pour water through the inside of cutting shoe while drilling contractor holds and manually rotates the shoe so that "PFAS-free" water contacts all sides of the shoe (Field Personnel #2). Collect runoff in the sample container, making sure that any excess "PFAS-free" water is contained in the sealable bucket or pail.
7. After collecting the necessary sample volume, place cap back on the sample bottle (Field Personnel #1). The bottle should be filled approximately full, but some headspace in the bottle is acceptable.
8. Collect the second bottle with the same procedure (Steps 5 to 7), if collecting a backup.
9. Record any label information that was not pre-filled out, if necessary (e.g., sample time), and place filled sample bottles in sealed Ziploc® bags. Record the label information and time of sampling in the field notes.
10. Add sample to the laboratory COC. Double check that the sample labels and COC agree. Note on the COC that one bottle should be held in reserve, if a backup bottle is collected.
11. Place sealed Ziploc® bag into the sample cooler. **Store PFAS samples in separate cooler from any other types of samples**.
12. Place dedicated plastic sheeting and nitrile gloves in plastic bags. These bags will be transferred into appropriately labeled waste containers for appropriate disposal.

7.1.3 Reusable Sediment Sampling Equipment (Stainless-Steel Hand Tools, Petite Ponar Grab Sampler)

- Two field personnel should participate in the collection of the equipment blank. One person ("Field Personnel #1") should hold the sampling bottle and collect the sample, and the second person ("Field Personnel #2") should pour the rinse water.
- The best timing to collect equipment blanks is immediately after the collection of a sample likely to contain high concentrations of PFASs, after the sampling equipment has been appropriately decontaminated.

1. Label the laboratory-provided HDPE bottles with applicable information (e.g., sample ID, date, time, analysis required). Keep bottle lid on until immediately prior to sample collection.
2. Lay down dedicated plastic sheeting or other clean surface to prevent sample contact with the ground.
3. Place sealable bucket or pail on top of plastic sheeting.
4. Don new pair of nitrile gloves prior to blank collection (both field personnel). Do not use gloved hands to handle other objects (e.g., papers, pens, clothes, equipment) before collecting samples.
5. Open sample container and position the clean, decontaminated piece of sample equipment (i.e., hand tool, grab sampler) above the container (Field Personnel #1). Keep the sample cap in the hand of the sampler (Field Personnel #1) until it is replaced on the bottle.
6. Slowly pour the laboratory-provided "PFAS-free" water over any surface of the sampling device that contacted sampled material (Field Personnel #2).
   - Pour water over front and back of all decontaminated hand tools such as spoons, spatulas, and trowels so that "PFAS-free" water touches all sides of the sampling device. Collect runoff in the sample container, making sure that any excess "PFAS-free" water is contained in the sealable bucket or pail (Field Personnel #1).
   - Pour water through inside of the decontaminated Petite Ponar Grab Sampler while rotating the sampler (or the "PFAS-free" water container) so that "PFAS-free" water contacts all interior sides of the sampler (Field Personnel #2). Collect runoff in the sample container, making sure that any excess "PFAS-free" water is contained in the sealable bucket or pail.
7. After collecting the necessary sample volume, place cap back on the sample bottle (Field Personnel #1). The bottle should be filled approximately full, but some headspace in the bottle is acceptable.
8. Collect the second bottle with the same procedure (Steps 5 to 7), if collecting a backup.
9. Record any label information that was not pre-filled out, if necessary (e.g., sample time), and place filled sample bottles in sealed Ziploc® bags. Record the label information and time of sampling in the field notes.
10. Add the sample to the laboratory COC. Double check that the sample labels and COC agree. Note on the COC that one bottle should be held in reserve, if a backup bottle is collected.
11. Place sealed Ziploc® bag into the sample cooler. **Store PFAS samples in separate cooler from any other types of samples**.
12. Place dedicated plastic sheeting and nitrile gloves in plastic bags. These bags will be transferred into appropriately labeled waste containers for appropriate disposal.

7.1.4 Disposable Sediment Sampling Equipment (Lexan ™ Liner Sleeve)

- Two field personnel should participate in the collection of the equipment blank. One person ("Field Personnel #1") should hold the sampling bottle and collect the sample, and the second person ("Field Personnel #2") should pour the rinse water.

- The best timing to collect equipment blanks is immediately after the collection of a sample likely to contain high concentrations of PFASs, after the sampling equipment has been appropriately decontaminated.

1. Label the laboratory-provided HDPE bottles with applicable information (e.g., sample ID, date, time, analysis required). Keep the bottle lid on until immediately prior to sample collection.
2. Lay down dedicated plastic sheeting or other clean surface to prevent sample contact with the ground.
3. Place sealable bucket or pail on top of plastic sheeting.
4. Don new pair of nitrile gloves prior to blank collection (both field personnel). Do not use gloved hands to handle other objects (e.g., papers, pens, clothes, equipment) before collecting samples.
5. Open sample container and position a clean, new, and unused section of Lexan™ liner above the container (Field Personnel #1). Keep the sample cap in the hand of the sampler (Field Personnel #1) until it is replaced on the bottle.
6. Slowly pour laboratory-provided "PFAS-free" water over any surface of the sampling device that contacted sampled material (Field Personnel #2).
   - Pour water through inside of Lexan ™ liner while rotating the liner so that "PFAS-free" water contacts all interior sides of the liner. Collect runoff in the sample container, making sure that any excess "PFAS-free" water is contained in the sealable bucket or pail.
7. After collecting the necessary sample volume, place cap back on the sample bottle (Field Personnel #1). The bottle should be filled approximately full, but some headspace in the bottle is acceptable.
8. Collect the second bottle with the same procedure (Steps 5 to 7), if collecting a backup.
9. Record any label information that was not pre-filled out, if necessary (e.g., sample time), and place filled sample bottles in sealed Ziploc® bags. Record the label information and time of sampling in the field notes.
10. Add sample to the laboratory COC. Double check that the sample labels and COC agree. Note on the COC that one bottle should be held in reserve, if a backup bottle is collected.
11. Place sealed Ziploc® bag into the sample cooler. **Store PFAS samples in separate cooler from any other types of samples**.
12. Place dedicated plastic sheeting and nitrile gloves in plastic bags. These bags will be transferred into appropriately labeled waste containers for appropriate disposal.

7.1.5 Reusable Water Sampling Equipment (Peristaltic Pump, Bladder Pump, Stainless-Steel Bailer)

7.1.5.1 Peristaltic Pump

- Two field personnel should participate in the collection of the equipment blank. One person ("Field Personnel #1") should hold the sampling bottle and collect the sample, and the second person ("Field Personnel #2") should set up the pump and pour/ transfer the blank water.
- The best timing to collect equipment blanks is immediately after the collection of a sample likely to contain high concentrations of PFASs, after the sampling equipment has been appropriately decontaminated.

1. Label the laboratory-provided HDPE bottles with applicable information (e.g., sample ID, date, time, analysis required). Keep bottle lid on until immediately prior to sample collection.
2. Lay down dedicated plastic sheeting other clean surface to prevent sample contact with the ground.

3. Don new pair of nitrile gloved prior to blank collection (both field personnel). Do not use gloved hands to handle other objects (e.g., papers, pens, clothes, equipment) before collecting samples.
4. Pour laboratory-supplied “PFAS-free” water into a clean HDPE sample bottle (Field Personnel #2).
5. Insert new HDPE tubing into the HDPE bottle containing “PFAS-free” water and connect tubing to peristaltic pump (with new silicone tubing) (Field Personnel #2).
6. Open sample container, keeping the sample cap in the hand of the sampler until it is replaced on the bottle (Field Personnel #1).
7. Turn the peristaltic pump on and slowly pump the “PFAS-free” water into the labeled sample container (Field Personnel #2).
8. After collecting the necessary sample volume, place cap back on the sample bottle (Field Personnel #1). The bottle should be filled approximately full, but some headspace in the bottle is acceptable.
9. Collect the second bottle with the same procedure (Steps 6 to 8), if collecting a backup.
10. Record any label information that was not pre-filled out, if necessary (e.g., sample time), and place filled sample bottles in sealed Ziploc® bags. Record the label information and time of sampling in the field notes.
11. Add the sample to the laboratory COC. Double check that the sample labels and COC agree. Note on the COC that one bottle should be held in reserve, if a backup bottle is collected.
12. Place sealed Ziploc® bag into the sample cooler. **Store PFAS samples in separate cooler from any other types of samples**.
13. Place dedicated plastic sheeting and nitrile gloves in plastic bags. These bags will be transferred into appropriately labeled waste containers for appropriate disposal.

7.1.5.2 Bladder Pump

- Two field personnel should participate in the collection of the equipment blank. One person (“Field Personnel #1”) should hold the sampling bottle and collect the sample, and the second person (“Field Personnel #2”) should set up the pump and pour/ transfer the blank water.
- The best timing to collect equipment blanks is immediately after the collection of a sample likely to contain high concentrations of PFASs, after the sampling equipment has been appropriately decontaminated.

1. Label the laboratory-provided HDPE bottles with applicable information (e.g., sample ID, date, time, analysis required). Keep the bottle lid on until immediately prior to sample collection.
2. Lay down dedicated plastic sheeting or other clean surface to prevent sample contact with the ground.
3. Don new pair of nitrile gloved prior to blank collection (both field personnel). Do not use gloved hands to handle papers, pens, clothes, equipment, etc., before collecting samples.
4. Pour laboratory-supplied “PFAS-free” water into an approved container (to avoid PFAS cross-contamination) large enough to submerge the bladder pump.
5. After properly decontaminating the bladder pump and replacing the bladder, attach a new section of HDPE tubing to the bladder pump, long enough to hold and direct flow into the labeled sample container. Submerge the bladder pump into the approved container of “PFAS-free” water (Field Personnel #2).
6. Open sample container, keeping the sample cap in the hand of the sampler until it is replaced on the bottle (Field Personnel #1).
7. Turn the bladder pump on and slowly pump the “PFAS-free” water into the labeled sample container (Field Personnel #2).

8. After collecting the necessary sample volume, place cap back on the sample bottle. The bottle should be filled approximately full, but some headspace in the bottle is acceptable.
9. Collect the second bottle with the same procedure (Steps 6 to 8), if collecting a backup.
10. Record any label information that was not pre-filled out, if necessary (e.g., sample time), and place filled sample bottles in sealed Ziploc® bags. Record the label information and time of sampling in the field notes.
11. Add sample to laboratory COC. Double check that the sample labels and COC agree. Note on the COC that one bottle should be held in reserve, if a backup bottle is collected.
12. Place sealed Ziploc® bag into the sample cooler. **Store PFAS samples in separate cooler from any other types of samples**.
13. Place dedicated plastic sheeting and nitrile gloves in plastic bags. These bags will be transferred into appropriately labeled waste containers for appropriate disposal.

7.1.5.3 Stainless-Steel Bailer

- Two field personnel should participate in the collection of the equipment blank. One person ("Field Personnel #1") should hold the sampling bottle and collect the sample, and the second person ("Field Personnel #2") should pour the rinse water.
- The best timing to collect equipment blanks is immediately after the collection of a sample likely to contain high concentrations of PFASs, after the sampling equipment has been appropriately decontaminated.

1. Label the laboratory-provided HDPE bottles with applicable information (e.g., sample ID, date, time, analysis required). Keep bottle lid on until immediately prior to sample collection.
2. Lay down dedicated plastic sheeting or other clean surface to prevent sample contact with the ground.
3. Place sealable bucket or pail on top of plastic sheeting.
4. Don new pair of nitrile gloves prior to blank collection (both field personnel). Do not use gloved hands to handle other objects (e.g., papers, pens, clothes, equipment) before collecting samples.
5. Open sample container (Field Personnel #1) and position the bailer above the container (Field Personnel #2). Keep the sample cap in the hand of the sampler (Field Personnel #1) until it is replaced on the bottle.
6. Fill the stainless-steel bailer with enough laboratory-provided "PFAS-free" water to collect the necessary sample volume (Field Personnel #2).
7. Slowly pour laboratory-provided "PFAS-free" water from the stainless-steel bailer into the sample container (Field Personnel #2).
8. After collecting the necessary sample volume, place cap back on the sample bottle. The bottle should be filled approximately full, but some headspace in the bottle is acceptable.
9. Collect the second bottle with the same procedure (Steps 5 to 8), if collecting a backup.
10. Place filled sample bottles in sealed Ziploc® bags, record any label information that was not pre-filled out, if necessary (e.g., sample time). Record the label information and time of sampling in the field notes and sampling forms.
11. Fill out the laboratory COC and check against the labels on the Equipment Blank sample bottle(s) progressively after each Equipment Blank is collected. Note on the COC that one bottle should be held in reserve, if a backup bottle is collected.
12. Place sealed Ziploc® bag into the sample cooler. **Store PFAS samples in a separate cooler from any other types of samples**.
13. Place dedicated plastic sheeting and nitrile gloves in plastic bags. These bags will be transferred into appropriately labeled waste containers for appropriate disposal.

7.2 Field Reagent Blank Sampling

- Two field personnel should participate in the collection of the reagent blank. One person (“Field Personnel #1”) should hold the sampling bottle and collect the sample, and the second person (“Field Personnel #2”) should pour the blank water.
- This sample should be collected after field staff return from an offsite break (e.g., lunch) to capture any potential cross-contamination from field personnel.

1. Label the laboratory-provided HDPE bottles with applicable information (e.g., sample ID, date, time, analysis required). Keep the bottle lid on until immediately prior to sample collection.
2. Don new pair of nitrile gloves prior to blank collection (both field personnel). Do not use gloved hands to handle other objects (e.g., papers, pens, clothes, equipment) before collecting samples.
3. Open sample container, keeping the sample cap in the hand of the sampler (Field Personnel #1) until it is replaced on the bottle (Field Personnel #1).
4. Slowly pour laboratory-provided “PFAS-free” water from the laboratory-provided container into the sample container (“Field Personnel #2”).
5. After collecting the necessary sample volume, place cap back on the sample bottle. The bottle should be filled approximately full, but some headspace in the bottle is acceptable.
6. Collect the second bottle with the same procedure (Steps 3 to 5) if collecting a backup.
7. Record any label information that was not pre-filled out, if necessary (e.g., sample time), and place filled sample bottles in sealed Ziploc® bags. Record the label information and time of sampling in the field notes.
8. Add sample to the laboratory COC. Double check that the sample labels and COC agree. Note on the COC that one bottle should be held in reserve, if a backup bottle is collected.
9. Place sealed Ziploc® bag into the sample cooler. **Store PFAS samples in separate cooler from any other types of samples**.
10. Place dedicated plastic sheeting and nitrile gloves in plastic bags. These bags will be transferred into appropriately labeled waste containers for appropriate disposal.

8 WASTE MANAGEMENT

Excess water generated during equipment and reagent blank collection procedures will be collected and contained on site in appropriate containers, (see the Investigation-Derived Waste Handling and Storage TGI for details [Arcadis 2017c]). All investigation-derived waste (IDW) generated will be placed in Department of Transportation approved containers, sealed, and labeled. Containerized IDW will be stored on site until it is profiled and subsequently transported to an approved facility for disposal or recycling. Waste manifests for all IDW suspected to have come into contact with PFAS should clearly note the presence of PFAS. Additional IDW sampling and management details will be provided in the site-specific Work Plan (QAPP addendum) and will be consistent with applicable Army policies and Army post requirements. Disposable personal protective equipment (e.g., gloves, disposable clothing, disposable equipment) will be placed in plastic bags. These bags will be transferred into appropriately labeled containers for appropriate disposal.

9 DATA RECORDING AND MANAGEMENT

The supervising field lead will be responsible for documenting equipment and reagent blank collection to record all relevant information in a clear and concise format. The record should include:

- Project name and location;
- Project number, client, and site location;
- Date and time of sample collection;
- Weather conditions.

Field staff should ensure COC Forms are properly completed, and verify which PFAS analytes (e.g., just PFOS and PFOA, some or all of the 537 list) are required for analysis and note on the COC. Any samples collected as backup and not intended to be immediately analyzed should be clearly documented.

9.1 Field Notes

Waterproof field books must not be used for field notes. Instead, field notes should be on loose paper on masonite, plastic, or aluminum clip boards. Other requirements for field notes include:

- Keep field notes, writing implements, and electronic data collection tablets away from samples and sampling materials; and,
- Do not write on sampling bottles unless they are closed.

10 QUALITY ASSURANCE

Refer to quality control requirements for the project to ensure that appropriate QA/QC samples are collected. When collecting QA/QC samples, the same guidelines apply as when collecting regular samples – specifically:

- **Duplicate samples of each equipment blank and reagent blank should be collected and submitted to the laboratory with instructions to hold for analysis. The purpose of this sample is to provide analytical back-up in case there are any issues with the original blank sample.**
- Samples should be collected in laboratory-supplied HDPE bottles;
- Bottle caps must remain in the hand of the sampler until replaced on the bottle;
- Labels must be completed after the caps have been placed back on each bottle; and,
- Samples must be stored in appropriate transport containers (coolers) with ice (Ziploc®-type bags for use as ice containers) with appropriate labeling. **Do not use blue ice. Store PFAS samples in a separate cooler from other types of samples.**

11 REFERENCES

Arcadis. 2018. TGI – Poly- and Perfluorinated Alkyl Substances (PFAS) Field Sampling Guidance. Rev. 2. October 15.

Arcadis. 2017a. SOP – Sample Chain of Custody, Rev. #1. May 23.

Arcadis. 2017b. TGI – Groundwater and Soil Sampling Equipment Decontamination, Rev. #0. February 23.

Arcadis. 2017c. TGI – Investigation-Derived Waste Handling and Storage, Rev. #0. February 23.

TECHNICAL GUIDANCE INSTRUCTIONS - VERTICAL AQUIFER PROFILING FOR PFAS ANALYSIS

USAEC PFAS PA/SI

Rev: 1

Rev Date: 3/26/2019

VERSION CONTROL

Revision No	Revision Date	Page No(s)	Description	Reviewed by
0	October 12, 2018	All	Created by combining aspects of the generic VAP TGI (Rev 0, June 22, 2018) and Ft. Leavenworth VAP TGI (Rev 1, July 19, 2018). PFAS-specific guidance.	Ankit Gupta
1	3/26/2019	Attachments	Added a restriction against all fluoropolymer materials in Table 2 for sampling; Removed Citranox as an appropriate decon solution in Table 1. Made a correction that Liquinox contains trace levels of 1,4 Dioxane, not Alconox.	Erika Houtz

APPROVAL SIGNATURES

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1 INTRODUCTION

This document describes general and/or specific procedures, methods, actions, steps, and considerations to be used and observed by Arcadis staff when performing work, tasks, or actions under the scope and relevancy of this document. This document may describe expectations, requirements, guidance, recommendations, and/or instructions pertinent to the service, work task, or activity it covers.

It is the responsibility of the Arcadis Certified Project Manager (CPM) to provide this document to the persons conducting services that fall under the scope and purpose of this procedure, instruction, and/or guidance. The Arcadis CPM will also ensure that the persons conducting the work falling under this document are appropriately trained and familiar with its content. The persons conducting the work under this document are required to meet the minimum competency requirements outlined herein, and inquire to the CPM regarding any questions, misunderstanding, or discrepancy related to the work under this document.

This document is not considered to be all inclusive nor does it apply to all projects. It is the CPM's responsibility to determine the proper scope and personnel required for each project. There may be project- and/or client- and/or state-specific requirements that may be more or less stringent than what is described herein. The CPM is responsible for informing Arcadis and/or Subcontractor personnel of omissions and/or deviations from this document that may be required for the project. In turn, project staff are required to inform the CPM if or when there is a deviation or omission from work performed as compared to what is described herein.

In following this document to execute the scope of work for a project, it may be necessary for staff to make professional judgment decisions to meet the project's scope of work based upon site conditions, staffing expertise, regulation-specific requirements, health and safety concerns, etc. Staff are required to consult with the CPM when or if a deviation or omission from this document is required that has not already been previously approved by the CPM. Upon approval by the CPM, the staff can perform the deviation or omission as confirmed by the CPM.

2 SCOPE AND APPLICATION

The intent of this Technical Guidance Instruction (TGI) is to provide instructions for groundwater VAP sampling during United States Army Environmental Command (USAEC) per- and polyfluoroalkyl substances (PFASs) Preliminary Assessments and Site Inspections (PA/SI) at various Army Installations. It also covers specific considerations for PFASs due to their unique chemical and physical properties, low detection limits, and low regulatory standards.

Soil borings will be advanced via direct push technology (DPT) or rotosonic drilling techniques to enable vertical aquifer profile (VAP) groundwater sampling to collect single or multiple depth-discrete groundwater samples using low-flow or grab sampling methodologies. Both methods will enable retrieval of continuous soil cores and lithologic logging, as well as collection of multiple depth-discrete dry and saturated soil samples. VAP groundwater sampling intervals should be co-located with or biased towards potential discrete transport zones (and target slow advection zones when feasible) as indicated by soil logging observations, permeability measurements (e.g., point slug tests, Geoprobe® hydraulic profiling tool [HPT] [preferred], Waterloo APS™ [alternate]), and/or interpreted hydrostratigraphy.

Multiple-depth discrete groundwater samples can be collected via drilling rod tooling They can be analyzed quickly by expedited, off-site, fixed lab or on-site mobile lab analysis to provide adaptive high-resolution quantitative groundwater concentration data. The vertical frequency of groundwater sampling within a formation should be determined relative to the scale of variability demonstrated in site hydrostratigraphy. Thin aquifers with transport zones only tens of feet thick can be sampled at intervals as close as 3 to 5 feet. In aquifers with transport zones of substantial thickness (e.g., more than 50 feet), sample spacing of 5 to 20 feet is usually adequate. It is important to note that field data should be evaluated to verify that sampling intervals provide sufficient resolution to meet data quality objectives (DQOs) (See **Section 7**).

3 PERSONNEL QUALIFICATIONS

VAP activities will be performed by persons who have been trained in proper drilling and sampling procedures under the guidance of an experienced field geologist, engineer, or technician. Drilling subcontractors will need current applicable drilling licenses. Arcadis and subcontractor personnel must also have completed any site/project/client-specific training requirements.

4 EQUIPMENT LIST

The following equipment and materials must be available for borehole advancement and VAP groundwater sampling:

- Site plan with proposed sampling locations;
- Relevant work plan (e.g., installation-specific Quality Assurance Project Plan [QAPP] Addendum);
- Site Safety and Health Plan (SSHP);
- Appropriate health and safety equipment, as specified in the SSHP;
- Drilling Equipment:
  - DPT and/or rotosonic drill rig (to be provided by drilling subcontractor). Type to be determined based on site-specific details;
  - Traffic cones, delineators, caution tape, and/or fencing as appropriate for securing the work area, if not provided by the drillers;
  - Note: Prior to mobilizing to the site, Arcadis personnel will contact the drilling subcontractor or in-house driller (as appropriate) to confirm that appropriate sampling equipment will be provided in quantities capable of achieving estimated target depths. Typical equipment/materials provided by the driller could include:
    - Acetate or other PFAS-free plastic liners;
    - Appropriate length of drilling rods and tooling;

    - Drilling and sampling equipment decontamination materials; and,
    - Decontamination pad materials, if required. See **Section 5.3** below for more information;
- Sampling:
  - Appropriate PFAS-free groundwater sampling equipment (e.g., disposable bailers for volumetric sampling, peristaltic pump for shallow groundwater sampling, submersible bladder pump for deeper sampling). Refer to the PFAS Field Sampling Guidance TGI (Arcadis 2018a) and Low-Flow Groundwater Purging and Sampling Procedures for Monitoring Wells TGI (Arcadis 2016) for necessary equipment;
  - Direct push groundwater samplers (e.g., Geoprobe® SP-22 or Geoprobe® SP-16) or rotosonic sampling devices (e.g., Cascade Packer Isolation Groundwater Profiler or Geoprobe® SP-60 Sonic Groundwater Sampler) to be provided by drilling subcontractor;
  - Appropriate soil sampling equipment if included in scope. Refer to the PFAS-Specific Drilling and Monitoring Well Installation TGI (Arcadis 2018b) for necessary equipment;
  - Dedicated low-density polyethylene (LDPE) plastic sheeting to prevent sample contact with the ground;
  - YSI 6-Series multi-parameter water quality probe (e.g., conductivity, temperature, dissolved oxygen, oxidation reduction potential) with flow-through cell;
  - Turbidity meter;
  - Water level meter with fluorine-free materials (Geotech ET 3/8" with Delrin tip and Buna-N O-ring);
  - Laboratory provided PFAS-free water for field and equipment blank QC samples.
  - Laboratory-provided HPDE PFAS shaker test vials
  - Appropriate sample containers and labels;
    - Laboratory-supplied HDPE sample bottles: see the Poly- and Perfluorinated Alkyl Substances (PFAS) Field Sampling Guidance (Arcadis 2018a) for PFAS-specific considerations;
    - Polyethylene bags (Ziploc® brand only) to hold ice and samples;
    - Appropriate blanks (field reagent blanks supplied by the laboratory);
    - Packing and shipping materials;
    - Chain-of-Custody (COC) Forms; see the Sample Chain of Custody Standard Operating Procedure (SOP) for reference (Arcadis 2017a);
    - Appropriate transport containers (coolers) with ice and appropriate labeling, no blue ice;
- Decontamination/Waste Management:
  - PFAS-free decontamination fluids and equipment
    - HDPE or PVC brushes and squirt bottles, stainless steel bowl

        - HDPE buckets to hold decontamination fluids
        - Alconox or Liquinox (other detergents prohibited)
        - Distilled or laboratory-supplied deionized water
        - Laboratory provided PFAS-free water
    - See the Poly- and Perfluorinated Alkyl Substances (PFAS) Field Sampling Guidance (Arcadis 2018a) or the Groundwater and Soil Sampling Equipment Decontamination TGI (Arcadis 2017b) for additional guidance;
    - Portable field hand washing setup
    - Non-hazardous drum labels as required for investigation-derived waste handling: see the Investigation-Derived Waste Handling and Storage TGI for details (Arcadis 2017c);
- Field Notes:
    - Pens, pencils, and/or Sharpies® for writing;
    - Appropriate field forms;
    - Clipboards, field binders, field notebook, and field note pages that are not waterproof.
- Other
    - Field clothing made of cotton or other natural fibers that is well laundered (i.e., washed at least 6 times)
    - Well laundered cotton blankets for covering field vehicle seats
    - PFAS-free sunscreen and insect repellant

5 CAUTIONS

5.1 Utility Clearance

The appropriate drilling authorities will be contacted and a site visit for public utility line clearance at the proposed boring locations will be conducted at least 72 hours prior to work commencing. As applicable, utility maps will be reviewed during field reconnaissance of the proposed inspection locations to determine if any are co-located with public utility lines. Arcadis will also contract an independent geophysical survey company to verify that proposed boring locations are not co-located with existing underground utility/substructure features, as necessary. Arcadis will clear locations with soft dig methods to assess the presence of underground utilities, as necessary. See the Utility Location and Clearance Arcadis Health and Safety Standard (Arcadis 2017d) for reference.

5.2 PFAS-Specific General Sampling Considerations

This section provides a summary of methods and procedures applicable to the collection of environmental samples for field screening or laboratory analysis during PFAS site characterization activities. In general, sampling techniques used for PFAS site characterization are consistent with conventional sampling techniques used in the environmental industry, but special consideration is made regarding PFAS-containing materials and cross-contamination potential. For example, Teflon™ and other fluoropolymer containing materials are found in pumps, tubing, and sample storage containers and therefore should be avoided (Department of Environment Regulation [DER], Western Australia 2016; New Hampshire Department of Environmental Services [NHDES] 2016). Certain field documentation materials such as waterproof paper or field books, adhesive paper products, and some writing utensils (grouped as non-Sharpie® markers) are also prohibited items during PFAS sampling (DER 2016; NHDES 2016).

New nitrile gloves should be donned before any of the following activities:

- Decontamination of re-usable sampling equipment;
- Contact with sample bottles or PFAS-free water bottles;
- Handling clean sample tubing/down-well equipment or connecting tubing;
- Handling QC samples including field blanks and equipment blanks.

Additionally, new nitrile gloves should also be donned after handling of any non-dedicated sampling equipment; contact with contaminated surfaces; and whenever judged necessary by field personnel. **When in doubt change your gloves.**

Waterproof field books must not be used for field notes. Instead, field notes should be on loose paper on Masonite, plastic, or aluminum clip boards. Other requirements for field notes include:

- Keep field notes, writing implements, and electronic data collection tablets away from samples and sampling materials; and,
- Do not write on sampling bottles unless they are closed.

Tables 1 and **2** in **Attachment 1** provides recommendations for PFAS Site Inspection equipment. **Table 1** provides a summary of materials that have been approved for site inspection; this list is expected to grow longer as industry experience increases. **Table 2** provides a summary of field equipment and materials that have available testing information and/or industry knowledge regarding PFAS cross-contamination potential and it is recommended that these materials be prohibited for sample collection. For materials that are suspected of containing PFASs and/or retaining PFASs, these recommendations are considered preliminary and subject to change.

Given the extremely low detection limits associated with PFAS analysis and the many potential sources of trace levels of PFASs, field personnel are typically advised to err on the side of caution by strictly following field wear guidelines and decontamination procedures as specified in the Poly- and Perfluorinated Alkyl Substances (PFAS) Field Sampling Guidance (Arcadis 2018a). **The most important consideration during PFAS related VAP sampling is to prevent contact between sample media and suspect PFAS sources.**

5.3 PFAS-Specific Groundwater Sampling

The potential presence of PFASs in equipment that may come in contact with the target water sample must be evaluated as part of the sample planning process to maintain sample integrity. For example, low-flow sampling with a peristaltic pump should be conducted using silicone or HDPE tubing; Teflon™ tubing is prohibited (DER 2016). If a bladder pump is used to collect samples, the bladder and other internal parts (e.g., check balls, o-rings, compression fittings) should not be made of Teflon™ either, and bladder and o-rings should be changed between samples (DER 2016).

Note that if high concentrations of PFASs related to Class B firefighting foams are expected in a groundwater sample, it has been recommended to collect and shake a small portion of the sample at the time of sample collection (USACE 2016; Arcadis 2018a). If foaming is noted within the sample, it indicates elevated concentrations of PFASs may be present and the sample should be proactively diluted at the laboratory prior to analysis. The foaming should be noted on the sample chain of custody form. It is recommended to collect sampling equipment blanks following foam observation to confirm the effectiveness of decontamination procedures.

6 HEALTH AND SAFETY CONSIDERATIONS

Field activities associated with borehole advancement and VAP groundwater sampling will be performed in accordance with the SSHP, a copy of which will be present on site during such activities.

7 PROCEDURE

The following sub-sections provide different approaches that can be utilized at different sites depending on the nature of the site to perform VAP sampling. The specific procedure for advancing borings for VAP groundwater sampling should be developed after careful review and consideration of project DQOs.

7.1 Direct Push Technology Vertical Aquifer Profile Sampling

Direct push tooling (DPT) is ideal for shallow unconsolidated aquifers (i.e. less than 100 feet bgs) and requires minimal water for drilling, thus reducing the potential for sample dilution. Typically, DPT VAP borings are conducted in boreholes adjacent to prior HPT borings to develop stratigraphic flux profiles. The primary advantage of completing permeability profiles via HPT in advance of sampling is to gain understanding of hydrofacies to ensure that the most appropriate intervals and sampling methods are used. Sampling depth intervals are determined based on the HPT profiles to target transport zones. Waterloo APS^{TM} can be utilized as an alternative to HPT to provide permeability profiles, but it is more time intensive than HPT; therefore, it is not considered the preferred tool for permeability profiling. In the absence of HPT data from a co-located adjacent borehole, sampling depth intervals can be determined based upon lithologic logging of soil cores, either from a separate co-located adjacent borehole or from the same borehole. Soil lithologic logging should be performed in accordance with Arcadis TGI for Soil Descriptions (Arcadis 2018c).

The VAP groundwater samples are typically collected every 5 to 20 feet with a bias to the more permeable transport zones. Samples are collected by driving a screen point sampling device such as Geoprobe® SP-22 or Geoprobe® SP-16 to the target interval and the screen opened to collect a groundwater sample. In poorly sorted aquifers with appreciable amounts of silt, VAP sampling from an adjacent borehole after completing initial permeability profiling (e.g., Geoprobe® HPT or point slug tests) is typically more efficient and cost effective.

DPT VAP sampling will be completed using a top-down sampling approach, which requires pulling the tooling out after each sample depth interval, decontaminating the tooling, resetting the groundwater sampler, and advancing the tooling to the next planned interval. This requires more time per borehole than some other sampling methods (e.g. bottom-up); however, it minimizes any potential for cross-contamination, and is therefore the preferred approach for PFAS projects due to the low detection limits and regulatory levels associated with PFASs. Furthermore, the top-down approach allows for grouting of the borehole from its bottom to the surface as tooling is retracted during borehole abandonment.

Single-Interval VAP Sampling

In some cases, it may be preferred to perform single-interval VAP sampling from the first encountered shallow groundwater. It should be verified that samples are taken below the water table (i.e., not perched water in the vadose zone). Single-interval VAP sampling should be performed with a Geoprobe® SP-16 sampling device or similar (e.g., HydroPunch ™). A primary difference with single-interval methods relative to multi-interval VAP sampling is that the sampling screen is driven to the appropriate depth by the drill rig (as opposed to lowering the sampling screen through the drill tools after reaching the appropriate depth).

If using a Geoprobe® SP-16 sampling device, the following steps should be followed:

1. Ensure 4-gas meter, YSI 6-Series multi-parameter water quality probe, and turbidity meter are calibrated each morning (see QAPP worksheet #22 and P-09 Calibration and Control of Measuring and Test Equipment in PQAPP Appendix A). Document calibration results on equipment calibration log;
2. Advance Geoprobe® SP-16, equipped with stainless-steel screen, using standard Geoprobe® rods to the target depth interval in accordance with Arcadis TGI for PFAS-Specific Drilling and Monitoring Well Installation (Arcadis 2018b);
3. Retract the tool string and screen sheath to expose the screen for the desired sample interval length, using extension rods to hold the screen in place. The Geoprobe® SP-16 sampling screen can range from 0” to approximately 44”. Note: no soil cores will be retrieved using the Geoprobe® SP-16;
4. Go to Step 13.

If using a HydroPunch ™ sampling device, the following steps should be followed:

5. Ensure 4-gas meter, YSI 6-Series multi-parameter water quality probe, and turbidity meter are calibrated each morning (see QAPP worksheet #22 and P-09 Calibration and Control of Measuring and Test Equipment in PQAPP Appendix A). Document calibration results on equipment calibration log;
6. The drilling subcontractor will advance the borehole to approximately 2 feet above the depth from which a discrete water sample is to be obtained;
7. The drilling subcontractor will disassemble the HydroPunch™ sampling device according to the manufacturer’s instructions to allow the sampler to be decontaminated. The sampler should be completely disassembled, including O-rings and/or check valves;
8. Decontaminate the sampler per instructions in Section 10 as appropriate for the range of groundwater analytes to be sampled for, by washing with laboratory-grade detergent and potable

water wash, followed by solvent rinse (if sampling for organics) and final rinse with deionized or distilled water. Check the condition of the O-rings during each cleaning and replace if necessary;

9. The drilling subcontractor will reassemble the decontaminated HydroPunch™ sampling device according to the manufacturer's instructions and lower the device to the bottom of the borehole;
10. The drilling subcontractor will push or drive the HydroPunch™ 5 feet below the bottom of the casing or augers, then retract the sampler 3 feet upward. Subsurface friction will retain the drive point in place, exposing the screen and allowing groundwater to enter the sampling tool;
11. Allow sufficient time to allow the sampler to fill with water. Typically, 30 minutes is sufficient, except in low permeability materials;
12. Go to Step 13.

Complete the following steps for sample collection:

13. Place LDPE plastic sheeting adjacent to the sample port for use as a clean work area, if conditions allow. Otherwise, prevent sampling equipment from contacting the ground or other surface that could compromise sample integrity. Do not allow vehicle exhaust to point towards the sample point;
14. Don a new set of nitrile gloves, connect tubing to sampling pump and flow-through cell and slowly lower tubing and/or pump into well. If possible, use two field personnel to insert tubing/pump into well to avoid contact with surrounding ground surface or other materials that could cause cross-contamination. Insert tubing (peristaltic pump, if depth to water <25 ft bgs), or pump intake (small-diameter bladder pump, if depth to water >25 ft bgs) at the approximate mid-depth of the sampler screen interval
    - Alternately, a Waterra-type inertial pump can be used to retrieve the water sample. If the formation has low-permeability and enough water is not anticipated in the tooling to allow purging of water, a stainless-steel bailer may be considered (after consulting with Arcadis RL);
15. Purge until water is visually clear of sediment, or for a maximum of 20 minutes before collecting GW samples;
    - Note: for low-permeability formations, collected a grab sample from the screen point sampling device and/or saturated soil sample from the soil core retrieved earlier, and then allow for overnight recovery of groundwater leaving temporary well casing and screen in the borehole for follow-up sampling the next day.
16. Don a new set of nitrile gloves prior to collecting groundwater sample and each QC sample. Do not use gloved hands to handle papers, pens, clothes, equipment, etc., before collecting samples;
17. Fill sample bottles using labeled HDPE bottles that are supplied by laboratory only. Make sure that the cap remains on the bottle until immediately prior to sample collection and gets placed back on the bottle immediately after sample collection. Do not place the cap on any surface, keep in hand opposite of sample collection, do not touch the inside of the cap;
18. If high concentration of PFAS related to class B Firefighting foams is expected in a groundwater sample (as specified in the QAPP Addendum), collect and shake a small portion of the sample (~10-25 mL) on site. If foaming is observed, document the foaming on the sample log and on the COC to notify laboratory personnel. The 'shaker test' vial can then be disposed;

19. Collect QC samples at frequency specified in PQAPP Worksheet #20. QC sample locations to be selected based on consultation with Arcadis RL;
20. Place filled sample bottles in a sealed (Ziploc) bag, record any label information that was not pre-filled out (i.e. sample time). Record the label information and time of sampling in the field notes and sampling forms. Place samples into sample coolers. Store PFAS samples in separate cooler from any other types of samples;
21. Fill out laboratory COC and check against the labels on the sample bottles progressively after each sample is collected;
22. Geoprobe® SP-16 sampling device is pulled back up and decontaminated (see Section 10);
23. Abandon the borehole as detailed in Section 7.3.

Multi-Interval VAP Sampling

In most cases, it is preferred to perform VAP sampling at multiple depth intervals in the same borehole. Multi-interval VAP sampling should be performed with a Geoprobe® SP-22 sampling device or similar. A primary difference with multiple-interval methods relative to single-interval VAP sampling is that the sampling screen is placed at the bottom of the borehole for sampling through the drill rods after retrieval of soil cores, rather than driven to the sampling depth by the drill rig.

If using a Geoprobe® SP-22 screen point sampling device, the following steps should be followed:

1. Ensure 4-gas meter, YSI 6-Series multi-parameter water quality probe, and turbidity meter are calibrated each morning (see QAPP worksheet #22 and P-09 Calibration and Control of Measuring and Test Equipment in PQAPP Appendix A). Document calibration results on equipment calibration log;
2. Advance dual-tube direct push casing with a plastic liner for soil core retrieval to target depth interval in accordance with Arcadis TGI for PFAS-Specific Drilling and Monitoring Well Installation (Arcadis 2018b);
3. Retrieve the soil core and characterize soils in accordance with Arcadis TGI for Soil Descriptions (Arcadis 2018c);
4. Lower the stainless-steel screen point sampling screen (Geoprobe® SP-22) to target depth and pull up the outer casing to expose the screen;
5. Place LDPE plastic sheeting adjacent to the sample port for use as a clean work area, if conditions allow. Otherwise, prevent sampling equipment from contacting the ground or other surface that could compromise sample integrity. Do not allow vehicle exhaust to point towards the sample point;
6. Don a new set of nitrile gloves, connect tubing to sampling pump and flow-through cell and slowly lower tubing and/or pump into well. If possible, use two field personnel to insert tubing/pump into well to avoid contact with surrounding ground surface or other materials that could cause cross-contamination. Insert tubing (peristaltic pump, if depth to water <25 ft bgs), or pump intake (bladder pump, if depth to water >25 ft bgs) at the approximate mid-depth of the sampler screen interval;
7. Purge well until water is visually clear of sediment, or for a maximum of 20 minutes before collecting GW samples;

   - Note: for low-permeability formations, collected a grab sample from the screen point sampling device and/or saturated soil sample from the soil core retrieved earlier, and then allow for overnight recovery of groundwater leaving temporary well casing and screen in the borehole for follow-up sampling the next day.

8. Don a new set of nitrile gloves prior to collecting groundwater sample and each QC sample. Do not use gloved hands to handle papers, pens, clothes, equipment, etc., before collecting samples;
9. Fill sample bottles using labeled HDPE bottles that are supplied by laboratory only. Make sure that the cap remains on the bottle until immediately prior to sample collection and gets placed back on the bottle immediately after sample collection. Do not place the cap on any surface, keep in hand opposite of sample collection, do not touch the inside of the cap;
10. If high concentration of PFAS related to class B Firefighting foams is expected in a groundwater sample (as specified in the QAPP Addendum), collect and shake a small portion of the sample (~10-25 mL) on site. If foaming is observed, document the foaming on the sample log and on the COC to notify laboratory personnel. The 'shaker test' vial can then be disposed;
11. Collect QC samples at frequency specified in PQAPP Worksheet #20. QC sample locations to be selected based on consultation with Arcadis RL;
12. Place filled sample bottles in a sealed (Ziploc) bag, record any label information that was not pre-filled out (i.e. sample time). Record the label information and time of sampling in the field notes and sampling forms. Place samples into sample coolers. Store PFAS samples in separate cooler from any other types of samples;
13. Fill out laboratory COC and check against the labels on the sample bottles progressively after each sample is collected;
14. Screen point sampling screen is pulled back up and decontaminated (see Section 10);
15. A new plastic liner is lowered back in and the entire assembly is then advanced to the next depth interval;
16. Repeat these steps until all samples have been collected from all target intervals;
17. Abandon the borehole as detailed in Section 7.3.

7.2 Sonic Drilling Vertical Aquifer Profile Sampling

For sites with deep unconsolidated aquifers or challenging drilling conditions (e.g., presence of dense tills, caliche, cobbles), direct push drilling may not be feasible or cost effective due to limited production rates. In these cases, alternate drilling methods (e.g., rotosonic) are required. Like direct push, groundwater profilers can be used to collect multiple depth-discrete groundwater samples biased towards transport zones based on soil lithological cores. The configuration of individual samplers varies based on their manufacturer and drilling contractor (e.g., Cascade Packer Isolation Groundwater Profiler or Geoprobe® SP-60 Packer Sampler). The overall strategy of sonic drilling VAP sampling is consistent with direct push VAP sampling; however, drilling with sonic or some rotary methods requires the introduction of drilling water that can potentially affect the integrity of the groundwater sample. If drilling water is used, a source blank sample will be collected prior to the start of work. Additionally, source water should be spiked with non-toxic fluorescence dyes per Arcadis SOP for use of visible tracer in drilling fluid to obtain representative groundwater samples during drilling (Arcadis 2010).

Sonic VAP sampling will be performed in a top-down manner using dual-tube casing. Packer Isolation Groundwater Profilers will be used to conduct VAP sampling. Thus, sampling will require pulling the tooling after each sample interval, decontaminating the tooling (if necessary), resetting the groundwater sampler, and advancing the tooling to the next planned interval. The biggest advantage of this device is that groundwater sampling depth intervals can be determined based on lithological logs obtained from the same borehole (since HPT is not deployable via rotosonic drilling methods), and the potential for cross-contamination between adjacent sampling intervals is limited.

The following steps should be followed:

1. Ensure 4-gas meter, YSI 6-Series multi-parameter water quality probe, and turbidity meter are calibrated each morning (see QAPP worksheet #22 and P-09 Calibration and Control of Measuring and Test Equipment in PQAPP Appendix A). Document calibration results on equipment calibration log;
2. Advance dual-tube sonic tooling casing to target depth interval in accordance with Arcadis TGI for PFAS-Specific Drilling and Monitoring Well Installation (Arcadis 2018b);
3. Retrieve the soil core and the inner sonic core barrel. Characterize soils in accordance with Arcadis TGI for Soil Descriptions (Arcadis 2018c);
4. Insert the stainless-steel screen and packer assembly (e.g., Cascade Packer Isolation Groundwater Profiler or Geoprobe® SP60 Packer Sampler) to the base of the sonic casing;
5. Extract the outer sonic casing to expose the screen to the formation;
6. Inflate the packer to isolate the screened interval from any water that might be above the packer in the sonic casing;
7. Place LDPE plastic sheeting adjacent to the sample port for use as a clean work area, if conditions allow. Otherwise, prevent sampling equipment from contacting the ground or other surface that could compromise sample integrity. Do not allow vehicle exhaust to point towards the sample point;
8. Don a new set of nitrile gloves, connect tubing to sampling pump and flow-through cell and slowly lower tubing and/or pump into well. If possible, use two field personnel to insert tubing/pump into well to avoid contact with surrounding ground surface or other materials that could cause cross-contamination. Insert tubing (peristaltic pump, if depth to water <25 ft bgs), or pump intake (bladder pump, if depth to water >25 ft bgs) at the approximate mid-depth of the sampler screen interval;
9. Purge well until water is visually clear of sediment, or for a maximum of 20 minutes before collecting GW samples;
    - Note: for low-permeability formations, collected a grab sample from the screen and/or saturated soil sample from the soil core retrieved earlier, and then allow for overnight recovery of groundwater leaving temporary well casing and screen in the borehole for follow-up sampling the next day.
10. Don a new set of nitrile gloves prior to collecting groundwater sample and each QC sample. Do not use gloved hands to handle papers, pens, clothes, equipment, etc., before collecting samples;
11. Fill sample bottles using labeled HDPE bottles that are supplied by laboratory only. Make sure that the cap remains on the bottle until immediately prior to sample collection and gets placed back on the bottle immediately after sample collection. Do not place the cap on any surface, keep in hand opposite of sample collection, do not touch the inside of the cap;
12. If high concentration of PFAS related to class B Firefighting foams is expected in a groundwater sample (as specified in the QAPP Addendum), collect and shake a small portion of the sample

(~10-25 mL) on site. If foaming is observed, document the foaming on the sample log and on the COC to notify laboratory personnel. The 'shaker test' vial can then be disposed;

13. Collect QC samples at frequency specified in PQAPP Worksheet #20. QC sample locations to be selected based on consultation with Arcadis RL;
14. Place filled sample bottles in a sealed (Ziploc) bag, record any label information that was not pre-filled out (i.e. sample time). Record the label information and time of sampling in the field notes and sampling forms. Place samples into sample coolers. Store PFAS samples in separate cooler from any other types of samples;
15. Fill out laboratory COC and check against the labels on the sample bottles progressively after each sample is collected;
16. Deflate the packer;
17. Packer Isolation Groundwater Profiler is pulled back up and decontaminated (see Section 10);
18. The dual-tube sonic tooling casing is then advanced to the next depth interval;
19. Repeat these steps until all samples have been collected from all target intervals;
20. Abandon the borehole as detailed in Section 7.3.

7.3 Borehole Abandonment

Borehole abandonment will be completed in accordance with the requirements set forth by applicable State agencies. Upon completion, each borehole is backfilled with bentonite grout from the terminal end (i.e. bottom) of the boring upward. A tremie grout pipe will be used to assist backfilling of deeper VAP boreholes. The top portion of each boring is sealed with asphalt or concrete to match the existing grade.

8 WASTE MANAGEMENT

Investigation-derived waste (IDW) soil cuttings, purge water, and decontamination water generated during cleaning procedures will be collected and contained on site in appropriate containers: see the Investigation-Derived Waste Handling and Storage TGI for details (Arcadis 2017c). All IDW generated during field activities will be placed in Department of Transportation approved containers, sealed, and labeled. Containerized IDW will be stored on site until waste characterization samples are analyzed and waste profile generated and are subsequently transported to an approved facility for disposal or recycling. Waste manifests for all IDW suspected to have come into contact with PFAS should clearly note the presence of PFAS. Additional IDW sampling and management details will be provided in the site-specific Work Plan (QAPP addendum) and will be consistent with applicable Army policies and Army post requirements. Personal protective equipment (e.g., gloves, disposable clothing, disposable equipment) resulting from personnel cleaning procedures and soil sampling activities will be placed in plastic bags. These bags will be transferred into appropriately labeled waste containers for appropriate disposal.

9 DATA RECORDING AND MANAGEMENT

The supervising field lead will be responsible for documenting drilling events to record all relevant information in a clear and concise format. The record of drilling events should include:

- Start and finish drilling dates;

- Project name and location;
- Project number, client, and site location;
- VAP boring number and depths;
- Soil descriptions;
- Depth to water;
- Type of VAP-special tools;
- Core barrel size;
- Names of contractor's drillers, inspectors, or other people onsite; and,
- Weather conditions.

Field staff should ensure COC Forms are properly completed, and verify which PFAS analytes (e.g., just PFOS and PFOA, some or all of the modified method 537 target analyte list) are required for analysis and note on the COC. All documents (and photographs) should be scanned and electronically filed in the appropriate project directory for easy access.

10 DECONTAMINATION

To avoid cross-contamination during drilling and sampling, all reusable groundwater sampling equipment that has or is suspected to have come into contact with groundwater or soil will be decontaminated between each sample using the following steps. If Class B firefighting foam is a suspected PFAS source at any sampling location, then these steps should be performed twice.

- Don new pair of Nitrile gloves prior to decontamination
- Scrub using a plastic brush and a non-phosphate soap free of VOCs (e.g., Liquinox, Alconox) and plastic brush;
- Double-rinse in potable deionized or distilled water;
- Rinse once with methanol or isopropyl alcohol;
- Rinse once with laboratory-certified PFAS-free water;
- Collect all rinsate in a sealed pail for disposal
- Allow time for equipment to air dry prior to re-use.

While strongly recommended, the use of solvents may be excluded for project-specific H&S concerns. If solvents are prohibited after DQO development, then additional procedures should be evaluated by the project team. Contingencies could include the use of dedicated sampling equipment at each sampling location or amending laboratory procedures to mitigate the increased risk of cross-contamination. Additionally, the following decontamination procedure could be utilized when organic solvent use is not possible.

- Don new pair of Nitrile gloves prior to decontamination

- Scrub using a plastic brush and a non-phosphate soap free of VOCs (e.g., Liquinox, Alconox) and plastic brush;
- Single-rinse in potable deionized or distilled water;
- Scrub using a plastic brush and a non-phosphate soap free of VOCs (e.g., Liquinox, Alconox) and plastic brush;
- Rinse twice with deionized water and once with PFAS-free water;
- Collect all rinsate in a sealed pail for disposal
- Allow time for equipment to air dry prior to re-use.

Drive casings and other drilling tooling (including Geoprobe® SP sampling tools, Packer Isolation Groundwater Profiler) will be steam cleaned between boreholes. Steam cleaning will be performed by the drillers within a temporary decontamination or other containment area designated by the supervising engineer or geologist that is located outside of the work zone. All decontamination water will be collected and containerized for disposal.

See additional specifics in P-04, TGI - Groundwater and Soil Sampling Equipment Decontamination in PQAPP Appendix A.

11 QUALITY ASSURANCE

In general, the following quality assurance and quality control (QA/QC) samples should be collected:

- Equipment blanks
- Field (i.e., reagent) blanks
- Field duplicates
- Matrix spike/matrix spike duplicate

Details on QC sampling requirements (e.g., frequency of collection, types of QA/QC samples) are provided in the PQAPP and will be outlined in various Site-specific sampling scopes of work in the QAPP Addendum. Additionally, detailed procedures related to equipment and field (i.e., reagent) blank sample collection are outlined in the Equipment and Reagent Blank Sample Collection TGI (Arcadis 2018d). In general, equipment blanks should be collected from every piece of downhole equipment that could come in contact with soil or groundwater during sample collection. This includes the profiling tools (e.g., Geoprobe® SP-16, Geoprobe® SP-22, Geoprobe® SP-60, Cascade Packer Isolation Groundwater Profiler).

Prior to initiating field activities, water sources to be used during drilling activities should be sampled to verify those sources are PFAS-free. While not part of the PQAPP, this is considered best practice and should be completed to the extent possible.

Refer to quality control requirements for the project to ensure that appropriate quality assurance and quality control (QA/QC) samples are collected. When collecting QA/QC samples, the same guidelines apply as when collecting regular samples – specifically that:

- Samples should be collected in laboratory-supplied HDPE bottles;
- Bottle caps must remain in the hand of the sampler until replaced on the bottle;
- Labels must be completed after the caps have been placed back on each bottle; and,
- Samples must be stored in appropriate transport containers (coolers) with ice (Ziploc®-type bags for use as ice containers) with appropriate labeling. **Do not use blue ice. Store PFAS samples in a separate cooler from other types of samples.**

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ATTACHMENT 1

Table 1 and Table 2: PFAS Inspection Material Recommendations

Table 1: Summary of Acceptable Sampling Equipment and Materials for PFAS Site Inspections

Sampling Materials	Additional Considerations	References
Water Sampling Materials		
High density polyethylene (HDPE) or silicone tubing materials	--	DER 2016; USACE 2016; NHDES 2016; MassDEP 2017
HDPE HydraSleeves^{TM}	Low density polyethylene (LDPE) HydraSleeves^{TM} are not recommended	USACE 2016; MassDEP 2017
Drilling and Soil Sampling Materials		
PFAS-free drilling fluids	--	DER 2016
PFAS-free makeup water	Confirm PFAS-free water source via laboratory analysis prior to inspections	--
Acetate liners	For use in soil sampling	USACE 2016
Sample Containers and Storage		
HDPE sample containers with HDPE lined lids for soil and water samples	Laboratory should provide; whole bottle analysis of aqueous samples combined with a solvent rinse of bottle is recommended	DER 2016, MassDEP 2017
Ice contained in plastic (polyethylene) bags (double bagged)	--	DER 2016; USACE 2016; NHDES 2016; MassDEP 2017
Field Documentation		
Sharpie®	--	NHDES 2016; USACE 2016; MassDEP 2017
Ball point pens	--	MassDEP 2017
Standard paper and paper labels	--	DER 2016; USACE 2016; NHDES 2016; MassDEP 2017
Decontamination		
Water-only decontamination	Confirm PFAS-free water source via laboratory analysis prior to inspections	DER 2016
Alconox® or Liquinox® followed by deionized water or PFAS-free water rinse	Liquinox® known to contain trace levels of 1,4-dioxane	NHDES 2016; USACE 2016; MassDEP 2017
Methanol, isopropanol, or acetone	Special health and safety precautions are necessary	UNEP 2015; USACE 2016

Note: This list is considered preliminary and additional materials may be added as additional information becomes available. Project teams are expected to follow a methodical evaluation process of materials to be used and confirm acceptance prior to implementation of field activities.

Table 2: Summary of Equipment and Materials Not Recommended for PFAS Site Inspections

Sampling Materials	Known PFAS-Containing Materials	Suspected PFAS-Containing Materials	Materials with Potential to Retain PFASs	References
Water Sampling Materials				
Teflon®, PTFE-containing or other fluoropolymer coated or containing field equipment (e.g., tubing, bailers, liners, tape, plumbing paste, pump parts)	x			DER 2016; USACE 2016; NHDES 2016; MassDEP 2017
Passive diffusion bags			x	MassDEP 2017
LDPE HydraSleeves ™			x	USACE 2016; MassDEP 2017
Water particle filters			x	MassDEP 2017
Drilling and Soil Sampling Materials				
Aluminum foil			x	DER 2016; USACE 2016; NHDES 2016; MassDEP 2017
Drilling fluid containing PFASs	x	x		DER 2016
Sample Containers and Storage				
Glass sample containers with lined lids			x	DER 2016; USACE 2016; NHDES 2016; MassDEP 2017
LDPE containers and lined lids			x	USACE 2016
Teflon® or PTFE- lined lids on containers (e.g., sample containers, rinsate water storage containers)	x			DER 2016; USACE 2016; NHDES 2016; MassDEP 2017
Reusable chemical or gel ice packs (e.g., BlueIce®)		x		DER 2016; USACE 2016; NHDES 2016; MassDEP 2017
Field Documentation				
Self-sticking notes and similar office products (e.g., 3M Post-it-notes)		x		DER 2016; USACE 2016; NHDES 2016; MassDEP 2017
Waterproof paper, notebooks, and labels	x			DER 2016, MassDEP 2017
Non-Sharpie® markers		x		NHDES 2016
Decontamination				
Some detergents and decontamination solutions (e.g., Decon 90® Decontamination Solution)	x	x		DER 2016; NHDES 2016; MassDEP 2017

Note: For materials that are suspected of containing PFASs, or have the potential to retain PFASs, project specific considerations may provide adequate justification for use during the field event. For example, further evaluation may be conducted in the form of pre-field equipment blank sample analysis.

TGI – SEDIMENT, SURFACE WATER, AND STORMWATER SAMPLE COLLECTION FOR PFAS ANALYSIS

Rev: 0

Rev Date: October 5, 2018

VERSION CONTROL

Revision No	Revision Date	Page No(s)	Description	Reviewed by
0	October 5, 2018	All	Combined aspects of generic Sediment Sample Collection TGI (Rev 0, June 18, 2018) and Stormwater Sampling TGI (Rev 0, August 29, 2018). Added surface water collection guidance and made this TGI PFAS-specific. Added stormwater and surface water sections; made PFAS-specific	Shannon Dunn

APPROVAL SIGNATURES

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10/5/2018

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Date:

1 INTRODUCTION

This document describes general and/or specific procedures, methods, actions, steps, and considerations to be used and observed by Arcadis staff when performing work, tasks, or actions under the scope and relevancy of this document. This document may describe expectations, requirements, guidance, recommendations, and/or instructions pertinent to the service, work task, or activity it covers.

It is the responsibility of the Arcadis Certified Project Manager (CPM) to provide this document to the persons conducting services that fall under the scope and purpose of this procedure, instruction, and/or guidance. The Arcadis CPM will also ensure that the persons conducting the work falling under this document are appropriately trained and familiar with its content. The persons conducting the work under this document are required to meet the minimum competency requirements outlined herein, and inquire to the CPM regarding any questions, misunderstanding, or discrepancy related to the work under this document.

This document is not considered to be all inclusive nor does it apply to any and all projects. It is the CPM’s responsibility to determine the proper scope and personnel required for each project. There may be project- and/or client- and/or state-specific requirements that may be more or less stringent than what is described herein. The CPM is responsible for informing Arcadis and/or Subcontractor personnel of omissions and/or deviations from this document that may be required for the project. In turn, project staff are required to inform the CPM if or when there is a deviation or omission from work performed as compared to what is described herein.

In following this document to execute the scope of work for a project, it may be necessary for staff to make professional judgment decisions to meet the project’s scope of work based upon site conditions, staffing expertise, state-specific requirements, health and safety concerns, etc. Staff are required to consult with the CPM when or if a deviation or omission from this document is required that has not already been previously approved by the CPM. Upon approval by the CPM, the staff can perform the deviation or omission as confirmed by the CPM.

2 SCOPE AND APPLICATION

This Technical Guidance Instruction (TGI) describes the collection of sediment, surface water, and stormwater samples, including field screening and logging of sediment samples. Sediment samples will be collected using a hand-held dredge, push cores, and/or stainless-steel scoop or trowel (the proper technique will be selected in the field depending on site conditions) for the laboratory analysis of sediment chemistry samples. Surface water and stormwater samples will be collected using direct-fill methods or peristaltic pumps. The general procedures to be utilized in obtaining sediment, surface water, and stormwater samples are outlined below. The intent of this TGI is to provide instructions for sampling during United States Army Environmental Command (USAEC) per- and polyfluoroalkyl substances (PFASs) Preliminary Assessment and Site Inspection (PA/SI) at various installations. It also covers specific considerations for PFASs due to their unique chemical and physical properties, low detection limits, and regulatory standards.

This TGI may change depending upon field conditions, equipment limitations, or limitations imposed by the procedure. Substantive modification to this TGI will be approved in advance by the Project Manager.

3 PERSONNEL QUALIFICATIONS

All field personnel must have the appropriate training required by Arcadis as described in the project Site Safety and Health Plan (SSHP). Arcadis field sampling personnel will be trained in proper sampling procedures under the guidance of an experienced field geologist, engineer, or technician. Arcadis field sampling personnel will also be versed in the relevant TGIs and standard operating procedures (SOPs) necessary to successfully complete the desired field work.

4 EQUIPMENT LIST

The following materials will be available, as required, during sampling. Not all equipment listed below may be necessary for a specific activity. Additional equipment may be required, pending field conditions.

Site plan with proposed sampling locations;

Relevant work plan (e.g., Programmatic Quality Assurance Project Plan [PQAPP]);

SSHP;

Health and Safety equipment, as required by the site SSHP and task-specific Job Safety Analysis;

Sediment Sampling Equipment:

- Boat with outboard motor and associated equipment (as necessary);
- Global Positioning System (GPS) unit;
- Navigation chart(s) for on-water activities (if available and as applicable);
- Stainless-steel hand-held dredge (6-inch x 6-inch Ekman or Petite Ponar);
- Lexan^{TM} tubes (4-inch) and PFAS-free plastic caps;
- Stainless-steel bowl;
- Stainless-steel spatula, scoop, bent spoon, or trowel;
- Steel core driver (i.e., slide hammer);
- YSI 6-Series Multi-Parameter Instrument water quality meter with flow-through cell for monitoring temperature, conductivity, oxidation reduction potential (ORP), and dissolved oxygen (DO);
- Supplemental turbidity meter;
- Stainless-steel probe rod – for evaluating bottom softness when wading to sampling locations
- Polypropylene twine/rope
- Hacksaw with stainless steel blade;
- Tape measure;
- Stainless steel, polyvinyl chloride (PVC) or high-density polyethylene (HDPE) yard stick for measuring water depth.
- Stainless-steel extension rod (if necessary to extend reach of scoop or trowel);

- Rubber boots or rubber waders (only non-coated rubber, other more high-tech waterproof material is not permitted);
- Life jacket or other personal flotation device (PFD) as necessary based on water depth (note, these will likely have PFAS-containing materials so need to be careful to avoid cross-contamination when using).

Surface Water Sampling Equipment:

- ISCO Model 150 peristaltic pump;
- Rechargeable marine or car battery (for peristaltic pump);
- Dedicated HDPE and silicon tubing (Teflon® or polytetrafluoroethylene [PTFE] tubing is prohibited);
- Stainless steel rod (1/4-inch diameter x 4-feet long or similar) to support HDPE sampling tubing;
- HDPE zip ties (nylon zip ties are not allowed) to attach tubing to rod;
- YSI 6-Series Multi-Parameter Instrument water quality meter with flow-through cell for monitoring temperature, conductivity, ORP, and DO;
- Supplemental turbidity meter;
- Pail or bucket with closable lid for pump discharge;
- Rubber boots or rubber waders (only non-coated rubber, other more high-tech waterproof material is not permitted);
- Life jacket or other PFD as necessary based on water depth (note, these will likely have PFAS-containing materials so need to be careful to avoid cross-contamination when using).

Stormwater Sampling Equipment:

- Wrench, socket, manhole cover hook or magnetic manhole cover remover for access;
- Approximately 1-inch outer diameter Lexan™ pipe long enough to extend from bottom of storm drain to at least 2 feet above the manhole;
- HDPE zip ties (nylon zip ties are not allowed) to attach tubing to the Lexan™ pipe;
- Tape measure;
- ISCO Model 150 peristaltic pump;
- Rechargeable marine or car battery (for peristaltic pump);
- Dedicated HDPE and silicon tubing (Teflon® or PTFE tubing is prohibited);
- YSI 6-Series Multi-Parameter Instrument water quality meter with flow-through cell for monitoring temperature, conductivity, ORP, and DO;
- Supplemental turbidity meter;
- Pail or bucket with closable lid for pump discharge.

Appropriate sample containers and labels:

- Labeled sample bottles: see the TGI - Poly- and Perfluorinated Alkyl Substances (PFAS) Field Sampling Guidance (Arcadis 2018a) for PFAS-specific considerations;
- 1-quart and 1-gallon polyethylene bags (Ziploc® brand only) to hold ice and samples;
- Appropriate blanks (field reagent blanks supplied by the laboratory);
- Packing and shipping materials;
- Chain-of-Custody (COC) Forms; see the Sample Chain of Custody Standard Operating Procedure (SOP) for reference (Arcadis 2017a);
- Appropriate transport containers (coolers) with ice and appropriate labeling, no blue ice;

Decontamination/Water Management:

- PFAS-free decontamination fluids and equipment
    - HDPE or PVC brushes and squirt bottles
    - Stainless steel bowl
    - HPDE buckets to hold decontamination fluids
    - Alconox® or Liquinox® (other detergents are prohibited)
    - Methanol or isopropyl alcohol (for sediment sampling equipment decontamination only)
    - Distilled or laboratory-supplied deionized water
    - Laboratory-provided PFAS-free water
- See the TGI - Poly- and Perfluorinated Alkyl Substances (PFAS) Field Sampling Guidance (Arcadis 2018a) or the TGI - Groundwater and Soil Sampling Equipment Decontamination (Arcadis 2017b) for additional guidance;
- Portable field hand washing setup;
- Non-hazardous drum labels as required for investigation-derived waste handling: see the TGI - Investigation-Derived Waste Handling and Storage for details (Arcadis 2017c);

Field Notes:

- Pens, pencils, and/or Sharpies® for writing;
- Appropriate field forms;
- Clipboards, field binders, field notebook, and field note pages that are <u>not</u> waterproof;
- Digital camera.

Other

- Garbage bags;
- Paper towels;

- Duct and packing tape;
- Dedicated low-density polyethylene (LDPE) plastic sheeting to prevent sample contact with the ground;
- Field clothing made of cotton or other natural fibers that is well laundered (i.e., washed at least 5 times);
- PFAS-free sunscreen and insect repellant.

5 CAUTIONS

5.1 Utility Clearance

Sediment sampling requires a minimum of three reliable lines of evidence for utility clearance to demonstrate that sample locations are clear of subsurface utilities. A site visit for public utility line clearance at the proposed boring locations will be conducted at least 72 hours prior to work commencing. As applicable, utility maps will be reviewed during field reconnaissance of the proposed inspection locations to determine if any are co-located with public utility lines. Arcadis will also contract an independent geophysical survey company to verify, if possible, that proposed boring locations are not co-located with existing underground utility/substructure features. See the Utility Location and Clearance Arcadis Health and Safety Standard (Arcadis 2017d), including Supplement 6 Utility Location Procedures for Aquatic Work Activities, for reference.

5.2 PFAS-Specific General Sampling Considerations

This section provides a summary of methods and procedures applicable to the collection of environmental samples for field screening or laboratory analysis during PFAS site characterization activities. In general, sampling techniques used for PFAS site characterization are consistent with conventional sampling techniques used in the environmental industry, but special consideration is made regarding PFAS-containing materials and cross-contamination potential. For example, Teflon™ and other fluoropolymer containing materials are found in pumps, tubing, and sample storage containers and therefore should be avoided if possible (Department of Environment Regulation [DER], Western Australia 2016; New Hampshire Department of Environmental Services [NHDES] 2016). Certain field documentation materials such as waterproof paper or field books, adhesive paper products, and some writing utensils (grouped as non-Sharpie® markers) are also prohibited items during PFAS sampling (DER 2016; NHDES 2016).

New nitrile gloves should be donned before any of the following activities:

- Decontamination of re-usable sampling equipment;
- Contact with sample bottles or PFAS-free water bottles;
- Handling clean sample tubing or connecting tubing;
- Handling QC samples including field blanks and equipment blanks.

Additionally, new nitrile gloves should also be donned after handling of any non-dedicated sampling equipment; contact with contaminated surfaces; and whenever judged necessary by field personnel. **When in doubt change your gloves.**

Waterproof field books must not be used for field notes. Instead, field notes should be on loose paper on Masonite, plastic, or aluminum clip boards. Other requirements for field notes include:

- Keep field notes, writing implements, and electronic data collection tablets away from samples and sampling materials; and
- Do not write on sampling bottles unless they are closed.

Tables 1 and **2** in **Attachment 1** provides recommendations for PFAS Site Inspection equipment. **Table 1** provides a summary of materials that have been approved for site inspection; this list is expected to grow longer as industry experience increases. **Table 2** provides a summary of field equipment and materials that have available testing information and/or industry knowledge regarding PFAS cross-contamination potential and it is recommended that these materials be prohibited for sample collection. For materials that are suspected of containing PFASs and/or retaining PFASs, these recommendations are considered preliminary and subject to change.

Given the extremely low detection limits associated with PFAS analysis and the many potential sources of trace levels of PFASs, field personnel are typically advised to err on the side of caution by strictly following field wear guidelines and decontamination procedures as specified in the Poly- and Perfluorinated Alkyl Substances (PFAS) Field Sampling Guidance (Arcadis 2018a).**The most important consideration during PFAS-related sampling is to prevent contact between sample media and suspect PFAS sources.**

5.3 PFAS-Specific Sediment Sampling

Because of the potential presence of PFASs in equipment typically used to collect samples, consideration for other sampling materials that contact sediment through the sampling process is necessary. Each piece of equipment that comes into direct contact with the sediment needs to be evaluated to determine if there are either PFAS-containing materials present, which could be a source of cross-contamination and cause false positives, or if PFASs adhere to the material, which has the potential to cause low bias sample results. For each additional piece of equipment that may introduce contamination, an equipment blank should be collected to confirm that materials in the sample equipment do not cause false positives by introducing PFASs. Equipment blanks are particularly important for any device/component where PFASs may be present or cannot be verified as being a non-PFAS containing material. Other quality assurance methods may be implemented to avoid materials that could result in potential losses associated with PFASs adhering to surfaces.

The following additional notes are provided regarding sediment sampling materials:

- Lexan™ liner sleeves are made of polycarbonate and they are not expected to contain PFASs based on review of the Safety Data Sheet (Sabic 2016).
- Studies evaluating the use of stainless steel indicate that PFASs do not strongly sorb to stainless-steel (Obal et al. 2012). Therefore, stainless-steel sleeves and equipment should be acceptable for collection of sediment samples for PFAS analysis.

5.4 PFAS-Specific Surface Water and Stormwater Sampling

As described for sediment sampling, the potential presence of PFASs in equipment that may come in contact with the target water sample must be evaluated as part of the sample planning process to maintain sample integrity.

Note that if high concentrations of PFASs related to Class B firefighting foams are expected in a surface water sample, it has been recommended to collect and shake a small portion of the sample at the time of sample collection (USACE 2016; Arcadis 2018a). If foaming is noted within the sample, it indicates elevated concentrations of PFASs may be present and the sample should be proactively diluted at the laboratory prior to analysis. The foaming should be noted on the sample COC form. It is recommended to collect sampling equipment blanks following foam observation to confirm the effectiveness of decontamination procedures.

While permissible during fog or intermittent showers, surface water samples should not be collected during steady, prolonged rainfall. Avoid entraining sediment in surface water samples. If accessing the sample location from water, approach slowly from downstream to avoid disturbing the bottom.

6 HEALTH AND SAFETY CONSIDERATIONS

Field activities associated with sediment, surface water, and stormwater sampling and description will be performed in accordance with a site-specific SSHP, a copy of which will be present on site during such activities. Additional health and safety discussions are specifically discussed below.

6.1 Sediment Sampling

- Walk established paths whenever possible to avoid slip/trip hazards. Take your time and watch your footing.
- A PFD may be required to complete sediment sampling. Review the Arcadis Water Operations Health and Safety Standard and the SSHP to determine if a PFD is required.
- To the extent possible, maintain three points of physical contact (i.e., two feet and one hand, or one foot and two hands) when entering and exiting a stream channel.
- Ensure the state One Call has been completed and the Arcadis Utilities and Structures Checklist is completed before sampling.
- Take breaks as needed to avoid repetitive use injury or muscle strain and take turns with co-workers as needed.
- Do not touch sediments with bare hands or detect odors by placing sediments close to your nose.
- STOP WORK when conditions change or become unsafe and discuss if/how to proceed safely before resuming work.
- If boats are required for sampling, the following considerations should be made:
    - Good housekeeping and three-points of physical contact should be maintained when entering/exiting the boat to prevent falls or trips
    - Boat operator will be properly trained
    - To avoid impact with other water traffic, ensure navigational lighting is functional (if applicable). Be vigilant and maintain situational awareness of other water traffic.

6.2 Surface Water Sampling

- A PFD may be required to complete surface water sampling. Review the Arcadis Water Operations Health and Safety Standard and the SSHP to determine if a PFD is required.
- Always have three points of contact when entering and exiting a stream channel, if necessary.
- If boats are required for sampling, the following considerations should be made:
  - Good housekeeping and three-points of physical contact should be maintained when entering/exiting the boat to prevent falls or trips
  - Boat operator will be properly trained
  - To avoid impact with other water traffic, ensure navigational lighting is functional (if applicable). Be vigilant and maintain situational awareness of other water traffic.

6.3 Stormwater Sampling

- The ability to safely access the stormwater sampling vaults or manholes should be verified prior to sampling. Confined space entry is not allowed.

7 PROCEDURE

7.1 Sediment Sampling

Sediment samples will be collected by one of the following methods considered most appropriate for the site conditions.

- Hand-held scoop or trowel – for shallow water depths (e.g., < 2 feet) that are nearshore and that sediment conditions preclude sampling by push core or grab sampler
- Push core – for sampling in deeper water (e.g., > 2 feet) or offshore
- Petite Ponar Grab Sampler – for sampling in deeper water offshore with coarse sediment or hard bottom.

Sampling Mobilization/Prep

- Don personal protective equipment (PPE) as discussed in Section 5.2 and the Poly- and Perfluorinated Alkyl Substances (PFAS) Field Sampling Guidance (Arcadis 2018a).
- Mobilize to sampling location.
  - If accessing by wading, approach slowly from a downstream direction to limit disturbance of the bottom and resulting suspension of sediment into the surface water at sampling location.
  - If accessing by boat, maneuver to the target sample location using GPS and secure the vessel in place.
- Identify the proposed sample location in the field notebook along with other appropriate information (e.g., location, date, time, personnel, weather).

- Verify all dedicated sample gear has been properly decontaminated as discussed in Section 10.
- Measure and record water depth at the sampling location.

Sample Collection by Stainless Steel Scoop or Trowel

- Attach stainless steel scoop, bent spoon, or trowel to a stainless-steel extension rod (if needed) and lower vertically downward through the water column until it reaches the bottom. Collect sediment from the top 2 inches (5 centimeters [cm]) of the bottom surface.
- Retrieve the scoop, bent spoon, or trowel. Slowly decant overlying water and take care to prevent fine sediment from being poured out with the water. Inspect recovered sediment to confirm it does not contain vegetation (e.g., grass, leaves, sticks or similar undecomposed organic material). Use the stainless-steel trowel to remove any vegetation prior to filling sample bottles. If the sample contains too much vegetation to be removed effectively, collect another sediment sample from the bottom.
- Place the sediment in a decontaminated stainless-steel bowl.
- Photograph the grab sample to provide reference for post-processing questions regarding descriptions of color/staining, general texture, recovery, and other characteristics. Photos of the sample will include the grab sample ID, date, and time, written on loose paper with a Sharpie® marker. The photo will also include a view of a tape measure for scale.
- Describe lithology of recovered sediment in accordance with Arcadis TGI for Soil Descriptions (Arcadis 2018b).
- Homogenize the sediment with a stainless-steel mixing spoon until the sediment is of uniform color.
- Collect sediment samples. If additional sediment is needed to fill the bottles, collect additional sample volume approximately 1-2 feet upstream from the first to minimize disturbance.
- Measure surface water pH, conductivity, temperature, and turbidity at the sampling location and record on sampling forms.
    - Use YSI 6-Series Multi-Parameter Instrument water quality meter with flow-through cell for monitoring temperature, conductivity, ORP, and DO.
    - Use the supplemental turbidity meter to measure turbidity.

Sample Collection by Push Core

- Lower section of clean Lexan™ tube (at least as long as the target sediment penetration depth plus the water depth) until it contacts the top of the sediment.
- Push Lexan™ tube with a straight vertical entry into the sediment to a depth of approximately 4 inches (10 cm) below the sediment surface. If necessary, drive the tube a few more inches down into the sediment either by hand or using a steel core driver to obtain a plug at the bottom of the core

that will prevent the sediment from falling out during core retrieval. Note that only the top 2 inches (5 cm) of soil will be used for laboratory sampling.

- Place a cap made of PFAS-free materials (e.g., HDPE, silicon) on the top of the sediment tube and slowly pull the tube from the sediment, twisting it slightly as it is removed (if necessary)
- Before the tube is fully removed from the water, place a PFAS-free cap on the bottom end of the tube while it is still submerged. Ensure that the bottom end cap fits tightly and will not inadvertently slip off. Remove the tube from the water.
- Keeping the tube upright, wipe the bottom end dry and double check that the bottom cap is tight. If necessary (e.g., walking away from the sampling area to a more secure area to fill sample jars), keep one hand beneath the bottom cap to prevent the cap from falling off. Measure the length of sediment recovered and evaluate the integrity of the core.
- While keeping the core upright, use a hacksaw to make a horizontal cut in the tube approximately 2 - 3 inches above the sediment and carefully drain water from the core to prepare it for inspection and sampling.
    - Note: If possible, use a section of Lexan ™ tubing short enough to allow for sampling without cutting the core. This is only possible in shallow water conditions, as the Lexan ™ tubing should be at least long enough to keep the top of the tube above water.
- Slowly decant overlying water and take care to prevent fine sediment from being poured out with the water. Inspect recovered sediment to confirm it does not contain vegetation (e.g., grass, leaves, sticks or similar undecomposed organic material). Use the stainless-steel trowel to remove any vegetation prior to filling sample bottles. If the sample contains too much vegetation to be removed effectively, collect another sediment sample from the bottom.
- Using a stainless-steel bent spoon, scoop, or trowel, place the top 2 inches (5 cm) of sediment in a decontaminated stainless-steel bowl.
- Photograph the grab sample to provide reference for post-processing questions regarding descriptions of color/staining, general texture, recovery, and other characteristics. Photos of the sample will include the grab sample ID, date, and time written on loose paper with a Sharpie® marker. The photo will also include a view of a tape measure for scale.
- Describe the lithology of recovered sediment in accordance with Arcadis TGI for Soil Descriptions (Arcadis 2018b).
- Homogenize the sediment with a stainless-steel mixing spoon until the sediment is of uniform color.
- Collect sediment samples. If additional sediment is needed to fill the bottles, collect additional sample volume approximately 1-2 feet upstream from the first to minimize disturbance
- Measure surface water pH, conductivity, temperature, and turbidity at the sampling location and record on sampling forms.
    - Use YSI 6-Series Multi-Parameter Instrument water quality meter with flow-through cell for monitoring temperature, conductivity, ORP, and DO.

  - Use supplemental turbidity meter to measure turbidity.

Sample Collection by Petite Ponar Grab Sampler

- Use polypropylene twine/rope with the dredge or similar PFAS-free approved material.
- Set the stainless-steel Petite Ponar grab sampler dredge and slowly lower the open dredge from the side of the boat until it is just above the top of the sediment surface. Then drop the open dredge into the sediment.
- Once the dredge has been allowed to settle into the bottom sediment, pull hard on the rope, or send the messenger to trigger the dredge and close the sediment inside.
- Retrieve the dredge onto the boat.
- Inspect the sample for acceptability in accordance with the following criteria:
  - Sampler is not overfilled with sample such that the sediment surface presses against the top of the sampler or is extruding through the top of the sampler.
  - Overlying water is present above the sediment (indicates minimal leakage)
  - At least 4 inches (10 cm) of sediment penetration depth has been achieved.
- Tilt the dredge over slightly to drain the overlying water to prepare the sediment for inspection and sampling, being careful not to disturb the recovered sediment. Also take care to prevent fine sediment from being poured out with the water.
- Inspect recovered sediment to confirm it does not contain vegetation (e.g., grass, leaves, sticks or similar undecomposed organic material). Use the stainless-steel trowel to remove any vegetation prior to filling sample bottles if possible to do so with minimum disturbance of the recovered sediment. If the sample contains too much vegetation to be removed effectively without disturbing sediment, collect another sediment sample from the bottom.
- Using a stainless-steel bent spoon, scoop, or trowel, place the top 2 inches (5 cm) of sediment in a decontaminated stainless-steel bowl.
- Photograph the grab sample to provide reference for post-processing questions regarding descriptions of color/staining, general texture, recovery, and other characteristics. Photos of the sample will include the grab sample ID, date, and time written on loose paper with a Sharpie® marker. The photo will also include a view of a tape measure for scale.
- Describe the lithology of recovered sediment in accordance with Arcadis TGI for Soil Descriptions (Arcadis 2018b).
- Homogenize the sediment with a stainless-steel mixing spoon until the sediment is of uniform color.
- If additional sediment volume is needed to fill sample bottles, redeploy the dredge 1 – 2 feet upstream from the previous sampling location.

- Measure surface water pH, conductivity, temperature, and turbidity at the sampling location and record on sampling forms.
    - Use YSI 6-Series Multi-Parameter Instrument water quality meter with flow-through cell for monitoring temperature, conductivity, ORP, and DO.
    - Use supplemental turbidity meter to measure turbidity.

Laboratory Sample Collection/Management, Post-Sampling

- Fill the sample bottle for PFAS analysis first, then fill bottles for any remaining analyses.
- Don clean nitrile gloves and use a stainless-steel trowel to fill clean labeled bottles supplied by the laboratory for the required analyses with sediment. Collect lab samples from the top 5 cm of the recovered 10 cm interval only. Do not overfill bottles.
- Make sure caps remain on PFAS sample bottles until immediately prior to filling. Caps must remain in the hand of the sampler until replaced on the bottle.
- Once the PFAS sample has been placed in the bottle, and the bottle cap has been completely tightened, label the sample with sample identification number, date, and time of collection. Labels must be completed only after the caps have been placed back on each bottle. (See P-01 QP#3.06 Field Activities documentation for sample label information).
- Collect QC samples at the frequency specified in Quality Assurance Project Plan (QAPP) Addendum Worksheet #20. QC sample locations are to be selected based on consultation with the Arcadis Regional Lead (RL). **Note, if using waders to access sampling locations, collect equipment blank off of the waders.**
- Record the label information and time of sampling in the field notes and sampling forms.
- Fill out the laboratory COC and check against the labels on the sample bottles progressively after each sample is collected.
- Place the sample bottles in a sealed Ziploc© bag, and then into sample coolers. Store PFAS samples in separate cooler from other samples.

7.2 Surface Water Sampling

Sampling Mobilization/Prep

- Don PPE as discussed in Section 5.2 and the Poly- and Perfluorinated Alkyl Substances (PFAS) Field Sampling Guidance (Arcadis 2018a).
- Mobilize to sampling location.
    - If accessing by wading, approach slowly from downstream direction to limit disturbance of bottom and resulting suspension of sediment into the surface water at the sampling location.

  - If accessing by boat, maneuver to the target sample location using GPS and secure the vessel in place.
- Identify the proposed sample location in the field notebook along with other appropriate information (e.g., location, date, time, personnel, weather).
- Verify all dedicated sample gear has been properly decontaminated as discussed in Section 10.
- Measure and record water depth at the sampling location.
- Do not sample surface water when it is raining. Fog or intermittent showers are okay, but not steady rainfall. Avoid entraining sediment in surface water samples.

Shallow Surface Water (0.5 – 2 feet)

- Cut a length of new HDPE tubing to the appropriate size for desired sampling depth and pump location and attach to stainless steel rod using HDPE zip ties. Insert a new length of silicon tubing into the peristaltic pump and connect HDPE tubing on intake side and a shorter length of new HDPE tubing on discharge side.
- Direct pump discharge into pail/bucket during sampling.
- Lower the HPDE tubing on intake side of pump to the desired depth in the water column. For water depths < 2 ft, place tubing intake at approximately mid-depth of the water column.
- Do not collect samples from the water surface. Do not disturb sediment at bottom of water body with sampling equipment, as this could cause suspension of sediment into the surface water that could introduce cross contamination into the sample.
- Verify pump flow direction and turn on pump.
- Once water fills the tubing and begins flowing out of the discharge end turn off pump and prepare to sample.
- Don fresh set of nitrile gloves. Disconnect HDPE tubing from silicon tubing on discharge end. Keep silicon tubing in clean gloved hand and do not allow it to contact any surfaces or equipment. Turn on pump and fill sample bottle to the neck directly from silicon tubing, headspace is acceptable. Do not rinse PFAS sample bottles during sampling.
- Only use labelled HDPE bottles that are supplied by the laboratory. Make sure the cap remains on the bottle until immediately prior to sample collection and gets placed back on the bottle immediately after sample collection. Do not place the cap on any surface, and keep cap in gloved hand opposite of sample collection, do not touch the inside of the cap.
- Measure surface water pH, conductivity, temperature, and turbidity at the sampling location and record on the sampling forms.
  - Use YSI 6-Series Multi-Parameter Instrument water quality meter with flow-through cell for monitoring temperature, conductivity, ORP, and DO.
  - Use supplemental turbidity meter to measure turbidity.

Deeper Surface Water (>2 feet)

- Don fresh set of nitrile gloves immediately prior to collecting samples. Use nitrile glove with long cuff that covers the forearm, as this will help avoid submerging clothing or skin during sampling.
- Only use labelled HDPE bottles that are supplied by the laboratory. Do not rinse PFAS sample bottles prior to collecting sample. Do not remove cap prior to or after sample collection. Do not place the cap on any surface, and keep cap in gloved hand opposite of sample collection, do not touch the inside of the cap.
- Facing the upstream direction (if the surface water body is flowing), place sample container in freshly gloved hand and gently submerge the sample container beneath the water surface with the cap on.
- Tilt the container so the mouth is angled slightly upward, then with the other gloved hand gently unscrew the cap, open it a crack and allow water to flow slowly down the inner wall of the container filling it.
- Do not submerge hands below top of gloves during sampling such that clothing or bare skin of sampling personnel comes into contact with the surface water.
- When the sample container is full, replace and tighten the cap while the container is still submerged, then remove it from the water.
- Measure surface water pH, conductivity, temperature, and turbidity at sampling location and record on sampling forms.
  - Use YSI 6-Series Multi-Parameter Instrument water quality meter with flow-through cell for monitoring temperature, conductivity, ORP, and DO.
  - Use supplemental turbidity meter to measure turbidity.

Laboratory Sample Management, Post-Sampling

- Once the PFAS sample has been placed in the bottle, and the bottle cap has been completely tightened, label the sample with sample identification number, date, and time of collection. Labels must be completed only after the caps have been placed back on each bottle. (See P-01 QP#3.06 Field Activities documentation for sample label information).
- Collect QC samples at the frequency specified in the QAPP Addendum Worksheet #20. QC sample locations are to be selected based on consultation with the Arcadis RL. **Note, if using waders to access sampling locations, collect equipment blank off of the waders.**
- Record the label information and time of sampling in the field notes and sampling forms.
- Fill out the laboratory COC and check against the labels on the sample bottles progressively after each sample is collected.
- Place sample bottles in a sealed Ziploc® bag, and then into sample coolers. Store PFAS samples in separate cooler from other samples.

7.3 Stormwater Sampling

The following general guidelines apply when sampling stormwater.

- Sampling should be started from the manhole farthest downstream and work upstream. This mitigates the impact of subsequent samples if anything on the bottom is disturbed and migrates downstream.
- Care should be taken not to disturb the bottom sediments in catch basin sumps or other storm water sampling locations.
- Stormwater samples should only be collected from active flow. Stormwater will not be collected from pools or standing water.

Use the following procedure to collect grab stormwater samples.

- Verify all dedicated sample gear has been properly decontaminated as discussed in Section 10.
- Mobilize to stormwater sampling location.
- Confirm that active flow is entering the sampling space.
- Measure the depths from the top of the manhole to the top of the stormwater surface and to the bottom of the stormwater system with a tape measure (do this downstream from the spot where the sample will be collected).
- Subtract the depth of the water surface from the depth of the stormwater system. This is the thickness of the stormwater column. Divide the thickness by two. Add the result to the depth of the stormwater surface. This is the sampling depth.
- Strap the HDPE sampling tubing to the Lexan ™ pipe using the HDPE zip ties.
- Place a HDPE zip tie on the Lexan ™ pipe that marks the sampling depth, as measured above. This HDPE zip tie will be used as a marker to guide how far to insert the pipe and tubing into the manhole. The HDPE zip tie marker will prevent over inserting the Lexan ™ pipe and tubing and thus prevent disturbing the deposited sediment in the stormwater system.
- Attach the other end of the tubing (the end that will not be placed into the stormwater for sampling) to the peristaltic pump.
- Collect active flow sample.
    - Slowly lower the Lexan ™ pipe and tubing into the stormwater system to the sample collection depth, using the marker HDPE zip tie as a guide.
- Verify pump flow direction and turn on pump.
- Once water fills the tubing and begins flowing out of the discharge end turn off pump and prepare to sample.
- Don fresh set of nitrile gloves. Disconnect HDPE tubing from silicon tubing on discharge end. Keep silicon tubing in clean gloved hand and do not allow it to contact any surfaces or equipment. Turn on pump and fill sample bottle to the neck directly from silicon tubing, headspace is acceptable. Do not rinse PFAS sample bottles during sampling.

- Only use labelled HDPE bottles that are supplied by laboratory. Make sure that the cap remains on the bottle until immediately prior to sample collection and gets placed back on the bottle immediately after sample collection. Do not place the cap on any surface, and keep cap in gloved hand opposite of sample collection, do not touch the inside of the cap.
- Measure surface water pH, conductivity, temperature, and turbidity at the sampling location and record on sampling forms.
  - Use YSI 6-Series Multi-Parameter Instrument water quality meter with flow-through cell for monitoring temperature, conductivity, ORP, and DO.

Use supplemental turbidity meter to measure turbidity.

Laboratory Sample Management, Post-Sampling

- Once the PFAS sample has been placed in the bottle, and the bottle cap has been completely tightened, label the sample with sample identification number, date, and time of collection. Labels must be completed only after the caps have been placed back on each bottle. (See P-01 QP#3.06 Field Activities documentation for sample label information).
- Collect QC samples at the frequency specified in the QAPP Addendum Worksheet #20. QC sample locations are to be selected based on consultation with the Arcadis RL. **Note, if using waders to access sampling locations, collect equipment blank off of the waders.**
- Record the label information and time of sampling in the field notes and sampling forms.
- Fill out the laboratory COC and check against the labels on the sample bottles progressively after each sample is collected.
- Place sample bottles in a sealed Ziploc® bag, and then into sample coolers. Store PFAS samples in separate cooler from other samples.

8 WASTE MANAGEMENT

Investigation-derived waste (IDW) including excess sediment, surface water, stormwater and decontamination fluids will be collected and placed in Department of Transportation approved containers, segregated by waste streams: see the Investigation-Derived Waste Handling and Storage TGI for details (Arcadis 2017c). All containers will be labeled as non-hazardous unless otherwise instructed by the Project Manager. Containerized IDW will be stored on site until it is profiled and subsequently transported to an approved facility for disposal or recycling. Waste manifests for all IDW suspected to have come into contact with PFAS should clearly note the presence of PFAS. Additional IDW sampling and management details will be provided in the site-specific QAPP Addendum and will be consistent with applicable Army policies and Army post requirements. Personal protective equipment (e.g., gloves, disposable clothing, disposable equipment) resulting from personnel cleaning procedures and soil sampling activities will be placed in plastic bags. These bags will be transferred into appropriately labeled waste containers for appropriate disposal.

9 DATA RECORDING AND MANAGEMENT

The supervising field lead will be responsible for documenting sampling events to record all relevant information in a clear and concise format. The record of sampling events should include:

- Sample dates
- Project name and location
- Project number, client, and site location
- Sampling details (e.g., field measured water quality parameters, standing water column depth)
- Sediment core log
- Type of tools used
- Weather conditions

Field staff should ensure COC Forms are properly completed, and verify which PFAS analytes (e.g., just PFOS and PFOA, some or all of the 537 list) are required for analysis and note on the COC.

10 DECONTAMINATION

To avoid cross-contamination during sampling, all reusable sampling equipment will be cleaned between sampling locations as follows. Repeat these steps twice at all locations suspected of containing a Class B firefighting foam source.

Sediment Sampling

With Organic Solvent Rinse (Preferred Method)

- Don new pair of nitrile gloves prior to decontamination
- Scrub using a plastic brush and non-phosphate soap (Liquinox® or Alconox® only)
- Double-rinse in deionized or distilled water
- Rinse once with methanol or isopropyl alcohol
- Rinse once with PFAS-free water
- Collect all rinsate in a sealed pail for disposal
- Allow time to air dry prior to re-use

Without Organic Solvent Rinse (Contingency Method)

- Don new pair of nitrile gloves prior to decontamination
- Scrub using a plastic brush and non-phosphate soap (Liquinox® or Alconox® only);
- Single-rinse in deionized or distilled water;
- Scrub using a plastic brush and non-phosphate soap (Liquinox® or Alconox® only);
- Double-rinse in deionized or distilled water and single-rinse with PFAS-free water;
- Collect all rinsate in a sealed pail for disposal;
- Allow time to air dry prior to re-use.

Surface Water/Stormwater Sampling

- Don new pair of nitrile gloves prior to decontamination
- Scrub using a plastic brush and non-phosphate soap (Liquinox® or Alconox® only);
- Double-rinse in deionized or distilled water;
- Collect all rinsate in a sealed pail for disposal;
- Allow time to air dry prior to re-use.

See additional specifics in P-04, TGI - Groundwater and Soil Sampling Equipment Decontamination in PQAPP Appendix A.

11 QUALITY ASSURANCE

In general, the following quality assurance and quality control (QA/QC) samples should be collected:

- Equipment blanks
- Field (i.e., reagent) blanks
- Field duplicates
- Matrix spike/matrix spike duplicate

Details on QC sampling requirements (e.g., frequency of collection, types of QA/QC samples) are provided in the PQAPP and will be outlined in various Site-specific sampling scopes of work in the QAPP Addendum. Additionally, detailed procedures related to equipment and field (i.e., reagent) blank sample collection are outlined in the Equipment and Reagent Blank Sample Collection TGI (Arcadis 2018c).

Refer to QC requirements for the project to ensure that appropriate QA/QC samples are collected. When collecting QA/QC samples, the same guidelines apply as when collecting regular samples – specifically that:

- Samples should be collected in laboratory-supplied HDPE bottles
- Bottle caps must remain in the hand of the sampler until replaced on the bottle
- Labels must be completed after the caps have been placed back on each bottle
- Samples must be stored in appropriate transport containers (coolers) with ice (Ziploc®-type bags for use as ice containers) with appropriate labeling. **Do not use blue ice. Store PFAS samples in a separate cooler from other types of samples.**

12 REFERENCES

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Arcadis. 2017c. TGI – Investigation-Derived Waste Handling and Storage, Rev. #0. February 23.

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ATTACHMENT 1

Table 1 and Table 2: PFAS Inspection Material Recommendations

Table 1: Summary of Acceptable Sampling Equipment and Materials for PFAS Site Inspections

Sampling Materials	Additional Considerations	References
Water Sampling Materials		
High density polyethylene (HDPE) or silicone tubing materials	--	DER 2016; USACE 2016; NHDES 2016; MassDEP 2017
HDPE HydraSleeves™	Low density polyethylene (LDPE) HydraSleeves™ are not recommended	USACE 2016; MassDEP 2017
Drilling and Soil Sampling Materials		
PFAS-free drilling fluids	--	DER 2016
PFAS-free makeup water	Confirm PFAS-free water source via laboratory analysis prior to inspections	--
Acetate liners	For use in soil sampling	USACE 2016
Sample Containers and Storage		
HDPE sample containers with HDPE lined lids for soil and water samples	Laboratory should provide; whole bottle analysis of aqueous samples combined with a solvent rinse of bottle is recommended	DER 2016, MassDEP 2017
Ice contained in plastic (polyethylene) bags (double bagged)	--	DER 2016; USACE 2016; NHDES 2016; MassDEP 2017
Field Documentation		
Sharpie®	--	NHDES 2016; USACE 2016; MassDEP 2017
Ball point pens	--	MassDEP 2017
Standard paper and paper labels	--	DER 2016; USACE 2016; NHDES 2016; MassDEP 2017
Decontamination		
Water-only decontamination	Confirm PFAS-free water source via laboratory analysis prior to inspections	DER 2016
Alconox® or Liquinox® followed by deionized water or PFAS-free water rinse	Alconox® known to contain trace levels of 1,4-dioxane	NHDES 2016; USACE 2016; MassDEP 2017
Methanol, isopropanol, or acetone	Special health and safety precautions are necessary	UNEP 2015; USACE 2016

Note: This list is considered preliminary and additional materials may be added as additional information becomes available. Project teams are expected to follow a methodical evaluation process of materials to be used and confirm acceptance prior to implementation of field activities.

Table 2: Summary of Equipment and Materials Not Recommended for PFAS Site Inspections

Sampling Materials	Known PFAS-Containing Materials	Suspected PFAS-Containing Materials	Materials with Potential to Retain PFASs	References
Water Sampling Materials				
Teflon®, PTFE-containing or other fluoropolymer coated or containing field equipment (e.g., tubing, bailers, liners, tape, plumbing paste, pump parts)	x			DER 2016; USACE 2016; NHDES 2016; MassDEP 2017
Passive diffusion bags			x	MassDEP 2017
LDPE HydraSleeves ™			x	USACE 2016; MassDEP 2017
Water particle filters			x	MassDEP 2017
Drilling and Soil Sampling Materials				
Aluminum foil			x	DER 2016; USACE 2016; NHDES 2016; MassDEP 2017
Drilling fluid containing PFASs	x	x		DER 2016
Sample Containers and Storage				
Glass sample containers with lined lids			x	DER 2016; USACE 2016; NHDES 2016; MassDEP 2017
LDPE containers and lined lids			x	USACE 2016
Teflon® or PTFE- lined lids on containers (e.g., sample containers, rinsate water storage containers)	x			DER 2016; USACE 2016; NHDES 2016; MassDEP 2017
Reusable chemical or gel ice packs (e.g., BlueIce®)		x		DER 2016; USACE 2016; NHDES 2016; MassDEP 2017
Field Documentation				
Self-sticking notes and similar office products (e.g., 3M Post-it®-notes)		x		DER 2016; USACE 2016; NHDES 2016; MassDEP 2017
Waterproof paper, notebooks, and labels	x			DER 2016, MassDEP 2017
Non-Sharpie® markers		x		NHDES 2016
Decontamination				
Some detergents and decontamination solutions (e.g., Decon 90® Decontamination Solution)	x	x		DER 2016; NHDES 2016; MassDEP 2017

Note: For materials that are suspected of containing PFASs, or have the potential to retain PFASs, project specific considerations may provide adequate justification for use during the field event. For example, further evaluation may be conducted in the form of pre-field equipment blank sample analysis.

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TGI - INVESTIGATION-DERIVED WASTE HANDLING AND STORAGE

Rev #: 0

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Revision No	Revision Date	Page No(s)	Description	Reviewed by
0	February 23, 2017	ALL	Conversion from SOP to TGI	Ryan Mattson / Peter Frederick

APPROVAL SIGNATURES

Prepared by: Derrick Maurer 02/23/2017

Derrick Maurer Date:

Technical Expert Reviewed by: 02/23/2017

Ryan Mattson (Technical Expert) Date:

1 INTRODUCTION

This document describes general and/or specific procedures, methods, actions, steps, and considerations to be used and observed by Arcadis staff when performing work, tasks, or actions under the scope and relevancy of this document. This document may describe expectations, requirements, guidance, recommendations, and/or instructions pertinent to the service, work task, or activity it covers.

It is the responsibility of the Arcadis Certified Project Manager (CPM) to provide this document to the persons conducting services that fall under the scope and purpose of this procedure, instruction, and/or guidance. The Arcadis CPM will also ensure that the persons conducting the work falling under this document are appropriately trained and familiar with its content. The persons conducting the work under this document are required to meet the minimum competency requirements outlined herein, and inquire to the CPM regarding any questions, misunderstanding, or discrepancy related to the work under this document.

This document is not considered to be all inclusive nor does it apply to any and all projects. It is the CPM's responsibility to determine the proper scope and personnel required for each project. There may be project- and/or client- and/or state-specific requirements that may be more or less stringent than what is described herein. The CPM is responsible for informing Arcadis and/or Subcontractor personnel of omissions and/or deviations from this document that may be required for the project. In turn, project staff are required to inform the CPM if or when there is a deviation or omission from work performed as compared to what is described herein.

In following this document to execute the scope of work for a project, it may be necessary for staff to make professional judgment decisions to meet the project's scope of work based upon site conditions, staffing expertise, state-specific requirements, health and safety concerns, etc. Staff are required to consult with the CPM when or if a deviation or omission from this document is required that has not already been previously approved by the CPM. Upon approval by the CPM, the staff can perform the deviation or omission as confirmed by the CPM.

2 SCOPE AND APPLICATION

The objective of this Technical Guidance Instruction (TGI) is to describe the procedures to manage investigation-derived wastes (IDW), both hazardous and nonhazardous, generated during site activities, which may include, but are not limited to: drilling, trenching/excavation, construction, demolition, monitoring well sampling, soil sampling, decontamination and remediation. For the purposes of this TGI, IDW is considered to be discarded materials which are defined as solid waste by United States Environmental Protection Agency (EPA) standard 40 CFR § 261.2 (which may include liquids, solids, or sludges). IDW may include soil, groundwater, drilling fluids, decontamination liquids, as well as contaminated personal protective equipment (PPE), sorbent materials, construction and demolition debris, and disposable sampling materials. Hazardous or uncharacterized IDW will be collected and staged at the point of generation. Quantities small enough to be containerized in 55-gallon drums will be taken to a designated temporary onsite storage area (discussed in further detail under Drum Storage) pending characterization and disposal. IDW materials will be characterized using process knowledge and appropriate laboratory analyses to determine the waste classification and evaluate proper safe handling and disposal methods.

This TGI describes the necessary equipment, field procedures, materials, regulatory references, and documentation procedures necessary for proper handling and storage of IDW up to the time it is properly transported from the project site and disposed. The procedures included in this TGI for handling and temporary storage of IDW are based on the EPA's guidance document *Guide to Management of Investigation Derived Wastes* (USEPA, 1992). IDW is assumed to be contaminated with the site constituents of concern (COCs) until analytical evidence indicates otherwise. IDW will be managed to ensure the protection of human health and the environment and will comply with all applicable or relevant and appropriate requirements (ARAR). Although not comprehensive, the following laws and regulations on Hazardous Waste Management should be considered as potential ARAR. It is the Arcadis Certified Project Manager (CPM) and/or designated Technical Expert to determine which laws and regulations, at all levels of government, are applicable to each project site and activity falling under this TGI.

Federal Laws and Regulations

- Resource Conservation and Recovery Act (RCRA) 42 USC § 6901-6987.
- Federal Hazardous Waste Regulations 40 CFR § 260-265

Department of Transportation (DOT) Hazardous Materials Transportation 49 CFR

Occupational Safety and Health Administration (OSHA) Regulations 29 CFR

State Laws and Regulations

- To be determined based on location of site and location of treatment, storage, and/or disposal facility (TSDF) to be utilized.

Regional, County, Municipal, and Local Regulations

- To be determined based on location of site and location of treatment, storage, and/or disposal facility (TSDF) to be utilized.

Initial Storage

Pending characterization, IDW will be temporarily stored appropriately within each area of contamination (AOC). Under RCRA, "storage" is defined as the "holding of hazardous waste for a temporary period, at the end of which the hazardous waste is treated, disposed of, or stored elsewhere" (40 CFR § 260.10). The onsite waste staging area will be in a secure and controlled area. Uncharacterized wastes are considered potentially hazardous wastes and must be stored in DOT approved packaging. Liquid wastes must be stored in DOT approved closed head drums or other approved containers (e.g., portable tank containers) that are compatible with the type of material stored therein. Solid materials must be stored in DOT approved open head drums where practicable. Larger quantities of solid IDW can be containerized in bulk containers (such as in a roll-off box). Soil from large excavation projects may be managed in stockpiles with within the AOC and does not need to be containerized until exiting the AOC.

Characterization

Waste characterization can either be based on generator knowledge, such as using historical process knowledge and safety data sheets (SDS), or can be based upon characterization sampling analytical results. IDW typically is not characterized using SDS as it is a mixture of aged chemicals and environmental media. Historical process knowledge should be used to determine if the IDW is a listed hazardous waste (40 CFR § 261.31-33). If the IDW is not a listed hazardous waste, waste characterization can be completed by laboratory analysis of representative samples of the IDW. The laboratory used for waste characterization analysis must have the appropriate state and federal accreditations and may be required to be pre-approved by the Client. IDW will be classified as RCRA hazardous or non-regulated under RCRA based on the waste characterization determination.

If IDW is characterized as RCRA hazardous waste, RCRA and DOT requirements must be followed for packaging, labeling, transporting, storing, and record keeping as described in 40 CFR § 262 and 49 CFR § 171-178. Waste material classified as RCRA nonhazardous may be handled and disposed of as nonhazardous waste in accordance with applicable federal, state, and local regulations.

Storage Time Limitations

Containerized hazardous wastes can be temporarily stored for a maximum of 90 calendar days from the accumulation start date for a large quantity generator or a maximum of 180 calendar days from the accumulation start date for a small quantity generator. Wastes classified as nonhazardous may be handled and disposed of as nonhazardous waste and are not subject to storage time limitations.

This is TGI may be modified by the CPM and/or Technical Expert for a specific project or client program, as required, dependent upon client requirements, site conditions, equipment limitations, or limitations imposed by the procedure. The resulting procedure employed to execute the work will be documented in the project work plans or reports. If changes to the sampling procedures are required due to unanticipated field conditions, the changes will be discussed with the CPM and/or Technical Expert as soon as practicable, and if approved to be performed, be documented.

3 PERSONNEL QUALIFICATIONS

Arcadis field sampling personnel will have current regulatory- and Arcadis-required health and safety training including 40-hour HAZWOPER training, site supervisor training, site-specific training, first aid, and cardiopulmonary resuscitation (CPR), as needed. Personnel handling and packaging hazardous waste and performing hazardous waste characterizations must have RCRA hazardous waste management training per 40 CFR § 264.16.

Although not common practice, in certain situations Arcadis personnel may sign waste profiles and/or waste manifests on a case by case basis for clients, provided the appropriate agreement is in place between Arcadis and the client documenting that Arcadis is not the generator, but is acting as an authorized representative of the generator. Arcadis personnel who sign waste profiles and/or waste manifests will have both current RCRA hazardous waste management training per 40 CFR § 264.16 and current DOT hazardous materials transportation training per 49 CFR § 172.704. Arcadis field personnel will also comply with client-specific training. In addition, Arcadis field sampling personnel will be knowledgeable in the relevant processes, procedures, and Technical Guidance Instructions (TGIs) and possess the demonstrated required skills and experience necessary to successfully complete the desired field work. The project health and safety plan (HASP) and other documents will identify other training requirements or access control requirements.

4 EQUIPMENT LIST

The Following Materials, as required, will be available for IDW handling and Storage:

- Appropriate personal protective equipment as specified in the Site Health and Safety Plan (HASP)
- DOT approved containers
- Hammer
- Leather gloves
- Drum dolly
- Appropriate drum labels (outdoor waterproof self-adhesive)
- Portable tank container
- Appropriate labeling, packing, chain-of-custody forms, and shipping materials as determined by the CPM and/or Technical Expert.
- Indelible ink and/or permanent marking pens
- Plastic sheeting
- Appropriate sample containers, labels, and forms
- Stainless-steel bucket auger
- Stainless steel spatula or knife
- Stainless steel hand spade
- Stainless steel scoop
- Digital camera
- Field logbook

5 CAUTIONS

Filled drums can be very heavy, become unbalanced, or spill its contents. Therefore, use appropriate moving techniques and equipment for safe handling. Similar media (e.g. soils with other soils; or liquids with other liquids) will be stored in the same drums to aid in sample analysis and disposal. Drum lids must be secured to prevent rainwater from entering the drums and leakage during movement. Drums containing solid material may not contain any free liquids. Waste containers stored for extended periods of time may be subject to deterioration. Drum Over Packs may be used as secondary containment. All drums must be visually inspected for condition to ensure that they are in good condition without visible evidence of rusting, holes, breakage, etc., to prevent potential leakage and facilitate subsequent disposal. All drum lids must be verified as having a properly functioning secured lid prior to use.

6 HEALTH AND SAFETY CONSIDERATIONS

Click here and enter text] As determined by the site's known and suspected hazards, appropriate PPE must be worn by all field personnel within the designated work area. Exposure air monitoring may be required during certain field activities as required in the Site Health and Safety Plan. If soil excavation in areas with potentially hazardous contaminants is possible, contingency plans will be developed to address the potential for encountering gross contamination or non-aqueous phase liquids. All excavation activities shall be in compliance with OSHA standard 29 CFR 1926.651 Excavations, and any other applicable regulations.

Arcadis field personnel and subcontractors will be trained in and perform their work in compliance with all applicable federal, state, and local health and safety regulations as well as Arcadis' HASP and applicable Client health and safety requirements.

7 PROCEDURE

Specific waste temporary storage and handling procedures to be used are dependent upon the type of generated waste, including type of media (e.g. soils or free liquids) and constituents of concern. For this reason, IDW can be stored in a secure location onsite in separate 55-gallon storage drums, where solids can be stockpiled onsite (if nonhazardous) and purge water may be stored in portable tank containers. Waste materials such as broken sample bottles or equipment containers and wrappings will be stored in 55-gallon drums unless they were not in contact with sample media.

Management of IDW

Minimization of IDW should be considered by the project team during all phases of the project. Site managers may want to consider techniques such as replacing solvent based cleaners with aqueous-based cleaners for decontamination of equipment, reuse of equipment (where it can be properly decontaminated), limitation of traffic between exclusion and support zones, and drilling methods and sampling techniques that minimize the generation of waste. Alternative drilling and subsurface sampling methods may include the use of small diameter boreholes, as well as borehole testing methods such as a core penetrometer or direct push technique instead of coring.

Drum Storage

Drums containing hazardous waste will be stored in accordance with the requirements of 40 CFR 265 Subpart I (for containers) and 265 Subpart DD (for containment buildings). All 55-gallon drums will be stored at a secure, centralized onsite location that is readily accessible for vehicular pick-up. Drums confirmed as, or assumed to contain hazardous waste will be stored over an impervious surface provided with secondary spill containment. The storage location will, for drums containing liquid, have a containment system that can contain at least the larger of 10% of the aggregate volume of staged materials or 100% of the volume of the largest container. Drums will be closed during storage and be in good condition in accordance with the Guide to Management of Investigation-Derived Wastes (USEPA, 1992).

Hazardous Waste Determination

Waste material must be characterized to determine if it meets any of the federal definitions of hazardous waste as required by 40 CFR § 262.11. If the waste does not meet any of the federal definitions, it must then be established if any state-specific or local-specific hazardous waste criteria exist/apply.

Generator Status

Once hazardous waste determination has been made, the generator status will be determined. Large quantity generators (LQG) are generators who generate more than 1,000 kilograms of hazardous waste in a calendar month. Small quantity generators (SQG) of hazardous waste are generators who generate greater than 100 kilograms but less than 1,000 kilograms of hazardous waste in a calendar month. Conditionally exempt small quantity generators (CESQG) are generators who generate less than 100 kilograms of hazardous waste per month. Please note that a generator status may change from month to month and that a notice of this change is usually required by the generator's state agency.

Accumulation Time for Hazardous Waste

A LQG may accumulate hazardous waste on site for 90 calendar days or less without a permit and without having interim status, provided that such accumulation is in compliance with requirements in 40 CFR § 262.34. A SQG may accumulate hazardous waste on site for 180 calendar days or less without a permit or without having interim status, subject to the requirements of 40 CFR § 262.34(d). CESQG requirements are found in 40 CFR § 261.5. NOTE: The CESQG and SQG provisions of 40 CFR § 261.5, 262.20(e), 262.42(b) and 262.44 may not be recognized by some states (e.g., California and Rhode Island). State-specific and local-specific regulations must be reviewed and understood prior to the generation of hazardous waste.

Satellite Accumulation of Hazardous Waste Satellite accumulation (SAA) will mean the accumulation of as much as fifty-five (55) gallons of hazardous waste, or the accumulation of as much as one quart of acutely hazardous waste, in containers at or near any point of generation where the waste initially accumulates, which is under the control of the operator of the process generating the waste, without a permit or interim status and without complying with the requirements of 40 CFR § 262.34(a) and without any storage time limit, provided that the generator complies with 40 CFR § 262.34(c)(1)(i).

Once more than 55 gallons of hazardous waste accumulates in SAA, the generator has three days to move this waste into storage.

Storage recommendations for hazardous waste include:

- Ignitable Hazardous wastes must be >50 feet from the property line per 40 CFR § 265.176 (LQG generators only).
- Hazardous waste must be stored on a concrete slab (asphalt is acceptable if there are no free liquids in the waste) per 40 CFR § 265.176.
- Drainage must be directed away from the accumulation area.
- Area must be properly vented.
- Area must be secure.

Drum/Container Labeling

Drums will be labeled on both the side and lid of the drum using a permanent marking pen. Old drum labels must be removed to the extent possible, descriptions crossed out should any information remain, and new labels affixed on top of the old labels. Other containers used to store various types of waste (e.g., polyethylene tanks, roll-off boxes, end-dump trailers, etc.) will be labeled with an appropriate "Waste Container" or “Testing in Progress” label pending characterization. Drums and containers will be labeled as follows:

- Appropriate waste characterization label (Pending Analysis, Hazardous, or Nonhazardous)
- Waste generator's name (e.g., client name)
- Project Name
- Name and telephone number of Arcadis project manager

- Composition of contents (e.g., used oil, acetone 40%, toluene 60%)
- Media (e.g., solid, liquid)
- Accumulation start date
- Drum number of total drums as reconciled with the Drum Inventory maintained in the field log book.

IDW containers will remain closed except when adding or removing waste. Immediately upon beginning to place waste into the drum/container, a “Waste Container” or “Pending Analysis” label will be filled out to include the information specified above, and affixed to the container. Once the contents of the container are identified as either non-hazardous or hazardous, the following additional labels will be applied.

- Containers with waste determined to be non-hazardous will be labeled with a green and white "Nonhazardous Waste" label over the "Waste Container" label.
- Containers with waste determined to be hazardous will be stored in an onsite storage area and will be labeled with the "Hazardous Waste" label and affixed over the "Waste Container" label.

The ACCUMULATION DATE for the hazardous waste is the date the waste is first placed in the container and is the same date as the date on the "Waste Container" label. DOT hazardous class labels must be applied to all hazardous waste containers for shipment offsite to an approved disposal or recycling facility. In addition, a DOT proper shipping name will be included on the hazardous waste label. The transporter should be equipped with the appropriate DOT placards. However, placarding or offering placards to the initial transporter is the responsibility of the generator per 40 CFR § 262.33.

Inspections and Documentation

All IDW will be documented as generated on a Drum Inventory Log maintained in the field log book. The Drum Inventory will record the generation date, type, quantity, matrix and origin (e.g., Boring-1, Test Pit 3, etc.) of materials in every drum, as well as a unique identification number for each drum. The drum inventory will be used during drum pickup to assist with labeling of drums. The drum storage area and any other areas of temporarily staged waste, such as soil/debris piles, will be inspected weekly. The weekly inspections will be recorded in the field notebook or on a Weekly Inspection Log. Digital photographs will be taken upon the initial generation and drumming/staging of waste, and final labeling after characterization to document compliance with labeling and storage protocols, and condition of the container. Evidence of damage, tampering or other discrepancy should be documented photographically.

Emergency Response and Notifications

Specific procedures for responding to site emergencies will be detailed in the HASP. If the generator is designated as a LQG, a Contingency Plan will need to be prepared to include emergency response and notification procedures per 40 CFR § 265 Subpart D. In the event of a fire, explosion, or other release which could threaten human health outside of the site or when Client or ARCADIS has knowledge of a spill that has reached surface water, Client or ARCADIS must immediately notify the National Response Center (800-424-8802) in accordance with 40 CFR § 262.34. Other notifications to state and/or other local regulatory agencies may also be necessary.

Drilling Soil Cuttings and Muds

Soil cuttings are solid to semi-solid soils generated during trenching activities, subsurface soil sampling, or installation of monitoring wells. Depending on the drilling method, drilling fluids known as "muds" may be used to remove soil cuttings. Drilling fluids flushed from the borehole must be directed into a settling section of a mud pit. This allows reuse of the decanted fluids after removal of the settled sediments. Soil cuttings will be labeled and stored in 55-gallon drums with bolt-sealed lids.

Excavated Solids

Excavated solids may include, but are not limited to: soil, fill, and construction and demolition debris. Prior to permitted treatment or offsite disposal, potentially hazardous excavated solids may be temporarily stockpiled onsite as long as the stockpile remains in the same AOC from where it was excavated. Potentially hazardous excavated solids removed from the AOC must be immediately containerized in labeled drums or closable top roll-offs lined with 9-mil polyvinyl chloride (PVC) sheeting and are subject to LQG storage time limits. Nonhazardous excavated solids can be stockpiled either inside or outside of the AOC, do not have to be containerized and are not subject to hazardous waste regulations. Potentially hazardous excavated solids must not be mixed with nonhazardous excavated solids. All classes of excavated solid stockpiles should be maintained in a secure area onsite. At a minimum, the floor of the stockpile area will be covered with a 20-mil high density polyethylene liner that is supported by a foundation or at least a 60-mil high density polyethylene liner that is not supported by a foundation. The excavated material will not contain free liquids. The owner/operator will provide controls for windblown dispersion, run-on control, and precipitation runoff. The run-on control system will prevent flow onto the active portion of the pile during peak discharge from at least a 25-year storm and the run-off management system will collect and control at least the water volume resulting from a 24-hour, 25-year storm (USEPA, 1992). Additionally, the stockpile area will be inspected on a weekly basis and after storm events. Individual states may require that the stockpile be inspected/certified by a licensed professional engineer. Stockpiled material will be covered with a 6-mil polyvinyl chloride (PVC) liner or sprayed dust control product. The stockpile cover will be secured in place with appropriate material (concrete blocks, weights, etc.) to prevent the movement of the cover.

Decontamination Solutions

Decontamination solutions are generated during the decontamination of personal protective equipment and sampling equipment. Decontamination solutions may range from detergents, organic solvents and acids used to decontaminate small field sampling equipment to steam cleaning rinsate used to wash heavy field equipment. These solutions are to be labeled and stored in closed head drums compatible with the decontamination solution. Decontamination procedures, including personnel and field sampling equipment, must comply with applicable Arcadis procedural documents.

Disposable Equipment

Disposable equipment includes personal protective equipment (e.g., tyvek coveralls, gloves, booties and APR cartridges) and disposable sampling equipment such as trowels or disposable bailers. If the media sampled exhibits hazardous characteristics per results of waste characterization sampling, contaminated disposable equipment will also be disposed of as a hazardous waste. If compatible with the original IDW waste stream (i.e., the IDW is a solid and the disposal equipment is a solid), the disposable equipment can be combined with the IDW. If these materials are not compatible (i.e., the IDW is a liquid and the disposal equipment is a solid), the disposable equipment will be stored onsite in separate labeled 55-gallon drums. Uncontaminated or decontaminated disposable equipment can be considered nonhazardous waste.

Purge Water

Purge water includes groundwater generated during well development, groundwater sampling, or aquifer testing. The volume of groundwater generated will dictate the appropriate storage procedure. Monitoring well development and groundwater sampling may generate three well volumes of groundwater or more. This volume will be stored in labeled 55-gallon drums. Aquifer tests may generate significantly greater volumes of groundwater depending on the well yield and the duration of the test. Therefore, large-volume portable polyethylene tanks will be considered for temporary storage pending groundwater-waste characterization.

Purged Water Storage Tank Decontamination and Removal

The following procedures will be used for inspection, cleaning, and offsite removal of storage tanks used for temporary storage of purge water. These procedures are intended to be used for rented portable tanks such as Baker Tanks or Rain for Rent containers. Storage tanks will be made of inert plastic materials. The major steps for preparing a rented tank for return to a vendor include characterizing the purge water, disposing of the purge water, decontaminating the tank, final tank inspection, and mobilization. Decontamination and inspection procedures are described in further detail below.

- Tank Cleaning: Most vendors require that tanks be free of any visible sediment and water before returning, a professional cleaning service may be required. Each specific vendor should be consulted concerning specific requirements for returning tanks.
- Tank Inspection: After emptying the tank, purged water storage tanks should be inspected for debris, chemical staining, and physical damage. The vendors require that tanks be returned in the original condition (i.e., free of sediment, staining and no physical damage).

8 WASTE MANAGEMENT

Soil/Solids Characterization

Waste characterization will be conducted in accordance with waste hauler, waste handling facility, and local/state/federal requirements. In general, RCRA hazardous wastes are those solid wastes determined by a Toxicity Characteristic Leaching Procedure (TCLP) test or to contain levels of certain toxic metals, pesticides, or other organic chemicals above specific applicable regulatory agency thresholds. If the one or more of 40 toxic compounds listed in Table I of 40 CFR § 261.24 are detected in the sample at levels above the maximum unregulated concentrations, the waste must be characterized as a toxic hazardous waste. Wastes can also be considered “listed” hazardous waste depending on site-specific processes.

Composite soil samples will be collected at a frequency of one sample per 10 cubic yard basis for stockpiled soil or one per 55-gallon drum for containerized. A four-point composite sample will be collected per 10 cubic yards of stockpiled material and for each drum. Sample and composite frequencies may be adjusted in accordance with the waste handling facility’s requirements. Waste characterization samples may be analyzed for the TCLP volatile organic compounds (VOCs), TCLP semi-volatile organic compounds (SVOCs), TCLP RCRA metals, and polychlorinated biphenyls (PCBs), as well as reactivity and flammability (flashpoint). Additional samples may be collected and analyzed by the laboratory on a contingency basis. Site-specific constituents of concern including pesticides may require additional sampling. Please note that state- or local-specific regulations may require a different or additional sampling approaches.

Wastewater Characterization

Waste characterization will be conducted in accordance with the requirements of the waste hauler, waste handling facility, and local/state/federal governments. In general, purge water should be analyzed by methods appropriate for the known contaminants, if any, that have been historically detected in the monitoring wells. Samples will be collected and analyzed in accordance with the requirements of the waste disposal facility. Wastewater characterization samples may be analyzed for TCLP volatile organic compounds (VOCs), TCLP semi-volatile organic compounds (SVOCs), TCLP RCRA metals, and polychlorinated biphenyls, as well as corrosivity (pH), reactivity and flammability (flashpoint). Additional samples may be collected and analyzed by the laboratory on a contingency basis. Site-specific constituents of concern including pesticides may require additional sampling. Please note that state- and/or local-specific regulations may require different or additional sampling approaches.

Sample Handling and Shipping

All samples will be appropriately labeled, packed, and shipped, and the chain-of-custody will be filled out in accordance with current Arcadis sample chain of custody, handling, packing, and shipping procedures and guidance instructions.

It should be noted that additional training is required for packaging and shipping of hazardous and/or dangerous materials. Please refer to the current Arcadis training requirements related to handling and shipping of samples, shipping determinations, and hazardous materials.

Preparing Waste Shipment Documentation (Hazardous and Nonhazardous)

Waste profiles will be prepared by the Arcadis CPM and forwarded, along with laboratory analytical data to the Client for approval/signature. The Client will then return the profile to Arcadis who will then forward to the waste removal contractor for preparation of a manifest. The manifest will be reviewed by Arcadis prior to forwarding to the Client for approval. Upon approval of the manifest, the Client will return the original signed manifest directly to the waste contractor or to the Arcadis CPM for forwarding to the waste contractor. Arcadis personnel may sign waste profiles and/or waste manifests on a case by case basis for clients, provided the appropriate agreement is in place between Arcadis and the client documenting that Arcadis is not the generator, but is acting as an authorized representative of the generator.

Final drum labeling and pickup will be supervised by an Arcadis representative who is trained and experienced with applicable waste labeling procedures. The Arcadis representative will have a copy of the drum inventory maintained in the field book and will reconcile the drum inventory with the profile numbers on the labels and on the manifest. Different profile numbers will be generated for different matrices or materials in the drums. For example, the profile number for drill cuttings will be different than the profile number for purge water. When there are multiple profiles it is critical that the proper label, with the profile number appropriate to a specific material be affixed to the proper drums. A copy of the Arcadis drum inventory will be provided to the waste transporter during drum pickup and to the facility receiving the waste.

9 DATA RECORDING AND MANAGEMENT

Waste characterization sample handling, packing, and shipping procedures will be documented in accordance with relevant Arcadis procedures and guidance instructions as well as applicable client and/or project requirements, such as a Quality Assurance Project Plan or Sampling and Analysis Plan. Copies of the chain-of-custody forms will be maintained in the project file. Arcadis should photograph or maintain a copy of any hazardous waste manifest signed on behalf of Client in the corresponding office DOT record file.

10 QUALITY ASSURANCE

The CPM or APM will review all field documentation once per week for errors or omissions as compared to applicable project requirements including but not limited to: the proposal/scope of work, QAPP, SAP, HASP, etc. Deficiencies will be noted, tracked, and resolved. Upon correction, they will be noted for project documentation.

11 REFERENCES

United States Environmental Protection Agency (USEPA). 1992. Guide to Management of Investigation-Derived Wastes. Office of Remedial and Emergency Response. Hazardous Site Control Division. January 1992.

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Appendix B

Final PFAS Sampling and Analysis White Paper

United States Army Environmental Command
United States Army Corps of Engineers

FINAL PFAS SAMPLING AND ANALYSIS WHITE PAPER

Active Army Installations, Nationwide

June 2018

FINAL PFAS SAMPLING AND ANALYSIS WHITE PAPER

Active Army Installations Nationwide

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Appendix B1-B3: U.S. PFAS Standards and Advisory Values in Drinking Water, Groundwater, and Soil.

ACRONYMS AND ABBREVIATIONS

AFFF	Aqueous film forming foam
ASTM	American Society for Testing and Materials
CMC	critical micelle concentration
DER	Department of Environment Regulation, Western Australia
DoD	Department of Defense
DoN	Department of Navy
ELAP	Environmental Laboratory Accreditation Program
FtS	Fluorotelomer sulfonate
g/L	grams per liter
GC	gas chromatography
HDPE	High density polyethylene
IDW	investigation derived waste
LC-MS/MS	Liquid chromatography tandem mass spectrometry
LDPE	Low density polyethylene
MassDEP	Massachusetts Department of Environmental Protection
mg/L	milligrams per liter
MS	mass spectrometry
NAPL	non-aqueous phase liquid
NHDES	New Hampshire Department of Environmental Services
ng/L	nanograms per liter
PFAA	Perfluoroalkyl Acid
PFAS	Per- and Polyfluoroalkyl Substance
PFBA	Perfluorobutanoic acid
PFHxA	Perfluorohexanoic acid
PFHxS	Perfluorohexanesulfonic acid
PFOA	Perfluorooctanoic acid
PFOS	Perfluorooctanesulfonic acid
PFOSA	Perfluorooctane sulfonamide
PFPeA	Perfluoropentanoic acid

PIGE	Particle induced gamma emission
pKa	acid dissociation constant
ppb	parts per billion
ppm	parts per million
ppt	parts per trillion
PVC	polyvinyl chloride
PTFE	polytetrafluoroethylene
QSM	Quality Systems Manual
RBSL	Risk-Based Screening Level
SOP	Standard Operating Procedure
SPE	Solid phase extraction
TCLP	toxicity characteristic leaching procedure
µg/L	micrograms per liter
UNEP	United Nations Environment Programme
USEPA	United States Environmental Protection Agency
USACE	United States Army Corps of Engineers
USAEC	United States Army Environmental Command
UV/vis	ultra violet/ visible

EXECUTIVE SUMMARY

The United States Army Environmental Command (USAEC) is conducting a nationwide survey at select continental and outside continental United States Army Installation Management Command, Army Materiel Command, and United States Army Reserve Command Installations through a Preliminary Assessment process to determine where impacts from per- and polyfluoroalkyl substances (PFASs) may be present. Aqueous film forming foam (AFFF), a material known to historically contain high concentrations of long-chain PFASs, was used for fire training and emergency response at many installations and is thought to be the primary source of PFAS releases to environmental media. As emerging contaminants, there has been considerable evolution in both the sampling and analysis of PFASs in impacted environmental media over the past ten years. This white paper is intended to provide an overview of best sampling and analysis practices available for PFASs in environmental media and provide recommendations so that any eventual USAEC PFAS data collection efforts are conducted according to reliable, representative, and accurate procedures.

Soil and groundwater sampling techniques for PFAS sample collection will typically follow industry standards with special considerations related to the sampling materials and their compatibility with PFASs. The following material compatibility concerns should be closely followed:

- High density polyethylene (HDPE) and, to a lesser extent, polypropylene sampling materials and containers are recommended. The use of glass sampling containers is not recommended as PFASs adhere to the surface of glass.
- Teflon™ (or other polytetrafluoroethylene - PTFE) materials should be strictly avoided for PFAS sample collection.
- Samples should not be filtered in the field or in the laboratory, as most types of filters retain PFASs. Centrifugation, followed by combining a solvent rinse of the particulate-containing centrifuge tube with the sample, is recommended to remove particles in turbid aqueous samples at the laboratory.
- All disposable sampling materials should be treated as single use.
- Decontamination of reusable equipment should be conducted with PFAS-free water, Alconox®, Liquinox®, Citranox®, or a solvent such as methanol, isopropanol, or acetone, pending safety considerations at the site.
- To avoid cross-contamination of PFASs from common low-level sources, personal care products should only be used for medical or health and safety reasons and all food consumption should occur offsite, preferably with outer field gear removed prior to eating.

Field-collected quality control samples should include a conservative number of separate equipment blanks for all types of reusable equipment that has direct contact with samples, field reagent blanks, field duplicates, matrix spikes and matrix spike duplicates, particularly in the material cannot be verified to be PFAS-free. Multiple bottles of highly sensitive aqueous samples should be sent to the laboratory in the event that re-analysis is required, as most laboratories are required to analyze the entire sample bottle during the first analysis.

Laboratory analysis of PFASs in groundwater, surface water, soil, and sediment should follow the guidelines laid out in the Department of Defense Quality Systems Manual (QSM) 5.1 or later version of the QSM to which the laboratory is accredited. Any commercial laboratory used for these analyses must be accredited for QSM 5.1 or later. Currently, there is only one United States Environmental Protection Agency (USEPA) method, USEPA Method 537 Version 1.1, available for the analysis of PFASs and it pertains specifically to drinking water. The laboratory conducting PFAS analysis is required by QSM 5.1 and USEPA Method 537 to include a laboratory control sample and method blank per preparatory batch. Aqueous preparation methods for analysis of PFASs are relatively prescribed by QSM 5.1 and, even more so, by USEPA Method 537. Soil preparation methods are not well defined by these official documents. Serial basic methanolic extractions are used by most researchers and commercial laboratories for analysis of PFASs in soils and other environmental solids. These methods are acceptable for most PFASs of current interest to the DoD, including anionic compounds like perfluorooctanoic acid (PFOA), and perfluorooctanesulfonic acid (PFOS), and 6:2 fluorotelomer sulfonate. With appropriate precautions for sample equipment, materials, and laboratory methods and procedures, the existing state of science provides an adequate foundation for collecting data of sufficient quality to make determinations regarding PFAS levels of contamination in environmental media.

1 INTRODUCTION

The United States (U.S.) Army Environmental Command (USAEC) is conducting a nationwide survey at select continental and outside continental United States Army Installation Management Command, Army Materiel Command, and United States Army Reserve Command Installations through a Preliminary Assessment process to determine where impacts from per- and polyfluoroalkyl substances (PFASs) may be present. The primary sources of PFASs at these installations are expected to be releases from the emergency use, training, and accidental discharge of aqueous film forming foam (AFFF), a material known to contain high concentrations of PFASs. In anticipation of site investigation activities to quantify PFASs, USAEC commissioned this white paper to provide an overview of the state of science of sampling and analysis for PFASs in environmental media. The objectives of this white paper are to provide sampling and analysis recommendations in order to enhance assurance that PFAS data collection efforts are reliable, representative, and accurate.

PFASs are a class of several thousand individual compounds that each contain a fully fluorinated carbon group known as a perfluoroalkyl group. The perfluoroalkyl substances are primarily composed of perfluoroalkyl acids (PFAAs) that consist of a perfluoroalkyl group bound to either a sulfonic or carboxylic acid functional group. The PFAAs do not contain any carbon hydrogen bonds, are completely resistant to environmental degradation (Vecitis et al. 2009) and tend to range in chain length from four carbons (C4) to fourteen carbons (C14); the two most common PFAAs, both by manufacturing volumes and environmental occurrence, are perfluorooctanoic acid (PFOA) and perfluorooctanesulfonic acid (PFOS). The polyfluoroalkyl substances contain a range of additional structural features, in addition to the perfluoroalkyl group, and are susceptible to transformation. The polyfluoroalkyl substances are often referred to as PFAA precursors, as they form PFAAs as terminal transformation products in the environment. In AFFF formulations that were used at multiple Department of Defense (DoD) installations, both per- and polyfluoroalkyl compounds have been commonly identified (Place and Field 2012) and detected in soil and groundwater impacted by AFFF (Moody and Field 1999, Schultz et al. 2004, Backe et al. 2013, Houtz et al. 2013, McGuire et al. 2014). PFASs are routinely referred to by or in reference to their perfluoroalkyl chain length. Long chain perfluoroalkyl sulfonic acids contain at least six fluorinated carbons (perfluorohexanesulfonic acid [PFHxS] and longer) and long chain perfluoroalkyl carboxylic acids contain at least seven fluorinated carbons (PFOA and longer); PFASs with fewer fluorinated carbons are referred to as short chain PFASs. Both PFOS and PFOA are considered long chain PFASs as they contain eight and seven fluorinated carbons, respectively.

Environmental sampling and analysis for the measurement of PFASs began in the late 1990’s, led by academic researchers (Moody and Field 1999, Giesy and Kannan 2001). While environmental samples for PFASs have been collected at DoD installations since that time (Moody and Field 1999, Schultz et al. 2004, Moody et al. 2003, McGuire et al. 2014), DoD branch level programmatic approaches to PFAS sampling and analysis did not arise until 2012 (Department of Navy [DoN] 2015, Department of the Air Force 2012, United States Army Corps of Engineers [USACE] 2016). Sampling and analysis approaches for PFASs have evolved significantly over this era in response to a better understanding of materials that can introduce PFAS contamination, the nature of PFAS partitioning and distribution in different kinds of media, and the recognition that differences in both sampling and analysis techniques generated unacceptably high levels of variance in PFAS levels among split samples (Martin et al. 2004).

Some of the properties that make PFASs desirable for use in the materials and equipment related to sampling and analysis of other organic constituents – low retention of organic compounds, durability, and heat resistance – has led to their widespread use in sampling materials and laboratory equipment. Fluorinated tubing, pump bladders, bottles and lids, internal components, and tape are all commonly used in sampling equipment for other organic compounds such as chlorinated solvents. In the laboratory setting, the instrument most commonly used to measure PFASs, a liquid chromatography tandem mass spectrometry (LC-MS/MS) system, is routinely sold with fluorinated tubing and components. While most of these materials are comprised of fluoropolymers such as polytetrafluoroethylene (PTFE), the production of these materials often results in residuals of commonly measured PFASs that can leach into environmental samples at the sampling or laboratory stage. This issue is particularly acute in the case of samples that have been extracted into solvents containing a high organic (e.g., methanol, acetonitrile) percentage, which more rapidly leach PFAS residuals out of fluoropolymer tubing than aqueous solutions. Because of the potential for cross-contamination of PFASs from sampling and analysis equipment, significant precautions are taken to avoid PFAS contributions during sampling and in the laboratory setting.

The surfactant nature of many PFASs, particularly those of common environmental interest, also contribute to some of the challenges in collecting representative samples and measuring PFASs. While most PFASs are relatively water soluble, they tend to partition at air-water and water-solid interfaces (Brusseau 2018). This can result in biased analysis results related to sub-sampling of aqueous environmental samples, as well as retention of PFASs on sampling bottles. As PFASs are a large class of chemicals, there is also variance in how individual PFASs may exhibit these behaviors (Barzen-Hanson et al. 2017b). Some polyfluorinated compounds like the polyfluoroalkyl phosphates tend to partition more strongly to surfaces than the PFAAs (Chandramouli et al. 2015), and as the perfluoroalkyl chain lengthens in a molecule, the more hydrophobic binding potential a PFAS molecule exhibits (Higgins and Luthy 2006). PFASs with higher organic carbon or electrostatic partitioning affinities to soils can be more challenging to fully extract from soils and other solid samples (Sepulvado et al. 2011, Barzen-Hanson et al. 2017b). Sampling and analytical techniques have evolved to address these PFAS-specific challenges.

Sampling and analysis for PFASs are subject to some of the same challenges that occur in the environmental sampling and analysis of other organic contaminants. For example, cross-contamination related to sampling equipment and sampling order are concerns for PFASs and collecting a representative soil sample may present challenges for PFASs as it does for other contaminants, given the heterogeneity of soil samples. Some common challenges are less problematic when sampling and analyzing for PFASs. For example, most target PFASs of interest are not volatile and cross-contamination via air space in coolers is not typically a concern.

Laboratory detection limits for PFASs tend to be quite low (i.e., less than 10 parts per trillion [ppt] for aqueous and soil samples) and achieving necessary reporting limits is not often limited by sample size. While PFAS measurements can be partially inhibited by matrix interferences, the specificity of the detection methods for PFASs mitigate against incorrect identification. PFASs measured by LC-MS/MS are identified by retention time, molecular weight, and one or two specific molecular weight transitions to known product ions. As a result, co-eluting analytes have a very low likelihood of being misidentified as the target PFAS of interest. There are also many isotopically labeled versions of PFASs that can be added during sample preparation and analysis to account for losses associated with extraction inefficiencies or matrix enhancements and suppression, resulting in a highly accurate sample quantification.

This white paper summarizes the current state of best practices for the sampling and analysis of PFASs in environmental media. It also provides an overview of the current U.S. regulatory landscape governing PFAS occurrence in environmental media.

2 SAMPLING METHODS AND PROCEDURES

This section provides a summary of methods and procedures applicable to the collection of environmental samples for field screening or laboratory analysis during PFAS site characterization activities. In general, sampling techniques used for PFAS site characterization are consistent with conventional sampling techniques used in the environmental industry, but special consideration is made regarding PFAS-containing materials and cross-contamination potential. For example, Teflon™ and other fluoropolymer containing materials are found in pumps, tubing, and sample storage containers and therefore should be avoided if possible (Department of Environment Regulation [DER], Western Australia 2016; New Hampshire Department of Environmental Services [NHDES] 2016). Certain field documentation materials such as waterproof paper or field books, adhesive paper products, and some writing utensils (grouped as non-Sharpie® markers) are also prohibited items during PFAS sampling (DER 2016; NHDES 2016). **Table 1a** provides a summary of materials that have been approved for site investigation; this list is expected to grow longer as industry experience increases. **Table 1b** provides a summary of field equipment and materials that have available testing information and/or industry knowledge regarding PFAS cross-contamination potential and it is recommended that these materials be prohibited for sample collection; for materials that are suspected of containing PFASs and/or to retain PFASs, these recommendations are considered preliminary and subject to change.

Given the extremely low detection limits associated with PFAS analysis and the many potential sources of trace levels of PFASs, field personnel are typically advised to err on the side of caution by strictly following field wear guidelines and decontamination procedures. A detailed summary of cross-contamination and decontamination procedures is provided in Section 4.

Table 1a: Summary of Acceptable Sampling Equipment and Materials for PFAS Site Investigations

Sampling Materials	Additional Considerations	References
Water Sampling Materials		
High density polyethylene (HDPE) or silicone tubing materials	--	DER 2016; USACE 2016; NHDES 2016; MassDEP 2017
HDPE HydraSleeves^{TM}	Low density polyethylene (LDPE) HydraSleeves^{TM} are not recommended	USACE 2016; MassDEP 2017
Drilling and Soil Sampling Materials		
PFAS-free drilling fluids	--	DER 2016
PFAS-free makeup water	Confirm PFAS-free water source via laboratory analysis prior to investigation	--
Acetate liners	For use in soil sampling	USACE 2016
Sample Containers and Storage		
HDPE sample containers with HDPE lined lids for soil and water samples	Laboratory should provide; whole bottle analysis of aqueous samples combined with a solvent rinse of bottle is recommended	DER 2016, MassDEP 2017

Sampling Materials	Additional Considerations	References
Ice contained in plastic (polyethylene) bags (double bagged)	--	DER 2016; USACE 2016; NHDES 2016; MassDEP 2017
Field Documentation		
Sharpie®	--	NHDES 2016; USACE 2016; MassDEP 2017
Ball point pens	--	MassDEP 2017
Standard paper and paper labels	--	DER 2016; USACE 2016; NHDES 2016; MassDEP 2017
Decontamination		
Water-only decontamination	Confirm PFAS-free water source via laboratory analysis prior to investigation	DER 2016
Alconox®, Liquinox® or Citranox® followed by deionized water or PFAS-free water rinse	Alconox® known to contain trace levels of 1,4-dioxane	NHDES 2016; USACE 2016; MassDEP 2017
Methanol, isopropanol, or acetone	Special health and safety precautions are necessary	UNEP 2015; USACE 2016

Note: This list is considered preliminary and additional materials may be added as additional information becomes available. Project teams are expected to follow a methodical evaluation process of materials to be used and confirm acceptance prior to implementation of field activities.

Table 1b: Summary of Sampling Equipment and Materials Not Recommended for PFAS Site Investigations.

Sampling Materials	Known PFAS-Containing Materials	Suspected PFAS-Containing Materials	Materials with Potential to Retain PFASs	References
Water Sampling Materials				
Teflon® or PTFE-containing or coated field equipment (e.g., tubing, bailers, tape, plumbing paste)	x			DER 2016; USACE 2016; NHDES 2016; MassDEP 2017
Passive diffusion bags			x	MassDEP 2017
LDPE HydraSleeves ™			x	USACE 2016; MassDEP 2017
Water particle filters			x	MassDEP 2017
Drilling and Soil Sampling Materials				
Aluminum foil			x	DER 2016; USACE 2016; NHDES 2016; MassDEP 2017
Drilling fluid containing PFASs	x	x		DER 2016

Sampling Materials	Known PFAS-Containing Materials	Suspected PFAS-Containing Materials	Materials with Potential to Retain PFASs	References
Sample Containers and Storage				
Glass sample containers with lined lids			x	DER 2016; USACE 2016; NHDES 2016; MassDEP 2017
LDPE containers and lined lids			x	USACE 2016
Teflon® or PTFE- lined lids on containers (e.g., sample containers, rinsate water storage containers)	x			DER 2016; USACE 2016; NHDES 2016; MassDEP 2017
Reusable chemical or gel ice packs (e.g., BlueIce®)		x		DER 2016; USACE 2016; NHDES 2016; MassDEP 2017
Field Documentation				
Self-sticking notes and similar office products (e.g., 3M Post-it-notes)		x		DER 2016; USACE 2016; NHDES 2016; MassDEP 2017
Waterproof paper, notebooks, and labels	x			DER 2016, MassDEP 2017
Non-Sharpie® markers		x		NHDES 2016
Decontamination				
[Some] detergents and decontamination solutions (e.g., Decon 90® Decontamination Solution)	x	x		DER 2016; NHDES 2016; MassDEP 2017

Note: For materials that are suspected of containing PFASs, or have the potential to retain PFASs, project specific considerations may provide adequate justification for use during the field event. For example, further evaluation may be conducted in the form of pre-field equipment blank sample analysis.

2.1 Soil and Sediment Sampling Techniques

Conventional soil drilling and sediment sampling can generally be used to obtain samples for analysis of PFASs (DER 2016). For PFAS sample collection, it is recommended that samples are collected in laboratory supplied HDPE sample containers. Additional considerations for common sampling technologies and materials include the following:

- Hand auger and hollow stem auger samples may be collected in a split spoon or Shelby sample container. Both samplers may be lined with stainless steel, carbon, brass, or acetate sleeves. Samples may be collected from the soil core and placed in laboratory supplied sample containers, which is the preferred method for PFAS soil sample collection. Historically, samples have been collected in the sleeves and plastic caps were placed on the sleeve ends and sent for laboratory analysis. This practice is no longer considered advisable since most laboratories lack the proper tooling to extract soil from the sleeves.
- Direct push samples are typically collected in Lexan^{TM} or acetate sleeves, or polyvinyl chloride (PVC) liners for dual-tube or Macrocore sampling. These materials are generally considered acceptable for

retrieving drilling cores for PFAS soil sample collection. Sample intervals may be cut using a cutting device and the sleeve can be capped and submitted to the laboratory. However, to limit laboratory sample processing, direct push soil cores should be split open and the soil samples collected into the laboratory supplied sample container.

- Rotosonic samples are collected from the core, which is retrieved in a plastic sleeve. Samples are typically collected directly into a laboratory supplied sample container and/or by using a trowel and placing the sample into the laboratory supplied sample container.
- Backhoe samples are collected from the bucket of the backhoe. Samples are typically collected directly into a laboratory supplied sample container and/or by using a trowel and placing the sample into the laboratory supplied sample container. For PFAS sampling, additional care should be taken to collect soil samples for PFAS analysis from the inner portion of large soil masses to obtain untouched soil for laboratory analysis, if such masses are observed during soil excavation.

Because of the potential presence of PFASs in equipment typically used to collect samples, consideration for other sampling materials that contact the soil cuttings through the sampling process is necessary. For example, a cutting shoe is used on the head of a direct push drill string and a bucket auger is used to collect samples from a test pit using a backhoe. Each piece of equipment that comes into direct contact with the soil cuttings needs to be evaluated to determine if there are either PFAS-containing materials present, which could be a source of cross-contamination and cause false positives, or if PFASs adhere to the material, which has the potential to cause low bias sample results. If there is concern that equipment may introduce contamination, a conservative number of equipment blanks should be collected to confirm that materials in the sample equipment do not cause false positives by introducing PFASs. Equipment blanks are particularly important for any device/component where PFASs may be present or cannot be verified as being a non-PFAS containing material. Other quality assurance methods may be implemented to avoid materials that could result in potential losses associated with PFASs adhering to surfaces. For example, collecting samples from an “undisturbed” portion of a large diameter soil core and transferring it to the laboratory supplied container may provide assurance that representative soil samples are collected for PFAS sample analysis.

The following additional notes are provided regarding soil sampling materials:

- Where drilling or decontamination water is needed it is recommended to submit water samples of the source water prior to investigation activities for PFAS analysis to enhance assurance that background PFASs will not be introduced. Note that some water systems may be constructed with PFAS-containing thread and gasket sealants and therefore an inspection of the source water distribution system may provide an additional level of assurance for identifying a source of PFAS-free water for site investigation.

- It is often standard practice to cover the ends of sample sleeves and protect the sample from potential cross-contamination from the plastic end caps with Teflon™ or other PTFE tape (Geotechnical Services, Inc. 2018); this practice should be strictly avoided for PFAS sample collection (DER 2016).

- Lexan™ liner sleeves are made of polycarbonate and they are not expected to contain PFASs based on review of the Safety Data Sheet (Sabic 2016).

- Acetate (i.e., cellulose acetate butyrate) liners are commonly used as sleeves and are not expected to contain PFASs.
- Studies evaluating the use of stainless steel indicate that PFASs do not strongly sorb to stainless-steel (Obal et al. 2012). Therefore, stainless steel sleeves and stainless-steel equipment should be acceptable for collection of soil samples for PFAS analysis.

2.2 Water Sampling Techniques

Groundwater samples for chemical analysis are commonly collected using the following sampling technologies and materials:

- Water levels are typically recorded prior to sample collection. For PFAS sample collection, it is recommended that water levels be measured following completion of sample collection to minimize the potential for cross-contamination between monitoring wells (USACE 2016). Site or project specific considerations may be considered when deciding the timing of water level collection.
- Grab groundwater samples may be collected by installing a Hydropunch™ type sampler or temporary monitoring well and collecting samples using a bailer, peristaltic pump, submersible pump (including bladder pumps). For PFAS sample analysis, collection of a conservative number of equipment blanks from the sampler or monitoring well materials may be appropriate to address concerns with potential cross-contamination (see **Table 1b**). Equipment blanks are particularly important for any device/component where PFASs may be present or cannot be verified as being a non-PFAS containing material.
- Groundwater samples may be collected from existing monitoring wells using purge and minimal to no-purge sampling techniques. It is recommended to use low-flow peristaltic pumps using silicone or HDPE tubing (DER 2016; MassDEP 2017). However, it will be necessary to use submersible pumps for sites with depth to groundwater greater than approximately 30 feet below ground surface. HDPE HydraSleeves^{TM} or similar products may also be used for passive sampling (DER 2016; MassDEP 2017). The tether that is provided by HydraSleeve™ is made of polyester and is not expected to affect measured PFAS concentrations.
- Surface water samples may be collected using dipping, scooping, bailing, and pumping sample techniques. For PFAS sampling, it is recommended that active/grab sampling methods are used (e.g., Niskin™ or other remotely activated water samplers), or simply hand-dipping. Samples should not be collected from the surface (United Nations Environment Programme [UNEP] 2015).
- Porewater samples may be collected using a porewater extracting device or by collecting intact sediment cores and centrifuging porewater from the sediment core. Intact sediment cores may be frozen with dry ice and shipped on ice, if needed for project objectives. Most PFAS-analysis related guidance prohibits the freezing of samples prior to extraction indicating a need for additional consideration of sediment sampling techniques for PFAS sample collection. Additional consideration of sample freezing is provided in Section 4.5 for consideration. Regardless, when shipping and storing samples for PFAS analysis, it is important to avoid BlueIce^{TM} (see **Table 1b**).

As described for soil and sediment sampling, the potential presence of PFASs in equipment that may come in contact with the target water sample must be evaluated as part of the sample planning process to maintain sample integrity. For example, low-flow sampling with a peristaltic pump should be conducted using silicone or HDPE tubing, and Teflon™ tubing is prohibited (DER 2016). If a bladder pump is used to collect samples, the bladder and other internal parts (check balls, o-rings, compression fittings) should not be made of Teflon™ either, and bladder and o-rings should be changed between samples (DER 2016). **Tables 1a-1b** provide a summary of sampling materials and available information regarding the advisability of their use during PFAS sampling. Section 4.1 provides additional detail regarding cross-contamination considerations.

Other sampling bias potential may exist due to the nature of PFASs as surfactants. For example, at low concentrations, surfactant molecules exist in the monomer state in aqueous solution. As the surfactant concentration increases, they can reach a critical micelle concentration (CMC) and begin to self-associate to form a new pseudo-phase called a micelle (Adak et al. 2005). Micelle formation is very unlikely to occur in the nanograms per liter (ng/L)/ ppt to microgram per liter (µg/L)/ parts per billion (ppb) range of PFAS concentrations observed at moderate to highly contaminated PFAS sites, as most CMCs for PFASs occur in the milligrams per liter (mg/L) to grams per liter (g/L) range (Martin et al. 2003). Therefore, micelle formation is not of concern for collection of water samples for typical environmental site investigations. PFAAs also partition preferentially at the air-water interface (Moody and Field 2000, Brusseau 2018). There is very limited information regarding this potential sampling bias, though the following considerations provide a framework for avoiding stratification if it is an issue:

- A sample plan may incorporate a minimum three well casing volume purge (subject to stabilized field parameters) to enhance assurance that groundwater is not stagnant prior to collecting a groundwater sample. However, this practice should ideally be conducted in advance (i.e., a minimum of 24-hours) of sample collection to prevent contaminant flux-based recharge from affecting the sample result.
- Low-flow groundwater sampling techniques also have the potential to result in sample results representative of flux-based recharge (e.g., to be representative of groundwater in the coarse-grained materials in a monitoring well cross-section).
- No-purge passive sampling techniques (such as the HDPE HydraSleeve^{TM}) provide the opportunity to collect in-situ groundwater samples from within the screened interval of a monitoring well. This technique has historically been shown to provide more conservative (i.e., higher concentration) values for other types of contaminants than samples collected using well-volume purging, and values equivalent to samples collected using low-flow purging and sampling.

Regardless of the selected sampling technique, the current state of practice for groundwater sample collection is to collect water samples from the mid-point of the saturated well screen interval. There is not any compelling evidence to suggest the practice should be different for samples collected for PFAS analysis (Arcadis 2017).

Note that if high concentrations of PFASs related to Class B firefighting foams are expected in a groundwater sample, it has been recommended to collect and shake a small portion of the sample at the time of sample collection (USACE 2016; Arcadis 2017). If foaming is noted within the sample, it indicates elevated concentrations of PFASs may be present and the sample should be proactively diluted at the laboratory prior to analysis. The foaming should be noted on the sample chain of custody form.

2.3 Sample Shipping

Following sample collection, samples for laboratory analyses are commonly placed in a polyethylene bag (e.g., Ziploc©) and placed in an ice-chilled cooler for sample preservation. A temperature range between 0 and 6ºC is considered appropriate for PFAS sample preservation (United States Environmental Protection Agency [USEPA] 2009). As noted in **Table 1b**, reusable chemical or gel ice packs (such as BlueIce^{TM}) are strictly prohibited for PFAS sample storage or transport. Ice contained in polyethylene bags is recommended instead (DER 2016).

2.4 Investigation Derived Waste (IDW)

Investigation derived waste (IDW), including drill cuttings and groundwater purge water is typically placed in drums and temporarily stored on-site pending waste characterization. Typical waste characterization procedures include collection of a composite sample of the drill cutting material and a composite sample of the purge water for laboratory analysis. Samples are typically analyzed for disposal toxicity characteristic leaching procedure (TCLP) analysis for metals and volatile organic compounds. For PFASs, a simple leach test with neutral pH water may be more indicative of actual risk, as PFASs leach more strongly at neutral than acidic pH due to their acid dissociation constants (pKas). Additionally, generators of waste are required to include analysis of other constituents that are reasonably believed to be present, including PFASs if detected in analyzed samples.

In general, PFAS-containing IDW poses a unique challenge for disposal because acceptance of such waste will be based on the local facility and their permit restrictions. Prior to off-site disposal, it is necessary for responsible parties (or their representatives) to confirm that the facility is meeting the regulatory requirements for accepting waste containing PFASs. Facilities that provide high temperature incineration (i.e., hazardous waste incinerators) are likely to meet the necessary technical requirements for complete destruction of PFASs. Water treatment technologies that may be suitable for onsite or offsite treatment of aqueous IDW include granular activated carbon or non-ion/anion-exchange resins, but the system must be designed with proper consideration for PFAS treatment and the treatment media will also need to be disposed of. Prior to disposal, soil may be stabilized for PFASs using amendments that exploit both the hydrophobic and electrostatic properties of PFASs to help fix PFAS mass in place (fixation). To date, the long-term permanence of fixation for PFASs is yet to be demonstrated in the field, although there are projects underway in 2018 with the aim of comparing three commercially-available adsorbents and performance monitoring of leachability of PFASs over a period of three to four years. Additionally, several innovative treatment options for PFASs in soil and water are in development and some will likely be practical for on-site IDW treatment. A detailed discussion of IDW treatment technologies for PFASs is the subject of a forthcoming white paper.

3 ANALYTICAL METHODS

The most common instrumentation used to measure PFASs is LC-MS/MS. Because most PFASs are measured by this comparatively modern technique, they were not reported on in the peer-reviewed literature until the late 1990’s, when researchers began to have access to this instrumentation (Moody and Field 1999, Giesy and Kannan 2001). In July 2004, prominent PFAS researchers wrote an editorial in Environmental Science and Technology entitled “Analytical Challenges Hamper Perfluoroalkyl Research” (Martin et al. 2004). The article argued for the need for additional certified analytical standards and stronger interlaboratory comparison of methods, two issues which have since been largely resolved. Van Leeuwen et al. reported on significant improvements in the analysis of PFASs through an interlaboratory comparison in 2009 (van Leeuwen et al. 2009). The first and only USEPA Method - USEPA Method 537 Version 1.1 - to measure PFASs was published in 2009, and it covers the analysis of fourteen individual PFASs in drinking water (**Table 2**). Notably other common PFASs of interest, including perfluorobutanoic acid (PFBA), perfluoropentanoic acid (PFPeA), and perfluorooctane sulfonamide (PFOSA) did not meet data quality objectives when this method was rigorously tested (USEPA 2009). The issuance of the Quality Systems Manual (QSM) 5.1 in January 2017 was the first governmental guidance that mandated certain analytical procedures for the analysis of PFASs in soil, sediment, surface water, and groundwater (U.S. DoD 2017). Commercial laboratories, under their DoD Environmental Laboratory Accreditation Program (ELAP) accreditation, must align their standard operating procedures (SOPs) with the requirements set forth in Table B-15 of QSM 5.1 (**Appendix A**), or later versions of the QSM to which the laboratory is accredited. These QSM 5.1 compliant methods for analysis of PFASs in environmental samples are typically referred to as modified 537 methods, but each lab uses a slightly different modified 537 method. Notably, DoD installations are required to use ELAP-certified laboratories for environmental analyses.

Since 2010, a proliferation in the number and type of PFAS analytes being measured has occurred. Some of these analytes are measured quantitatively with authentic analytical standards, some are measured semi-quantitatively with commercial materials (Place and Field 2012), and some are tentatively identified and estimated using high resolution techniques (Barzen-Hanson et al. 2017a, Strynar et al. 2015). Depending on the types of PFASs of interest and the media in which they are to be measured, different extraction methods, instrumentation tuning, and even instrument type may be used. In addition to the array of methods that have been developed to measure individual PFASs, several methods that measure either total organic fluorine or the total concentration of PFAA precursors have also been developed. This white paper addresses all of these analytical nuances, but primarily focuses on the sample preparation and analysis of discrete PFASs in environmental aqueous media and soil.

Table 2: List of PFAS Analytes Certified for Analysis Under USEPA Method 537.

Name	Abbreviation	Chemical Abstract Service (CAS) Number
Perfluorohexanoic acid	PFHxA	307-24-4
Perfluoroheptanoic acid	PFHpA	375-85-9
Perfluorooctanoic acid	PFOA	335-67-1
Perfluorononanoic acid	PFNA	375-95-1
Perfluorodecanoic acid	PFDA	335-76-2

Name	Abbreviation	Chemical Abstract Service (CAS) Number
Perfluoroundecanoic acid	PFUnA	2058-94-8
Perfluorododecanoic acid	PFDoA	307-55-1
Perfluorobutanesulfonic acid	PFBS	375-73-5
Perfluorohexanesulfonic acid	PFHxS	355-46-4
Perfluorooctanesulfonic acid	PFOS	1763-23-1
Perfluorotridecanoic acid	PFTrA	72629-94-8
Perfluorotetradecanoic acid	PFTeA	376-06-7
N-ethyl perfluorooctanesulfonamidoacetic acid	N-EtFOSAA	2991-50-6
N-methyl perlfuorooctanesulfonamidoacetic acid	N-MeFOSAA	2355-31-9

3.1 Sample Preparation

3.1.1 Isotope dilution

For many PFASs, an isotopically labelled form of the same compound is commercially available. This means that, for example, a PFOA molecule that has one or more carbons comprised of ^{13}C, rather than the predominantly occurring ^{12}C, can be procured. It is advantageous to add isotopically labelled compounds to either a raw or prepared sample because it will mimic the non-labelled (i.e., native) compound in how matrix effects impact the particular PFAS. If the labelled compound's response is quantified, it can be used to adjust the response of the native compound to improve the accuracy of quantification. This is a less arduous process than standard additions; however, the isotopically labelled compounds can be somewhat expensive to procure. It is important to note that the use of isotopically labelled compounds for any quantification purposes presupposes that the quantification method is based on mass detection. A detection technique such as ultraviolet (UV) absorbance or fluorescence cannot distinguish between two compounds with the same structure but slightly different masses.

The practice of quantifying a PFAS of interest using isotopically labelled surrogate compounds is called isotope dilution. When using isotope dilution, all samples analyzed are amended with the same amount of the labelled compound, including calibration standards. Typically, this means that calibration curves are prepared with an x-axis that is the compound concentration, and a y-axis that is the response of the native compound divided by the response of the labelled compound with which it is paired. If an exact match is unavailable, then a labelled compound that is a close structural match may be used instead.

Most methods developed by academic researchers (Sepulvado et al. 2011, Houtz et al. 2013, Backe et al. 2013) and QSM 5.1 (Table B-15 – **Appendix A**) stipulate the amendment of the isotopically labelled compounds to the sample prior to any sample preparation steps, so that the labelled compounds can also quantitatively capture any losses due to preparation steps like extraction. These extraction surrogates are then used for quantification of PFASs in the sample. In QSM 5.1, these compounds are called "Extracted Internal Standard Analytes" (U.S. DoD 2017). The use of extracted internal standards allow for the reporting of PFASs with lower absolute recoveries, although there are still constraints placed around minimum recoveries of PFASs in QSM 5.1 (between 50 percent [%] and 150% of their true value). In

USEPA Method 537 and the American Society for Testing and Materials (ASTM) methods for analysis of PFASs in soil and aqueous media, some isotopically labelled PFAS surrogates are included and separately tracked for recovery, but they are **not** used for quantification (USEPA 2009, ASTM 2014, ASTM 2015).

Isotopically-labelled compounds can also be added after method preparation steps to track instrument response consistency; these are usually called internal standards. In QSM 5.1, a select list of these additional isotopically labelled compounds, called “Injection Internal Standard Analytes”, are used for this purpose; they are not used for quantification, and they have a different number of labelled atoms than the Extracted Internal Standard Analytes (U.S. DoD 2017). In USEPA Method 537, an additional set of isotopically-labelled compounds are added after extraction and used for quantification (USEPA 2009). They are referred to as “internal standards” in this method.

Because instrument reliability is generally considered less problematic than potential matrix interferences, it is more accurate to quantify with the compounds that are added in advance of sample preparation (i.e., extracted internal standard analytes) rather than those added after sample preparation (i.e., injection internal standard analytes or the internal standards within USEPA Method 537).

3.1.2 Aqueous samples

The sample preparation of aqueous samples for PFAS analysis varies primarily in the amount of matrix cleanup deemed necessary.

PFASs are well known to stick to nylon and, to a lesser extent, glass particle filters (Chandramouli et al. 2015, Figure 1), so samples should not be pre-filtered prior to sub-sampling or extraction. The ASTM method for analysis of aqueous media for PFASs stipulates filtration of samples through a filter; however, the samples are diluted in a 50% methanolic solution prior to filtration (ASTM 2015). Most commercial laboratories centrifuge aqueous samples to remove particulate content prior to further extraction or analysis, if they suspect the particulates will cause analysis problems (personal communication with TestAmerica, Eurofins, and GCAL Laboratories). As with requirements to solvent rinse aqueous sample bottles, a solvent rinse of the centrifuge tube and its remaining particulate contents would help enhance removal of PFASs retained to the tube. If any particulate management steps are taken, isotopically labelled compounds should be added in advance of those steps to account for any associated losses. Management of particulates is not specified by USEPA Method 537, QSM 5.1, or laboratory accreditation standards.

The simplest sample preparation can involve the sub-sampling of an aqueous sample, addition of isotopically-labelled compounds, and subsequent instrumental analysis. Many peer-reviewed publications and the ASTM method for PFASs in aqueous media have used this technique, particularly to preserve sample volume for future analysis or if sample concentrations are known to be very high (Higgins et al. 2006, Backe et al. 2013, Houtz et al. 2013, ASTM 2015). It is generally not considered the best laboratory practice to analyze a partial sample. QSM 5.1 allows sub-sampling of AFFF formulations that will require dilution but does not allow sub-sampling of environmental aqueous samples unless they are known to contain PFASs at concentrations that will require dilution prior to analysis (e.g., samples that foam upon shaking or samples that are collected from a location previously characterized for PFASs). Isotopically-labelled extracted internal standard analytes are added to the sample prior to analysis rather than prior to sub-sampling for these types of high concentration samples (U.S. DoD 2017).

Solid phase extraction (SPE) is a technique of extracting target compounds from an aqueous sample onto a solid-phase cartridge that does not retain some matrix interferences. The SPE cartridge is then eluted with a much smaller volume of organic solvent to make the target compounds available for analysis, resulting in a more concentrated sample and, typically, lower quantification limits. SPE is specified by both USEPA Method 537 and QSM 5.1 for all aqueous samples that do not contain high levels (i.e., requiring dilution prior to analysis) of PFASs. Different SPE cartridges are available, automated in-line SPE coupled with instrumental analysis or offline manual SPE may be used, and the exact procedure for SPE can vary. The most commonly used types of SPE cartridges used to retain PFASs are C18 cartridges, which retain PFASs via hydrophobic interactions and are less effective at retaining short chain PFASs, and weak anion exchange cartridges, which retain PFASs through a combination of anion exchange and hydrophobic interactions. PFASs with positive charges that lack significant hydrophobic character may not be well retained on either type of cartridge. Liquid-liquid extraction, another extraction technique that can concentrate organic compounds, can also be used for PFASs but is generally less desirable due to the generation of large volumes of solvent waste.

Because there is concern over PFASs sticking to the sample bottle, some laboratory SOPs stipulate extraction of the entire sample, including a solvent rinsate of the sample bottle to remove any sorbed PFASs. USEPA Method 537 also requires whole bottle analysis and rinsate with solvent. Because a laboratory will use the entire sample, any re-analysis would require a backup sample in a separate bottle.

QSM 5.1 requires SPE solvent eluents to be further amended with an activated carbon type of product called ENVI-CARB,^{TM} centrifuged, then transferred (i.e., the supernatant) to a new vessel prior to analysis. When PFASs are dissolved in an organic solvent such as methanol, ENVI-CARB^{TM} will remove many interfering compounds but will not retain PFASs.

It is important to note that even with analysis following the guidelines of QSM 5.1, sample preparation procedures and analysis (e.g., SPE cartridges, extraction solvents, whole bottle analysis vs. sub-sampling, exact instrumental procedures) will vary somewhat from laboratory to laboratory. Accreditation processes and laboratory participation in round robin analyses enhance assurance that consistent performance is achieved among laboratories. A project may want to use a single laboratory to avoid inter-laboratory methodological variance.

An alternative PFAS extraction method for groundwater has been developed by Jennifer Field's laboratory at Oregon State University to effectively extract many AFFF-related PFASs that contain positive charges (Backe et al. 2013); this technique involves acidic liquid-liquid extraction of PFASs using ethyl acetate and 2,2,2-trifluoroethanol. This method is not commercially available and would only be necessary if positively charged PFASs are of particular analytical interest.

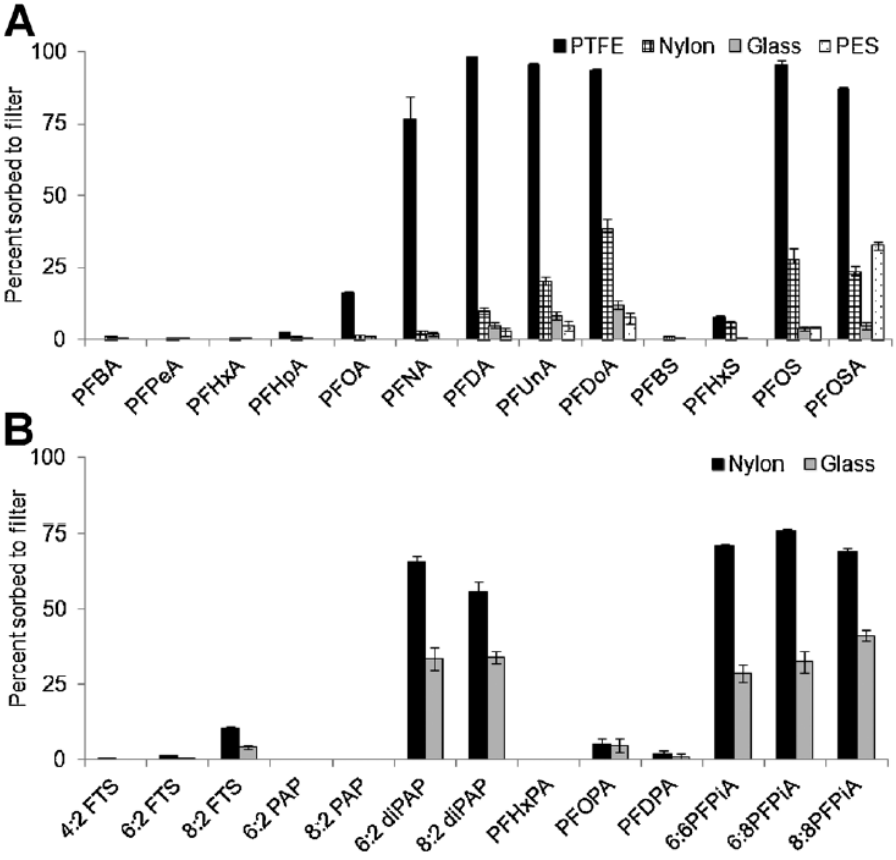

Figure 1: Sorption of per- and polyfluoroalkyl substances (PFASs) from spiked bottled water onto various filter media. (A) Sorption as percentage sorbed on filter for perfluoroalkyl carboxylic acids, perfluoroalkyl sulfonic acids, and PFOSA. (B) Percent sorbed for FTSs, monoPAPs, diPAPs, perfluoroalkyl phosphonic acids, and PFPiAs. Error bars represent standard error. (Figure copied from Chandramouli et al. 2015). PES = polyethersulfone. PTFE = polytetrafluoroethylene.

3.1.3 Solid Samples

Typical environmental solid samples analyzed for PFASs include soil, sediment, and biosolids. There are no USEPA methods governing the analysis of PFASs in these media, and QSM 5.1 does not provide any guidelines around soil and sediment preparation, apart from requiring homogenization of the entire sample and cleanup of the sample extract with ENVI-CARB^{TM}. There is a published ASTM method on analysis of PFASs in soil (ASTM 2014); however, some of its analytical requirements differ significantly from requirements set under QSM 5.1. Early soil preparation and analysis methods focused primarily on anionic PFASs such as the PFAAs and fluorotelomer sulfonates (FtSs) (Higgins et al. 2005, Sepulvado et al. 2011, Houtz et al. 2013). More recent methods have targeted a broader scope of analytes that include positively charged functional groups (Mejia-Avendaño et al. 2017, Barzen-Hanson et al. 2017b).

Prior to sample extraction, sieving of samples (finer than 2 millimeter pore size) to remove rocks and large particles is often conducted (Higgins et al. 2006, Sepulvado et al. 2011, Weber et al. 2017, Barzen-

Hanson et al. 2017b). Sample homogenization is also typically conducted, although methodological details are rarely provided (Higgins et al. 2006, Sepulvado et al. 2011, Houtz et al. 2013, Weber et al. 2017, Barzen-Hanson et al. 2017b, U.S. DoD 2017).

Most researchers report some type of serial methanolic extraction of solid samples, often conducted in conjunction with vortexing, heating samples between 30ºC and 60ºC, and sonication to improve efficiency of analyte desorption (Higgins et al. 2006, Sepulvado et al. 2011, Houtz et al. 2013, Mejia Avendaño 2017, Barzen Hanson 2017b, ASTM 2014). Isotopically labelled compounds are typically added to the solid sample to be extracted prior to or in conjunction with the addition of solvent extractant solutions. Many researchers have used the addition of either ammonium hydroxide (0.1% to 1%) (Houtz et al. 2013, Sepulvado et al. 2011, ASTM 2014) or, for more aggressive extractions of solid samples containing PFASs with betaine and quaternary ammonium functional groups, 200 mM sodium hydroxide (Mejia Avendaño et al. 2017). To extract zwitterionic and cationic polyfluorinated compounds found in some AFFF formulations, Barzen-Hanson et al. used an acidic methanolic extraction containing 0.1 M hydrochloride acid (2017b). For extraction of PFAAs and FtSs, basic methanolic extractions are sufficient (Houtz et al. 2013, Mejia Avendaño et al. 2017). For extraction of the widest range of PFASs on solids, both a basic and an acidic extraction is likely to be required (Barzen-Hanson et al 2017b). Extractions are conducted in centrifuge tubes containing an approximately 1 g to 10 mL soil to solvent ratio (Higgins et al. 2006, Sepulvado et al. 2011, Houtz et al. 2013, Mejia Avendano 2017, Barzen Hanson 2017b), and extracts are separated from the solids by removing the supernatant after centrifugation.

After extracts are collected and combined, the pH may be adjusted, and further cleanup is conducted prior to analysis with either SPE (Higgins et al. 2005) or ENVI-CARB^{TM} (Sepulvado et al. 2011, Houtz et al. 2013, Mejia Avendaño 2017, Barzen-Hanson 2017b, U.S. DoD 2017). Cleaned up sample extracts are reconstituted in methanol or a mixture of methanol and water prior to analysis by LC-MS/MS.

Although no standard extraction method for PFASs in soil is stipulated by QSM 5.1 or an USEPA method, Table B-15 in the QSM 5.1 does stipulate specific recovery limits on extracted internal standard analytes and relative percent differences on matrix spike duplicates (U.S. DoD 2017). These limits offer a guarantee that individual laboratory SOPs with differing extraction procedures will generate defensible PFAS concentration data despite the lack of standard methodology. A project may want to use a single laboratory to avoid inter-laboratory methodological variance.

3.1.4 Other Matrices

Methods for the extraction and measurement of PFASs in other matrices beyond aqueous and environmental solids have also been developed but do not have published USEPA standard methods. A widely used method for measuring PFASs in blood and breast milk and developed by the United States Centers for Disease Control is reported in Kuklenyik et al. 2004. Briefly, it involves denaturing the protein content of samples with formic acid in an High Performance Liquid Chromatography vial, then proceeding through a typical LC-MS/MS method that includes online SPE. Other blood analysis preparation methods have included extraction with methyl tert butyl ether and an ion pairing reagent (Lee and Mabury 2011). A method for the determination of PFASs in dust has been reported by two USEPA researchers; fluorotelomer alcohols were extracted in hexane, subjected to SPE cleanup, and analyzed by gas chromatography (GC)-MS, while the PFAAs were extracted in acetonitrile and analyzed by LC-MS/MS (Strynar and Lindstrom 2008). Numerous methods have been published in the peer reviewed literature on extraction and analysis of PFASs in biota, with van Leeuwen et al. comparing the efficacy of various extraction methods for fish tissue (2009). Like environmental solid samples, many methods for other matrices involve an extraction step with methanol or other organic solvent and cleanup with ENVI-CARB^{TM}.

3.1.5 Influence of Co-Contaminants

The influence of co-contaminants on the partitioning of PFASs has been investigated and published in the peer reviewed literature (Guelfo and Higgins 2013, Mejia Avendaño et al. 2017). Non-aqueous phase liquids (NAPL; dodecane and trichloroethene), amphoteric surfactants, and anionic surfactants generally increased sorption of PFAAs to soils (Guelfo and Higgins 2013); however, these effects were dependent on organic carbon fraction, PFAA chain length, and surface charge of soil. Guelfo and Higgins did not require any adjustments to their basic methanolic soil extraction procedures in the presence of these co-contaminants, as they did not interfere with the efficacy of the soil preparation techniques for PFAS measurement.

Mejia-Avendaño et al. 2017 noted slightly depressed recoveries for PFASs on soils in the presence of 40,000 parts per million (ppm) diesel; however, neither crude oil nor diesel spiked at 5,000 ppm or 40,000 ppm led to unacceptable recoveries of PFASs in contaminated soils (Figure 2). The type of PFAS had a much greater influence on method recovery than the presence of co-contaminants.

The influence of co-contaminants on PFAS extraction from groundwater samples has not been extensively reported. From laboratory preparation steps, it is not uncommon to see an SPE cartridge washed with a 10% or 20% methanolic rinse in water with no desorption of PFASs (van Leeuwen et al. 2009). Most organic co-contaminants occur at significantly lower concentrations in groundwater or surface water than 10% or 20% and have less affinity for PFASs as a solvent than methanol. Thus, organic co-contaminants are unlikely to interfere in groundwater preparation steps by prematurely desorbing PFASs from the SPE cartridge. Significant concentrations of organic carbon may preferentially sorb to SPE cartridges or cause matrix effects upon analysis. Similarly, samples with high concentrations of dissolved ions might diminish the anionic sorption capacity of PFASs to an SPE cartridge. However, isotope dilution and recording of isotopically-labelled standard recoveries can mitigate or identify the need for corrective actions if these effects occur.

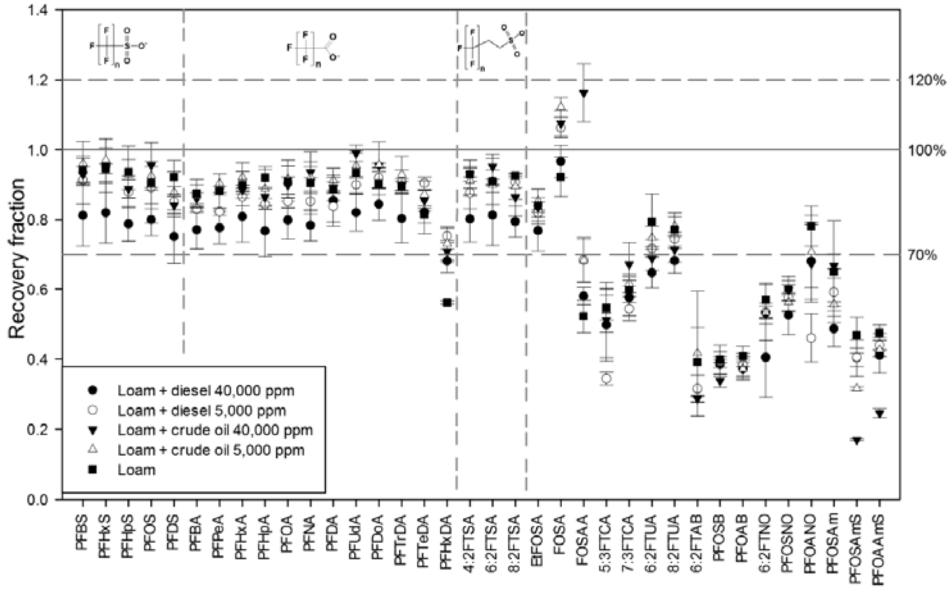

Figure 2: Recovery fraction of all studied PFASs in a loam soil with methanol/ ammonium hydroxide as extraction solvent in the presence and absence of hydrocarbon co-contaminants. Figure reproduced from Mejia Avendaño et al. 2017.

3.2 Instrumentation

LC-MS/MS is the instrumentation of choice for the measurement of most PFASs. The PFAAs are predominantly negatively charged at pH values greater than 3 to 5, so they are not amenable to GC, which is better suited for neutral, volatile molecules. The PFAAs do not fluoresce and do not absorb significantly within the UV/ visible (UV/vis) spectrum, so these types of detection methods are not suitable for PFAAs (Martin et al. 2004). The PFAAs, given their non-reactive nature, are also not easily derivatized (i.e., reacted with another compound) to molecules that are either volatile or possess UV/vis absorbing or fluorescing properties. As a result, liquid chromatography separation with mass spectrometry detection (LC-MS/MS) has become the de facto analysis choice for the PFAAs as well as many of the PFAA precursor or polyfluorinated compounds. An exception occurs for the measurement of volatile PFASs, including the fluorotelomer alcohols and the sulfonamide alcohols, which are most amenable to GC separation and analysis (Strynar and Lindstrom 2008). Notably, volatile PFASs are not intentionally included in AFFF formulations because they lack an ionic charge that is crucial to their functionality as surfactants.

Multiple types of MS detectors may be used, including single or triple quadrupole, ion trap, and time of flight. Single quadrupole, or LC-MS, is not considered sufficient to unequivocally identify compounds such as PFOS, as interfering compounds with similar elution times and the same nominal mass are often present in complex matrices. Thus, an MS detector that can fragment the parent molecule into one or more reproducible fragments is desirable for more specific and accurate identification of the correct PFAS. LC paired with triple quadrupole (LC-MS/MS) is most common due its cost (i.e., less expensive than time of flight instrumentation) and reliability for the range of PFASs of interest. LC-MS/MS for PFAS analysis is typically operated in negative electrospray ionization mode (Taniyasu et al. 2005 Higgins et al.

2005, Backe et al. 2013, Houtz et al. 2013, U.S. DoD 2017), which allows negatively charged PFAS molecular ions to pass through the MS. Occasionally, for the case of certain positively charged PFASs that are found in AFFF, positively charged electrospray ionization is used. In both USEPA Method 537 and QSM 5.1, LC-MS/MS analysis is stipulated for PFASs. LC-MS/MS analysis of PFASs is widely available in U.S. commercial laboratories, including in a mobile laboratory context offered by the company Cascade.

When analyzing PFASs by LC-MS/MS, some compounds will resolve as two individual or attached peaks (**Figure 3**). One peak is representative of the aggregate branched structural forms of the compound and the other peak is representative of the linear form of the compound. Historically, some laboratories have only quantitated the linear peak. It is now standard practice and required by QSM 5.1 and the 2016 USEPA 537 Technical Advisory, to quantitate both peaks when reporting the total concentration of any PFAS (U.S. DoD 2017, USEPA 2016).

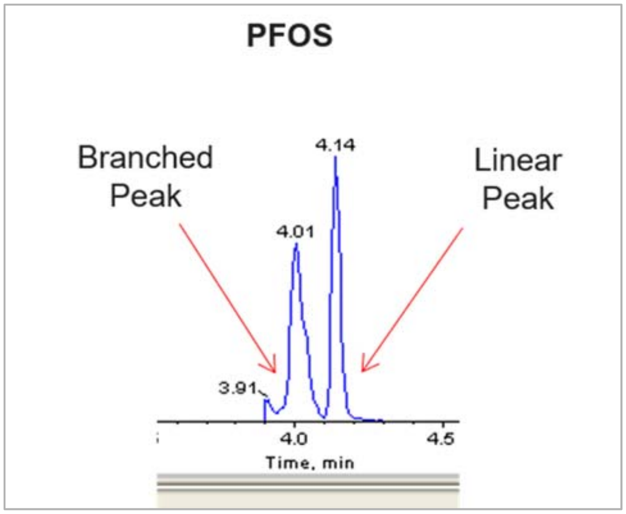

Figure 3: Branched and linear peaks of PFOS on an LC-MS/MS chromatogram.

Many LC-MS/MS instruments are sold with PTFE tubing and PTFE-coated components that can leach PFASs, particularly in the presence of organic solvents like methanol and acetonitrile. To avoid contamination of sample measurements with PFAS contributions from the instrument itself, tubing in the instrument is often replaced with stainless steel or polyetheretherketone tubing, where it is accessible (Houtz and Sedlak 2012, Roberts et al. 2017). Because all PTFE-based components can rarely be replaced, an LC column that either traps or delays the PFASs from the instrument is often placed after the LC pump. By delaying the PFAS responses from the instrument itself, the peak associated with the sample can be separated from the peak associated with the instrument's background contamination (Roberts et al. 2017).

For alternative methods that assess total PFAS concentrations, multiple other types of instrumentation may be used. The Total Oxidizable Precursor Assay, which converts polyfluorinated compounds to PFAAs, uses LC-MS/MS (Houtz et al. 2013). For methods that measure total organofluorine, detection of combusted organofluorine with ion chromatography is used in the adsorbable organofluorine or total organofluorine methods (Yeung et al. 2008), and particle induced gamma ray emission (PIGE) spectroscopy is used to measure isolated organic content containing fluorine (Ritter et al. 2017). All three of these methods are available commercially on a limited basis. For tentative identification of PFASs for which analytical standards are unavailable, an MS technique that can measure exact or accurate mass (i.e., 498.9302 vs. a nominal mass of 499) is required to constrain the number of empirical formulas of the parent and product ion (Newton et al. 2017, Barzen-Hanson 2017a); accurate mass measurement and structural prediction is available commercially and through some academic labs. Fluorous membrane-based ion selective electrodes have been used for field measurement of aggregate PFASs in groundwater (Chen et al. 2013) and are offered for PFAS analysis by a single company commercially. These methodologies would be most appropriate when a detailed source characterization effort is needed or when evaluating the longevity and dosing of site-specific PFAS remediation strategies. Additionally, a recent release of PFASs that is unlikely to contain PFOS, PFOA, or PFASs targeted by QSM 5.1 or USEPA 537, such as a release from a currently manufactured, fluorotelomer-based AFFF, may be identified with one of these alternative techniques.

4 PROCEDURAL CONSIDERATIONS

4.1 Cross-Contamination

In addition to typical best practices for field sampling of environmental media, several guidance documents specify stringent precautions regarding the use of consumer care products, technical field gear, and equipment during PFAS sample collection processes. A detailed summary of cross-contamination related to sampling equipment is summarized in Section 2. As discussed, it is important to recognize that Teflon™ and other fluoropolymer containing materials are found in pumps, tubing, and sample storage containers and therefore should be avoided if possible (DER, Western Australia 2016; NHDES 2016). As such, as a basic consideration, it is important to use appropriate laboratory supplied sample bottles that are PTFE-free (including avoiding Teflon® or PTFE- lined lids on containers). There are additional detail for consideration regarding cross-contamination considerations for personal care products including health and safety considerations, food packaging, and collection of samples during a large rain event is provided below.

4.1.1 Personal Care Products

For PFAS sampling, the general recommendation for field personnel is to avoid using personal care products such as cosmetics, moisturizers, hand cream, sunscreen, and other non-essential products (USACE 2016; MassDEP 2017). Exemptions are allowed for medically necessary products, or the use of sunscreen and insect repellent required for health and safety reasons. A list of approved products is provided in the NHDES Perfluorinated Compound Sample Collection Guidance (2016). Where personal care products must be used, best practices apply, including applying any products prior to initiating field sampling at a safe distance away from the sampling locations and equipment (i.e., more than 10 meters away) and washing hands after application, prior to donning new gloves.

PFASs are also commonly found on coated textiles including waterproof fabrics, stain resistant fabrics, water resistant fabrics, and performance wear under brand names such as Gore-Tex®. Several PFAS sampling guidance references prohibit the use of outdoor performance wear that is water or stain resistant, or appears to be, and recommend that sampling personnel wear pre-laundered (multiple washings, i.e., 6+) clothing that is made of natural fabrics such as cotton (USACE 2016; NHDES 2016). Synthetic fabrics may also be acceptable if there is no indication on the label that the fabric is water and stain resistant (NHDES 2016; Arcadis 2017). Further consideration regarding fabric used on the field vehicle seats, which may be treated with stain resistant products, has prompted the recommendation that the seats of the vehicle be covered with a well laundered cotton blanket for the duration of the field program (USACE 2016). Fabric softeners are also suspected as providing a potential source of PFAS cross-contamination (NHDEH 2016; MassDEP 2017).

These stringent practices may not be necessary if contact between field personnel's clothing and personal care items are avoided with sampling equipment, bottles, and/or samples. However, these personal care measures are currently standard practice for PFAS sample collection and should be followed until further information documenting their lack of utility becomes available.

4.1.2 Personal Protective Equipment

Some types of safety products including footwear, disposable coveralls, and safety gloves are manufactured with PFASs. For example, safety footwear may be treated to provide a degree of waterproofing and increased durability, and this represents a potential source of trace PFASs during field work. Guidance documents prohibit boots with Gore-Tex® or other synthetic water-resistant and/or stain-resistant materials by personnel conducting sampling (DER 2016; NHDEH 2016; MassDEP 2017). It is also well documented that leather may be treated with tanning products that likely also contain PFASs (UNEP 2012), indicating limited options for safety boots that do not definitively contain trace levels of PFASs. For the health and safety of field personnel, feet must be protected with safety shoes (Occupational Safety and Health Administration standard 1910.136(a)). Additionally, if proper handling procedures are implemented during sample collection, it is reasonable to assume that safety footwear will not cause cross-contamination issues during field sampling programs. Therefore, the following recommendations are incorporated into the USACE Standard Operation Procedure for PFAS Field Sampling (USACE 2016) and Arcadis' Technical Instruction Guidance for PFAS sample collection (Arcadis 2017):

- Personnel must not touch safety footwear in the immediate vicinity of the sampling location (i.e., within 10 meters).
- Personnel must not allow gloves used for sampling to come in contact with safety footwear.

Another precautionary measure relates to the use of coveralls. In general, common coveralls in the environmental industry include Tyvek® and poly-coated suits to protect against dirt and potential exposure to chemicals. Waterproof chest waders may also be needed for special field applications. The potential for PFASs to be used to coat these coveralls is considered likely given their water and chemical resistant applications. Therefore, special care and consideration is necessary if coveralls are needed. Some PFAS sampling guidance limits the list of acceptable substitutions to clothing made of synthetic fabric and/or cotton (NHDEP 2016; MassDEP 2017). However, this would not adequately protect workers if Level C protection is required. Therefore, it may not be possible to completely avoid the use of these materials, even if these common materials are generally restricted.

Safety gloves are one of the few safety products that serve the dual purpose of worker protection and sample protection. It is unavoidable that personnel will use their hands to collect environmental samples. Some safety gloves are manufactured with PFASs (e.g., Vitron®). In most cases, it is recommended that field personnel wear disposable nitrile gloves at all times, and to don new gloves as field activities transition from decontamination, sampling, note taking, handling of equipment and field blanks, contact with sample bottles, and when judged necessary by field personnel (USACE 2016; Arcadis 2017). If other safety gloves are necessary for worker protection, a thorough review of the glove materials should be undertaken to avoid any types that may contain PFASs.

Safety measures must take priority during any sampling event, and sample procedures and guidance may need to be adjusted to account for potential cross-contamination from health and safety products. The inclusion of additional quality control samples such as equipment blanks will help assess the extent to which PFAS cross-contamination is introduced from unavoidable PFAS-containing field gear.

4.1.3 Food Packaging

Some food packaging may be treated with PFAS-containing chemicals to prevent permeation of oil and water in the food outside of the packaging (Schaider et al. 2017). To avoid potential food packaging-related PFAS contact, it is recommended that pre-packaged food, fast food wrappers or containers should not be used by the personnel conducting sampling at the sampling site (DER 2016; MassDEP 2017). Alternative products such as rigid plastic containers or bags or stainless-steel containers may be used to bring food to the site (DER 2016). It is also recommended that personnel wash their hands after eating and prior to resuming work after taking a food break. Other additional measures could include removing field garments or outer layers prior to eating and putting them back on after hands are washed.

4.1.4 Rain Events

Due to concerns with cross-contamination from use of waterproof materials, it is recommended that personnel avoid sampling during rain if possible (DER 2016). Potential cross-contamination from rain that may contain background levels of PFASs is also avoided by following the restriction for working in the rain. If necessary, sampling may continue during rain conditions with the use of polyethylene (e.g., disposable LDPE), vinyl, or PVC clothing and rain gear (DER 2016). A gazebo tent could also be erected over the work area to provide shelter from the rain (USACE 2016). The canopy material may be a PFAS-treated surface and should not be handled when collecting samples (USACE 2016; Arcadis 2017).

4.2 Decontamination

Detergents and decontamination solutions (e.g., Decon 90® Decontamination Solution) are prohibited for all equipment decontamination when conducting PFAS site investigations (DER 2016; NHDES 2016; MassDEP 2017). Alternative decontamination measures appropriate to equipment being used to sample PFASs include a water-only decontamination approach with PFAS-free water (DER 2016), and Alconox®, Liquinox®, or Citranox® followed by a deionized water rinse (USACE 2016; NHDEP 2016; MassDEP 2017).

Use of an organic solvent including methanol, isopropanol, or acetone for decontamination is also recommended for collection of water samples (UNEP 2015; USACE 2016). Use of methanol for field decontamination may be desirable as it provides additional confidence that decontamination procedures are effective; however, it may not be practical under all circumstances. Based on experience, ordering and storing significant quantities of laboratory grade methanol is challenging. Methanol is also extremely flammable and burns with an invisible flame (Methanex 2008). While they are less typical solvents used for PFASs, isopropanol or acetone can also significantly enhance the decontamination of PFASs from sampling materials compared to water and would also result in fewer safety concerns than methanol.

Other decontamination protocols that are recommended include frequently replacing nitrile gloves (DER 2016), and repeating decontamination steps on field equipment that is used on highly contaminated soil and groundwater sampling.

4.3 Collection of Representative Background Samples

Due to their widespread uses, PFASs are detected relatively ubiquitously in the environment at low concentrations (i.e., single digit ppt and lower). It may be appropriate to sample for upgradient background concentrations of PFASs during site investigation to compare with concentrations present in and downgradient of suspected source areas. It may also be desirable to consider a statistical background sampling program if a risk assessment for the site is anticipated. When characterizing background levels of PFASs, the areas sampled need to represent areas that would be clearly unaffected by specific releases related to the areas of interest, or any other potential AFFF or other PFAS-containing material handling or disposal practices. If potential upgradient PFAS sources are identified during the desk top evaluation in preparation for field investigation, it may also be appropriate to sample the upgradient property boundary for PFASs.

4.4 Types of Quality Control Samples

Best practices for quality control sampling during PFAS site investigation includes daily collection of equipment blanks using laboratory-supplied “PFAS-free” water, field reagent blanks (i.e., transfer of PFAS-free water from the laboratory supplied reagent blank to an empty sample bottle), and field duplicate samples. A conservative number of separate equipment blanks may be collected from any equipment that is likely to be in contact with the sample such as new tubing, deconned bladder pumps, soil sample liners, drilling equipment (e.g., geoprobe cutting shoes), and temporary or permanent well materials. It is also appropriate to collect equipment blanks if certain equipment maintenance requirements introduce new products in the middle of the sample event (i.e., using a lubricant on the drilling equipment between boreholes). Equipment blanks are particularly important for any device/component where PFASs may be present or cannot be verified as being a non-PFAS containing material.

Regarding duplicate sample collection, typical industry practice includes collection of a minimum of one field duplicate per day or per sampling event, or one per 10 to 20 samples collected during a single field sampling event. In the case of PFAS site investigation, practitioners should prepare for a higher frequency of duplicate samples (i.e., greater than 10%) as it provides a very powerful level of confidence when evaluating unexpected elevated sample results. Use of blind duplicates and split samples provides assurance to investigation teams that their data is representative of site conditions. Additional assurances are provided from use of mobile laboratories where samples remain on-site and can be re-analyzed immediately if sample results do not sufficiently meet the data quality requirements of the project. It may be reasonable to collect several duplicate samples and place them on-hold and analyze as needed, if confirmation is necessary to make appropriate project decisions. For aqueous samples that require whole bottle analysis, backup samples will not be available at the laboratory unless it is submitted in a separate bottle.

QSM 5.1 requires the inclusion of matrix spikes and matrix spike duplicates for groundwater, surface water, soil, and sediment analysis (U.S. DoD 2017) at a rate of one each per preparatory batch. Additional samples to accommodate these matrix spikes will need to be collected.

4.5 Hold Times

For PFAS analysis in drinking water, hold times are specified as part of USEPA method 537 (USEPA 2009). Fourteen days are permitted from sample collection to extraction, and an additional 28 days are permitted from extraction to analysis, with aqueous samples stored unfrozen between 0 and 6ºC. For PFAS analysis in soils and aqueous media, the ASTM methods permit 28 days from sample collection to sample analysis (ASTM 2014, 2015); however, both methods explicitly state that they did not conduct any hold time studies when setting those hold times. Some commercial laboratories follow a 14-day hold time for soils, and some follow a 28-day hold time. QSM 5.1 does not specify any specific hold times or temperatures for PFAS analysis of soils or groundwater (U.S. DoD 2017).

Most likely, 14 to 28-day hold times are overly conservative, particularly if, in the case of aqueous samples, the entire sample is analyzed and the bottle is rinsed. Jennifer Field’s laboratory has retained frozen groundwater samples from military bases over more than a decade and re-analyzed them with similar results (Moody and Field 2002, Schultz et al. 2004, Backe et al. 2013). AXYS-SGS in British Columbia, Canada has conducted stability studies on reagent water samples spiked with PFASs over 90 days in amber glass, HDPE, and polypropylene containers (Kaiser et al. 2009). All losses of PFAAs were due to recoverable sorption on sample containers (i.e., not degradation) and notably, despite current sampling recommendations to avoid glass, losses on amber glass containers were less than on either type of plastic container. A solvent rinse of the aqueous sample bottle will thus mitigate against losses due to increased hold times to sample vessels. For solid samples, PFAS analytes are more likely to be retained within the soil sample than preferentially partition to the sample vessel.

Additionally, there is no expectation that the PFAAs will break down in either soil or groundwater considering their stability to microbial transformation and sunlight (Vecitis et al. 2009). PFAA precursors may slowly form additional PFAAs in storage, but their transformation rates will be depressed at typical storage temperatures compared to ambient conditions at many sites. The rates of precursor transformation have not been quantified under storage; however, PFAA precursors have been observed to persist at least partially in groundwater and soil at military bases over decades after their release, so they are not likely to transform significantly under typical laboratory hold times (Backe et al. 2013, Houtz et al. 2013).

5 STATE AND FEDERAL STANDARDS

Tables 3 through 5 summarize proposed and promulgated regulatory and guidance values in the U.S. for PFASs in drinking water, soil, and groundwater. A full list of PFAS standards for the U.S. in drinking water, soils, and groundwater are included in **Appendix B**, including weblinks.

In drinking water, the most commonly regulated analytes are PFOS and PFOA, followed by PFBS, PFNA, and PFHpA. GenX, a manufacturing processing aid that Chemours used to replace PFOA, is also currently regulated in drinking water in North Carolina. PFOS and PFOA are often regulated as a summation in drinking water, following the USEPA lifetime Health Advisories. Connecticut also regulated five PFASs in drinking water as a summation. USEPA has issued Risk Based Screening Levels (RBSLs) for PFOA, PFOS, and PFBS in residential tap water.

In soils, the most commonly regulated analytes are PFOS and PFOA, followed by PFBS and PFBA. USEPA has issued soil RBSLs for PFOA, PFOA, and PFBS under multiple exposure scenarios. Texas regulates the most individual PFASs – up to sixteen – in soils under multiple exposure and release scenarios.

In groundwater, the most commonly regulated analytes are PFOS and PFOA, followed by PFBS, PFBA, and PFNA. The USEPA Health Advisories for PFOS and PFOA drinking water are applied in some states to protection of groundwater. As with soil, Texas regulated up to sixteen individual PFASs in groundwater under multiple exposure and release scenarios.

Table 3: U.S. Standards and Advisory Values for PFASs in Drinking Water (abridged). Full tables are included in Appendix B. Values in parentheses are regulated as a summation of two or more PFASs.

State or Jurisdiction	PFBS	PFOS	PFHpA	PFOA	PFNA	GenX	Type	Date Issued or Updated	Proposed or Promulgated*
	ng/l	**ng/l**	**ng/l**	**ng/l**	**ng/l**	**ng/l**			
Federal		(70)		(70)			Health Advisory	2016	Promulgated
Federal	401,000	401		401			USEPA Risk-Based Screening Level (RBSL), Residential	2017	Proposed
Connecticut; PFHxS also included in summation		(70)	(70)	(70)	(70)		Drinking Water Action Level	2016	Promulgated
Indiana	380,000						IDEM OLQ Screening Levels - Tap	2017	Promulgated
Maine		70		70			Maximum Exposure Guideline	2016	Promulgated
Massachusetts		(70)		(70)			Health Advisory	2016	Promulgated
Michigan		(70)		(70)			Non-residential Drinking Water Criteria	2018	Promulgated
Michigan		(70)		(70)			Residential Drinking Water Criteria	2018	Promulgated
Minnesota	7,000	300; 27 proposed		300; 35 proposed			Health Risk Limit - Chronic	2011	Promulgated
Nevada	66,700	667		667			Basic Comparison Level	2017	Promulgated
New Jersey		13		14			Drinking water guidance value	2017	Proposed
New Jersey					10		Interim groundwater quality criterion	2016	Proposed
New Mexico		(70)		(70)			New Mexico Environment Department Soil Screening Levels	2017	Promulgated
New York				100			Health Advisory	2016	Provisional
North Carolina						140	Health Goal	2017	Proposed
North Carolina				2000			Interim Maximum Allowable Concentration	2013	Proposed
Oregon		30,0000	30,0000	24,000	1000		Initiation level	2017	Proposed
Pennsylvania				6			Proposed value	2017	Proposed
Vermont		(20)		(20)			Health Based Value	2016	Proposed
West Virginia				150,000			Drinking Water Screening Value	2002	Proposed

*Promulgated in this table means there is a regulation or advisory value, but it may not meet the definition of promulgated under CERCLA.

ng/L = nanograms per liter; PFBS = perfluorobutanesulfonic acid; PFOS = perfluorooctanesulfonic acid; PFHpA = perfluoroheptanoic acid; PFBA = perfluorobutanoic acid; PFOA = perfluoroctanoic acid; PFNA = perfluorononanoic acid; RBSL = risk-based screening level; PFHxS = perfluorohexanesulfonic acid; IDEM = Indiana Department of Environmental Management; OLQ = Office of Land Quality

Table 4: U.S. Standards and Advisory Values for PFASs in Soils (abridged). Full tables are included in Appendix B.

State or Jurisdiction	PFBS	PFOS	PFBA	PFOA	Type	Date Issued or Updated	Proposed or Promulgated*
	mg/kg	mg/kg	mg/kg	mg/kg			
Federal	1,260	1.26		1.26	Risk- Based Screening Level (RBSL), Residential	2017	Proposed
Federal	0.13	0.000172		0.000378	RBSL, Groundwater Protection	2017	Proposed
Federal	4,670	46.7		46.7	RBSL, Indoor Worker	2017	Proposed
Federal	1,640	16.4		16.4	RBSL, Composite Worker	2017	Proposed
Federal	182	1.82		1.82	RBSL, Outdoor Worker	2017	Proposed
USEPA Region 4		6		16	Residential Surface Exposure	2009	Proposed
Alaska		2.2		2.2	Remediation - Arctic Zone - Risk-Based Value	2016	Proposed
Alaska		1.6		1.6	Remediation - Under 40" Zone - Risk-Based Value	2016	Proposed
Alaska		1.3		1.3	Remediation - Over 40" Zone - Risk-Based value	2016	Proposed
Alaska		0.003		0.0017	Remediation - Migration to Groundwater (MTGW) - Risk-Based Value	2016	Proposed
Delaware	130	6		16	Screening Levels - Hazardous Substance Cleanup Act	2017	Proposed
Indiana	2200				Indiana Department of Environmental Management (IDEM) Office of Land Quality (OLQ) Screening Levels - Residential	2017	Promulgated
Indiana	23000				IDEM OLQ Screening Levels - Industrial/Commercial	2017	Promulgated
Indiana	39000				IDEM OLQ Screening Levels - Excavation	2017	Promulgated
Indiana	4.2				IDEM OLQ Screening Levels - Soil Migration to Groundwater, Residential	2017	Proposed
Iowa		1.8		1.2	Statewide Brownfield Standards for Soil	2016	Promulgated
Maine		11		0.8	Soil Remedial Action Guideline - Residential	2016	Promulgated
Maine		18		1.3	Soil Remedial Action Guideline - Park User	2016	Promulgated
Maine		82		6.2	Soil Remedial Action Guideline - Commercial Worker	2016	Promulgated
Maine		19		1.4	Soil Remedial Action Guideline - Construction Worker	2016	Promulgated
Michigan		2.1		2.1	Residential Direct Contact Criteria	2017	Proposed

State or Jurisdiction	PFBS	PFOS	PFBA	PFOA	Type	Date Issued or Updated	Proposed or Promulgated*
Michigan		25		25	Non-residential Direct Contact Criteria	2017	Proposed
Michigan		0.0014		0.059	Non-residential Drinking Water Protection Criteria	2017	Proposed
Michigan		0.0014		0.059	Residential Drinking Water Protection Criteria	2017	Proposed
Minnesota	30	1.7	63	0.33	Soil Reference Value - Residential/Recreational	2009	Proposed
Minnesota	450	21	150	0.33	Soil Reference Value - Commercial/Industrial	2009	Proposed
Nevada	125	1.56		1.56	Basic Comparison Levels - Residential	2017	Promulgated
Nevada	125	26		26	Basic Comparison Levels - Industrial/Commercial	2017	Promulgated
New Hampshire		0.5		0.5	Direct Contact Risk-Based Soil Concentration - child	2016	Promulgated
New Hampshire		4.3		4.3	Direct Contact Risk-Based Soil Concentration - construction worker	2016	Promulgated
North Carolina	250				Residential Health Based Preliminary Soil Remediation Goal (PSRG)	2017	Proposed
North Carolina	3300				Commercial/Industrial Health Based PSRG	2017	Proposed
North Carolina				0.017	Protection of Groundwater	2017	Proposed
Texas	2900	47	5900	25	Commercial Soil Risk-Based Exposure Limit (RBEL) - Dermal	2017	Proposed
Texas	1400	24	3000	12	Commercial RBEL - Ingestion	2017	Proposed
Texas	500	8.2	1000	4.3	Residential RBEL - Dermal	2017	Proposed
Texas	110	1.9	240	0.98	Residential RBEL - Ingestion	2017	Proposed
Texas	2900	47	5900	25	Tier 1 Individual Commercial Soil Protective Concentration Level (PCL) - Dermal	2017	Proposed
Texas	1400	24	3000	12	Tier 1 Individual Commercial PCL - Ingestion	2017	Proposed
Texas	500	8.2	1000	4.3	Tier 1 Individual Residential PCL - Dermal	2017	Proposed
Texas	110	1.9	240	0.98	Tier 1 Individual Residential PCL - Ingestion	2017	Proposed
Vermont				0.30	Soil Screening Value - Resident Soil	2017	Promulgated
West Virginia				240	Residential Soil	2002	Proposed
Wisconsin	1260	1.26		1.26	Do Not Exceed Soil Residual Contaminant Level (RCL) - Non-Industrial	2017	Proposed
Wisconsin	16400	16.4		16.4	Do Not Exceed Soil RCL - Industrial	2017	Proposed

*Promulgated in this table means there is a regulation or advisory value, but it may not meet the definition of promulgated under CERCLA.
mg/kg = milligrams per kilogram; PFBS = perfluorobutanesulfonic acid; PFOS = perfluorooctanesulfonic acid; PFBA = perfluorobutanoic acid; PFOA = perfluoroctanoic acid; RBSL = risk-based screening level; USEPA = United States Environmental Protection Agency; MTGW = Migration to Groundwater; IDEM = Indiana Department of

Environmental Management; OLQ = Office of Land Quality; PSRG = Preliminary Soil Remediation Goal; RBEL = Risk-based Exposure Limit; PCL = Protective Concentration Level; RCL = residual contamination level.

Table 5: U.S. Standards and Advisory Values for PFASs in Groundwater (abridged). Full table is included in Appendix B. Values in parentheses are regulated as a summation of two or more PFASs.

State or Jurisdiction	PFBS	PFOS	PFHpA	PFOA	PFNA	Type	Date Issued or Updated	Proposed or Promulgated*
	ng/L	ng/L	ng/L	ng/L	ng/L			
Alaska		400		400		Risk-Based Level	2016	Proposed
Connecticut; PFHxS also included in summation		(70)	(70)	(70)	(70)	Groundwater Action Level	2016	Promulgated
Colorado		(70)		(70)		Site-Specific Groundwater Standard	2017	Proposed
Delaware	40000	(70)		(70)		Screening Levels - Hazardous Substance Cleanup Act	2017	Proposed
Iowa		70		70		State Brownfield Standards for Protected Groundwater Source	2016	Promulgated
Iowa		1000				State Brownfield Standards for a Non-Protected Groundwater Source	2016	Promulgated
Maine		5,300		220		Groundwater Remedial Action Guideline - Groundwater Construction Worker	2016	Promulgated
Maine		560		130		Groundwater Remedial Action Guideline - Groundwater Residential	2016	Promulgated
Michigan		12		12,000		Groundwater Surface Water Interface Criteria	2017	Proposed
New Hampshire		(70)		(70)		Ambient Groundwater Quality Standard	2017	Promulgated
New Jersey					10	Risk-Based Level	2016	Proposed
North Carolina				2000		North Carolina Groundwater Protection Standard 2L Interim Maximum Allowable Concentration	2017	Proposed
Rhode Island		(70)		(70)		Groundwater Quality Standard	2017	Promulgated
Texas	100000	1700	1700	880	880	Protective Concentration Level (PCL)- Industrial, Ingestion	2017	Proposed
Texas	34000	560	560	290	290	PCL - Residential, Ingestion	2017	Proposed
Texas	100000	1700	1700	880	880	Risk-Based Exposure Limit (RBEL) - Commercial, Ingestion	2017	Proposed
Texas	34000	560	560	290	290	RBEL - Residential, Ingestion	2017	Proposed

*Promulgated in this table means there is a regulation or advisory value, but it may not meet the definition of promulgated under CERCLA.
ng/L = nanograms per liter; PFBS = perfluorobutanesulfonic acid; PFOS = perfluorooctanesulfonic acid; PFHpA = perfluoroheptanoic acid; PFOA = perfluoroctanoic acid; PFNA = perfluorononanoic acid; PFHxS = perfluorohexanesulfonic acid; PCL = Protective Concentration Level; RBEL = Risk-Based Exposure Limit

6 RECOMMENDATIONS

6.1 Soil and Groundwater Sampling Techniques

Soil and groundwater sampling techniques for PFAS sample collection will typically follow industry standards with special considerations related to the sampling materials and their compatibility with PFASs. Material compatibility for PFASs is of greater concern than specific procedures.

The following provides a summary of recommended sampling procedures, as documented in the literature:

- HDPE and, to a lesser extent, polypropylene sampling materials and containers are recommended (USEPA 2009; DoN 2015).
- The use of glass sampling containers is not recommended as PFASs adhere to the surface of glass (USEPA 2009). Data from AXYS-SGS suggests that glass sample containers may actually sorb PFASs less than HDPE or polypropylene; however, industry practice is still to avoid the use of glass sampling containers.
- Teflon™ (or other PTFE) materials should be strictly avoided for PFAS sample collection (DER 2016).
- Samples should not be filtered in the field or in the laboratory, as most types of filters retain PFASs (UNEP 2016; Chandramouli et al. 2015). Centrifugation, followed by combining a solvent rinse of the particulate-containing centrifuge tube with the sample, is recommended to remove particles in turbid aqueous samples at the laboratory.
- All disposable sampling materials should be treated as single use and disposed of appropriately after sampling.

Awareness for potential cross-contamination due to personal care, food packaging, and during rain events is necessary to prevent unnecessary sources of PFASs to the sampling process and minimize the potential for cross-contamination. Additionally, the following precautions are recommended during PFAS site investigation to avoid cross-contamination during sampling procedures.

- Plastic sheeting (preferably HDPE) may be placed adjacent to the work area to use as a clean work area, if conditions allow. Otherwise, measures need to be taken to protect sampling equipment from contacting the ground or other surface that could compromise sample integrity.
- Trowels or drilling equipment that will come into contact with a sample should be decontaminated prior to sample collection (see Section 4);
- HDPE sampling containers should be provided by the laboratory in the volume commensurate with sample analysis and limit of quantification and/or limit of detection requirements.
- Caps should be retained on the sample bottles until immediately prior to sample collection.
- Additional duplicate samples may be collected as backup if the laboratory conducts whole bottle analysis.

Consistent with best practices to prevent cross-contamination among reusable equipment, groundwater samples should be collected in a pre-determined order from least impacted to most impacted based on previous analytical data or knowledge about past activities at the site. Additionally, because PFASs are detected at background levels in the environment, consideration for characterizing background levels at sites is recommended.

6.2 Quality Assurance and Quality Control

- The relevant quality assurance/quality control guidelines for both PFAS sampling and PFAS analysis conducted at DoD installations should be stipulated in a Quality Assurance Project Plan following the Uniform Federal Policy and a DoD ELAP-accredited lab should be selected to conduct the PFAS analysis.
- Equipment blanks should be included for all types of reusable equipment that has direct contact with samples, especially for any device/component where PFASs may be present or cannot be verified as being a non-PFAS containing material. Field reagent blanks, in which laboratory provided PFAS-free water is decanted into a new container at the field site, are also recommended.
- Matrix spike and matrix spike duplicates are required by QSM 5.1 and should be included for all soil, groundwater, surface water, and sediment samples.
- Duplicate samples should be included at a rate of one per site or one per every ten to twenty samples per media, whichever is more frequent.
- Multiple bottles of highly sensitive aqueous samples should be sent to the laboratory in the event that re-analysis is required, as most laboratories analyze the entire sample bottle during the first analysis.
- The laboratory conducting PFAS analysis is required by QSM 5.1 and USEPA Method 537 to include a laboratory control sample and method blank per preparatory batch.

6.3 Analytical Methods

- No USEPA Methods are available for PFAS analysis in groundwater, surface water, sediment, and soil. Until USEPA methods become available and are accepted by the Army, analysis for PFASs in environmental samples should be conducted according to modified 537 methods that are accredited for QSM 5.1 Table B-15, or later version as determined by laboratory’s accreditation schedule.
- USEPA Method 537 may be used to analyze for PFASs in drinking water. A QSM 5.1-compliant modified 537 method may be used for drinking water samples if it also follows the procedures around hold times, whole sample analysis, and other areas that are specified by USEPA 537 but left open ended by QSM 5.1. QSM 5.1- methodological procedures may be desired for drinking water if a longer PFAS analyte list is needed, e.g., if analysis of PFBA, PFPeA, or 6:2 FtS is desired. QSM 5.1 also employs isotope dilution, which is the most accurate form of targeted PFAS quantification.
- Serial basic methanolic extractions are used by most researchers and commercial laboratories for analysis of PFASs in soils and other environmental solids. These methods are acceptable for PFAAs and FTSs.

- If an extensive PFAS analyte list or a total PFAS measurement is desired for sample analysis, alternative methods are available but are likely not governed by a laboratory's QSM 5.1 ELAP scope of accreditation or a USEPA method. A laboratory that is accredited for such methods by a DoD-approved accrediting body should be employed for the analyses. Alternatively, an academic laboratory may be used if the analysis is for research purposes. These analyses are not recommended unless characterizing a source area in detail, designing a remediation strategy, or identifying a recent release unlikely to contain the PFASs measured by a laboratory's QSM 5.1 ELAP scope of accreditation or a USEPA method.

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APPENDIX A

Quality System Manual (QSM) 5.1 Table B-15:

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

Department of Defense (DoD)
Department of Energy (DOE)
Consolidated
Quality Systems Manual (QSM) for Environmental Laboratories

Based on ISO/IEC 17025:2005(E)

and

The NELAC Institute (TNI) Standards, Volume 1, (September 2009)

DoD Quality Systems Manual Version 5.1
DOE Quality Systems for Analytical Services Version 3.1
2017

Department of Defense (DoD)
Quality Systems Manual (QSM) for
Environmental Laboratories

Based on ISO/IEC 17025:2005(E)

and

The NELAC Institute (TNI) Standard, Volume 1, (September 2009)

DoD Quality Systems Manual Version 5.1
2017

Department of Defense (DoD)
Quality Systems Manual (QSM) for
Environmental Laboratories

Version 5.1

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Army Principal

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Navy Principal, EDQW Chair

Date

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

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action	Flagging Criteria	Comments
Aqueous Sample Preparation	Each sample and associated batch QC samples.	Solid Phase Extraction (SPE) must be used unless samples are known to contain high PFAS concentrations (e.g., AFFF formulations). Inline SPE is acceptable. Samples of known high PFAS concentrations can be prepared by serial dilution instead of SPE, with documented project approval.	NA.	NA.	NA.
Soil and Sediment Sample Preparation	Each sample and associated batch QC samples.	Entire sample received by the laboratory must be homogenized prior to subsampling.	NA.	NA.	NA.
Sample Cleanup Procedure using ENVI-Carb™ or equivalent	Each sample and associated batch QC samples. Not applicable to AFFF formulation samples.	Removal of interferences from matrix.	NA.	Flagging is not appropriate.	Cleanup should reduce bias from matrix background.

Table B-15. Per- and Polyfluoroalkyl Substances (PFAS) Using Liquid Chromatography Tandem Mass Spectrometry (LC/MS/MS) With Isotope Dilution or Internal Standard Quantification in Matrices Other Than Drinking Water					
QC Check	**Minimum Frequency**	**Acceptance Criteria**	**Corrective Action**	**Flagging Criteria**	**Comments**
Mass Calibration	Initially prior to use and after performing major maintenance, as required to maintain documented instrument sensitivity and stability performance.	Calibrate the mass scale of the MS with calibration compounds and procedures described by the manufacturer. Entire range needs to be mass calibrated.	NA.	Flagging is not appropriate.	NA.
Tune Check	When the masses fall outside of the ±0.5 amu of the true value (as determined by the product ion formulas).	Mass assignments of tuning standard within 0.5 amu of true value.	Retune instrument and verify. If the tuning will not meet acceptance criteria, an instrument mass calibration must be performed and the tune check repeated.	Flagging is not appropriate.	No samples shall be analyzed without a valid tune.
Mass Spectral Acquisition Rate	Each analyte, Extracted Internal Standard Analyte, and Injection Internal Standard Analyte.	A minimum of 10 spectra scans are acquired across each chromatographic peak.	NA.	Flagging is not appropriate.	NA.

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

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action	Flagging Criteria	Comments
Calibration, Calibration Verification, and Spiking Standards	All analytes.	Standards containing both branched and linear isomers must be used when commercially available. If not available, the total response of the analyte must be integrated (i.e., accounting for peaks that are identified as linear and branched isomers) and quantitated using a calibration curve which includes the linear isomer only for that analyte (e.g., PFOA).	NA.	Flagging is not appropriate.	Standards containing both branched and linear isomers are to be used during method validation to ensure the total response is quantitated for that analyte. Technical grade standards cannot be used for quantitative analysis.

Table B-15. Per- and Polyfluoroalkyl Substances (PFAS) Using Liquid Chromatography Tandem Mass Spectrometry (LC/MS/MS) With Isotope Dilution or Internal Standard Quantification in Matrices Other Than Drinking Water					
QC Check	**Minimum Frequency**	**Acceptance Criteria**	**Corrective Action**	**Flagging Criteria**	**Comments**
Ion Transitions (Parent-> Product)	Prior to method implementation.	The chemical derivation of the ion transitions, both those used for quantitation and those used for confirmation, must be documented. Two transitions and the ion transition ratio per analyte shall be monitored and documented with the exception of PFBA and PFPeA. 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 *(continued next page)*	NA.	Flagging is not appropriate.	NA.

Table B-15. Per- and Polyfluoroalkyl Substances (PFAS) Using Liquid Chromatography Tandem Mass Spectrometry (LC/MS/MS) With Isotope Dilution or Internal Standard Quantification in Matrices Other Than Drinking Water					
QC Check	**Minimum Frequency**	**Acceptance Criteria**	**Corrective Action**	**Flagging Criteria**	**Comments**
Ion Transitions (Parent-> Product) *(Continued)*		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).			

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

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action	Flagging Criteria	Comments
Initial Calibration (ICAL)	At instrument set-up and after ICV or CCV failure, prior to sample analysis.	The isotopically labeled analog of an analyte (Extracted Internal Standard Analyte) must be used for quantitation if commercially available (Isotope Dilution Quantitation). If a labeled analog is not commercially available, the Extracted Internal Standard Analyte with the closest retention time to the analyte must be used for quantitation. (Internal Standard Quantitation) S/N Ratio: ≥ 10:1 for all ions used for quantification. For analytes having a promulgated standard, (e.g., HA levels for PFOA and PFOS), the qualitative (confirmation) transition ion must have a S/N Ratio of ≥ 3:1. *(continued next page)*	Correct problem, then repeat ICAL.	Flagging is not appropriate.	No samples shall be analyzed until ICAL has passed. Isotope Dilution or Internal Standard Calibration is required for all analytes. External Calibration is not allowed. Calibration can be linear (minimum of 5 standards) or quadratic (minimum of 6 standards); weighting is allowed.

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

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action	Flagging Criteria	Comments
Initial Calibration (ICAL) *(Continued)*		The %RSD of the RFs for all analytes must be <20%. Linear or non-linear calibrations must have $r^2 \geq 0.99$ for each analyte. Analytes must be within 70-130% of their true value for each calibration standard.			

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

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action	Flagging Criteria	Comments
Instrument Sensitivity Check (ISC)	Prior to analysis and at least once every 12 hours.	Analyte concentrations must be at LOQ; concentrations must be within ±30% of their true values.	Correct problem, rerun ISC. If problem persists, repeat ICAL.	Flagging is not appropriate.	No samples shall be analyzed until ISC has met acceptance criteria. ISC can serve as the initial daily CCV.
Initial Calibration Verification (ICV)	Once after each ICAL, analysis of a second source standard prior to sample analysis.	Analyte concentrations must be within ±30% of their true value.	Correct problem, rerun ICV. If problem persists, repeat ICAL.	Flagging is not appropriate.	No samples shall be analyzed until calibration has been verified.
Continuing Calibration Verification (CCV)	Prior to sample analysis, after every 10 field samples, and at the end of the analytical sequence.	Concentration of analytes must range from the LOQ to the mid-level calibration concentration. Analyte concentrations must be within ±30% of their true value.	Immediately analyze two additional consecutive CCVs. If both pass, samples may be reported without reanalysis. If either fails, or if two consecutive CCVs cannot be run, perform corrective action(s) and repeat CCV and all associated samples since last successful CCV. Alternately, recalibrate if necessary; then reanalyze all associated samples since the last acceptable CCV.	If reanalysis cannot be performed, data must be qualified and explained in the Case Narrative. Apply Q-flag to all results for the specific analyte(s) in all samples since the last acceptable calibration verification.	Results may not be reported without valid CCVs. Instrument Sensitivity Check (ISC) can serve as a bracketing CCV.

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

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action	Flagging Criteria	Comments
Instrument Blanks	Immediately following the highest standard analyzed and daily prior to sample analysis.	Concentration of each analyte must be ≤ ½ the LOQ.	If acceptance criteria are not met after the highest calibration standard, calibration must be performed using a lower concentration for the highest standard until acceptance criteria is met. If acceptance criteria are not met after the highest standard which is not included in the calibration, the standard cannot be used to determine the highest concentration in samples at which carryover does not occur. If acceptance criteria are not met after sample, additional instrument blanks must be analyzed until acceptance criteria are met. Additional samples shall not be analyzed until acceptance criteria are met.	Flagging is only appropriate in cases when the sample cannot be reanalyzed and when there is no more sample left.	Note: Successful analysis following the highest standard analyzed determines the highest concentration that carryover does not occur. The highest standard analyzed may be analyzed as part of the calibration curve or following the calibration curve. If analyzed following the calibration curve, it is not used to extend out the calibration range. It is used only to document a higher concentration at which carryover still does not occur. If sample concentrations exceed this range and the sample(s) following exceed this acceptance criteria (>1/2 LOQ), they must be reanalyzed.

Table B-15. Per- and Polyfluoroalkyl Substances (PFAS) Using Liquid Chromatography Tandem Mass Spectrometry (LC/MS/MS) With Isotope Dilution or Internal Standard Quantification in Matrices Other Than Drinking Water					
QC Check	**Minimum Frequency**	**Acceptance Criteria**	**Corrective Action**	**Flagging Criteria**	**Comments**
Extracted Internal Standard Analytes	Every field sample, standard, blank, and QC sample.	Added to sample prior to extraction. For aqueous samples prepared by serial dilution instead of SPE, added to samples prior to analysis. Extracted Internal Standard Analyte recoveries must be within 50% to150% of the true value.	If recoveries are acceptable for QC samples, but not field samples, the field samples must be reprepped and reanalyzed (greater dilution may be needed). If recoveries are unacceptable for QC samples, correct problem, and reanalyze all associated failed field samples.	Apply Q-flag and discuss in the Case Narrative only if reanalysis confirms failures in exactly the same manner.	Failing analytes shall be thoroughly documented in the Case Narrative.

Table B-15. Per- and Polyfluoroalkyl Substances (PFAS) Using Liquid Chromatography Tandem Mass Spectrometry (LC/MS/MS) With Isotope Dilution or Internal Standard Quantification in Matrices Other Than Drinking Water					
QC Check	**Minimum Frequency**	**Acceptance Criteria**	**Corrective Action**	**Flagging Criteria**	**Comments**
Injection Internal Standard Analytes	Every field sample, standard, blank, and QC sample.	Added to aliquot of sample dilutions, QC samples, and standards just prior to analysis. Peak areas must be within -50% to +50% of the area measured in the ICAL midpoint standard. On days when ICAL is not performed, the peak areas must be within -50% to +50% of the peak area measured in daily initial CCV.	If peak areas are unacceptable, analyze a second aliquot of the extract or sample if enough extract remains. If there is not enough extract, reanalyze the first aliquot. If second analysis meets acceptance criteria, report the second analysis. If it fails, either analysis may be reported with the appropriate flags.	Apply Q-flag and discuss in the Case Narrative.	Alternative Injection Internal Standard Analytes are recommended when there is obvious chromatographic interference.

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

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action	Flagging Criteria	Comments
Method Blank (MB)	One per preparatory batch.	No analytes detected > ½ LOQ or > 1/10th the amount measured in any sample or 1/10th the regulatory limit, whichever is greater.	Correct problem. If required, reprep and reanalyze MB and all QC samples and field samples processed with the contaminated blank.	If reanalysis cannot be performed, data must be qualified and explained in the Case Narrative. Apply B-flag to all results for the specific analyte(s) in all samples in the associated preparatory batch.	Results may not be reported without a valid MB. Flagging is only appropriate in cases where the samples cannot be reanalyzed.
Laboratory Control Sample (LCS)	One per preparatory batch.	Blank spiked with all analytes at a concentration ≥ LOQ and ≤ the mid-level calibration concentration. Use in-house LCS limits if project limits are not specified.	Correct problem, then re-prep and reanalyze the LCS and all samples in the associated preparatory batch for failed analytes if sufficient sample material is available.	If reanalysis cannot be performed, data must be qualified and explained in the Case Narrative. Apply Q-flag to specific analyte(s) in all samples in the associated preparatory batch.	Results may not be reported without a valid LCS. Flagging is only appropriate in cases where the samples cannot be reanalyzed.

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

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action	Flagging Criteria	Comments
Matrix Spike	One per preparatory batch. Not required for aqueous samples prepared by serial dilution instead of SPE.	Sample spiked with all analytes at a concentration ≥ LOQ and ≤ the mid-level calibration concentration. Use in-house LCS limits if project limits are not specified.	Examine the project-specific requirements. Contact the client as to additional measures to be taken.	For the specific analyte(s) in the parent sample, apply J-flag if acceptance criteria are not met and explain in the Case Narrative.	For matrix evaluation only. If MS results are outside the limits, the data shall be evaluated to determine the source(s) of difference (i.e., matrix effect or analytical error).

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

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action	Flagging Criteria	Comments
Matrix Spike Duplicate (MSD) or Matrix Duplicate (MD)	For MSD: One per preparatory batch. For MD: Each aqueous sample prepared by serial dilution instead of SPE.	For MSD: Sample spiked with all analytes at a concentration ≥ LOQ and ≤ the mid-level calibration concentration. For MSD: Use in-house LCS limits if project limits are not specified. RPD ≤ 30% (between MS and MSD or sample and MD).	Examine the project-specific requirements. Contact the client as to additional measures to be taken.	For the specific analyte(s) in the parent sample, apply J-flag if acceptance criteria are not met and explain in the Case Narrative.	The data shall be evaluated to determine the source of difference. For Sample/MD: RPD criteria only apply to analytes whose concentration in the sample is greater than or equal to the LOQ. The MD is a second aliquot of the field sample that has been prepared by serial dilution.
Post Spike Sample	Only applies to aqueous samples prepared by serial dilution instead of SPE that have reported value of "<LOQ" for analyte(s).	Spike aliquot(s) of sample at the final dilution(s) reported for sample with all analytes that have reported value of "<LOQ" in the final dilution. The spike must be at the LOQ concentration to be reported with the sample (the "<LOQ" value). When analyte concentrations are calculated as "<LOQ,"	When analyte concentrations are calculated as "<LOQ," and the spike recovery does not meet the 70-130% acceptance criteria, the sample, sample duplicate, and post spike sample must be reanalyzed at consecutively higher dilutions until the criteria is met.	Flagging is not appropriate.	When analyte concentrations are calculated as "<LOQ," results may not be reported without acceptable post spike recoveries.

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

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action	Flagging Criteria	Comments
		the spike must recover within 70-130%of its true value.			

APPENDIX B

U.S. PFAS Standards and Advisory Values in Drinking Water, Groundwater, and Soil.

Appendix B-1
U.S. PFAS Standards and Advisory Values in Drinking Water

Country	State or Jurisdiction	Media	PFBS	PFHxS	PFOS	PFDS	PFBA	PFPeA	PFHxA	PFHpA	PFOA	PFNA	PFDA	PFUA	PFDoA	PFTrA	PFTeA	PFOSA	GenX	Type	Units	Author	Date Issued or Updated	Proposed or Promulgated[1]	Web link
USA	Federal	Drinking Water			(70)						(70)									Health Advisory	ng/L	U.S. Environmental Protection Agency (EPA)	2016	Promulgated	https://www.epa.gov/sites/production/files/2016-05/documents/pfoa_health_advisory_final_508.pdf
USA	Federal	Drinking Water	401,000		401						401									U.S. EPA Risk-Based Screening Level (RSL), Residential	ng/L	U.S. Environmental Protection Agency (EPA)	2017	Proposed	https://epa-prgs.ornl.gov/cgi-bin/chemicals/csl_search
USA	Connecticut	Drinking Water		(70)	(70)					(70)	(70)	(70)								Drinking Water Action Level	ng/L	Connecticut Department of Public Health	2016	Promulgated	http://www.ct.gov/dph/lib/dph/environmental_health/eoha/groundwater_well_contamination/052317_pfas_action_level_dec_2016.pdf
USA	Indiana	Drinking Water	380000																	Indiana Department of Environmental Management (IDEM) Office of Land Quality (OLQ) Screening Levels - Tap	ng/L	Indiana Department of Environmental Management (IDEM)	2017	Promulgated	http://www.in.gov/idem/cleanups/files/risc_screening_table_2017_a6.pdf
USA	Maine	Drinking Water			70						70									Maximum Exposure Guideline	ng/L	Maine Department of Health and Human Services	2016	Promulgated	http://www.maine.gov/dhhs/mecdc/environmental-health/eohp/wells/documents/megtable2016.pdf
USA	Massachusetts	Drinking Water			(70)						(70)									Health Advisory	ng/L	Massachusetts Department of Environmental Protection	2016	Promulgated	http://www.mass.gov/eea/agencies/massdep/water/drinking/standards/standards-and-guidelines-for-drinking-water-contaminants.html
USA	Michigan	Drinking Water			(70)						(70)									Non-residential Drinking Water Criteria	ng/L	Michigan Department of Environmental Quality (DEQ)	2018	Promulgated	http://www.michigan.gov/documents/deq/deq-rrd-UpdatedGroundwaterCleanupCrieriaTableWithFootnotesPFOSPFOA1-25-2017_610379_7.pdf
USA	Michigan	Drinking Water			(70)						(70)									Residential Drinking Water Criteria	ng/L	Michigan Department of Environmental Quality (DEQ)	2018	Promulgated	http://www.michigan.gov/documents/deq/deq-rrd-UpdatedGroundwaterCleanupCrieriaTableWithFootnotesPFOSPFOA1-25-2017_610379_7.pdf
USA	Minnesota	Drinking Water	7000		300; 27 proposed		7000				300; 35 proposed									Health Risk Limit - Chronic	ng/L	Minnesota Department of Health (MDH)	2011	Promulgated	http://www.health.state.mn.us/divs/eh/risk/guidance/gw/table.html#top
USA	Nevada	Drinking Water	66,700		667						667									Basic Comparison Level	ng/L	Nevada Division of Environmental Protection (DEP)	2017	Promulgated	https://ndep.nv.gov/resources/risk-assessment-and-toxicology-basic-comparison-levels
USA	New Jersey	Drinking Water			13						14									Drinking water guidance value	ng/L	Department of Environmental Protection of the State of New Jersey	2017	Proposed	http://www.nj.gov/dep/watersupply/pdf/pfoa-recommend.pdf
USA	New Jersey	Drinking Water										10								Interim groundwater quality criterion	ng/L	Environmental Protection of the State of New Jersey	2016	Proposed	http://www.state.nj.us/dep/wms/bears/gwqs_interim_criteria_table.htm#4 http://www.state.nj.us/dep/watersupply/pdf/pfna-health-
USA	New Mexico	Drinking Water			(70)						(70)									NMED Soil Screening Levels	ng/L	New Mexico Environment Department	2017	Promulgated	https://www.env.nm.gov/wp-content/uploads/2016/11/NMED_SSG_VOL-I_-March_2017_revised.pdf
USA	New York	Drinking Water									100									Health Advisory	ng/L	New York State Department (NYSD) of Environmental Conservation and NYSD Public Health/ U.S. Environmental Protection Agency (EPA) Local Guidance	2016	Provisional	http://www.dec.ny.gov/press/105309.html
USA	North Carolina	Drinking Water																	140	Health Goal	ng/L	North Carolina Department of Health and Human Services	2017	Provisional	https://ncdenr.s3.amazonaws.com/s3fs-public/GenX/NC%20DHHS%20Risk%20Assessment%20FAQ%20Final%20Clean%20071417%20PM.pdf
USA	North Carolina	Drinking Water									2000									Interim Maximum Allowable Concentration	ng/L	North Carolina Department of Health and Human Services	2013	Provisional	No web link available. See pdf file.
USA	Oregon	Drinking Water			300000					300000	24000	1000						200		Inititation level	ng/L	Oregon Health Authority	2017	Proposed	http://www.oregon.gov/deq/EQCdocs/20170913ItemD.pdf
USA	Pennsylvania	Drinking Water									6									Proposed value	ng/L	Delaware Riverkeeper's Network	2017	Proposed	https://stateimpact.npr.org/pennsylvania/2017/08/17/pa-environmental-regulators-to-consider-health-limits-for-pfoa/
USA	Vermont	Drinking Water			(20)						(20)									Health Based Value	ng/L	Vermont Department of Health	2016	Proposed	http://www.healthvermont.gov/health-environment/drinking-water/perfluorooctanoic-acid-pfoa

Appendix B-1
U.S. PFAS Standards and Advisory Values in Drinking Water

Country	State or Jurisdiction	Media	PFBS	PFHxS	PFOS	PFDS	PFBA	PFPeA	PFHxA	PFHpA	PFOA	PFNA	PFDA	PFUA	PFDoA	PFTrA	PFTeA	PFOSA	GenX	Type	Units	Author	Date Issued or Updated	Proposed or Promulgated[1]	Web link
USA	Washington	N/A																		N/A	N/A	Washington State Depts. of Ecology and Health	2017	Chemical action plan in progress, may be released in 2017	http://www.ecy.wa.gov/programs/hwtr/RTT/pbt/pfas.html
USA	West Virginia	Drinking Water									150,000									Drinking Water Screening Value	ng/L	West Virginia Dept. of Environmental Protection	2002	Proposed	http://dep.wv.gov/WWE/watershed/wqmonitoring/Documents/C-8/C-8_FINAL_CATT_REPORT_8-02.pdf

* Values in parentheses are regulated as a summation of two or more PFASs

[1] Promulgated in this table means there is a regulation or advisory value, but it may not meet the definition of promulgated under CERCLA

Acronyms and Abbreviations:

mg/g = milligrams per gram
mg/kg = milligrams per kilogram
ng/L = nanograms per liter
N/A = not applicable
DEC = Department of Environmental Conservation
DEP = Division of Environmental Protection
DEQ = Department of Environmental Quality
EPA = U.S. Environmental Protection Agency
IDEM = Department of Environmental Management
HAL = Health Advisory Level
MCL = Maximum Contaminant Level
MDH = Minnesota Department of Health
MTGW = Migration to Groundwater □
OLQ = Office of Land Quality
PCL = Protective Concentration Level
PFAS = per- and polyfluoroalkyl substance
PFBA = perfluorobutanoic acid or perfluorobutanoate
PFBS = perfluorobutanesulfonic acid or perfluorobutanesulfonate
PFDA = perfluorodecanoic acid or perfluorodecanoate
PFDoA = perfluorododecanoic acid or perfluorododecanoate
PFDS = perfluorodecanesulfonic acid or perfluorodecanesulfonate
PFHpA = perfluoroheptanoic acid or perfluoroheptanoate
PFHxA = perfluorohexanoic acid or perfluorohexanoate
PFHxS = perfluorohexanesulfonic acid or perfluorohexanesulfonate
PFNA = perfluorononoic acid or perfluorononoate
PFOA = perfluorooctanoic acid or perfluorooctanoate
PFOS = perfluorooctanesulfonic acid or perfluorooctanesulfonate
PFOSA = perfluorooctane sulfonamide
PFPeA = perfluoropentanoic acid or perfluoropentanoate
PFTeDA = perfluorotetradecanoic acid or perfluorotetradecanoate
PFTrDA = perfluorotridecanoic acid or perfluorotridecanoate
PFUA = perfluoroundecanoic acid or perfluoroundecanoate
PSRG = Preliminary Soil Remediation Goal
RBEL = Risk-Based Exposure Limit
RCL = Residual Contaminant Level
RSL = Risk-Based Screening Level

Appendix B-2
U.S. PFAS Standards and Advisory Values in Soils

Country	State or Jurisdiction	Media	PFBS	PFHxS	PFOS	PFDS	PFBA	PFPeA	PFHxA	PFHpA	PFOA	PFNA	PFDA	PFUA	PFDoA	PFTrA	PFTeA	PFOSA	Type	Units	Author	Date Issued or Updated	Proposed or Promulgated[1]	Web link
USA	Federal	Soil	1,260		1.26						1.26								Risk- Based Screening Level (RSL), Residential	mg/kg	U.S. Environmental Protection Agency	2017	Proposed	https://epa-prgs.ornl.gov/cgi-bin/chemicals/csl_search
USA	Federal	Soil	0.13		0.000172						0.000378								Risk- Based Screening Level (RSL), Groundwater Protection	mg/kg	U.S. Environmental Protection Agency	2017	Proposed	https://epa-prgs.ornl.gov/cgi-bin/chemicals/csl_search
USA	Federal	Soil	4,670		46.7						46.7								Risk-Based Screening Level (RSL), Indoor Worker	mg/kg	U.S. Environmental Protection Agency	2017	Proposed	https://epa-prgs.ornl.gov/cgi-bin/chemicals/csl_search
USA	Federal	Soil	1,640		16.4						16.4								Risk-Based Screening Level (RSL), Composite Worker	mg/kg	U.S. Environmental Protection Agency	2017	Proposed	https://epa-prgs.ornl.gov/cgi-bin/chemicals/csl_search
USA	Federal	Soil	182		1.82						1.82								Risk-Based Screening Level (RSL), Outdoor Worker	mg/kg	U.S. Environmental Protection Agency	2017	Proposed	https://epa-prgs.ornl.gov/cgi-bin/chemicals/csl_search
USA	U.S. EPA Region 4	Soil			6						16								Residential Surface Exposure	mg/kg	U.S. Environmental Protection Agency	2009	Proposed	ments/web/pdf/d_final_pfc_soil_screening_values_11_20_09.pdf
USA	Alaska	Soil			2.2						2.2								Remediation - Arctic Zone - Risk-Based Value	mg/kg	Alaska Department of Environmental	2016	Proposed	http://dec.alaska.gov/spar/regulation_projects/cs18AAC75.htm
USA	Alaska	Soil			1.6						1.6								Remediation - Under 40" Zone - Risk-Based Value	mg/kg	Alaska Department of Environmental	2016	Proposed	http://dec.alaska.gov/spar/regulation_projects/cs18AAC75.htm
USA	Alaska	Soil			1.3						1.3								Remediation - Over 40" Zone - Risk-Based value	mg/kg	Alaska Department of Environmental	2016	Proposed	http://dec.alaska.gov/spar/regulation_projects/cs18AAC75.htm
USA	Alaska	Soil			0.003						0.0017								Remediation - Migration to Groundwater (MTGW) - Risk-	mg/kg	Alaska Department of Environmental	2016	Proposed	http://dec.alaska.gov/spar/regulation_projects/cs18AAC75.htm
USA	Delaware	Soil	130		6						16								Screening Levels - Hazardous Substance Cleanup Act	mg/kg	Department of Natural Resources	2017	Proposed	http://www.dnrec.delaware.gov/dwhs/sirb/Documents/Screening%20Level%20Table.pdf
USA	Indiana	Soil	2200																Indiana Department of Environmental Management (IDEM) Office of Land Quality (OLQ) Screening Levels - Residential	mg/kg	Indiana Department of Environmental Management	2017	Promulgated	http://www.in.gov/idem/cleanups/files/risc_screening_table_2017_a6.pdf
USA	Indiana	Soil	23000																Indiana Department of Environmental Management (IDEM) Office of Land Quality (OLQ) Screening Levels - Industrial/Commercial	mg/kg	Indiana Department of Environmental Management	2017	Promulgated	http://www.in.gov/idem/cleanups/files/risc_screening_table_2017_a6.pdf
USA	Indiana	Soil	39000																Indiana Department of Environmental Management (IDEM) Office of Land Quality (OLQ) Screening Levels - Excavation	mg/kg	Indiana Department of Environmental Management	2017	Promulgated	http://www.in.gov/idem/cleanups/files/risc_screening_table_2017_a6.pdf
USA	Indiana	Soil	4.2																Indiana Department of Environmental Management (IDEM) Office of Land Quality (OLQ) Screening Levels - Soil Migration to Groundwater,	mg/kg	Indiana Department of Environmental Management (IDEM)	2017	Proposed	http://www.in.gov/idem/cleanups/files/risc_screening_table_2017_a6.pdf
USA	Iowa	Soil			1.8						1.2								Statewide Brownfield Standards for Soil	mg/kg	Iowa Department of Natural Resources	2016	Promulgated	https://programs.iowadnr.gov/riskcalc/Home/statewidestandards
USA	Maine	Soil			11						0.8								Soil Remedial Action Guideline - Residential	mg/kg	Maine Department of Environmental	2016	Promulgated	http://www.maine.gov/dep/spills/publications/guidance/rags/ME-RAGS-Revised-Final_020516.pdf
USA	Maine	Soil			18						1.3								Soil Remedial Action Guideline - Park User	mg/kg	Maine Department of Environmental	2016	Promulgated	http://www.maine.gov/dep/spills/publications/guidance/rags/ME-RAGS-Revised-Final_020516.pdf
USA	Maine	Soil			82						6.2								Soil Remedial Action Guideline - Commercial Worker	mg/kg	Maine Department of Environmental	2016	Promulgated	http://www.maine.gov/dep/spills/publications/guidance/rags/ME-RAGS-Revised-Final_020516.pdf
USA	Maine	Soil			19						1.4								Soil Remedial Action Guideline - Construction Worker	mg/kg	Maine Department of Environmental	2016	Promulgated	http://www.maine.gov/dep/spills/publications/guidance/rags/ME-RAGS-Revised-Final_020516.pdf
USA	Michigan	Soil			2.1						2.1								Residential Direct Contact Criteria	mg/kg	Michigan Department of Environmental	2017	Proposed	No web link available. See Excel file.
USA	Michigan	Soil			25						25								Non-residential Direct Contact Criteria	mg/kg	Michigan Department of Environmental	2017	Proposed	No web link available. See Excel file.
USA	Michigan	Soil			0.0014						0.059								Non-residential Drinking Water Protection Criteria	mg/kg	Michigan Department of Environmental	2017	Proposed	No web link available. See Excel file.
USA	Michigan	Soil			0.0014						0.059								Residential Drinking Water Protection Criteria	mg/kg	Michigan Department of Environmental	2017	Proposed	No web link available. See Excel file.
USA	Minnesota	Soil	30		1.7		63				0.33								Soil Reference Value - Residential/Recreational	mg/kg	Minnesota Pollution Control Agency	2009	Proposed	https://www.pca.state.mn.us/waste/risk-based-site-evaluation-guidance
USA	Minnesota	Soil	450		21		150				0.33								Soil Reference Value - Commercial/Industrial	mg/kg	Minnesota Pollution Control Agency	2009	Proposed	https://www.pca.state.mn.us/waste/risk-based-site-evaluation-guidance
USA	Nevada	Soil	125		1.56						1.56								Basic Comparison Levels - Residential	mg/kg	Nevada Division of Environmental	2017	Promulgated	https://ndep.nv.gov/resources/risk-assessment-and-toxicology-basic-comparison-levels
USA	Nevada	Soil	125		26						26								Basic Comparison Levels - Industrial/Commercial	mg/kg	Nevada Division of Environmental Protection (DEP)	2017	Promulgated	https://ndep.nv.gov/resources/risk-assessment-and-toxicology-basic-comparison-levels
USA	New Hampshire	Soil			0.5						0.5								Direct Contact Risk-Based Soil Concentration - child	mg/kg	Department of Environmental Services Environmental	2016	Promulgated	https://www4.des.state.nh.us/nh-pfas-investigation/wp-content/uploads/2017/09/pfoa-dcrb-value.pdf

Country	State or Jurisdiction	Media	PFBS	PFHxS	PFOS	PFDS	PFBA	PFPeA	PFHxA	PFHpA	PFOA	PFNA	PFDA	PFUA	PFDoA	PFTrA	PFTeA	PFOSA	Type	Units	Author	Date Issued or Updated	Proposed or Promulgated[1]	Web link
USA	New Hampshire	Soil			4.3						4.3								Direct Contact Risk-Based Soil Concentration - construction worker	mg/kg	Department of Environmental Services Environmental	2016	Promulgated	https://www4.des.state.nh.us/nh-pfas-investigation/wp-content/uploads/2017/09/pfoa-dcrb-value.pdf
USA	North Carolina	Soil	250																Residential Health Based Preliminary Soil Remediation Goal (PSRG)	mg/kg	North Carolina Department of Environmental Quality	2017	Proposed	https://files.nc.gov/ncdeq/Waste%20Management/DWM/SF/RiskBasedRemediation/20171023_PSRGsandAppA.PDF
USA	North Carolina	Soil	3300																Commercial/Industrial Health Based Preliminary Soil Remediation Goal (PSRG)	mg/kg	North Carolina Department of Environmental Quality	2017	Proposed	https://files.nc.gov/ncdeq/Waste%20Management/DWM/SF/RiskBasedRemediation/20171023_PSRGsandAppA.PDF
USA	North Carolina	Soil									0.017								Protection of Groundwater	mg/kg	North Carolina Department of	2017	Proposed	WM/SF/RiskBasedRemediation/20171023_PSRGsandAppA.PDF
USA	Texas	Soil	2900	7.8	47	25	5900	7.8	7.8	47	25	25	31	25	25	25	25	25	Commercial Soil Risk-Based Exposure Limit (RBEL) -	mg/kg	Texas Commission on Environmental	2017	Proposed	trrp/2017%20Protective Concentration Level (PCL)%20Tables%20March31.pdf
USA	Texas	Soil	1400	3.9	24	12	3000	3.9	3.9	24	12	12	15	12	12	12	12	12	Commercial Soil Risk-Based Exposure Limit (RBEL) - Ingestion	mg/kg	Texas Commission on Environmental Quality	2017	Proposed	https://www.tceq.texas.gov/assets/public/remediation/trrp/2017%20Protective Concentration Level (PCL)%20Tables%20March31.pdf
USA	Texas	Soil	500	1.4	8.2	4.3	1000	1.4	1.4	8.2	4.3	4.3	5.3	4.3	4.3	4.3	4.3	4.3	Residential Soil Risk-Based Exposure Limit (RBEL) -	mg/kg	Texas Commission on Environmental	2017	Proposed	trrp/2017%20Protective Concentration Level (PCL)%20Tables%20March31.pdf
USA	Texas	Soil	110	0.31	1.9	0.98	240	0.31	0.31	1.9	0.98	0.98	1.2	0.98	0.98	0.98	0.98	0.98	Residential Soil Risk-Based Exposure Limit (RBEL) -	mg/kg	Texas Commission on Environmental	2017	Proposed	trrp/2017%20Protective Concentration Level (PCL)%20Tables%20March31.pdf
USA	Texas	Soil	2900	7.8	47	25	5900	7.8	7.8	47	25	25	31	25	25	25	25	25	Tier 1 Individual Commercial Soil Protective Concentration	mg/kg	Texas Commission on Environmental	2017	Proposed	trrp/2017%20Protective Concentration Level (PCL)%20Tables%20March31.pdf
USA	Texas	Soil	1400	3.9	24	12	3000	3.9	3.9	24	12	12	15	12	12	12	12	12	Tier 1 Individual Commercial Soil Protective Concentration	mg/kg	Texas Commission on Environmental	2017	Proposed	trrp/2017%20Protective Concentration Level (PCL)%20Tables%20March31.pdf
USA	Texas	Soil	500	1.4	8.2	4.3	1000	1.4	1.4	8.2	4.3	4.3	5.3	4.3	4.3	4.3	4.3	4.3	Tier 1 Individual Residental Soil Protective Concentration Level	mg/kg	Texas Commission on Environmental	2017	Proposed	sets/public/remediation/trrp/2
USA	Texas	Soil	110	0.31	1.9	0.98	240	0.31	0.31	1.9	0.98	0.98	1.2	0.98	0.98	0.98	0.98	0.98	Tier 1 Individual Residental Soil Protective Concentration Level	mg/kg	Texas Commission on Environmental	2017	Proposed	trrp/2017%20Protective Concentration Level (PCL)%20Tables%20March31.pdf
USA	Texas	Soil	0.32	0.0061	0.075	0.12	0.58	0.001	0.0014	0.014	0.0088	0.0092	0.067	0.055	0.1	0.18	0.34	2.8	Tier 1 Protective Concentration Level (PCL): Commercial - Soil to Groundwater (Ingestion), 0.5-acre source area	mg/kg	Texas Commission on Environmental Quality	2017	Proposed	https://www.tceq.texas.gov/assets/public/remediation/trrp/2017%20Protective Concentration Level (PCL)%20Tables%20March31.pdf
USA	Texas	Soil	0.16	0.003	0.05	0.06	0.29	0.0005	0.0007	0.0068	0.0044	0.0046	0.033	0.027	0.05	0.091	0.17	1.4	Tier 1 Protective Concentration Level (PCL): Commercial - Soil to Groundwater (Ingestion), 30-acre source area	mg/kg	Texas Commission on Environmental Quality	2017	Proposed	https://www.tceq.texas.gov/assets/public/remediation/trrp/2017%20Protective Concentration Level (PCL)%20Tables%20March31.pdf
USA	Texas	Soil	0.11	0.002	0.025	0.04	20	0.0003	0.0005	0.0046	0.003	0.0031	0.022	0.018	0.034	0.061	0.11	0.92	Tier 1 Protective Concentration Level (PCL): Residential - Soil to Groundwater (Ingestion), 0.5-acre source area	mg/kg	Texas Commission on Environmental Quality	2017	Proposed	https://www.tceq.texas.gov/assets/public/remediation/trrp/2017%20Protective Concentration Level (PCL)%20Tables%20March31.pdf
USA	Texas	Soil	0.053	0.001	1.5	0.02	0.098	0.0002	0.0002	0.0023	0.0015	0.0015	0.011	0.0092	0.017	0.03	0.056	0.46	Tier 1 Protective Concentration Level (PCL): Residential - Soil to Groundwater (Ingestion), 30-acre source area	mg/kg	Texas Commission on Environmental Quality	2017	Proposed	https://www.tceq.texas.gov/assets/public/remediation/trrp/2017%20Protective Concentration Level (PCL)%20Tables%20March31.pdf
USA	Texas	Soil	80	0.24	110	0.8	160	0.25	0.25	1.5	0.49	0.73	0.98	0.8	0.78	0.61	0.51	0.031	Tier 1 Protective Concentration Level (PCL): Residential - Total Soil Combined, 30-acre source area	mg/kg	Texas Commission on Environmental Quality	2017	Proposed	https://www.tceq.texas.gov/assets/public/remediation/trrp/2017%20Protective Concentration Level (PCL)%20Tables%20March31.pdf
USA	Texas	Soil	820	8.2	220		1400				1.7	12	62		50			0.045	Tier 1 Soil Protective Concentration Level (PCL): Commercial - Soil to Air, 30-acre source	mg/kg	Texas Commission on Environmental Quality	2017	Proposed	https://www.tceq.texas.gov/assets/public/remediation/trrp/2017%20Protective Concentration Level (PCL)%20Tables%20March31.pdf
USA	Texas	Soil	1600	16	7.5		2700				3.4	24	120		97			0.088	Tier 1 Soil Protective Concentration Level (PCL): Commercial - Soil to Air, 0.5-acre source	mg/kg	Texas Commission on Environmental Quality	2017	Proposed	https://www.tceq.texas.gov/assets/public/remediation/trrp/2017%20Protective Concentration Level (PCL)%20Tables%20March31.pdf
USA	Texas	Soil	16	0.3	15	2	29	0.016	0.024	0.23	0.44	0.46	3.3	2.7	5	9.1	17	140	Tier 1 Soil Protective Concentration Level (PCL): Commercial - Soil to Groundwater, class 3, 30-	mg/kg	Texas Commission on Environmental Quality	2017	Proposed	https://www.tceq.texas.gov/assets/public/remediation/trrp/2017%20Protective Concentration Level (PCL)%20Tables%20March31.pdf
USA	Texas	Soil	32	0.61	15000	4	58	0.03	0.048	0.46	0.88	0.92	6.7	5.5	10	18	34	280	Tier 1 Soil Protective Concentration Level (PCL): Commercial - Soil to Groundwater, class 3, 5-	mg/kg	Texas Commission on Environmental Quality	2017	Proposed	https://www.tceq.texas.gov/assets/public/remediation/trrp/2017%20Protective Concentration Level (PCL)%20Tables%20March31.pdf
USA	Texas	Soil	1000000	870	230000		1E+06				83	620	7100		5800			0.015	Tier 1 Soil Protective Concentration Level (PCL): Commercial - GW-Soil (Air), 30-acre source	mg/kg	Texas Commission on Environmental Quality	2017	Proposed	https://www.tceq.texas.gov/assets/public/remediation/trrp/2017%20Protective Concentration Level (PCL)%20Tables%20March31.pdf
USA	Texas	Soil	1000000	8800	80		1E+06				1300	9500	110000		89000			0.23	Tier 1 Soil Protective Concentration Level (PCL): Commercial - GW-Soil (Air), 0.5-acre source	mg/kg	Texas Commission on Environmental Quality	2017	Proposed	https://www.tceq.texas.gov/assets/public/remediation/trrp/2017%20Protective Concentration Level (PCL)%20Tables%20March31.pdf

Appendix B-2
U.S. PFAS Standards and Advisory Values in Soils

Country	State or Jurisdiction	Media	PFBS	PFHxS	PFOS	PFDS	PFBA	PFPeA	PFHxA	PFHpA	PFOA	PFNA	PFDA	PFUA	PFDoA	PFTrA	PFTeA	PFOSA	Type	Units	Author	Date Issued or Updated	Proposed or Promulgated[1]	Web link
USA	Texas	Soil	580	5.8	150		1000				1.2	8.9	44		36			0.032	Tier 1 Soil Protective Concentration Level (PCL): Residential - Soil to Air, 30-acre source	mg/kg	Texas Commission on Environmental Quality	2017	Proposed	https://www.tceq.texas.gov/assets/public/remediation/trrp/2017%20Protective Concentration Level (PCL)%20Tables%20March31.pdf
USA	Texas	Soil	1100	11	2.5		2000				2.4	17	86		69			0.063	Tier 1 Soil Protective Concentration Level (PCL): Residential - Soil to Air, 0.5-acre source	mg/kg	Texas Commission on Environmental Quality	2017	Proposed	https://www.tceq.texas.gov/assets/public/remediation/trrp/2017%20Protective Concentration Level (PCL)%20Tables%20March31.pdf
USA	Texas	Soil	5.3	0.1	5	2	9.8	0.016	0.024	0.23	0.15	0.15	1.1	0.92	1.7	3	5.6	46	Tier 1 Soil Protective Concentration Level (PCL): Residential - Soil to Groundwater, class 3, 30-acre source	mg/kg	Texas Commission on Environmental Quality	2017	Proposed	https://www.tceq.texas.gov/assets/public/remediation/trrp/2017%20Protective Concentration Level (PCL)%20Tables%20March31.pdf
USA	Texas	Soil	11	0.2	1.5	4	20	0.032	0.048	0.46	0.3	0.31	2.2	1.8	3.4	6.1	11	92	Tier 1 Soil Protective Concentration Level (PCL): Residential - Soil to Groundwater, class 3, 0.5-acre source	mg/kg	Texas Commission on Environmental Quality	2017	Proposed	https://www.tceq.texas.gov/assets/public/remediation/trrp/2017%20Protective Concentration Level (PCL)%20Tables%20March31.pdf
USA	Texas	Soil	86	0.25	11000	0.8	180	0.25	0.25	1.5	0.6	0.76	0.99	0.8	0.79	0.61	0.51	0.058	Tier 1 Soil Protective Concentration Level (PCL): Residential - Total Soil Combined, 0.5-acre source area	mg/kg	Texas Commission on Environmental Quality	2017	Proposed	https://www.tceq.texas.gov/assets/public/remediation/trrp/2017%20Protective Concentration Level (PCL)%20Tables%20March31.pdf
USA	Texas	Soil	720000	620	160000		980000				59	440	5000		4100			0.011	Tier 1 Soil Protective Concentration Level (PCL): Residential - GW-Soil (Air), 30-acre source	mg/kg	Texas Commission on Environmental Quality	2017	Proposed	https://www.tceq.texas.gov/assets/public/remediation/trrp/2017%20Protective Concentration Level (PCL)%20Tables%20March31.pdf
USA	Texas	Soil	1000000	6300	15		1E+06				910	6800	78000		64000			0.17	Tier 1 Soil Protective Concentration Level (PCL): Residential - GW-Soil (Air), 0.5-acre source	mg/kg	Texas Commission on Environmental Quality	2017	Proposed	https://www.tceq.texas.gov/assets/public/remediation/trrp/2017%20Protective Concentration Level (PCL)%20Tables%20March31.pdf
USA	Texas	Soil	600	2.2	14	8.2	1100	2.6	2.6	16	2.4	6.1	9.4	8.2	7.5	8.2	8.2	0.087	Tier 1: Protective Concentration Level (PCL) Commercial - Total Soil Combined, 0.5-acre source area	mg/kg	Texas Commission on Environmental Quality	2017	Proposed	https://www.tceq.texas.gov/assets/public/remediation/trrp/2017%20Protective Concentration Level (PCL)%20Tables%20March31.pdf
USA	Texas	Soil	440	2	0.15	8.2	820	2.6	2.6	16	1.4	4.9	8.8	8.2	7	8.2	8.2	0.045	Tier 1: Protective Concentration Level (PCL) Industrial - Total Soil Combined, 30-acre source area	mg/kg	Texas Commission on Environmental Quality	2017	Proposed	https://www.tceq.texas.gov/assets/public/remediation/trrp/2017%20Protective Concentration Level (PCL)%20Tables%20March31.pdf
USA	Texas	Soil														0.19	0.19		Tier 1 Individual Residental Soil Protective Concentration Level (PCL) - Vegetable Ingestion	mg/kg	Texas Commission on Environmental Quality	2017	Proposed	https://www.tceq.texas.gov/assets/public/remediation/trrp/2017%20Protective Concentration Level (PCL)%20Tables%20March31.pdf
USA	Vermont	Soil									0.30								Soil Screening Value - Resident Soil	mg/kg	State of Vermont Agency of Natural	2017	Promulgated	http://dec.vermont.gov/sites/dec/files/wmp/Sites/07.11.2017.Adopted.Rule_.for_.SOS_.filing.pdf
USA	West Virginia	Soil									240								Residential Soil	mg/kg	West Virginia Dept. of Environmental	2002	Proposed	http://dep.wv.gov/WWE/watershed/wqmonitoring/Documents/C-8/C-8_FINAL_CATT_REPORT_8-02.pdf
USA	Wisconsin	Soil	1260		1.26						1.26								Do Not Exceed Soil Residual Contaminant Level (RCL) - Non-Industrial	mg/kg	Wisconsin Department of Natural Resources	2017	Proposed	http://dnr.wi.gov/topic/brownfields/professionals.html
USA	Wisconsin	Soil	16400		16.4						16.4								Do Not Exceed Soil Residual Contaminant Level (RCL) - Industrial	mg/kg	Wisconsin Department of Natural Resources	2017	Proposed	http://dnr.wi.gov/topic/brownfields/professionals.html

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Acronyms and Abbreviations:
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DEC = Department of Environmental Conservation
DEP = Division of Environmental Protection
DEQ = Department of Environmental Quality
EPA = U.S. Environmental Protection Agency
IDEM = Department of Environmental Management
HAL = Health Advisory Level
MCL = Maximum Contaminant Level
MDH = Minnesota Department of Health
MTGW = Migration to Groundwater
OLQ = Office of Land Quality
PCL = Protective Concentration Level

Appendix B-2
U.S. PFAS Standards and Advisory Values in Soils

Country	State or Jurisdiction	Media	PFBS	PFHxS	PFOS	PFDS	PFBA	PFPeA	PFHxA	PFHpA	PFOA	PFNA	PFDA	PFUA	PFDoA	PFTrA	PFTeA	PFOSA	Type	Units	Author	Date Issued or Updated	Proposed or Promulgated[1]	Web link

PFAS = per- and polyfluoroalkyl substance
PFBA = perfluorobutanoic acid or perfluorobutanoate
PFBS = perfluorobutanesulfonic acid or perfluorobutanesulfonate
PFDA = perfluorodecanoic acid or perfluorodecanoate
PFDoA = perfluorododecanoic acid or perfluorododecanoate
PFDS = perfluorodecanesulfonic acid or perfluorodecanesulfonate
PFHpA = perfluoroheptanoic acid or perfluoroheptanoate
PFHxA = perfluorohexanoic acid or perfluorohexanoate
PFHxS = perfluorohexanesulfonic acid or perfluorohexanesulfonate
PFNA = perfluorononoic acid or perfluorononoate
PFOA = perfluorooctanoic acid or perfluorooctanoate
PFOS = perfluorooctanesulfonic acid or perfluorooctanesulfonate
PFOSA = perfluorooctane sulfonamide
PFPeA = perfluoropentanoic acid or perfluoropentanoate
PFTeDA = perfluorotetradecanoic acid or perfluorotetradecanoate
PFTrDA = perfluorotridecanoic acid or perfluorotridecanoate
PFUA = perfluoroundecanoic acid or perfluoroundecanoate
PSRG = Preliminary Soil Remediation Goal
RBEL = Risk-Based Exposure Limit
RCL = Residual Contaminant Level
RSL = Risk-Based Screening Level

Appendix B-3
U.S. PFAS Standards and Advisory Values in Groundwater

Country	State or Jurisdiction	Media		PFBS	PFHxS	PFOS	PFDS	PFBA	PFPeA	PFHxA	PFHpA	PFOA	PFNA	PFDA	PFUA	PFDoA	PFTrA	PFTeA	PFOSA	GenX	Type	Units	Author	Date Issued or Updated	Proposed or Promulgated[1]	Web link
USA	Alaska	Groundwater				400						400									Risk-Based Level	ng/L	Alaska Department of Environmental Conservation (DEC)	2016	Proposed	http://dec.alaska.gov/spar/regulation_projects/cs18AAC75.htm
USA	Connecticut	Groundwater			(70)	(70)					(70)	(70)	(70)								Groundwater Action Level	ng/L	Connecticut Department of Public Health	2016	Promulgated	http://www.ct.gov/dph/lib/dph/environmental_health/eoha/groundwater_well_contamination/110916_ct_action_level_list_nov_2016_update.pdf
USA	Colorado	Groundwater				(70)						(70)									Site-Specific Groundwater Standard	ng/L	Colorado Department of Public Health & Environment	2017	Proposed	https://www.colorado.gov/pacific/sites/default/files/WQ_GWStandard_PFOA_100417%20FINAL.pdf
USA	Delaware	Groundwater		40000		(70)						(70)									Screening Levels - Hazardous Substance Cleanup Act	ng/L	Department of Natural Resources and Environmental Control	2017	Proposed	http://www.dnrec.delaware.gov/dwhs/sirb/Documents/Screening%20Level%20Table.pdf
USA	Iowa	Groundwater				70						70									State Brownfield Standards for Protected Groundwater Source	ng/L	Iowa Department of Natural Resources	2016	Promulgated	https://programs.iowadnr.gov/riskcalc/Home/statewidestandards
USA	Iowa	Groundwater				1000															State Brownfield Standards for a Non-Protected Groundwater Source	ng/L	Iowa Department of Natural Resources	2016	Promulgated	https://programs.iowadnr.gov/riskcalc/Home/statewidestandards
USA	Maine	Groundwater				5,300						220									Groundwater Remedial Action Guideline - Groundwater Construction Worker	ng/L	Maine Department of Environmental Protection	2016	Promulgated	http://www.maine.gov/dep/spills/publications/guidance/rags/ME-RAGS-Revised-Final_020516.pdf
USA	Maine	Groundwater				560						130									Groundwater Remedial Action Guideline - Groundwater Residential	ng/L	Maine Department of Environmental Protection	2016	Promulgated	http://www.maine.gov/dep/spills/publications/guidance/rags/ME-RAGS-Revised-Final_020516.pdf
USA	Michigan	Groundwater				12						12,000									Groundwater Surface Water Interface Criteria	ng/L	Michigan Department of Environmental Quality (DEQ)	2017	Proposed	No web link available. See Excel file.
USA	New Hampshire	Groundwater				(70)						(70)									Ambient Groundwater Quality Standard	ng/L	New Hampshire Department for Environmental Services	2017	Promulgated	https://www4.des.state.nh.us/nh-pfas-investigation/wp-content/uploads/2017/08/5-18-17-PFAS-Sampling-Letter.pdf
USA	New Jersey	Groundwater											10								Risk-Based Level	ng/L	Department of Environmental Protection of the State of New Jersey	2018	Promulgated	http://www.nj.gov/dep/rules/adoptions/adopt_20180116c.pdf
USA	North Carolina	Groundwater										2000									North Carolina Groundwater Protection Standard 2L Interim Maximum Allowable Concentration	ng/L	North Carolina Department of Environmental Quality	2017	Proposed	https://files.nc.gov/ncdeq/Waste%20Management/DWM/SF/RiskBasedRemediation/20171023_PSRGsandAppA.PDF https://ncdenr.s3.amazonaws.com/s3fs-public/Waste%20Management/DWM/UST/Law-Rules-Memos/2L%20Rules%20040113.pdf
USA	Rhode Island	Groundwater				(70)						(70)									Groundwater Quality Standard	ng/L	Rhode Island Department of Environmental Management	2017	Promulgated	http://www.dem.ri.gov/programs/benviron/water/quality/pdf/pfoa.pdf
USA	Texas	Groundwater		7.60E+11	400000000	2600000000		1.00E+12				1.3E+08	910000000	1800000000		780000000			74		Protective Concentration Level - Industrial, Air, 0.5-acre source area	ng/L	Texas Commission on Environmental Quality	2017	Proposed	https://www.tceq.texas.gov/assets/public/remediation/trrp/2017%20Protective Concentration Level (PCL)%20Tables%20March31.pdf
USA	Texas	Groundwater		6.50E+11	79000000	340000000		1.00E+12				16000000	120000000	230000000		100000000			9.6		Protective Concentration Level - Industrial, Air, 30-acre source area	ng/L	Texas Commission on Environmental Quality	2017	Proposed	https://www.tceq.texas.gov/assets/public/remediation/trrp/2017%20Protective Concentration Level (PCL)%20Tables%20March31.pdf
USA	Texas	Groundwater		10	0.028	0.17	0.088	21	0.028	0.028	0.17	0.088	0.088	0.11	0.088	0.088	0.088	0.088	0.088		Protective Concentration Level - Industrial, Class 3 Groundwater	ng/L	Texas Commission on Environmental Quality	2017	Proposed	https://www.tceq.texas.gov/assets/public/remediation/trrp/2017%20Protective Concentration Level (PCL)%20Tables%20March31.pdf
USA	Texas	Groundwater		100000	280	1700	880	210000	280	280	1700	880	880	1100	880	880	880	880	880		Protective Concentration Level - Industrial, Ingestion	ng/L	Texas Commission on Environmental Quality	2017	Proposed	https://www.tceq.texas.gov/assets/public/remediation/trrp/2017%20Protective Concentration Level (PCL)%20Tables%20March31.pdf
USA	Texas	Groundwater		5.40E+11	2.90E+08	1.80E+09		8.50E+11				9.00E+07	6.50E+08	1.30E+09		5.50E+08			5.30E+01		Protective Concentration Level - Residential, Air, 0.5-acre source area	ng/L	Texas Commission on Environmental Quality	2017	Proposed	https://www.tceq.texas.gov/assets/public/remediation/trrp/2017%20Protective Concentration Level (PCL)%20Tables%20March31.pdf

Appendix B-3
U.S. PFAS Standards and Advisory Values in Groundwater

Country	State or Jurisdiction	Media		PFBS	PFHxS	PFOS	PFDS	PFBA	PFPeA	PFHxA	PFHpA	PFOA	PFNA	PFDA	PFUA	PFDoA	PFTrA	PFTeA	PFOSA	GenX	Type	Units	Author	Date Issued or Updated	Proposed or Promulgated[1]	Web link
USA	Texas	Groundwater		650000	79	340		1000000				16	120	230		100			0.0000096		Protective Concentration Level - Residential, Air, 30-acre source area	ng/L	Texas Commission on Environmental Quality	2017	Proposed	https://www.tceq.texas.gov/assets/public/remediation/trrp/2017%20Protective Concentration Level (PCL)%20Tables%20March31.pdf
USA	Texas	Groundwater		3400000	9300	56000	29000	7100000	9300	9300	56000	29000	29000	37000	29000	29000	29000	29000	29000		Protective Concentration Level - Residential, Class 3 Groundwater	ng/L	Texas Commission on Environmental Quality	2017	Proposed	https://www.tceq.texas.gov/assets/public/remediation/trrp/2017%20Protective Concentration Level (PCL)%20Tables%20March31.pdf
USA	Texas	Groundwater		34000	93	560	290	71000	93	93	560	290	290	370	290	290	290	290	290		Protective Concentration Level - Residential, Ingestion	ng/L	Texas Commission on Environmental Quality	2017	Proposed	https://www.tceq.texas.gov/assets/public/remediation/trrp/2017%20Protective Concentration Level (PCL)%20Tables%20March31.pdf
USA	Texas	Groundwater		10000000	28000	170000	88000	21000000	28000	28000	170000	88000	88000	110000	88000	88000	88000	88000	88000		Risk-Based Exposure Limits - Commercial, Class 3 Groundwater	ng/L	Texas Commission on Environmental Quality	2017	Proposed	https://www.tceq.texas.gov/assets/public/remediation/trrp/2017%20Protective Concentration Level (PCL)%20Tables%20March31.pdf
USA	Texas	Groundwater		100000	280	1700	880	210000	280	280	1700	880	880	1100	880	880	880	880	880		Risk-Based Exposure Limits - Commercial, Ingestion	ng/L	Texas Commission on Environmental Quality	2017	Proposed	https://www.tceq.texas.gov/assets/public/remediation/trrp/2017%20Protective Concentration Level (PCL)%20Tables%20March31.pdf
USA	Texas	Groundwater		3400000	9300	56000	29000	7100000	9300	9300	56000	29000	29000	37000	29000	29000	29000	29000	29000		Risk-Based Exposure Limits - Residential, Class 3 Groundwater	ng/L	Texas Commission on Environmental Quality	2017	Proposed	https://www.tceq.texas.gov/assets/public/remediation/trrp/2017%20Protective Concentration Level (PCL)%20Tables%20March31.pdf
USA	Texas	Groundwater		34000	93	560	290	71000	93	93	560	290	290	370	290	290	290	290	290		Risk-Based Exposure Limits - Residential, Ingestion	ng/L	Texas Commission on Environmental Quality	2017	Proposed	https://www.tceq.texas.gov/assets/public/remediation/trrp/2017%20Protective Concentration Level (PCL)%20Tables%20March31.pdf

* Values in parentheses are regulated as a summation of two or more PFASs

[1] Promulgated in this table means there is a regulation or advisory value, but it may not meet the definition of promulgated under CERCLA

Acronyms and Abbreviations:

ng/L = nanograms per liter
N/A = not applicable
DEC = Department of Environmental Conservation
DEP = Division of Environmental Protection
DEQ = Department of Environmental Quality
EPA = U.S. Environmental Protection Agency
IDEM = Department of Environmental Management
HAL = Health Advisory Level
MCL = Maximum Contaminant Level
MDH = Minnesota Department of Health
MTGW = Migration to Groundwater
OLQ = Office of Land Quality
PCL = Protective Concentration Level
PFAS = per- and polyfluoroalkyl substance
PFBA = perfluorobutanoic acid or perfluorobutanoate
PFBS = perfluorobutanesulfonic acid or perfluorobutanesulfonate
PFDA = perfluorodecanoic acid or perfluorodecanoate
PFDoA = perfluorododecanoic acid or perfluorododecanoate
PFDS = perfluorodecanesulfonic acid or perfluorodecanesulfonate
PFHpA = perfluoroheptanoic acid or perfluoroheptanoate
PFHxA = perfluorohexanoic acid or perfluorohexanoate
PFHxS = perfluorohexanesulfonic acid or perfluorohexanesulfonate
PFNA = perfluorononoic acid or perfluorononoate
PFOA = perfluorooctanoic acid or perfluorooctanoate
PFOS = perfluorooctanesulfonic acid or perfluorooctanesulfonate
PFOSA = perfluorooctane sulfonamide
PFPeA = perfluoropentanoic acid or perfluoropentanoate
PFTeDA = perfluorotetradecanoic acid or perfluorotetradecanoate
PFTrDA = perfluorotridecanoic acid or perfluorotridecanoate
PFUA = perfluoroundecanoic acid or perfluoroundecanoate
PSRG = Preliminary Soil Remediation Goal
RBEL = Risk-Based Exposure Limit
RCL = Residual Contaminant Level
RSL = Risk-Based Screening Level

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Appendix C

Analytical Laboratory Quality Assurance Plans and SOPs

SCOPE OF ACCREDITATION TO ISO/IEC 17025:2005

EUROFINS LANCASTER LABORATORIES ENVIRONMENTAL LLC
2425 New Holland Pike
Lancaster, PA 17601
Dorothy M. Love Phone: 717-556-7327

ENVIRONMENTAL

Valid To: November 30, 2018 Certificate Number: 0001.01

In recognition of the successful completion of the A2LA evaluation process (including an assessment of the laboratory's compliance with ISO IEC 17025:2005, the 2009 TNI Environmental Testing Laboratory Standard, and the requirements of the DoD Environmental Laboratory Accreditation Program (DoD ELAP) as detailed in version 5.0 of the DoD Quality Systems Manual for Environmental Laboratories, accreditation is granted to this laboratory to perform recognized EPA methods using the following testing technologies and in the analyte categories identified below:

Testing Technologies

Atomic Absorption/ICP-AES Spectrometry, ICP-MS Spectrometry, Gas Chromatography, Gas Chromatography/Mass Spectrometry, Gravimetry, High Performance Liquid Chromatography, Ion Chromatography, Misc.-Electronic Probes (pH, F^-, O_2), Oxygen Demand, Spectrophotometry (Visible), Spectrophotometry (Automated), Titrimetry, TCLP, Total Organic Carbon, Turbidity, Liquid Chromatography/Mass Spectrometry/Mass Spectrometry, High Resolution Gas Chromatography/Mass Spectrometry

Parameter/Analyte	**Tissue**	**Air**	**Nonpotable Water (*DW)**	**Solid Hazardous Waste**	
				Aqueous	**Solid**
Demands					
BOD	---------------	----------	SM 5210B-2001	---------------	---------------
CBOD	---------------	----------	SM 5210B-2001	---------------	---------------
COD	---------------	----------	EPA 410.4	---------------	---------------
Total carbon	---------------	----------	---------------	SM 5310C-2000	SM 5310B-2000 MOD
Total inorganic carbon	---------------	----------	---------------	SM 5310C-2000	SM 5310B-2000 MOD

Parameter/Analyte	**Tissue**	**Air**	**Nonpotable Water (*DW)**	**Solid Hazardous Waste**	
				Aqueous	**Solid**
Total organic carbon	---------------	----------	EPA 415.1 EPA 9060 EPA 9060A SM 5310C-2000	EPA 9060 EPA 9060A SM 5310C-2000	EPA 9060 EPA 9060A SM 5310B MOD
Nutrients					
Ammonia	---------------	-----------	EPA 350.1 SM 4500 NH3 B & D-1997	---------------	EPA 350.1
Fluoride	---------------	-----------	SM 4500 FC-1997 EPA 300.0 EPA 340.2 EPA 9056 EPA 9056A	EPA 9056 EPA 9056A	EPA 300.0
Nitrate (as N)	---------------	----------	EPA 300.0 EPA 9056 EPA 9056A	EPA 9056 EPA 9056A	EPA 300.0
Nitrite (as N)	---------------	-----------	EPA 300.0 EPA 9056 EPA 9056A	EPA 9056 EPA 9056A	EPA 300.0
Nitrate/Nitrite	---------------	-----------	EPA 353.2	---------------	----------------
Orthophosphate (as P)	---------------	-----------	EPA 365.3	---------------	----------------
Total kjeldahl nitrogen	---------------	-----------	EPA 351.2	---------------	EPA 351.2
Total phosphorus	---------------	-----------	EPA 365.1	---------------	EPA 365.1
Wet Chemistry					
Acid volatile sulfide	---------------	-----------	---------------	---------------	EPA-821-R-91-100
Acidity	---------------	-----------	SM 2310B-1997	---------------	---------------
Alkalinity	---------------	-----------	SM 2320B-1997	---------------	---------------
Bromide	---------------	-----------	EPA 300.0 EPA 9056 EPA 9056A	EPA 9056 EPA 9056A	---------------
Bulk density	---------------	-----------	---------------	ASTM E868-82	ASTM E868-82
Chloride	---------------	-----------	EPA 300.0 EPA 325.3 EPA 9056 EPA 9056A	EPA 9056 EPA 9056A	EPA 300.0
Color	---------------	-----------	SM 2120B-2001	---------------	---------------
Corrosivity	---------------	-----------	---------------	SW-846 Chapter 7	SW-846 Chapter 7

Parameter/Analyte	**Tissue**	**Air**	**Nonpotable Water (*DW)**	**Solid Hazardous Waste**	
				Aqueous	**Solid**
Cyanide	EPA 9012A EPA 9012B	-----------	EPA 335.2 EPA 335.4 MOD EPA 9012A EPA 9012B ASTM D7511 OIA-1677-09	EPA 9012A EPA 9012B ASTM D7511 OIA-1677-09	EPA 9012A EPA 9012B
Dissolved oxygen	---------------	-----------	SM 4500 OG-2001	---------------	---------------
Dissolved silica	---------------	-----------	EPA 370.1 SM 4500 SiC-1997	---------------	---------------
Ferrous Iron	---------------	----------	SM 3500Fe B-MOD 1997	---------------	---------------
Filterable residue	---------------	----------	SM 2540C-1997	---------------	---------------
Flashpoint	---------------	----------	---------------	EPA1010A	EPA 1010A
Grain size	---------------	----------	---------------	---------------	ASTM D422
Hardness	---------------	----------	SM 2340C-1997	---------------	---------------
HEM-SGT	---------------	----------	EPA 1664A EPA 1664B	---------------	EPA 9071B
Hexavalent chromium digestion	EPA 3060A	----------	---------------	---------------	EPA 3060A
Hexavalent chromium	EPA 7196A	----------	SM 3500 CrB-2009 EPA 218.6 EPA 7196A EPA 7199	EPA 218.6 EPA 7196A EPA 7199	EPA 7196A EPA 7199
Ignitability	---------------	----------	---------------	40 CFR 261.21	40 CFR 261.21
Non-filterable residue	---------------	----------	EPA 160.2 SM 2540D-1997	---------------	---------------
Oxidation reduction potential	---------------	----------	ASTM D1498	ASTM D1498	ASTM D1498
Paint filter test	---------------	----------	EPA 9095A	EPA 9095A	EPA 9095A
pH	---------------	----------	SM 4500 H+B-2000 EPA 150.1 EPA 9040B EPA 9040C	EPA 9040B EPA 9040C EPA 9045C EPA 9045D	EPA 9040B EPA 9040C EPA 9045C EPA 9045D
Phenol	---------------	----------	EPA 420.4 EPA 9066	EPA 9066	---------------
Reactivity	---------------	----------	---------------	SW-846 Chapter 7.3	SW-846 Chapter 7.3
Settleable residue	---------------	----------	SM 2540F-1997	---------------	---------------
Specific conductance	---------------	----------	EPA 120.1 SM 2510B-1997 EPA 9050A	EPA 9050A	---------------

Parameter/Analyte	**Tissue**	**Air**	**Nonpotable Water (*DW)**	**Solid Hazardous Waste**	
				Aqueous	**Solid**
Sulfate	---------------	----------	EPA 300.0 EPA 375.4 EPA 9056 EPA 9056A	EPA 9056 EPA 9056A	EPA 300.0
Sulfide	---------------	----------	EPA 376.1 EPA 376.2 SM 4500 S2D-2000 SM 4500 S2F-2000	---------------	---------------
Surfactants	---------------	----------	SM 5540C-2000	---------------	---------------
Total filterable residue	---------------	----------	SM 2540C-1997	---------------	---------------
Total residue	---------------	----------	EPA 160.3 SM 2540B-1997	---------------	---------------
Total fixed and total volatile solids, Dissolved fixed and dissolved volatile solids, Suspended fixed and Suspended volatile solids	---------------	----------	SM 2540 E-1997	---------------	---------------
Turbidity	---------------	----------	EPA 180.1 SM 2130 B-2001	---------------	---------------
Volatile residue	---------------	----------	EPA 160.4	---------------	---------------
Metals					
Metals digestion	EPA 3050B	EPA 3050B	EPA 200.2 EPA 3050B EPA 3005A EPA 3010A EPA 3010A MOD EPA 3020	EPA 3050B EPA 3010A EPA 3010A MOD EPA 3020	EPA 3050B
Aluminum	EPA 6010B EPA 6010C EPA 6020 EPA 6020A	----------	EPA 200.7 EPA 200.8 EPA 6010B EPA 6010C EPA 6010D EPA 6020 EPA 6020A EPA 6020B	EPA 6010B EPA 6010C EPA 6010D EPA 6020 EPA 6020A EPA 6020B	EPA 6010B EPA 6010C EPA 6010D EPA 6020 EPA 6020A EPA 6020B
Antimony	EPA 6010B EPA 6010C EPA 6020 EPA 6020A	EPA 200.8 MOD EPA 6020 EPA 6020A	EPA 200.7 EPA 200.8 EPA 6010B EPA 6010C EPA 6010D EPA 6020 EPA 6020A EPA 6020B	EPA 6010B EPA 6010C EPA 6010D EPA 6020 EPA 6020A EPA 6020B	EPA 6010B EPA 6010C EPA 6010D EPA 6020 EPA 6020A EPA 6020B

Parameter/Analyte	**Tissue**	**Air**	**Nonpotable Water (*DW)**	**Solid Hazardous Waste**	
				Aqueous	**Solid**
Arsenic	EPA 6010B EPA 6010C EPA 6020 EPA 6020A	EPA 200.8 MOD EPA 6020 EPA 6020A	EPA 200.7 EPA 200.8 EPA 6010B EPA 6010C EPA 6010D EPA 6020 EPA 6020A EPA 6020B	EPA 6010B EPA 6010C EPA 6010D EPA 6020 EPA 6020A EPA 6020B	EPA 6010B EPA 6010C EPA 6010D EPA 6020 EPA 6020A EPA 6020B
Barium	EPA 6010B EPA 6010C EPA 6020 EPA 6020A	----------	EPA 200.7 EPA 200.8 EPA 6010B EPA 6010C EPA 6010D EPA 6020 EPA 6020A EPA 6020B	EPA 6010B EPA 6010C EPA 6010D EPA 6020 EPA 6020A EPA 6020B	EPA 6010B EPA 6010C EPA 6010D EPA 6020 EPA 6020A EPA 6020B
Beryllium	EPA 6010B EPA 6010C EPA 6020 EPA 6020A	EPA 200.8 MOD EPA 6020 EPA 6020A	EPA 200.7 EPA 200.8 EPA 6010B EPA 6010C EPA 6010D EPA 6020 EPA 6020A EPA 6020B	EPA 6010B EPA 6010C EPA 6010D EPA 6020 EPA 6020A EPA 6020B	EPA 6010B EPA 6010C EPA 6010D EPA 6020 EPA 6020A EPA 6020B
Boron	EPA 6010B EPA 6010C	----------	EPA 200.7 EPA 6010B EPA 6010C EPA 6010D	EPA 6010B EPA 6010C EPA 6010D	EPA 6010B EPA 6010C EPA 6010D
Cadmium	EPA 6010B EPA 6010C EPA 6020 EPA 6020A	EPA 200.8 MOD EPA 6020 EPA 6020A	EPA 200.7 EPA 200.8 EPA 6010B EPA 6010C EPA 6010D EPA 6020 EPA 6020A EPA 6020B	EPA 6010B EPA 6010C EPA 6010D EPA 6020 EPA 6020A EPA 6020B	EPA 6010B EPA 6010C EPA 6010D EPA 6020 EPA 6020A EPA 6020B
Calcium	EPA 6010B EPA 6010C EPA 6020 EPA 6020A	----------	EPA 200.7 EPA 200.8 EPA 6010B EPA 6010C EPA 6010D EPA 6020 EPA 6020A EPA 6020B	EPA 6010B EPA 6010C EPA 6010D EPA 6020 EPA 6020A EPA 6020B	EPA 6010B EPA 6010C EPA 6010D EPA 6020 EPA 6020A EPA 6020B

Parameter/Analyte	**Tissue**	**Air**	**Nonpotable Water (*DW)**	**Solid Hazardous Waste**	
				Aqueous	**Solid**
Chromium	EPA 6010B EPA 6010C EPA 6020 EPA 6020A	EPA 200.8 MOD EPA 6020 EPA 6020A	EPA 200.7 EPA 200.8 EPA 6010B EPA 6010C EPA 6010D EPA 6020 EPA 6020A EPA 6020B	EPA 6010B EPA 6010C EPA 6010D EPA 6020 EPA 6020A EPA 6020B	EPA 6010B EPA 6010C EPA 6010D EPA 6020 EPA 6020A EPA 6020B
Cobalt	EPA 6010B EPA 6010C EPA 6020 EPA 6020A	----------	EPA 200.7 EPA 200.8 EPA 6010B EPA 6010C EPA 6010D EPA 6020 EPA 6020A EPA 6020B	EPA 6010B EPA 6010C EPA 6010D EPA 6020 EPA 6020A EPA 6020B	EPA 6010B EPA 6010C EPA 6010D EPA 6020 EPA 6020A EPA 6020B
Copper	EPA 6010B EPA 6010C EPA 6020 EPA 6020A	----------	EPA 200.7 EPA 200.8 EPA 6010B EPA 6010C EPA 6010D EPA 6020 EPA 6020A EPA 6020B	EPA 6010B EPA 6010C EPA 6010D EPA 6020 EPA 6020A EPA 6020B	EPA 6010B EPA 6010C EPA 6010D EPA 6020 EPA 6020A EPA 6020B
Iron	EPA 6010B EPA 6010C EPA 6020 EPA 6020A	----------	EPA 200.7 EPA 200.8 EPA 6010B EPA 6010C EPA 6010D EPA 6020 EPA 6020A EPA 6020B	EPA 6010B EPA 6010C EPA 6010D EPA 6020 EPA 6020A EPA 6020B	EPA 6010B EPA 6010C EPA 6010D EPA 6020 EPA 6020A EPA 6020B
Lead	EPA 6010B EPA 6010C EPA 6020 EPA 6020A	EPA 200.8 MOD EPA 6020 EPA 6020A	EPA 200.7 EPA 200.8 EPA 6010B EPA 6010C EPA 6010D EPA 6020 EPA 6020A EPA 6020B	EPA 6010B EPA 6010C EPA 6010D EPA 6020 EPA 6020A EPA 6020B	EPA 6010B EPA 6010C EPA 6010D EPA 6020 EPA 6020A EPA 6020B
Lithium	--------------	----------	EPA 6010B EPA 6010C EPA 6010D	EPA 6010B EPA 6010C EPA 6010D	EPA 6010B EPA 6010C EPA 6010D

Parameter/Analyte	**Tissue**	**Air**	**Nonpotable Water (*DW)**	**Solid Hazardous Waste**	
				Aqueous	**Solid**
Molybdenum	EPA 6010B EPA 6010C EPA 6020 EPA 6020A	----------	EPA 200.7 EPA 200.8 EPA 6010B EPA 6010C EPA 6010D EPA 6020 EPA 6020A EPA 6020B	EPA 6010B EPA 6010C EPA 6010D EPA 6020 EPA 6020A EPA 6020B	EPA 6010B EPA 6010C EPA 6010D EPA 6020 EPA 6020A EPA 6020B
Magnesium	EPA 6010B EPA 6010C EPA 6020 EPA 6020A	----------	EPA 200.7 EPA 200.8 EPA 6010B EPA 6010C EPA 6010D EPA 6020 EPA 6020A EPA 6020B	EPA 6010B EPA 6010C EPA 6010D EPA 6020 EPA 6020A EPA 6020B	EPA 6010B EPA 6010C EPA 6010D EPA 6020 EPA 6020A EPA 6020B
Manganese	EPA 6010B EPA 6010C EPA 6020 EPA 6020A	EPA 200.8 MOD EPA 6020 EPA 6020A	EPA 200.7 EPA 200.8 EPA 6010B EPA 6010C EPA 6010D EPA 6020 EPA 6020A EPA 6020B	EPA 6010B EPA 6010C EPA 6010D EPA 6020 EPA 6020A EPA 6020B	EPA 6010B EPA 6010C EPA 6010D EPA 6020 EPA 6020A EPA 6020B
Mercury	EPA 7471A EPA 7471B	----------	EPA 245.1 EPA 7470A	EPA 7470A	EPA 7471A EPA 7471B
Nickel	EPA 6010B EPA 6010C EPA 6020 EPA 6020A	EPA 200.8 MOD EPA 6020 EPA 6020A	EPA 200.7 EPA 200.8 EPA 6010B EPA 6010C EPA 6010D EPA 6020 EPA 6020A EPA 6020B	EPA 6010B EPA 6010C EPA 6010D EPA 6020 EPA 6020A EPA 6020B	EPA 6010B EPA 6010C EPA 6010D EPA 6020 EPA 6020A EPA 6020B
Potassium	EPA 6010B EPA 6010C EPA 6020 EPA 6020A	----------	EPA 200.7 EPA 200.8 EPA 6010B EPA 6010C EPA 6010D EPA 6020 EPA 6020A EPA 6020B	EPA 6010B EPA 6010C EPA 6010D EPA 6020 EPA 6020A EPA 6020B	EPA 6010B EPA 6010C EPA 6010D EPA 6020 EPA 6020A EPA 6020B

Parameter/Analyte	**Tissue**	**Air**	**Nonpotable Water (*DW)**	**Solid Hazardous Waste**	
				Aqueous	**Solid**
Selenium	EPA 6010B EPA 6010C EPA 6020 EPA 6020A	----------	EPA 200.7 EPA 200.8 EPA 6010B EPA 6010C EPA 6010D EPA 6020 EPA 6020A EPA 6020B	EPA 6010B EPA 6010C EPA 6010D EPA 6020 EPA 6020A EPA 6020B	EPA 6010B EPA 6010C EPA 6010D EPA 6020 EPA 6020A EPA 6020B
Silicon	---------------	----------	EPA 6010B EPA 6010C EPA 6010D	EPA 6010B EPA 6010C EPA 6010D	EPA 6010B EPA 6010C EPA 6010D
Silver	EPA 6010B EPA 6010C EPA 6020 EPA 6020A	----------	EPA 200.7 EPA 200.8 EPA 6010B EPA 6010C EPA 6010D EPA 6020 EPA 6020A EPA 6020B	EPA 6010B EPA 6010C EPA 6010D EPA 6020 EPA 6020A EPA 6020B	EPA 6010B EPA 6010C EPA 6010D EPA 6020 EPA 6020A EPA 6020B
Sodium	EPA 6010B EPA 6010C EPA 6020 EPA 6020A	----------	EPA 200.7 EPA 200.8 EPA 6010B EPA 6010C EPA 6010D EPA 6020 EPA 6020A EPA 6020B	EPA 6010B EPA 6010C EPA 6010D EPA 6020 EPA 6020A EPA 6020B	EPA 6010B EPA 6010C EPA 6010D EPA 6020 EPA 6020A EPA 6020B
Strontium	EPA 6010B EPA 6010C EPA 6020 EPA 6020A	----------	EPA 200.7 EPA 200.8 EPA 6010B EPA 6010C EPA 6010D EPA 6020 EPA 6020A EPA 6020B	EPA 6010B EPA 6010C EPA 6010D EPA 6020 EPA 6020A EPA 6020B	EPA 6010B EPA 6010C EPA 6010D EPA 6020 EPA 6020A EPA 6020B
Thallium	EPA 6010B EPA 6010C EPA 6020 EPA 6020A	----------	EPA 200.7 EPA 200.8 EPA 6010B EPA 6010C EPA 6010D EPA 6020 EPA 6020A EPA 6020B	EPA 6010B EPA 6010C EPA 6010D EPA 6020 EPA 6020A EPA 6020B	EPA 6010B EPA 6010C EPA 6010D EPA 6020 EPA 6020A EPA 6020B
Tin	EPA 6010B EPA 6010C	-----------	EPA 200.7 EPA 6010B EPA 6010C EPA 6010D	EPA 6010B EPA 6010C EPA 6010D	EPA 6010B EPA 6010C EPA 6010D

Parameter/Analyte	**Tissue**	**Air**	**Nonpotable Water (*DW)**	**Solid Hazardous Waste**	
				Aqueous	**Solid**
Titanium	---------------	-----------	EPA 200.7 EPA 6010B EPA 6010C EPA 6010D	EPA 6010B EPA 6010C EPA 6010D	EPA 6010B EPA 6010C EPA 6010D
Tungsten	---------------	-----------	EPA 200.7 EPA 6010B EPA 6010C EPA 6010D	EPA 6010B EPA 6010C EPA 6010D	EPA 6010B EPA 6010C EPA 6010D
Uranium	---------------	-----------	EPA 200.8 EPA 6020 EPA 6020A EPA 6020B	EPA 6020 EPA 6020A EPA 6020B	EPA 6020 EPA 6020A EPA 6020B
Vanadium	EPA 6010B EPA 6010C EPA 6020 EPA 6020A	EPA 200.8 MOD EPA 6020 EPA 6020A	EPA 200.7 EPA 200.8 EPA 6010B EPA 6010C EPA 6010D EPA 6020 EPA 6020A EPA 6020B	EPA 6010B EPA 6010C EPA 6010D EPA 6020 EPA 6020A EPA 6020B	EPA 6010B EPA 6010C EPA 6010D EPA 6020 EPA 6020A EPA 6020B
Zinc	EPA 6010B EPA 6010C EPA 6020 EPA 6020A	EPA 200.8 MOD EPA 6020 EPA 6020A	EPA 200.7 EPA 200.8 EPA 6010B EPA 6010C EPA 6010D EPA 6020 EPA 6020A EPA 6020B	EPA 6010B EPA 6010C EPA 6010D EPA 6020 EPA 6020A EPA 6020B	EPA 6010B EPA 6010C EPA 6010D EPA 6020 EPA 6020A EPA 6020B
Zirconium	---------------	-----------	EPA 200.7 EPA 6010B EPA 6010C EPA 6010D	EPA 6010B EPA 6010C EPA 6010D	EPA 6010B EPA 6010C EPA 6010D
Purgeable Organics (Volatiles)					
Volatile preparation	---------------	----------	EPA 5030A EPA 5030B	EPA 5030A EPA 5030B	EPA 5035 EPA 5035A
Acetone	---------------	EPA TO-15	EPA 624 EPA 8260B EPA 8260C EPA 524.2 (DW) EPA 6200B	EPA 8260B EPA 8260C	EPA 8260B EPA 8260C
Acetonitrile	---------------	EPA TO-15	EPA 624 EPA 8260B EPA 8260C	EPA 8260B EPA 8260C	EPA 8260B EPA 8260C

Parameter/Analyte	**Tissue**	**Air**	**Nonpotable Water (*DW)**	**Solid Hazardous Waste**	
				Aqueous	**Solid**
Acrolein	---------------	EPA TO-15	EPA 624 EPA 8260B EPA 8260C EPA 524.2 (DW)	EPA 8260B EPA 8260C	EPA 8260B EPA 8260C
Acrylonitrile	---------------	EPA TO-15 EPA TO-15 SIM	EPA 624 EPA 8260B EPA 8260C EPA 524.2 (DW)	EPA 8260B EPA 8260C	EPA 8260B EPA 8260C
Alpha methyl styrene	---------------	EPA TO-15	---------------	---------------	---------------
Allyl chloride	---------------	EPA TO-15	EPA 624 EPA 8260B EPA 8260C EPA 524.2 (DW)	EPA 8260B EPA 8260C	EPA 8260B EPA 8260C
Tert-amyl alcohol	---------------	---------	------------------	---------------	EPA 8260B EPA 8260C
Tert-Amyl methyl ether	---------------	EPA TO-15	EPA 624 EPA 8260B EPA 8260C EPA 524.2 (DW) EPA 6200B	EPA 8260B EPA 8260C	EPA 8260B EPA 8260C
Tert-butyl alcohol	---------------	EPA TO-15	EPA 624 EPA 8260B EPA 8260C EPA 524.2 (DW) EPA 6200B	EPA 8260B EPA 8260C	EPA 8260B EPA 8260C
Tert-butyl Formate	--------------	---------	-----------------	----------------	EPA 8260B EPA 8260C
Benzene	---------------	EPA TO-15 EPA TO-15 SIM EPA 18 mod EPA 25 mod	EPA 602 EPA 624 EPA 8021B EPA 8260B EPA 8260C EPA 524.2 (DW) EPA 6200B OA-1	EPA 8021B EPA 8260B EPA 8260C OA-1	EPA 8021B EPA 8260B EPA 8260C OA-1
Benzyl chloride	---------------	EPA TO-15	---------------	---------------	---------------
Bromobenzene	---------------	EPA TO-15	EPA 624 EPA 8260B EPA 8260C EPA 524.2 (DW) EPA 6200B	EPA 8260B EPA 8260C	EPA 8260B EPA 8260C
Bromochloromethane	---------------	-----------	EPA 8260B EPA 8260C EPA 524.2 (DW) EPA 6200B	EPA 8260B EPA 8260C	EPA 8260B EPA 8260C

Parameter/Analyte	**Tissue**	**Air**	**Nonpotable Water (*DW)**	**Solid Hazardous Waste**	
				Aqueous	**Solid**
Bromodichloromethane	---------------	EPA TO-15 EPA TO-15 SIM	EPA 624 EPA 8260B EPA 8260C EPA 524.2 (DW) EPA 6200B	EPA 8260B EPA 8260C	EPA 8260B EPA 8260C
Bromoethene	---------------	EPA TO-15	---------------	---------------	---------------
Bromoform	---------------	EPA TO-15	EPA 624 EPA 8260B EPA 8260C EPA 524.2 (DW) EPA 6200B	EPA 8260B EPA 8260C	EPA 8260B EPA 8260C
Bromomethane	---------------	EPA TO-15	EPA 624 EPA 8260B EPA 8260C EPA 524.2 (DW) EPA 6200B	EPA 8260B EPA 8260C	EPA 8260B EPA 8260C
Butane	--------------	EPA 18 mod EPA 25 mod	------------------	------------------	---------------
1,3-Butadiene	---------------	EPA TO-15 EPA TO-15 SIM	------------------	------------------	---------------
2-Butanone	---------------	EPA TO-15	EPA 624 EPA 8260B EPA 8260C EPA 524.2 (DW) EPA 6200B	EPA 8260B EPA 8260C	EPA 8260B EPA 8260C
n-Butylbenzene	---------------	EPA TO-15	EPA 624 EPA 8260B EPA 8260C EPA 524.2 (DW) EPA 6200B	EPA 8260B EPA 8260C	EPA 8260B EPA 8260C
sec-Butylbenzene	---------------	EPA TO-15	EPA 624 EPA 8260B EPA 8260C EPA 524.2 (DW) EPA 6200B	EPA 8260B EPA 8260C	EPA 8260B EPA 8260C
tert-Butylbenzene	---------------	EPA TO-15	EPA 624 EPA 8260B EPA 8260C EPA 524.2 (DW) EPA 6200B	EPA 8260B EPA 8260C	EPA 8260B EPA 8260C

Parameter/Analyte	**Tissue**	**Air**	**Nonpotable Water (*DW)**	**Solid Hazardous Waste**	
				Aqueous	**Solid**
Carbon disulfide	---------------	EPA TO-15	EPA 624 EPA 8260B EPA 8260C EPA 524.2 (DW)	EPA 8260B EPA 8260C	EPA 8260B EPA 8260C
Carbon tetrachloride	---------------	EPA TO-15 EPA TO-15 SIM	EPA 624 EPA 8260B EPA 8260C EPA 524.2 (DW) EPA 6200B	EPA 8260B EPA 8260C	EPA 8260B EPA 8260C
2-Chloro-1,3-butadiene	---------------	-----------	EPA 624 EPA 8260B EPA 8260C	EPA 8260B EPA 8260C	EPA 8260B EPA 8260C
Chloroacetonitrile	---------------	-----------	EPA 8260B EPA 8260C EPA 524.2 (DW)	EPA 8260B EPA 8260C	EPA 8260B EPA 8260C
Chlorobenzene	---------------	EPA TO-15	EPA 624 EPA 8260B EPA 8260C EPA 524.2 (DW) EPA 6200B	EPA 8260B EPA 8260C	EPA 8260B EPA 8260C
1-Chlorobutane	---------------	-----------	EPA 8260B EPA 8260C EPA 524.2 (DW)	EPA 8260B EPA 8260C	EPA 8260B EPA 8260C
Chlorodifluoromethane	---------------	EPA TO-15	------------------	---------------	---------------
Chloroethane	---------------	EPA TO-15 EPA TO-15 SIM	EPA 624 EPA 8260B EPA 8260C EPA 524.2 (DW) EPA 6200B	EPA 8260B EPA 8260C	EPA 8260B EPA 8260C
2-Chloroethyl vinyl ether	---------------	-----------	EPA 624 EPA 8260B EPA 8260C	EPA 8260B EPA 8260C	EPA 8260B EPA 8260C
Carbon range organics C1-C10 (including subsets of this range i.e. hydrocarbons as propane, hydrocarbons as methane, hydrocarbons as hexane)	---------------	EPA 18 mod EPA 25 mod	------------------	----------------	--------------
Chloroform	---------------	EPA TO-15 EPA TO-15 SIM	EPA 624 EPA 8260B EPA 8260C EPA 524.2 (DW) EPA 6200B	EPA 8260B EPA 8260C	EPA 8260B EPA 8260C

Parameter/Analyte	**Tissue**	**Air**	**Nonpotable Water (*DW)**	**Solid Hazardous Waste**	
				Aqueous	**Solid**
Chloromethane	---------------	EPA TO-15 EPA TO-15 SIM	EPA 624 EPA 8260B EPA 8260C EPA 524.2 (DW) EPA 6200B	EPA 8260B EPA 8260C	EPA 8260B EPA 8260C
3-Chloroprene	---------------	EPA TO-15	------------------	---------------	---------------
2-Chlorotoluene	---------------	EPA TO-15	EPA 624 EPA 8260B EPA 8260C EPA 524.2 (DW) EPA 6200B	EPA 8260B EPA 8260C	EPA 8260B EPA 8260C
4-Chlorotoluene	---------------	-----------	EPA 624 EPA 8260B EPA 8260C EPA 524.2 (DW) EPA 6200B	EPA 8260B EPA 8260C	EPA 8260B EPA 8260C
Cyclohexane	---------------	EPA TO-15	EPA 624 EPA 8260B EPA 8260C	EPA 8260B EPA 8260C	EPA 8260B EPA 8260C
Di-Isopropyl ether	---------------	EPA TO-15	EPA 624 EPA 8260B EPA 8260C EPA 524.2 (DW) EPA 6200B	EPA 8260B EPA 8260C	EPA 8260B EPA 8260C
Dibromochloromethane	---------------	EPA TO-15	EPA 624 EPA 8260B EPA 8260C EPA 524.2 (DW) EPA 6200B	EPA 8260B EPA 8260C	EPA 8260B EPA 8260C
1,2-Dibromo-3-chloropropane	---------------	EPA TO-15 EPA TO-15 SIM	EPA 624 EPA 8011 EPA 8260B EPA 8260C EPA 524.2 (DW)	EPA 8011 EPA 8260B EPA 8260C	EPA 8260B EPA 8260C
Dibromomethane	---------------	EPA TO-15	EPA 624 EPA 8260B EPA 8260C EPA 524.2 (DW)	EPA 8260B EPA 8260C	EPA 8260B EPA 8260C
1,2-Dibromoethane (EDB)	---------------	EPA TO-15 EPA TO-15 SIM	EPA 624 EPA 8011 EPA 8260B EPA 8260C EPA 524.2 (DW) EPA 6200B	EPA 8011 EPA 8260B EPA 8260C	EPA 8260B EPA 8260C

Parameter/Analyte	Tissue	Air	Nonpotable Water (*DW)	Solid Hazardous Waste	
				Aqueous	Solid
1,2-Dichlorobenzene	---------------	EPA TO-15 EPA TO-15 SIM	EPA 624 EPA 8260B EPA 8260C EPA 524.2 (DW) EPA 6200B	EPA 8260B EPA 8260C	EPA 8260B EPA 8260C
1,3-Dichlorobenzene	---------------	EPA TO-15 EPA TO-15 SIM	EPA 624 EPA 8260B EPA 8260C EPA 524.2 (DW) EPA 6200B	EPA 8260B EPA 8260C	EPA 8260B EPA 8260C
1,4-Dichlorobenzene	---------------	EPA TO-15 EPA TO-15 SIM	EPA 624 EPA 8260B EPA 8260C EPA 524.2 (DW) EPA 6200B	EPA 8260B EPA 8260C	EPA 8260B EPA 8260C
trans-1,4-dichloro-2-butene	---------------	---------	EPA 624 EPA 8260B EPA 8260C EPA 524.2 (DW)	EPA 8260B EPA 8260C	EPA 8260B EPA 8260C
Dichlorodifluoromethane	---------------	EPA TO-15 EPA TO-15 SIM	EPA 624 EPA 8260B EPA 8260C EPA 524.2 (DW) EPA 6200B	EPA 8260B EPA 8260C	EPA 8260B EPA 8260C
1,1-Dichloroethane	---------------	EPA TO-15 EPA TO-15 SIM	EPA 624 EPA 8260B EPA 8260C EPA 524.2 (DW) EPA 6200B	EPA 8260B EPA 8260C	EPA 8260B EPA 8260C
1,2-Dichloroethane	---------------	EPA TO-15 EPA TO-15 SIM	EPA 624 EPA 8260B EPA 8260C EPA 524.2 (DW) EPA 6200B	EPA 8260B EPA 8260C	EPA 8260B EPA 8260C
1,1-Dichloroethene	---------------	EPA TO-15 EPA TO-15 SIM	EPA 624 EPA 8260B EPA 8260C EPA 524.2 (DW) EPA 6200B	EPA 8260B EPA 8260C	EPA 8260B EPA 8260C
cis-1,2-Dichloroethene	---------------	EPA TO-15 EPA TO-15 SIM	EPA 624 EPA 8260B EPA 8260C EPA 524.2 (DW) EPA 6200B	EPA 8260B EPA 8260C	EPA 8260B EPA 8260C

Parameter/Analyte	**Tissue**	**Air**	**Nonpotable Water (*DW)**	**Solid Hazardous Waste**	
				Aqueous	**Solid**
trans-1,2-Dichloroethene	---------------	EPA TO-15 EPA TO-15 SIM	EPA 624 EPA 8260B EPA 8260C EPA 524.2 (DW) EPA 6200B	EPA 8260B EPA 8260C	EPA 8260B EPA 8260C
Dichlorofluoromethane	---------------	EPA TO-15	EPA 524.2 (DW)	---------------	---------------
1,2-Dichloropropane	---------------	EPA TO-15 EPA TO-15 SIM	EPA 624 EPA 8260B EPA 8260C EPA 524.2 (DW) EPA 6200B	EPA 8260B EPA 8260C	EPA 8260B EPA 8260C
1,3-Dichloropropane	---------------	-----------	EPA 624 EPA 8260B EPA 8260C EPA 524.2 (DW) EPA 6200B	EPA 8260B EPA 8260C	EPA 8260B EPA 8260C
2,2-Dichloropropane	---------------	-----------	EPA 624 EPA 8260B EPA 8260C EPA 524.2 (DW) EPA 6200B	EPA 8260B EPA 8260C	EPA 8260B EPA 8260C
1,1-Dichloropropanone	---------------	-----------	EPA 524.2 (DW)	---------------	---------------
1,1-Dichloropropene	---------------	-----------	EPA 624 EPA 8260B EPA 8260C EPA 524.2 (DW) EPA 6200B	EPA 8260B EPA 8260C	EPA 8260B EPA 8260C
cis-1,3-Dichloropropene	---------------	EPA TO-15	EPA 624 EPA 8260B EPA 8260C EPA 524.2 (DW) EPA 6200B	EPA 8260B EPA 8260C	EPA 8260B EPA 8260C
trans-1,3-Dichloropropene	---------------	EPA TO-15	EPA 624 EPA 8260B EPA 8260C EPA 524.2 (DW) EPA 6200B	EPA 8260B EPA 8260C	EPA 8260B EPA 8260C
1,4-Dioxane	---------------	EPA TO-15	EPA 8260B EPA 8260C EPA 8260 SIM	EPA 8260B EPA 8260C EPA 8260 SIM	EPA 8260B EPA 8260C EPA 8260 SIM
Ethanol	---------------	EPA TO-15	EPA 8260B EPA 8260C EPA 6200B	EPA 8260B EPA 8260C	EPA 8260B EPA 8260C

Parameter/Analyte	**Tissue**	**Air**	**Nonpotable Water (*DW)**	**Solid Hazardous Waste**	
				Aqueous	**Solid**
Ethane	---------------	EPA 18 mod EPA 25 mod	------------------	---------------	---------------
Ethyl Acetate	---------------	EPA TO-15	------------------	---------------	---------------
Ethyl Acrylate	---------------	EPA TO-15	------------------	---------------	---------------
Ethylbenzene	---------------	EPA TO-15 EPA TO-15 SIM EPA 18 mod EPA 25 mod	EPA 602 EPA 624 EPA 8021B EPA 8260B EPA 8260C EPA 524.2 (DW) EPA 6200B OA-1	EPA 8021B EPA 8260B EPA 8260C OA-1	EPA 8021B EPA 8260B EPA 8260C OA-1
Ethyl ether	---------------	----------	EPA 8260B EPA 8260C EPA 524.2 (DW)	EPA 8260B EPA 8260C	EPA 8260B EPA 8260C
Ethyl methacrylate	---------------	EPA TO-15	EPA 624 EPA 8260B EPA 8260C EPA 524.2 (DW)	EPA 8260B EPA 8260C	EPA 8260B EPA 8260C
4-Ethyltoluene	---------------	EPA TO-15	------------------	---------------	---------------
Ethyl tert-butyl ether	---------------	EPA TO-15	EPA 624 EPA 8260B EPA 8260C EPA 524.2 (DW) EPA 6200B	EPA 8260B EPA 8260C	EPA 8260B EPA 8260C
Freon-113	---------------	EPA TO-15 EPA TO-15 SIM	EPA 624 EPA 8260B EPA 8260C EPA 524.2 (DW)	EPA 8260B EPA 8260C	EPA 8260B EPA 8260C
Freon-114	---------------	EPA TO-15	------------------	---------------	---------------
Gasoline Range Organics (GRO) [Volatile Petroleum Hydrocarbons (VPH)]	---------------	-----------	EPA 8015B EPA 8015C EPA 8015D EPA 8260B EPA 8260C NW TPH-Gx MA VPH WA DOE VPH OA-1 AK101	EPA 8015B EPA 8015C EPA 8015D EPA 8260B EPA 8260C NW TPH-Gx MA VPH WA DOE VPH OA-1 AK101	EPA 8015B EPA 8015C EPA 8015D EPA 8260B EPA 8260C NW TPH-Gx MA VPH WA DOE VPH OA-1 AK101

Parameter/Analyte	**Tissue**	**Air**	**Nonpotable Water (*DW)**	**Solid Hazardous Waste**	
				Aqueous	**Solid**
Heptane	---------------	EPA TO-15	EPA 8260B EPA 8260C	EPA 8260B EPA 8260C	EPA 8260B EPA 8260C
Hexane	---------------	EPA TO-15 EPA 18 mod EPA 25 mod	EPA 8260B EPA 8260C	EPA 8260B EPA 8260C	EPA 8260B EPA 8260C
2-Hexanone	---------------	EPA TO-15	EPA 624 EPA 8260B EPA 8260C EPA 524.2 (DW) EPA 6200B	EPA 8260B EPA 8260C	EPA 8260B EPA 8260C
Hexachlorobutadiene	---------------	EPA TO-15	EPA 624 EPA 8260B EPA 8260C EPA 524.2 (DW)	EPA 8260B EPA 8260C	EPA 8260B EPA 8260C
Hexachloroethane	---------------	EPA TO-15	EPA 8260B EPA 8260C EPA 524.2 (DW)	EPA 8260B EPA 8260C	EPA 8260B EPA 8260C
Isooctane	---------------	EPA TO-15	-------------------	---------------	---------------
Isopropyl alcohol	---------------	EPA TO-15	EPA 8260B EPA 8260C	EPA 8260B EPA 8260C	EPA 8260B EPA 8260C
Isopropylbenzene	---------------	EPA TO-15	EPA 624 EPA 8021B EPA 8260B EPA 8260C EPA 524.2 (DW) EPA 6200B OA-1	EPA 8021B EPA 8260B EPA 8260C OA-1	EPA 8021B EPA 8260B EPA 8260COA-1
1,4-Isopropyltoluene	---------------	-----------	EPA 624 EPA 8260B EPA 8260C EPA 524.2 (DW) EPA 6200B	EPA 8260B EPA 8260C	EPA 8260B EPA 8260C
Methane	---------------	EPA 18 mod EPA 25 mod	-------------------	------------------	---------------
Methylacrylonitrile	---------------	-----------	EPA 624 EPA 8260B EPA 8260C EPA 524.2 (DW)	EPA 8260B EPA 8260C	EPA 8260B EPA 8260C
Methyl acetate	---------------	-----------	EPA 8260B EPA 8260C	EPA 8260B EPA 8260C	EPA 8260B EPA 8260C

Parameter/Analyte	**Tissue**	**Air**	**Nonpotable Water (*DW)**	**Solid Hazardous Waste**	
				Aqueous	**Solid**
Methyl acrylate	---------------	EPA TO-15	EPA 8260B EPA 8260C EPA 524.2 (DW)	EPA 8260B EPA 8260C	EPA 8260B EPA 8260C
Methyl iodide	---------------	EPA TO-15	EPA 624 EPA 8260B EPA 8260C EPA 524.2 (DW)	EPA 8260B EPA 8260C	EPA 8260B EPA 8260C
Methyl ethyl ketone	---------------	EPA TO-15	EPA 624 EPA 8260B EPA 8260C	EPA 8260B EPA 8260C	EPA 8260B EPA 8260C
Methylene chloride	---------------	EPA TO-15 EPA TO-15 SIM	EPA 624 EPA 8260B EPA 8260C EPA 524.2 (DW) EPA 6200B	EPA 8260B EPA 8260C	EPA 8260B EPA 8260C
Methyl isobutyl ketone	---------------	EPA TO-15	EPA 624 EPA 8260B EPA 8260C EPA 6200B	EPA 8260B EPA 8260C	EPA 8260B EPA 8260C
Methyl methacrylate	---------------	EPA TO-15	EPA 624 EPA 8260B EPA 8260C EPA 524.2 (DW)	EPA 8260B EPA 8260C	EPA 8260B EPA 8260C
Methyl tert-butyl ether	---------------	EPA TO-15 EPA TO-15 SIM EPA 18 mod EPA 25 mod	EPA 602 EPA 624 EPA 8021B EPA 8260B EPA 8260C EPA 524.2 (DW) EPA 6200B OA-1	EPA 8021B EPA 8260B EPA 8260C OA-1	EPA 8021B EPA 8260B EPA 8260C OA-1
4-Methyl-2-pentanone	---------------	EPA TO-15	EPA 624 EPA 8260B EPA 8260C EPA 524.2 (DW)	EPA 8260B EPA 8260C	EPA 8260B EPA 8260C
Methylcyclohexane	---------------	-----------	EPA 624 EPA 8260B EPA 8260C	EPA 8260B EPA 8260C	EPA 8260B EPA 8260C
2-Nitropropane	---------------	-----------	EPA 624 EPA 8260B EPA 8260C EPA 524.2 (DW)	EPA 8260B EPA 8260C	EPA 8260B EPA 8260C

Parameter/Analyte	**Tissue**	**Air**	**Nonpotable Water (*DW)**	**Solid Hazardous Waste**	
				Aqueous	**Solid**
Naphthalene	---------------	EPA TO-15 EPA TO-15 SIM	EPA 602 EPA 624 EPA 8021B EPA 8260B EPA 8260C EPA 524.2 (DW) EPA 6200B OA-1	EPA 8021B EPA 8260B EPA 8260C OA-1	EPA 8021B EPA 8260B EPA 8260C OA-1
Nitrobenzene	---------------	-----------	EPA 524.2 (DW)	---------------	---------------
Octane	---------------	EPA TO-15	------------------	---------------	---------------
Pentachloroethane	---------------	-----------	EPA 624 EPA 8260B EPA 8260C EPA 524.2 (DW)	EPA 8260B EPA 8260C	EPA 8260B EPA 8260C
Pentane	---------------	EPA TO-15 EPA 18 mod EPA 25 mod	------------------	---------------	---------------
Propionitrile	---------------	-----------	EPA 624 EPA 8260B EPA 8260C EPA 524.2 (DW)	EPA 8260B EPA 8260C	EPA 8260B EPA 8260C
Propane	---------------	EPA 18 mod EPA 25 mod	-------------------	----------------	---------------
Propene	---------------	EPA TO-15	------------------	---------------	---------------
n-Propylbenzene	---------------	EPA TO-15	EPA 624 EPA 8260B EPA 8260C EPA 524.2 (DW) EPA 6200B	EPA 8260B EPA 8260C	EPA 8260B EPA 8260C
Styrene	---------------	EPA TO-15 EPA TO-15 SIM	EPA 602 EPA 624 EPA 8260B EPA 8260C EPA 524.2 (DW) EPA 6200B	EPA 8260B EPA 8260C	EPA 8260B EPA 8260C
tert-Amyl ethyl ether	---------------	-----------	EPA 8260B EPA 8260C EPA 6200B	EPA 8260B EPA 8260C	EPA 8260B EPA 8260C

Parameter/Analyte	**Tissue**	**Air**	**Nonpotable Water (*DW)**	**Solid Hazardous Waste**	
				Aqueous	**Solid**
1,1,1,2-Tetrachloroethane	---------------	EPA TO-15	EPA 624 EPA 8260B EPA 8260C EPA 524.2 (DW) EPA 6200B	EPA 8260B EPA 8260C	EPA 8260B EPA 8260C
1,1,2,2-Tetrachloroethane	---------------	EPA TO-15	EPA 624 EPA 8260B EPA 8260C EPA 524.2 (DW) EPA 6200B	EPA 8260B EPA 8260C	EPA 8260B EPA 8260C
Tetrachloroethene	---------------	EPA TO-15 EPA TO-15 SIM	EPA 624 EPA 8260B EPA 8260C EPA 524.2 (DW) EPA 6200B	EPA 8260B EPA 8260C	EPA 8260B EPA 8260C
Tetrahydrofuran	---------------	EPA TO-15	EPA 624 EPA 8260B EPA 8260C EPA 524.2 (DW)	EPA 8260B EPA 8260C	EPA 8260B EPA 8260C
Toluene	---------------	EPA TO-15 EPA TO-15 SIM EPA 18 mod EPA 25 mod	EPA 602 EPA 624 EPA 8021B EPA 8260B EPA 8260C EPA 524.2 (DW) EPA 6200B OA-1	EPA 8021B EPA 8260B EPA 8260C OA-1	EPA 8021B EPA 8260B EPA 8260C OA-1
1,2,3-Trichlorobenzene	---------------	---------	EPA 624 EPA 8260B EPA 8260C EPA 524.2 (DW) EPA 6200B	EPA 8260B EPA 8260C	EPA 8260B EPA 8260C
1,2,4-Trichlorobenzene	---------------	EPA TO-15	EPA 624 EPA 8260B EPA 8260C EPA 524.2 (DW) EPA 6200B	EPA 8260B EPA 8260C	EPA 8260B EPA 8260C
1,1,1-Trichloroethane	---------------	EPA TO-15 EPA TO-15 SIM	EPA 624 EPA 8260B EPA 8260C EPA 524.2 (DW) EPA 6200B	EPA 8260B EPA 8260C	EPA 8260B EPA 8260C
1,1,2-Trichloroethane	---------------	EPA TO-15 EPA TO-15 SIM	EPA 624 EPA 8260B EPA 8260C EPA 524.2 (DW) EPA 6200B	EPA 8260B EPA 8260C	EPA 8260B EPA 8260C

Parameter/Analyte	**Tissue**	**Air**	**Nonpotable Water (*DW)**	**Solid Hazardous Waste**	
				Aqueous	**Solid**
Trichloroethene	---------------	EPA TO-15 EPA TO-15 SIM	EPA 624 EPA 8260B EPA 8260C EPA 524.2 (DW) EPA 6200B	EPA 8260B EPA 8260C	EPA 8260B EPA 8260C
Trichlorofluoromethane	---------------	EPA TO-15	EPA 624 EPA 8260B EPA 8260C EPA 524.2 (DW) EPA 6200B	EPA 8260B EPA 8260C	EPA 8260B EPA 8260C
1,2,3-Trichloropropane	---------------	EPA TO-15 EPA TO-15 SIM	EPA 624 EPA 8260B EPA 8260C EPA 524.2 (DW) EPA 6200B	EPA 8260B EPA 8260C	EPA 8260B EPA 8260C
1,2,4-Trimethylbenzene	---------------	EPA TO-15 EPA TO-15 SIM	EPA 624 EPA 8260B EPA 8260C EPA 524.2 (DW) EPA 6200B	EPA 8260B EPA 8260C	EPA 8260B EPA 8260C
1,3,5-Trimethylbenzene	---------------	EPA TO-15	EPA 624 EPA 8260B EPA 8260C EPA 524.2 (DW) EPA 6200B	EPA 8260B EPA 8260C	EPA 8260B EPA 8260C
Vinyl acetate	---------------	EPA TO-15	EPA 624 EPA 8260B EPA 8260C EPA 6200B	EPA 8260B EPA 8260C	EPA 8260B EPA 8260C
Vinyl chloride	---------------	EPA TO-15 EPA TO-15 SIM	EPA 624 EPA 8260B EPA 8260C EPA 524.2 (DW) EPA 6200B	EPA 8260B EPA 8260C	EPA 8260B EPA 8260C
Xylenes, total	---------------	EPA TO-15 EPA TO-15 SIM EPA 18 mod EPA 25 mod	EPA 602 EPA 624 EPA 8021B EPA 8260B EPA 8260C EPA 524.2 (DW) EPA 6200B OA-1	EPA 8021B EPA 8260B EPA 8260C OA-1	EPA 8021B EPA 8260B EPA 8260C OA-1

Parameter/Analyte	Tissue	Air	Nonpotable Water (*DW)	Solid Hazardous Waste	
				Aqueous	Solid
1,2-Xylene	---------------	EPA TO-15 EPA TO-15 SIM	EPA 602 EPA 624 EPA 8021B EPA 8260B EPA 8260C EPA 524.2 (DW) EPA 6200B OA-1	EPA 8021B EPA 8260B EPA 8260C OA-1	EPA 8021B EPA 8260B EPA 8260C OA-1
1,3-Xylene	---------------	EPA TO-15 EPA TO-15 SIM	EPA 602 EPA 624 EPA 8021B EPA 8260B EPA 8260C EPA 524.2 (DW) EPA 6200B OA-1	EPA 8021B EPA 8260B EPA 8260C OA-1	EPA 8021B EPA 8260B EPA 8260C OA-1
1,4-Xylene	---------------	EPA TO-15 EPA TO-15 SIM	EPA 602 EPA 624 EPA 8021B EPA 8260B EPA 8260C EPA 524.2 (DW) EPA 6200B OA-1	EPA 8021B EPA 8260B EPA 8260C OA-1	EPA 8021B EPA 8260B EPA 8260C OA-1
Extractable Organics (Semivolatiles)					
Organic Extraction	EPA 3540C EPA 3546 EPA 3550B EPA 3550C	---------	EPA 3510C EPA 3511	EPA 3510C EPA 3511	EPA 3540C EPA 3546 EPA 3550B EPA 3550C
Acenaphthene	EPA 8270C EPA 8270D EPA 8270C SIM EPA 8270D SIM	---------	EPA 625 EPA 8270C EPA 8270C SIM EPA 8270D EPA 8270D SIM	EPA 8270C EPA 8270C SIM EPA 8270D EPA 8270D SIM	EPA 8270C EPA 8270C SIM EPA 8270D EPA 8270D SIM
Acenaphthylene	EPA 8270C EPA 8270D EPA 8270C SIM EPA 8270D SIM	---------	EPA 625 EPA 8270C EPA 8270C SIM EPA 8270D EPA 8270D SIM	EPA 8270C EPA 8270C SIM EPA 8270D EPA 8270D SIM	EPA 8270C EPA 8270C SIM EPA 8270D EPA 8270D SIM
Acetic acid	---------------	---------	EPA 8015B EPA 8015D	EPA 8015B EPA 8015D	---------------
Acetophenone	EPA 8270C EPA 8270D	---------	EPA 8270C EPA 8270D	EPA 8270C EPA 8270D	EPA 8270C EPA 8270D

Parameter/Analyte	**Tissue**	**Air**	**Nonpotable Water (*DW)**	**Solid Hazardous Waste**	
				Aqueous	**Solid**
2-Acetylaminofluorene	EPA 8270C EPA 8270D	---------	EPA 8270C EPA 8270D	EPA 8270C EPA 8270D	EPA 8270C EPA 8270D
Alkylated PAHs	EPA 8270C SIM EPA 8270D SIM	---------	EPA 8270C SIM EPA 8270D SIM	EPA 8270C SIM EPA 8270D SIM	EPA 8270C SIM EPA 8270D SIM
4-Aminobiphenyl	EPA 8270C EPA 8270D	---------	EPA 8270C EPA 8270D	EPA 8270C EPA 8270D	EPA 8270C EPA 8270D
2-Amino-4,6-dinitrotoluene	---------------	---------	EPA 8330 EPA 8330A EPA 8330B	EPA 8330 EPA 8330A EPA 8330B	EPA 8330 EPA 8330A EPA 8330B
4-Amino-2,6-dinitrotoluene	---------------	---------	EPA 8330 EPA 8330A EPA 8330B	EPA 8330 EPA 8330A EPA 8330B	EPA 8330 EPA 8330A EPA 8330B
Aniline	EPA 8270C EPA 8270D	---------	EPA 625 EPA 8270C EPA 8270D	EPA 8270C EPA 8270D	EPA 8270C EPA 8270D
Anthracene	EPA 8270C EPA 8270D EPA 8270C SIM EPA 8270D SIM	---------	EPA 625 EPA 8270C EPA 8270D EPA 8270C SIM EPA 8270D SIM	EPA 8270C EPA 8270D EPA 8270C SIM EPA 8270D SIM	EPA 8270C EPA 8270D EPA 8270C SIM EPA 8270D SIM
Atrazine	EPA 8270C EPA 8270D	---------	EPA 8270C EPA 8270D	EPA 8270C EPA 8270D	EPA 8270C EPA 8270D
Benzaldehyde	EPA 8270C EPA 8270D	---------	EPA 8270C EPA 8270D	EPA 8270C EPA 8270D	EPA 8270C EPA 8270D
Benzidine	EPA 8270C EPA 8270D	---------	EPA 625 EPA 8270C EPA 8270D	EPA 8270C EPA 8270D	EPA 8270C EPA 8270D
Benzoic acid	EPA 8270C EPA 8270D	---------	EPA 625 EPA 8270C EPA 8270D	EPA 8270C EPA 8270D	EPA 8270C EPA 8270D
Benzo (a) anthracene	EPA 8270C EPA 8270D EPA 8270C SIM EPA 8270D SIM	---------	EPA 625 EPA 8270C EPA 8270D EPA 8270C SIM EPA 8270D SIM	EPA 8270C EPA 8270D EPA 8270C SIM EPA 8270D SIM	EPA 8270C EPA 8270D EPA 8270C SIM EPA 8270D SIM
Benzo (b) fluoranthene	EPA 8270C EPA 8270D EPA 8270C SIM EPA 8270D SIM	---------	EPA 625 EPA 8270C EPA 8270D EPA 8270C SIM EPA 8270D SIM	EPA 8270C EPA 8270D EPA 8270C SIM EPA 8270D SIM	EPA 8270C EPA 8270D EPA 8270C SIM EPA 8270D SIM

Parameter/Analyte	Tissue	Air	Nonpotable Water (*DW)	Solid Hazardous Waste	
				Aqueous	Solid
Benzo (k) fluoranthene	EPA 8270C EPA 8270D EPA 8270C SIM EPA 8270D SIM	---------	EPA 625 EPA 8270C EPA 8270D EPA 8270C SIM EPA 8270D SIM	EPA 8270C EPA 8270D EPA 8270C SIM EPA 8270D SIM	EPA 8270C EPA 8270D EPA 8270C SIM EPA 8270D SIM
Benzo (ghi) perylene	EPA 8270C EPA 8270D EPA 8270C SIM EPA 8270D SIM	---------	EPA 625 EPA 8270C EPA 8270D EPA 8270C SIM EPA 8270D SIM	EPA 8270C EPA 8270D EPA 8270C SIM EPA 8270D SIM	EPA 8270C EPA 8270D EPA 8270C SIM EPA 8270D SIM
Benzo (a) pyrene	EPA 8270C EPA 8270D EPA 8270C SIM EPA 8270D SIM	---------	EPA 625 EPA 8270C EPA 8270D EPA 8270C SIM EPA 8270D SIM	EPA 8270C EPA 8270D EPA 8270C SIM EPA 8270D SIM	EPA 8270C EPA 8270D EPA 8270C SIM EPA 8270D SIM
Benzo (e) pyrene	EPA 8270C SIM EPA 8270D SIM	---------	EPA 8270C SIM EPA 8270D SIM	EPA 8270C SIM EPA 8270D SIM	EPA 8270C SIM EPA 8270D SIM
Benzyl alcohol	EPA 8270C EPA 8270D	---------	EPA 625 EPA 8270C EPA 8270D	EPA 8270C EPA 8270D	EPA 8270C EPA 8270D
Biphenyl	EPA 8270C EPA 8270D	---------	EPA 625 EPA 8270C EPA 8270D	EPA 8270C EPA 8270D	EPA 8270C EPA 8270D
bis (2-chloroethoxy) methane	EPA 8270C EPA 8270D	---------	EPA 625 EPA 8270C EPA 8270D	EPA 8270C EPA 8270D	EPA 8270C EPA 8270D
bis (2-chloroethoxy) ether	EPA 8270C EPA 8270D	---------	EPA 625 EPA 8270C EPA 8270D	EPA 8270C EPA 8270D	EPA 8270C EPA 8270D
bis (2-chloroethyl) ether	EPA 8270C EPA 8270D	---------	EPA 625 EPA 8270C EPA 8270D EPA 8270C SIM	EPA 8270C EPA 8270D EPA 8270 C SIM	EPA 8270C EPA 8270D
bis (2-chloroisopropyl) ether	EPA 8270C EPA 8270D	---------	EPA 625 EPA 8270C EPA 8270D	EPA 8270C EPA 8270D	EPA 8270C EPA 8270D
bis (2-ethylhexyl) phthalate	EPA 8270C EPA 8270D EPA 8270C SIM EPA 8270D SIM	---------	EPA 625 EPA 8270C EPA 8270D EPA 8270C SIM EPA 8270D SIM	EPA 8270C EPA 8270D EPA 8270C SIM EPA 8270D SIM	EPA 8270C EPA 8270D EPA 8270C SIM EPA 8270D SIM

Parameter/Analyte	**Tissue**	**Air**	**Nonpotable Water (*DW)**	**Solid Hazardous Waste**	
				Aqueous	**Solid**
4-Bromophenylphenyl ether	EPA 8270C EPA 8270D	---------	EPA 625 EPA 8270C EPA 8270D	EPA 8270C EPA 8270D	EPA 8270C EPA 8270D
Butyl benzyl phthalate	EPA 8270C EPA 8270D	---------	EPA 625 EPA 8270C EPA 8270D EPA 8270C SIM	EPA 8270C EPA 8270D EPA 8270C SIM	EPA 8270C EPA 8270D
Butyric acid	---------------	---------	EPA 8015B EPA 8015D	EPA 8015B EPA 8015D	--------------
Caprolactam	EPA 8270C EPA 8270D	---------	EPA 8270C EPA 8270D	EPA 8270C EPA 8270D	EPA 8270C EPA 8270D
Carbazole	EPA 8270C EPA 8270D	---------	EPA 625 EPA 8270C EPA 8270D	EPA 8270C EPA 8270D	EPA 8270C EPA 8270D
Carbon Range Organics C8-C44 (including subsets of this range i.e. HRO, MRO, ORO, RRO)	---------------	---------	EPA 8015B EPA 8015C EPA 8015D EPA 8270C TN EPH	EPA 8015B EPA 8015C EPA 8015D EPA 8270C TN EPH	EPA 8015B EPA 8015C EPA 8015D EPA 8270C TN EPH
4-Chloroaniline	EPA 8270C EPA 8270D	---------	EPA 625 EPA 8270C EPA 8270D	EPA 8270C EPA 8270D	EPA 8270C EPA 8270D
4-Chloro-3-methylphenol	EPA 8270C EPA 8270D	---------	EPA 625 EPA 8270C EPA 8270D	EPA 8270C EPA 8270D	EPA 8270C EPA 8270D
Chlorobenzilate	EPA 8270C EPA 8270D	---------	EPA 8270C EPA 8270D	EPA 8270C EPA 8270D	EPA 8270C EPA 8270D
1-Chloronaphthalene	EPA 8270C EPA 8270D	---------	EPA 8270C EPA 8270D	EPA 8270C EPA 8270D	EPA 8270C EPA 8270D
2-Chloronaphthalene	EPA 8270C EPA 8270D	---------	EPA 625 EPA 8270C EPA 8270D	EPA 8270C EPA 8270D	EPA 8270C EPA 8270D
2-Chlorophenol	EPA 8270C EPA 8270D	---------	EPA 625 EPA 8270C EPA 8270D	EPA 8270C EPA 8270D	EPA 8270C EPA 8270D
4-Chlorophenyl phenyl ether	EPA 8270C EPA 8270D	---------	EPA 625 EPA 8270C EPA 8270D	EPA 8270C EPA 8270D	EPA 8270C EPA 8270D
Chrysene	EPA 8270C EPA 8270D EPA 8270C SIM EPA 8270D SIM	---------	EPA 625 EPA 8270C EPA 8270D EPA 8270C SIM EPA 8270D SIM	EPA 8270C EPA 8270D EPA 8270C SIM EPA 8270D SIM	EPA 8270C EPA 8270D EPA 8270C SIM EPA 8270D SIM
Citric acid	---------------	---------	EPA 8015B EPA 8015D	EPA 8015B EPA 8015D	--------------

Parameter/Analyte	**Tissue**	**Air**	**Nonpotable Water (*DW)**	**Solid Hazardous Waste**	
				Aqueous	**Solid**
Cresols (Methyl hhenols)	EPA 8270C EPA 8270D	---------	EPA 625 EPA 8270C EPA 8270D	EPA 8270C EPA 8270D	EPA 8270C EPA 8270D
cis-/trans-Diallate	EPA 8270C EPA 8270D	---------	EPA 8270C EPA 8270D	EPA 8270C EPA 8270D	EPA 8270C EPA 8270D
2,4-Diamino-6-nitrotoluene	---------------	---------	EPA 8330B	EPA 8330B	EPA 8330B
2,6-Diamino-4-nitrotoluene	---------------	---------	EPA 8330B	EPA 8330B	EPA 8330B
Dibenzo (a,h) acridine	EPA 8270C EPA 8270D	---------	EPA 8270C EPA 8270D	EPA 8270C EPA 8270D	EPA 8270C EPA 8270D
Dibenzo (a,h) anthracene	EPA 8270C EPA 8270D EPA 8270C SIM EPA 8270D SIM	---------	EPA 625 EPA 8270C EPA 8270D EPA 8270C SIM EPA 8270D SIM	EPA 8270C EPA 8270D EPA 8270C SIM EPA 8270D SIM	EPA 8270C EPA 8270D EPA 8270C SIM EPA 8270D SIM
Dibenzofuran	EPA 8270C EPA 8270D	---------	EPA 625 EPA 8270C EPA 8270D EPA 8270D SIM	EPA 8270C EPA 8270D EPA 8270D SIM	EPA 8270C EPA 8270D EPA 8270D SIM
Dibenzothiophene	EPA 8270C SIM EPA 8270D SIM	---------	EPA 8270C SIM EPA 8270D SIM	EPA 8270C SIM EPA 8270D SIM	EPA 8270C SIM EPA 8270D SIM
1,2-Dichlorobenzene	EPA 8270C EPA 8270D	---------	EPA 625 EPA 8270C EPA 8270D	EPA 8270C EPA 8270D	EPA 8270C EPA 8270D
1,3-Dichlorobenzene	EPA 8270C EPA 8270D	---------	EPA 625 EPA 8270C EPA 8270D	EPA 8270C EPA 8270D	EPA 8270C EPA 8270D
1,4-Dichlorobenzene	EPA 8270C EPA 8270D	---------	EPA 625 EPA 8270C EPA 8270D	EPA 8270C EPA 8270D	EPA 8270C EPA 8270D
3,3’-Dichlorobenzidine	EPA 8270C EPA 8270D	---------	EPA 625 EPA 8270C EPA 8270D	EPA 8270C EPA 8270D	EPA 8270C EPA 8270D

Parameter/Analyte	**Tissue**	**Air**	**Nonpotable Water (*DW)**	**Solid Hazardous Waste**	
				Aqueous	**Solid**
Diesel Range Organics (DRO) [Extractable Petroleum Hydrocarbons (EPH)]	---------------	---------	EPA 8015B EPA 8015C EPA 8015D EPA 8270C CT ETPH MA EPH NWTPH DX NJ EPH TX1005/TX1006 WADOE EPH OA-2 AK102 AK102-SV	EPA 8015B EPA 8015C EPA 8015D EPA 8270C CT ETPH MA EPH NWTPH DX NJ EPH TX1005/TX1006 WADOE EPH OA-2 AK102 AK102-SV	EPA 8015B EPA 8015C EPA 8015D EPA 8270C CT ETPH MA EPH NWTPH DX NJ EPH TX1005/TX1006 WADOE EPH OA-2 AK102
2,4-Dichlorophenol	EPA 8270C EPA 8270D	---------	EPA 625 EPA 8270C EPA 8270D	EPA 8270C EPA 8270D	EPA 8270C EPA 8270D
2,6-Dichlorophenol	EPA 8270C EPA 8270D	---------	EPA 625 EPA 8270C EPA 8270D	EPA 8270C EPA 8270D	EPA 8270C EPA 8270D
Diethyl phthalate	EPA 8270C EPA 8270D	---------	EPA 625 EPA 8270C EPA 8270D	EPA 8270C EPA 8270D	EPA 8270C EPA 8270D
Dimethoate	EPA 8270C EPA 8270D	---------	EPA 8270C EPA 8270D	EPA 8270C EPA 8270D	EPA 8270C EPA 8270D
p-Dimethylaminoazobenze	EPA 8270C EPA 8270D	---------	EPA 8270C EPA 8270D	EPA 8270C EPA 8270D	EPA 8270C EPA 8270D
7,12-Dimethylbenz (a) anthracene	EPA 8270C EPA 8270D	---------	EPA 8270C EPA 8270D	EPA 8270C EPA 8270D	EPA 8270C EPA 8270D
alpha-,alpha-Dimethyphenethylamine	EPA 8270C EPA 8270D	---------	EPA 8270C EPA 8270D	EPA 8270C EPA 8270D	EPA 8270C EPA 8270D
2,4-Dimethylphenol	EPA 8270C EPA 8270D	---------	EPA 625 EPA 8270C EPA 8270D	EPA 8270C EPA 8270D	EPA 8270C EPA 8270D
Dimethyl phthalate	EPA 8270C EPA 8270D	---------	EPA 625 EPA 8270C EPA 8270D	EPA 8270C EPA 8270D	EPA 8270C EPA 8270D
3,3’-Dimethylbenzidine	EPA 8270C EPA 8270D	---------	EPA 8270C EPA 8270D	EPA 8270C EPA 8270D	EPA 8270C EPA 8270D
Di-n-butyl phthalate	EPA 8270C EPA 8270D	---------	EPA 625 EPA 8270C EPA 8270D EPA 8270C SIM	EPA 8270C EPA 8270D EPA 8270C SIM	EPA 8270C EPA 8270D
Di-n-octyl phthalate	EPA 8270C EPA 8270D	---------	EPA 625 EPA 8270C EPA 8270D	EPA 8270C EPA 8270D	EPA 8270C EPA 8270D
3,5-Dinitroaniline	---------------	---------	EPA 8330B	EPA 8330B	EPA 8330B

Parameter/Analyte	**Tissue**	**Air**	**Nonpotable Water (*DW)**	**Solid Hazardous Waste**	
				Aqueous	**Solid**
1,3-Dinitrobenzene	EPA 8270C EPA 8270D	---------	EPA 8270C EPA 8270D EPA 8330 EPA 8330A EPA 8330B	EPA 8270C EPA 8270D EPA 8330 EPA 8330A EPA 8330B	EPA 8270C EPA 8270D EPA 8330 EPA 8330A EPA 8330B
2,4-Dinitrophenol	EPA 8270C EPA 8270D	---------	EPA 625 EPA 8270C EPA 8270D	EPA 8270C EPA 8270D	EPA 8270C EPA 8270D
2,4-Dinitrotoluene	EPA 8270C EPA 8270D	---------	EPA 625 EPA 8270C EPA 8270D EPA 8330 EPA 8330A EPA 8330B	EPA 8270C EPA 8270D EPA 8330 EPA 8330A EPA 8330B	EPA 8270C EPA 8270D EPA 8330 EPA 8330A EPA 8330B
2,6-Dinitrotoluene	EPA 8270C EPA 8270D	---------	EPA 625 EPA 8270C EPA 8270D EPA 8330 EPA 8330A EPA 8330B	EPA 8270C EPA 8270D EPA 8330 EPA 8330A EPA 8330B	EPA 8270C EPA 8270D EPA 8330 EPA 8330A EPA 8330B
1,4-Dioxane	EPA 8270C EPA 8270D EPA 8270C SIM EPA 8270D SIM	---------	EPA 625 EPA 8270C EPA 8270D EPA 8270C SIM EPA 8270D SIM	EPA 8270C EPA 8270D EPA 8270C SIM EPA 8270D SIM	EPA 8270C EPA 8270D EPA 8270C SIM EPA 8270D SIM
Diphenylamine	EPA 8270C EPA 8270D	---------	EPA 625 EPA 8270C EPA 8270D	EPA 8270C EPA 8270D	EPA 8270C EPA 8270D
Diphenyl ether	EPA 8270C EPA 8270D	---------	EPA 625 EPA 8270C EPA 8270D	EPA 8270C EPA 8270D	EPA 8270C EPA 8270D
1,2-Diphenylhydrazine	EPA 8270C EPA 8270D	---------	EPA 625 EPA 8270C EPA 8270D	EPA 8270C EPA 8270D	EPA 8270C EPA 8270D
Ethyl methane sulfonate	EPA 8270C EPA 8270D	---------	EPA 8270C EPA 8270D	EPA 8270C EPA 8270D	EPA 8270C EPA 8270D
Fluoroanthene	EPA 8270C EPA 8270D EPA 8270C SIM EPA 8270D SIM	---------	EPA 625 EPA 8270C EPA 8270D EPA 8270C SIM EPA 8270D SIM	EPA 8270C EPA 8270D EPA 8270C SIM EPA 8270D SIM	EPA 8270C EPA 8270D EPA 8270C SIM EPA 8270D SIM

Parameter/Analyte	**Tissue**	**Air**	**Nonpotable Water (*DW)**	**Solid Hazardous Waste**	
				Aqueous	**Solid**
Fluorene	EPA 8270C EPA 8270D EPA 8270C SIM EPA 8270D SIM	---------	EPA 625 EPA 8270C EPA 8270D EPA 8270C SIM EPA 8270D SIM	EPA 8270C EPA 8270D EPA 8270C SIM EPA 8270D SIM	EPA 8270C EPA 8270D EPA 8270C SIM EPA 8270D SIM
Formic acid	---------------	---------	EPA 8015B EPA 8015D	EPA 8015B EPA 8015D	--------------
Hexachlorobenzene	EPA 8270C EPA 8270D	---------	EPA 625 EPA 8270C EPA 8270D EPA 8270C SIM	EPA 8270C EPA 8270D EPA 8270C SIM	EPA 8270C EPA 8270D
Hexachlorobutadiene	EPA 8270C EPA 8270D	---------	EPA 625 EPA 8270C EPA 8270D	EPA 8270C EPA 8270D	EPA 8270C EPA 8270D
Hexachlorocyclo-pentadiene	EPA 8270C EPA 8270D	---------	EPA 625 EPA 8270C EPA 8270D	EPA 8270C EPA 8270D	EPA 8270C EPA 8270D
Hexachloroethane	EPA 8270C EPA 8270D	---------	EPA 625 EPA 8270C EPA 8270D	EPA 8270C EPA 8270D	EPA 8270C EPA 8270D
Hexachloropropene	EPA 8270C EPA 8270D	---------	EPA 8270C EPA 8270D	EPA 8270C EPA 8270D	EPA 8270C EPA 8270D
Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)	---------------	---------	EPA 8330 EPA 8330A EPA 8330B	EPA 8330 EPA 8330A EPA 8330B	EPA 8330 EPA 8330A EPA 8330B
Indeno (1,2,3-cd) pyrene	EPA 8270C EPA 8270D EPA 8270C SIM EPA 8270D SIM	---------	EPA 625 EPA 8270C EPA 8270D EPA 8270C SIM EPA 8270D SIM	EPA 8270C EPA 8270D EPA 8270C SIM EPA 8270D SIM	EPA 8270C EPA 8270D EPA 8270C SIM EPA 8270D SIM
Isodrin	EPA 8270C EPA 8270D	---------	EPA 8270C EPA 8270D	EPA 8270C EPA 8270D	EPA 8270C EPA 8270D
Isophorone	EPA 8270C EPA 8270D	---------	EPA 625 EPA 8270C EPA 8270D	EPA 8270C EPA 8270D	EPA 8270C EPA 8270D
Isosafrole	EPA 8270C EPA 8270D	---------	EPA 8270C EPA 8270D	EPA 8270C EPA 8270D	EPA 8270C EPA 8270D
Isobutyric acid	---------------	---------	EPA 8015B EPA 8015D	EPA 8015B EPA 8015D	--------------
Lactic acid	---------------	---------	EPA 8015B EPA 8015D	EPA 8015B EPA 8015D	--------------
Methapyriline	EPA 8270C EPA 8270D	---------	EPA 8270C EPA 8270D	EPA 8270C EPA 8270D	EPA 8270C EPA 8270D
3-Methycholanthrene	EPA 8270C EPA 8270D	---------	EPA 8270C EPA 8270D	EPA 8270C EPA 8270D	EPA 8270C EPA 8270D

Parameter/Analyte	**Tissue**	**Air**	**Nonpotable Water (*DW)**	**Solid Hazardous Waste**	
				Aqueous	**Solid**
2-Methyl-4,6-dinitrophenol	EPA 8270C EPA 8270D	---------	EPA 625 EPA 8270C EPA 8270D	EPA 8270C EPA 8270D	EPA 8270C EPA 8270D
Methyl methane sulfonate	EPA 8270C EPA 8270D	---------	EPA 8270C EPA 8270D	EPA 8270C EPA 8270D	EPA 8270C EPA 8270D
1-Methylnaphthalene	EPA 8270C EPA 8270D EPA 8270C SIM EPA 8270D SIM	---------	EPA 625 EPA 8270C EPA 8270D EPA 8270C SIM EPA 8270D SIM	EPA 8270C EPA 8270D EPA 8270C SIM EPA 8270D SIM	EPA 8270C EPA 8270D EPA 8270C SIM EPA 8270D SIM
2-Methylnaphthalene	EPA 8270C EPA 8270D EPA 8270C SIM EPA 8270D SIM	---------	EPA 625 EPA 8270C EPA 8270D EPA 8270C SIM EPA 8270D SIM	EPA 8270C EPA 8270C SIM EPA 8270D SIMEPA 8270D	EPA 8270C EPA 8270C SIM EPA 8270D SIM EPA 8270D
2-Methylphenol	EPA 8270C EPA 8270D	---------	EPA 625 EPA 8270C EPA 8270D	EPA 8270C EPA 8270D	EPA 8270C EPA 8270D
4-Methylphenol	EPA 8270C EPA 8270D	---------	EPA 625 EPA 8270C EPA 8270D	EPA 8270C EPA 8270D	EPA 8270C EPA 8270D
Naphthalene	EPA 8270C EPA 8270D EPA 8270C SIM EPA 8270D SIM	---------	EPA 625 EPA 8270C EPA 8270D EPA 8270C SIM EPA 8270D SIM	EPA 8270C EPA 8270D EPA 8270C SIM EPA 8270D SIM	EPA 8270C EPA 8270D EPA 8270C SIM EPA 8270D SIM
1,4-Naphthoquinone	EPA 8270C EPA 8270D	---------	EPA 8270C EPA 8270D	EPA 8270C EPA 8270D	EPA 8270C EPA 8270D
1-Naphthylamine	EPA 8270C EPA 8270D	---------	EPA 8270C EPA 8270D	EPA 8270C EPA 8270D	EPA 8270C EPA 8270D
2-Naphthylamine	EPA 8270C EPA 8270D	---------	EPA 8270C EPA 8270D	EPA 8270C EPA 8270D	EPA 8270C EPA 8270D
4-Nitroquinoline-1-oxide	EPA 8270C EPA 8270D	---------	EPA 8270C EPA 8270D	EPA 8270C EPA 8270D	EPA 8270C EPA 8270D
2-Nitroaniline	EPA 8270C EPA 8270D	---------	EPA 625 EPA 8270C EPA 8270D	EPA 8270C EPA 8270D	EPA 8270C EPA 8270D
3-Nitroaniline	EPA 8270C EPA 8270D	---------	EPA 625 EPA 8270C EPA 8270D	EPA 8270C EPA 8270D	EPA 8270C EPA 8270D
4-Nitroaniline	EPA 8270C EPA 8270D	---------	EPA 625 EPA 8270C EPA 8270D	EPA 8270C EPA 8270D	EPA 8270C EPA 8270D

Parameter/Analyte	Tissue	Air	Nonpotable Water (*DW)	Solid Hazardous Waste	
				Aqueous	Solid
Nitrobenzene	EPA 8270C EPA 8270D	---------	EPA 625 EPA 8270C EPA 8270D EPA 8330 EPA 8330A EPA 8330B	EPA 8270C EPA 8270D EPA 8330 EPA 8330A EPA 8330B	EPA 8270C EPA 8270D EPA 8330 EPA 8330A EPA 8330B
Nitroglycerin	---------------	---------	EPA 8330 EPA 8330A EPA 8330B	EPA 8330 EPA 8330A EPA 8330B	EPA 8330 EPA 8330A EPA 8330B
2-Nitrophenol	EPA 8270C EPA 8270D	---------	EPA 625 EPA 8270C EPA 8270D	EPA 8270C EPA 8270D	EPA 8270C EPA 8270D
4-Nitrophenol	EPA 8270C EPA 8270D	---------	EPA 625 EPA 8270C EPA 8270D	EPA 8270C EPA 8270D	EPA 8270C EPA 8270D
2-Nitrotoluene	---------------	---------	EPA 8330 EPA 8330A EPA 8330B	EPA 8330 EPA 8330A EPA 8330B	EPA 8330 EPA 8330A EPA 8330B
3-Nitrotoluene	---------------	---------	EPA 8330 EPA 8330A EPA 8330B	EPA 8330 EPA 8330A EPA 8330B	EPA 8330 EPA 8330A EPA 8330B
4-Nitrotoluene	---------------	---------	EPA 8330 EPA 8330A EPA 8330B	EPA 8330 EPA 8330A EPA 8330B	EPA 8330 EPA 8330A EPA 8330B
5-Nitro-o-toluidine	EPA 8270C EPA 8270D	---------	EPA 8270C EPA 8270D	EPA 8270C EPA 8270D	EPA 8270C EPA 8270D
n-Nitroso-di-n-butylamine	EPA 8270C EPA 8270D	---------	EPA 625 EPA 8270C EPA 8270D	EPA 8270C EPA 8270D	EPA 8270C EPA 8270D
n-Nitrosodiethylamine	EPA 8270C EPA 8270D	---------	EPA 625 EPA 8270C EPA 8270D	EPA 8270C EPA 8270D	EPA 8270C EPA 8270D
n-Nitrosodimethylamine	EPA 8270C EPA 8270D	---------	EPA 625 EPA 8270C EPA 8270D	EPA 8270C EPA 8270D	EPA 8270C EPA 8270D
n-Nitrosodimethylethylamine	EPA 8270C EPA 8270D	---------	EPA 8270C EPA 8270D	EPA 8270C EPA 8270D	EPA 8270C EPA 8270D
n-Nitrosomorpholine	EPA 8270C EPA 8270D	---------	EPA 8270C EPA 8270D	EPA 8270C EPA 8270D	EPA 8270C EPA 8270D
n-Nitrosodi-n-propylamine	EPA 8270C EPA 8270D	---------	EPA 625 EPA 8270C EPA 8270D	EPA 8270C EPA 8270D	EPA 8270C EPA 8270D
n-Nitrosodiphenylamine	EPA 8270C EPA 8270D	---------	EPA 625 EPA 8270C EPA 8270D	EPA 8270C EPA 8270D	EPA 8270C EPA 8270D

Parameter/Analyte	**Tissue**	**Air**	**Nonpotable Water (*DW)**	**Solid Hazardous Waste**	
				Aqueous	**Solid**
n-Nitrosopiperidine	EPA 8270C EPA 8270D	---------	EPA 8270C EPA 8270D	EPA 8270C EPA 8270D	EPA 8270C EPA 8270D
n-Nitrosopyrrolidine	EPA 8270C EPA 8270D	---------	EPA 625 EPA 8270C EPA 8270D	EPA 8270C EPA 8270D	EPA 8270C EPA 8270D
Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)	---------------	---------	EPA 8330 EPA 8330A EPA 8330B	EPA 8330 EPA 8330A EPA 8330B	EPA 8330 EPA 8330A EPA 8330B
Oxalic acid	---------------	---------	EPA 8015B EPA 8015D	EPA 8015B EPA 8015D	---------------
2,2-Oxybis (1-chloropropane)	EPA 8270C EPA 8270D	---------	EPA 8270C EPA 8270D	EPA 8270C EPA 8270D	EPA 8270C EPA 8270D
Pentachlorobenzene	EPA 8270C EPA 8270D	---------	EPA 8270C EPA 8270D	EPA 8270C EPA 8270D	EPA 8270C EPA 8270D
Pentachloronitrobenzene	EPA 8270C EPA 8270D	---------	EPA 8270C EPA 8270D	EPA 8270C EPA 8270D	EPA 8270C EPA 8270D
Pentachlorophenol	EPA 8270C EPA 8270D	---------	EPA 625 EPA 8270C EPA 8270D	EPA 8270C EPA 8270D	EPA 8270C EPA 8270D
Pentaerythritol Tetranitrate (PETN)	---------------	---------	EPA 8330 EPA 8330A EPA 8330B	EPA 8330 EPA 8330A EPA 8330B	EPA 8330 EPA 8330A EPA 8330B
Perylene	EPA 8270C SIM EPA 8270D SIM	---------	EPA 8270C SIM EPA 8270D SIM	EPA 8270C SIM EPA 8270D SIM	EPA 8270C SIM EPA 8270D SIM
Petroleum Range Organics	---------------	---------	FLPRO	FLPRO	FLPRO
Phenacetin	EPA 8270C EPA 8270D	---------	EPA 8270C EPA 8270D	EPA 8270C EPA 8270D	EPA 8270C EPA 8270D
Phenanthrene	EPA 8270C EPA 8270D EPA 8270C SIM EPA 8270D SIM	---------	EPA 625 EPA 8270C EPA 8270D EPA 8270C SIM EPA 8270D SIM	EPA 8270C EPA 8270D EPA 8270C SIM EPA 8270D SIM	EPA 8270C EPA 8270D EPA 8270C SIM EPA 8270D SIM
Phenol	EPA 8270C EPA 8270D	---------	EPA 625 EPA 8270C EPA 8270D	EPA 8270C EPA 8270D	EPA 8270C EPA 8270D
1,4-Phenylenediamine	EPA 8270C EPA 8270D	---------	EPA 8270C EPA 8270D	EPA 8270C EPA 8270D	EPA 8270C EPA 8270D
2-Picoline	EPA 8270C EPA 8270D	---------	EPA 8270C EPA 8270D	EPA 8270C EPA 8270D	EPA 8270C EPA 8270D
Pronamide	EPA 8270C EPA 8270D	---------	EPA 8270C EPA 8270D	EPA 8270C EPA 8270D	EPA 8270C EPA 8270D
Propionic acid	---------------	---------	EPA 8015B EPA 8015D	EPA 8015B EPA 8015D	---------------

Parameter/Analyte	**Tissue**	**Air**	**Nonpotable Water (*DW)**	**Solid Hazardous Waste**	
				Aqueous	**Solid**
Pyrene	EPA 8270C EPA 8270D EPA 8270C SIM EPA 8270D SIM	---------	EPA 625 EPA 8270C EPA 8270D EPA 8270C SIM EPA 8270D SIM	EPA 8270C EPA 8270D EPA 8270C SIM EPA 8270D SIM	EPA 8270C EPA 8270D EPA 8270C SIM EPA 8270D SIM
Pyridine	EPA 8270C EPA 8270D	---------	EPA 625 EPA 8270C EPA 8270D	EPA 8270C EPA 8270D	EPA 8270C EPA 8270D
Pyruvic acid	---------------	---------	EPA 8015B EPA 8015D	EPA 8015B EPA 8015D	--------------
Quinic acid	---------------	---------	EPA 8015B EPA 8015D	EPA 8015B EPA 8015D	--------------
Residual Range Organics (RRO)			AK103	AK103	AK103
Succinic acid	---------------	---------	EPA 8015B EPA 8015D	EPA 8015B EPA 8015D	--------------
Tartaric acid	---------------	---------	EPA 8015B EPA 8015D	EPA 8015B EPA 8015D	--------------
Safrole	EPA 8270C EPA 8270D	---------	EPA 8270C EPA 8270D	EPA 8270C EPA 8270D	EPA 8270C EPA 8270D
1,2,4,5-Tetrachlorobenzene	EPA 8270C EPA 8270D	---------	EPA 625 EPA 8270C EPA 8270D	EPA 8270C EPA 8270D	EPA 8270C EPA 8270D
2,3,4,6-Tetrachlorophenol	EPA 8270C EPA 8270D	---------	EPA 625 EPA 8270C EPA 8270D	EPA 8270C EPA 8270D	EPA 8270C EPA 8270D
Tetraethyl dithiopyrophosphate	EPA 8270C EPA 8270D	---------	EPA 8270C EPA 8270D	EPA 8270C EPA 8270D	EPA 8270C EPA 8270D
Tetraethy lead	---------------	---------	EPA 8270C EPA 8270D	EPA 8270C EPA 8270D	EPA 8270C EPA 8270D
Tetramethyl lead	---------------	---------	EPA 8270C EPA 8270D	EPA 8270C EPA 8270D	---------------
Tetryl	---------------	---------	EPA 8330 EPA 8330A EPA 8330B	EPA 8330 EPA 8330A EPA 8330B	EPA 8330 EPA 8330A EPA 8330B
Thionazin	EPA 8270C EPA 8270D	---------	EPA 8270C EPA 8270D	EPA 8270C EPA 8270D	EPA 8270C EPA 8270D
o-Toluidine	EPA 8270C EPA 8270D	---------	EPA 625 EPA 8270C EPA 8270D	EPA 8270C EPA 8270D	EPA 8270C EPA 8270D
1,2,4-Trichlorobenzene	EPA 8270C EPA 8270D	---------	EPA 625 EPA 8270C EPA 8270D	EPA 8270C EPA 8270D	EPA 8270C EPA 8270D
1,3,5-Trinitrobenzene	---------------	---------	EPA 8330 EPA 8330A EPA 8330B	EPA 8330 EPA 8330A EPA 8330B	EPA 8330 EPA 8330A EPA 8330B

Parameter/Analyte	**Tissue**	**Air**	**Nonpotable Water (*DW)**	**Solid Hazardous Waste**	
				Aqueous	**Solid**
2,4,5-Trichlorophenol	EPA 8270C EPA 8270D	---------	EPA 625 EPA 8270C EPA 8270D	EPA 8270C EPA 8270D	EPA 8270C EPA 8270D
2,4,6-Trichlorophenol	EPA 8270C EPA 8270D	---------	EPA 625 EPA 8270C EPA 8270D	EPA 8270C EPA 8270D	EPA 8270C EPA 8270D
O,O,O-Tri-ethylphosphorothioate	EPA 8270C EPA 8270D	---------	EPA 8270C EPA 8270D	EPA 8270C EPA 8270D	EPA 8270C EPA 8270D
1,3,5-Trinitrobenzene	EPA 8270C EPA 8270D	---------	EPA 8270C EPA 8270D	EPA 8270C EPA 8270D	EPA 8270C EPA 8270D
2,4,6-Trinitrotoluene	---------------	---------	EPA 8330 EPA 8330A EPA 8330B	EPA 8330 EPA 8330A EPA 8330B	EPA 8330 EPA 8330A EPA 8330B
Pesticides/Herbicides/ PCBs					
Organic Extraction	EPA 3540C EPA 3546 EPA 3550B EPA 3550C	---------	EPA 3510C EPA 3511	EPA 3510C EPA 3511	EPA 3540C EPA 3546 EPA 3550B EPA 3550C
Acifluorfen	---------	---------	EPA 8151A	EPA 8151A	EPA 8151A
Aldrin	EPA 8081A EPA 8081B	---------	EPA 608 EPA 8081A EPA 8081B	EPA 8081A EPA 8081B	EPA 8081A EPA 8081B
Azinphos methyl (Guthion)	---------------	---------	EPA 8141A EPA 8141B	EPA 8141A EPA 8141B	EPA 8141A EPA 8141B
alpha-BHC	EPA 8081A EPA 8081B	---------	EPA 608 EPA 8081A EPA 8081B	EPA 8081A EPA 8081B	EPA 8081A EPA 8081B
beta-BHC	EPA 8081A EPA 8081B	---------	EPA 608 EPA 8081A EPA 8081B	EPA 8081A EPA 8081B	EPA 8081A EPA 8081B
delta-BHC	EPA 8081A EPA 8081B	---------	EPA 608 EPA 8081A EPA 8081B	EPA 8081A EPA 8081B	EPA 8081A EPA 8081B
gamma-BHC (Lindane)	EPA 8081A EPA 8081B	---------	EPA 608 EPA 8081A EPA 8081B	EPA 8081A EPA 8081B	EPA 8081A EPA 8081B
Bentazon	---------------	---------	EPA 8151A	EPA 8151A	EPA 8151A
Bolstar	---------------	---------	EPA 8141A EPA 8141B	EPA 8141A EPA 8141B	EPA 8141A EPA 8141B
alpha-Chlordane	EPA 8081A EPA 8081B	---------	EPA 608 EPA 8081A EPA 8081B	EPA 8081A EPA 8081B	EPA 8081A EPA 8081B
Chloramben	---------	---------	EPA 8151A	EPA 8151A	EPA 8151A

Parameter/Analyte	**Tissue**	**Air**	**Nonpotable Water (*DW)**	**Solid Hazardous Waste**	
				Aqueous	**Solid**
Chlordane (Technical)	EPA 8081A EPA 8081B	---------	EPA 608 EPA 8081A EPA 8081B	EPA 8081A EPA 8081B	EPA 8081A EPA 8081B
Chlorobenzilate	---------------	---------	EPA 8081A EPA 8081B	EPA 8081A EPA 8081B	EPA 8081A EPA 8081B
Chlorpyrifos	---------------	---------	EPA 8141A EPA 8141B	EPA 8141A EPA 8141B	EPA 8141A EPA 8141B
Coumaphos	---------------	---------	EPA 8141A EPA 8141B	EPA 8141A EPA 8141B	EPA 8141A EPA 8141B
2,4-D	EPA 8151A	---------	EPA 8151A	EPA 8151A	EPA 8151A
2,4’-DDD	EPA 8081A EPA 8081B	---------	EPA 8081A EPA 8081B	EPA 8081A EPA 8081B	EPA 8081A EPA 8081B
2,4’-DDE	EPA 8081A EPA 8081B	---------	EPA 8081A EPA 8081B	EPA 8081A EPA 8081B	EPA 8081A EPA 8081B
2,4’-DDT	EPA 8081A EPA 8081B	---------	EPA 8081A EPA 8081B	EPA 8081A EPA 8081B	EPA 8081A EPA 8081B
Dalapon	EPA 8151A	---------	EPA 8151A	EPA 8151A	EPA 8151A
2,4-DB	EPA 8151A	---------	EPA 8151A	EPA 8151A	EPA 8151A
4,4’-DDD	EPA 8081A EPA 8081B	---------	EPA 608 EPA 8081A EPA 8081B	EPA 8081A EPA 8081B	EPA 8081A EPA 8081B
4,4’-DDE	EPA 8081A EPA 8081B	---------	EPA 608 EPA 8081A EPA 8081B	EPA 8081A EPA 8081B	EPA 8081A EPA 8081B
4,4’-DDT	EPA 8081A EPA 8081B	---------	EPA 608 EPA 8081A EPA 8081B	EPA 8081A EPA 8081B	EPA 8081A EPA 8081B
Demeton-O	---------------	---------	EPA 8141A EPA 8141B	EPA 8141A EPA 8141B	EPA 8141A EPA 8141B
Demeton-S	---------------	---------	EPA 8141A EPA 8141B	EPA 8141A EPA 8141B	EPA 8141A EPA 8141B
Diallate	---------------	---------	EPA 8081A EPA 8081B	EPA 8081A EPA 8081B	EPA 8081A EPA 8081B
Diazinon	---------------	---------	EPA 8141A EPA 8141B	EPA 8141A EPA 8141B	EPA 8141A EPA 8141B
1.2-Dibromo-3-chloropropane (DBCP)	---------------	---------	EPA 8081A EPA 8081B	EPA 8081A EPA 8081B	EPA 8081A EPA 8081B
Dicamba	EPA 8151A	---------	EPA 8151A	EPA 8151A	EPA 8151A
3,5-Dichlorobenzoic acid	---------------	---------	EPA 8151A	EPA 8151A	EPA 8151A
Dichlorvos	---------------	---------	EPA 8141A EPA 8141B	EPA 8141A EPA 8141B	EPA 8141A EPA 8141B
Dichloroprop	EPA 8151A	---------	EPA 8151A	EPA 8151A	EPA 8151A
Dieldrin	EPA 8081A EPA 8081B	---------	EPA 608 EPA 8081A EPA 8081B	EPA 8081A EPA 8081B	EPA 8081A EPA 8081B

Parameter/Analyte	**Tissue**	**Air**	**Nonpotable Water (*DW)**	**Solid Hazardous Waste**	
				Aqueous	**Solid**
Dinoseb	EPA 8151A	---------	EPA 8151A EPA 8270C EPA 8270D	EPA 8151A EPA 8270C EPA 8270D	EPA 8151A EPA 8270C EPA 8270D
Disulfoton	---------------	---------	EPA 8141A EPA 8141B	EPA 8141A EPA 8141B	EPA 8141A EPA 8141B
Diuron	---------------	---------	EPA 8321A	EPA 8321A	EPA 8321A
Endosulfan I (alpha)	EPA 8081A EPA 8081B	---------	EPA 608 EPA 8081A EPA 8081B	EPA 8081A EPA 8081B	EPA 8081A EPA 8081B
Endosulfan II (beta)	EPA 8081A EPA 8081B	---------	EPA 608 EPA 8081A EPA 8081B	EPA 8081A EPA 8081B	EPA 8081A EPA 8081B
Endosulfan Sulfate	EPA 8081A EPA 8081B	---------	EPA 608 EPA 8081A EPA 8081B	EPA 8081A EPA 8081B	EPA 8081A EPA 8081B
Endrin	EPA 8081A EPA 8081B	---------	EPA 608 EPA 8081A EPA 8081B	EPA 8081A EPA 8081B	EPA 8081A EPA 8081B
Endrin aldehyde	EPA 8081A EPA 8081B	---------	EPA 608 EPA 8081A EPA 8081B	EPA 8081A EPA 8081B	EPA 8081A EPA 8081B
Endrin ketone	EPA 8081A EPA 8081B	---------	EPA 608 EPA 8081A EPA 8081B	EPA 8081A EPA 8081B	EPA 8081A EPA 8081B
Ethion	---------------	---------	EPA 8141A EPA 8141B	EPA 8141A EPA 8141B	EPA 8141A EPA 8141B
Ethoprop	---------------	---------	EPA 8141A EPA 8141B	EPA 8141A EPA 8141B	EPA 8141A EPA 8141B
Fensulfothion	---------------	---------	EPA 8141A EPA 8141B	EPA 8141A EPA 8141B	EPA 8141A EPA 8141B
Fenthion	---------------	---------	EPA 8141A EPA 8141B	EPA 8141A EPA 8141B	EPA 8141A EPA 8141B
Fenuron	---------------	---------	EPA 8321A	EPA 8321A	EPA 8321A
Gamma-Chlordane	EPA 8081A EPA 8081B	---------	EPA 608 EPA 8081A EPA 8081B	EPA 8081A EPA 8081B	EPA 8081A EPA 8081B
Heptachlor	EPA 8081A EPA 8081B	---------	EPA 608 EPA 8081A EPA 8081B	EPA 8081A EPA 8081B	EPA 8081A EPA 8081B
Heptachlor epoxide	EPA 8081A EPA 8081B	---------	EPA 608 EPA 8081A EPA 8081B	EPA 8081A EPA 8081B	EPA 8081A EPA 8081B
Hexachlorobenzene	EPA 8081A EPA 8081B	---------	EPA 8081A EPA 8081B	EPA 8081A EPA 8081B	EPA 8081A EPA 8081B
Hexachlorocyclopentadiene	---------------	---------	EPA 8081A EPA 8081B	EPA 8081A EPA 8081B	EPA 8081A EPA 8081B

Parameter/Analyte	**Tissue**	**Air**	**Nonpotable Water (*DW)**	**Solid Hazardous Waste**	
				Aqueous	**Solid**
Isodrin	---------------	---------	EPA 8081A EPA 8081B	EPA 8081A EPA 8081B	EPA 8081A EPA 8081B
Malathion	---------------	---------	EPA 8141A EPA 8141B	EPA 8141A EPA 8141B	EPA 8141A EPA 8141B
MCPA	EPA 8151A	---------	EPA 8151A	EPA 8151A	EPA 8151A
MCPP	EPA 8151A	---------	EPA 8151A	EPA 8151A	EPA 8151A
Merphos	---------------	---------	EPA 8141A EPA 8141B	EPA 8141A EPA 8141B	EPA 8141A EPA 8141B
Methoxychlor	EPA 8081A EPA 8081B	---------	EPA 608 EPA 8081A EPA 8081B	EPA 8081A EPA 8081B	EPA 8081A EPA 8081B
Mevinphos	---------------	---------	EPA 8141A EPA 8141B	EPA 8141A EPA 8141B	EPA 8141A EPA 8141B
Mirex	EPA 8081A EPA 8081B	---------	EPA 608 EPA 8081A EPA 8081B	EPA 8081A EPA 8081B	EPA 8081A EPA 8081B
Parathion ethyl	---------------	---------	EPA 8141A EPA 8141B	EPA 8141A EPA 8141B	EPA 8141A EPA 8141B
Parathion methyl	---------------	---------	EPA 8141A EPA 8141B	EPA 8141A EPA 8141B	EPA 8141A EPA 8141B
PCB-1016 (Arochlor)	EPA 8082 EPA 8082A	---------	EPA 608 EPA 8082 EPA 8082A	EPA 8082 EPA 8082A	EPA 8082 EPA 8082A
PCB-1221	EPA 8082 EPA 8082A	---------	EPA 608 EPA 8082 EPA 8082A	EPA 8082 EPA 8082A	EPA 8082 EPA 8082A
PCB-1232	EPA 8082 EPA 8082A	---------	EPA 608 EPA 8082 EPA 8082A	EPA 8082 EPA 8082A	EPA 8082 EPA 8082A
PCB-1242	EPA 8082 EPA 8082A	---------	EPA 608 EPA 8082 EPA 8082A	EPA 8082 EPA 8082A	EPA 8082 EPA 8082A
PCB-1248	EPA 8082 EPA 8082A	---------	EPA 608 EPA 8082 EPA 8082A	EPA 8082 EPA 8082A	EPA 8082 EPA 8082A
PCB-1254	EPA 8082 EPA 8082A	---------	EPA 608 EPA 8082 EPA 8082A	EPA 8082 EPA 8082A	EPA 8082 EPA 8082A
PCB-1260	EPA 8082 EPA 8082A	---------	EPA 608 EPA 8082 EPA 8082A	EPA 8082 EPA 8082A	EPA 8082 EPA 8082A
PCB-1262	EPA 8082 EPA 8082A	---------	EPA 608 EPA 8082 EPA 8082A	EPA 8082 EPA 8082A	EPA 8082 EPA 8082A
PCB-1268	EPA 8082 EPA 8082A	---------	EPA 608 EPA 8082 EPA 8082A	EPA 8082 EPA 8082A	EPA 8082 EPA 8082A

Parameter/Analyte	**Tissue**	**Air**	**Nonpotable Water (*DW)**	**Solid Hazardous Waste**	
				Aqueous	**Solid**
Aroclor 5432	---------------	---------	EPA 8082 EPA 8082A	EPA 8082 EPA 8082A	EPA 8082 EPA 8082A
Aroclor 5442	---------------	---------	EPA 8082 EPA 8082A	EPA 8082 EPA 8082A	EPA 8082 EPA 8082A
Aroclor 5460	---------------	---------	EPA 8082 EPA 8082A	EPA 8082 EPA 8082A	EPA 8082 EPA 8082A
PCB congeners (209)	EPA 1668	---------	EPA 1668A EPA 1668C	EPA 1668A EPA 1668C	EPA 1668A EPA 1668C
Pentachlorophenol (PCP)	EPA 8151A	---------	EPA 8151A	EPA 8151A	EPA 8151A
Phorate	---------------	---------	EPA 8141A EPA 8141B	EPA 8141A EPA 8141B	EPA 8141A EPA 8141B
Picloram	---------------	---------	EPA 8151A	EPA 8151A	EPA 8151A
Simazine	---------------	---------	EPA 8141A EPA 8141B	EPA 8141A EPA 8141B	EPA 8141A EPA 8141B
Stirophos (Tetrachlorvinphos)	---------------	---------	EPA 8141A EPA 8141B	EPA 8141A EPA 8141B	EPA 8141A EPA 8141B
2,4,5-T	EPA 8151A	---------	EPA 8151A	EPA 8151A	EPA 8151A
Tokuthion (Prothiofos)	---------------	---------	EPA 8141A EPA 8141B	EPA 8141A EPA 8141B	EPA 8141A EPA 8141B
2,4,5-TP (Silvex)	EPA 8151A	---------	EPA 8151A	EPA 8151A	EPA 8151A
Toxaphene	EPA 8081A EPA 8081B	---------	EPA 608 EPA 8081A EPA 8081B	EPA 8081A EPA 8081B	EPA 8081A EPA 8081B
Trichloronate	---------------	---------	EPA 8141A EPA 8141B	EPA 8141A EPA 8141B	EPA 8141A EPA 8141B
PCB Homologues					
Monochlorobiphenyls	---------------	---------	EPA 680	EPA 680	EPA 680
Dichlorobiphenyls	---------------	---------	EPA 680	EPA 680	EPA 680
Trichlorobiphenyls	---------------	---------	EPA 680	EPA 680	EPA 680
Tetrachlorobiphenyls	---------------	---------	EPA 680	EPA 680	EPA 680
Pentachlorobiphenyls	---------------	---------	EPA 680	EPA 680	EPA 680
Hexachlorobiphenyls	---------------	---------	EPA 680	EPA 680	EPA 680
Heptachlorobiphenyls	---------------	---------	EPA 680	EPA 680	EPA 680
Octachlorobiphenyls	---------------	---------	EPA 680	EPA 680	EPA 680
Nonachlorobiphenyls	---------------	---------	EPA 680	EPA 680	EPA 680
Decachlorobiphenyls	---------------	---------	EPA 680	EPA 680	EPA 680
Dioxins/Furans					
2,3,7,8-TCDD	EPA 1613B EPA 8290A	---------	EPA 1613B EPA 8290A	EPA 1613B EPA 8290A	EPA 1613B EPA 8290A
2,3,7,8-TCDF	EPA 1613B EPA 8290A	---------	EPA 1613B EPA 8290A	EPA 1613B EPA 8290A	EPA 1613B EPA 8290A
1,2,3,7,8-PeCDF	EPA 1613B EPA 8290A	---------	EPA 1613B EPA 8290A	EPA 1613B EPA 8290A	EPA 1613B EPA 8290A

Parameter/Analyte	**Tissue**	**Air**	**Nonpotable Water (*DW)**	**Solid Hazardous Waste**	
				Aqueous	**Solid**
2,3,4,7,8-PeCDF	EPA 1613B EPA 8290A	---------	EPA 1613B EPA 8290A	EPA 1613B EPA 8290A	EPA 1613B EPA 8290A
1,2,3,7,8-PeCDD	EPA 1613B EPA 8290A	---------	EPA 1613B EPA 8290A	EPA 1613B EPA 8290A	EPA 1613B EPA 8290A
1,2,3,4,7,8-HxCDF	EPA 1613B EPA 8290A	---------	EPA 1613B EPA 8290A	EPA 1613B EPA 8290A	EPA 1613B EPA 8290A
1,2,3,6,7,8-HxCDF	EPA 1613B EPA 8290A	---------	EPA 1613B EPA 8290A	EPA 1613B EPA 8290A	EPA 1613B EPA 8290A
2,3,4,6,7,8-HxCDF	EPA 1613B EPA 8290A	---------	EPA 1613B EPA 8290A	EPA 1613B EPA 8290A	EPA 1613B EPA 8290A
1,2,3,7,8,9-HxCDF	EPA 1613B EPA 8290A	---------	EPA 1613B EPA 8290A	EPA 1613B EPA 8290A	EPA 1613B EPA 8290A
1,2,3,4,7,8,-HxCDD	EPA 1613B EPA 8290A	-----------	EPA 1613B EPA 8290A	EPA 1613B EPA 8290A	EPA 1613B EPA 8290A
1,2,3,6,7,8-HxCDD	EPA 1613B EPA 8290A	-----------	EPA 1613B EPA 8290A	EPA 1613B EPA 8290A	EPA 1613B EPA 8290A
1,2,3,7,8,9-HxCDD	EPA 1613B EPA 8290A	-----------	EPA 1613B EPA 8290A	EPA 1613B EPA 8290A	EPA 1613B EPA 8290A
1,2,3,4,6,7,8-HpCDF	EPA 1613B EPA 8290A	-----------	EPA 1613B EPA 8290A	EPA 1613B EPA 8290A	EPA 1613B EPA 8290A
1,2,3,4,7,8,9-HpCDF	EPA 1613B EPA 8290A	-----------	EPA 1613B EPA 8290A	EPA 1613B EPA 8290A	EPA 1613B EPA 8290A
1,2,3,4,6,7,8-HpCDD	EPA 1613B EPA 8290A	-----------	EPA 1613B EPA 8290A	EPA 1613B EPA 8290A	EPA 1613B EPA 8290A
OCDF	EPA 1613B EPA 8290A	-----------	EPA 1613B EPA 8290A	EPA 1613B EPA 8290A	EPA 1613B EPA 8290A
OCDD	EPA 1613B EPA 8290A	-----------	EPA 1613B EPA 8290A	EPA 1613B EPA 8290A	EPA 1613B EPA 8290A
Total HpCDD	EPA 1613B EPA 8290A	-----------	EPA 1613B EPA 8290A	EPA 1613B EPA 8290A	EPA 1613B EPA 8290A
Total HpCDF	EPA 1613B EPA 8290A	----------	EPA 1613B EPA 8290A	EPA 1613B EPA 8290A	EPA 1613B EPA 8290A
Total HxCDD	EPA 1613B EPA 8290A	-----------	EPA 1613B EPA 8290A	EPA 1613B EPA 8290A	EPA 1613B EPA 8290A
Total HxCDF	EPA 1613B EPA 8290A	-----------	EPA 1613B EPA 8290A	EPA 1613B EPA 8290A	EPA 1613B EPA 8290A
Total PeCDD	EPA 1613B EPA 8290A	-----------	EPA 1613B EPA 8290A	EPA 1613B EPA 8290A	EPA 1613B EPA 8290A
Total PeCDF	EPA 1613B EPA 8290A	-----------	EPA 1613B EPA 8290A	EPA 1613B EPA 8290A	EPA 1613B EPA 8290A
Total TCDD	EPA 1613B EPA 8290A	-----------	EPA 1613B EPA 8290A	EPA 1613B EPA 8290A	EPA 1613B EPA 8290A
Total TCDF	EPA 1613B EPA 8290A	-----------	EPA 1613B EPA 8290A	EPA 1613B EPA 8290A	EPA 1613B EPA 8290A

Parameter/Analyte	**Tissue**	**Air**	**Nonpotable Water (*DW)**	**Solid Hazardous Waste**	
				Aqueous	**Solid**
Misc. Headspace Analysis					
Carbon dioxide	---------------	---------	RSK-175	RSK-175	---------------
Ethane	---------------	---------	RSK-175	RSK-175	---------------
Ethene	---------------	---------	RSK-175	RSK-175	---------------
Methane	---------------	---------	RSK-175	RSK-175	---------------
Hazardous Waste Characteristics					
Toxicity Characteristic Leaching Procedure	---------------	---------	------------------	EPA 1311	EPA 1311
Synthetic Precipitation Leaching Procedure	---------------	---------	------------------	EPA 1312	EPA 1312
Other					
Perchlorate	---------------	---------	EPA 6850	EPA 6850	EPA 6850
Hydrazine	---------------	---------	EPA 8315A MOD	EPA 8315A MOD	EPA 8315A MOD
Formaldehyde	---------------	---------	------------------	EPA 8315A	EPA 8315A
Methylhydrazine	---------------	---------	EPA 8315A MOD	EPA 8315A MOD	EPA 8315A MOD
1,1-Dimethylhydrazine	---------------	---------	EPA 8315A MOD	EPA 8315A MOD	EPA 8315A MOD
Volatile preparation	---------------	---------	EPA 5030A EPA 5030B	EPA 5030A EPA 5030B	EPA 5035 EPA 5035A
Organic extraction	EPA 3540C EPA 3546 EPA 3550B EPA 3550C	---------	EPA 3510C EPA 3511	EPA 3510C EPA 3511	EPA 3540C EPA 3546 EPA 3550B EPA 3550C
Perfluorinated Alkyl Acids (PFAAs)					
N-ethyl perfluorooctane-sulfonamidoacetic acid (NEtFOSAA)	---------------	---------	EPA 537 / 537 MOD (DW and NPW)	EPA537 MOD	---------------
N-methyl perfluorooctane-sulfonamidoacetic acid (NMeFOSAA)	---------------	---------	EPA 537 / 537 MOD (DW and NPW)	EPA537 MOD	---------------
Perfluorobutanesulfonate	---------------	---------	EPA 537 / 537 MOD (DW and NPW)	EPA 537 MOD	EPA 537 MOD
Perfluorodecanoic acid	---------------	---------	EPA 537 / 537 MOD (DW and NPW)	EPA 537 MOD	EPA 537 MOD

Parameter/Analyte	**Tissue**	**Air**	**Nonpotable Water (*DW)**	**Solid Hazardous Waste**	
				Aqueous	**Solid**
Perfluorododecanoic acid	---------------	---------	EPA 537 / 537 MOD (DW and NPW)	EPA 537 MOD	EPA 537 MOD
Perfluoroheptanoic acid	---------------	---------	EPA 537 / 537 MOD (DW and NPW)	EPA 537 MOD	EPA 537 MOD
Perfluorohexanesulfonate	---------------	---------	EPA 537 / 537 MOD (DW and NPW)	EPA 537 MOD	EPA 537 MOD
Perfluorohexanoic acid	---------------	---------	EPA 537 / 537 MOD (DW and NPW)	EPA 537 MOD	EPA 537 MOD
Perfluorononanoic acid	---------------	---------	EPA 537 / 537 MOD (DW and NPW)	EPA 537 MOD	EPA 537 MOD
Perfluoro-Octanesulfonate	---------------	---------	EPA 537 / 537 MOD (DW and NPW)	EPA 537 MOD	EPA 537 MOD
Perfluorooctanoic acid	---------------	---------	EPA 537 / 537 MOD (DW and NPW)	EPA 537 MOD	EPA 537 MOD
Perfluorotetradecanoic acid	---------------	---------	EPA 537 / 537 MOD (DW and NPW)	EPA 537 MOD	EPA 537 MOD
Perfluorotridecanoic acid	---------------	---------	EPA 537 / 537 MOD (DW and NPW)	EPA 537 MOD	EPA 537 MOD
Perfluoroundecanic acid	---------------	---------	EPA 537 / 537 MOD (DW and NPW)	EPA 537 MOD	EPA 537 MOD
8:2 Fluorotelomersulfonate	---------------	---------	EPA 537 / 537 MOD	EPA 537 MOD	---------------

* **DW noted in parenthesis for drinking water method**

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Environmental Quality Policy Manual

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Microbiology Technical Director
Quality Assurance Director
(as documented on page 1)

Table of Contents

Revision Log:

Revision: 14		**Effective Date:** This version
Section	**Justification**	**Changes**
Revision Log	Formatting requirement per 1-P-QM-QMA-9017356	Removed revision logs up to the previous version
Throughout document	Title change	Update QA Manager references to be QA Director
Throughout document	Clarification	General rewording for better clarity and flow of information
Section 1.3	Reflect current version	Revised mission statement
Section 1.4	Enhancement	Revised display of information
Section 2.4	Additional scope of document	Added service centers associated with Lancaster to the scope of this document
Section 2.6	Process change	Remove reference to quarterly reports as this information is communicated to management through different means
Section 2.11.1	Process change	Added "Note" regarding training for seasonal and temporary staff
Section 2.16	Unnecessary statement	Removed reference to Eurofins sister laboratories
Section 2.17	Clarification/Process change	Clarified that the Ethics Statement is signed annually Changed Ethics Committee to Ethics hotline service
Section 3.1	Changes to campus	Updated description of campus to reflect current state
Section 3.3	Clarification	Added IT systems to the areas addressed by disaster recovery
Section 3.4	Added information	Clarified actions taken if there are adverse environmental conditions in the facility
Section 4.2	Clarification	Added explanation for applying signatures electronically to document through the document control interface
Section 5.1	Added information	Revised to include information on the bottle lot checks
Sections 5.4 & 5.5	Enhancement	Added explanations of the bar code reading process used in sample tracking and the individual bottle code tracking
Sections 5.4, 6.1 & 6.3	Added information	Specified that samples and standards/reagents are stored separately.
Section 6.3	Updated requirement	Added information regarding the need for ISO Guide 34 and ISO 17025 approved materials.
Section 6.4.4	Clarification	Added notation for reporting noncompliant data when approved by the client and comments added to the report.
Section 6.5.1.2	Added information	Specified that passwords must adhere to the Eurofins Password Policy and must be "strong: passwords
Section 6.5.2	Enhancements	Added information on the software change request, periodic reviews and retirement documents. Generalized the explanation on validation plans.
Section 8.1	Reflects current process	Changed the listing of services to current offerings and updated the website link for certification
Section 10.1	Enhancement	Added Bottle orders and clarified to reflect current flow
Section 11.1	Clarification	Added ability of QA to stop work for critical internal audit issues
Section 11.2	Process change	Added electronic means of routing documents; removed quarterly report reference
Section 11.5	Unnecessary statement	Removed the need to stamp documents as confidential
Section 12.1	Clarification	Explanations added regarding actions for noncompliant QC data; removed quarterly report reference
Section 12.2	Updated process	Information on the ICAR process was revised to reflect the current practice using Jira
Section 12.3	Clarification	Added information regarding QA trend evaluation of client concerns and routing of the client satisfaction survey

Revision: 14	**Effective Date:**	This version
Section 12.4	Process change	Revised to remove references to the Ethics Committee and add information on the Ethics Hotline service; removed quarterly report reference
Section 12.4	Enhancement	Added information about use of Project Cycle to proactively ensure meeting the needs of the client
Section 13.4	Process change	Removed reference to subcontract warranty statement and added Laboratory Analytical Services Subcontract form
Appendices A-F and J-I	Updated for current information	Updated to reflect current SOPs, personnel, methods, etc.

Revision: 13	**Effective Date:**	Aug 8, 2014
Section	**Justification**	**Changes**
Revision Log	Formatting requirement per 1-P-QM-QMA-9017356	Removed revision logs up to the previous version
Throughout Document	Reflect re-identification of documents in EtQ	Replaced all prior Level 1, 2, 3, and 4 document numbers (analyses excluded) with EDR numbers
Title Page	Regulatory compliance	Added text for address, phone, reviewer/approver titles (previously listed on hardcopy covers and pre-EtQ versions)
Section 1	Updated training requirements	Removed requirement for all employees to read the appendices, they are available as resources; required for dept. 4052 only.
Section 1.2	Regulatory compliance	Inserted additional ISO17025 text at opening and closing of Quality Policy Statement
Section 2.1.1	New Section	Summarize processes to ensure business continuity and contingency plans
Section 2.2	Reflect current structure	Moved summation of technical director and QA manager to this section; changed employee responsible for daily operation from COB to VP. Throughout document, clarified management structure to include VP.
Section 2.6	Added process	Added ability for management and/or QA to issue a stop work notice.
Section 2.16	Regulatory compliance	Inserted additional ISO17025 text regarding ensuring impartiality, operation integrity, etc.
Section 3	Added building	Added building D
Section 4.2	Clarification	Noted that interim amendments to controlled procedures are not allowed.
Section 5.5	Added information	Noted that minimum sample retention period is 2 weeks form reporting
Section 6.4	Clarification	Standardized use or the terminology for equipment (supporting units) vs instruments (data producing units)
Section 6.5.1.9	New section	Added to address passwords and audit trails for systems used to process electronic data
Section 6.5.2	Clarification	Clarified SDLC processes
Section 8.1	Added information	Added reference to laboratory website for all current accreditation records
Section 10.2	Added information	Added information regarding electronic data, signatures, and audit trails
Section 10.4	Regulatory compliance	Added DoD reporting requirements for DL, LOD, LOQ
Section 10.5	Clarification	Clarified process and intent of data review
Section 10.7	Updated process	Added process for identification of accreditation status Noted use of LlabWeb for secure data transfer
Section 12.1	Added process	Added ability for management and/or QA to issue a stop work notice.

Revision: 13		**Effective Date:** Aug 8, 2014
Section 12.4	Clarification, new process	Clarified processes that address preventive action; changed “PPI” to “Lean”
Section 13.2	Clarification	Added detail on project evaluations
13.4	Added detail	Added information regarding the subcontractor warranty and the need to ensure subcontractor can meet accreditation requirements
Appendices A-J	Updated for current information	Updated to reflect current SOPs, personnel, methods, etc.

INTRODUCTION

This *Quality Policy Manual* is based upon Eurofins Lancaster Laboratories Environmental LLC's (herein referred to as the laboratory) overall business and management philosophies, mission, and goals. This manual is written to present the policies employed by the laboratory as well as the support departments that serve the environmental laboratories and to comply with the requirements of the National Environmental Laboratory Accreditation Program, ISO 17025, and the Department of Defense (DoD). These policies define the "what" we do with emphasis on management's responsibilities and commitment to quality. Governing SOPs are in place within the organization, to ensure the proper execution of this policy document (refer to Appendix A). This manual is required reading for laboratory personnel. The appendices are available resources to all personnel but are not required reading for all employees. The most recent and up-to-date *Quality Policy Manual* and all referenced documents are available to all laboratory personnel who work in or support the laboratory. The laboratory actively strives for continuous improvement of its quality systems to better serve our clients.

1.1. Mission Statement

The laboratory offers analytical and consulting services in the chemical and biological sciences with comprehensive expertise in environmental laboratory applications. The company mission statement describes the corporate philosophy:

At Eurofins Lancaster Laboratories, Environmental LLC we are people working together to serve the health and environmental needs of society through science and technology. We strive to be the recognized leader in all that we do.

Our mission is to provide independent laboratory services in the chemical and biological sciences with excellent quality and service. As a corporate community, we:

- Deliver quality by fully understanding and always meeting the requirements of those we serve.
- Live our values by relating to our clients, coworkers, shareholders, suppliers, and community in a fair and ethical manner.
- Manage our growth and financial resources so we can serve our clients well, provide a satisfactory return to shareholders, and maintain our meaningful and enriching workplace.

1.2. Quality Policy

The Executive Management Group recognizes quality as a key element of the laboratory's standard of service. The group supports the laboratory's commitment to quality as defined by NELAP, ISO 17025, DoD, and other regulatory agencies (i.e. states) through the strict adherence to the Quality Policy Statement. The Quality Assurance Director wrote the Quality Policy Statement, with final approval from the laboratory Vice-President. The policy cannot be revised without their approval.

The Quality Policy Statement gives employees clear requirements for the production of analytical data. Employees are trained on the components of the Quality Policy Statement during their first day of orientation. Each employee signs the statement upon hire as agreement to implement the policy in all aspects of their work. Employee agreement to any subsequent revisions of the statement is obtained by documented reading and understanding of an agreement to follow the Quality Manual, which contains the current version of the statement. The statement is as follows:

As an organization, all personnel are committed to high quality professional practice, testing and data, and service to our clients.

We strive to provide the highest quality data achievable by:

- Following all documentation requirements; describing clearly and accurately all activities performed; documenting “real time” as the task is carried out; understanding that it is never acceptable to “back date” entries and should additional information be required at a later date, the actual date and by whom the notation is made must be documented.
- Providing accountability and traceability for each sample analyzed through proper sample handling, labeling, preparation, instrument calibration/qualification, analysis, and reporting; establishing an audit trail that identifies date, time, analyst, instrument used, instrument conditions, quality control samples (where appropriate and/or required by the method), and associated standard material.
- Emphasizing a total quality management process and commitment to continuous improvement which provides accuracy, and strict compliance with agency regulations and client requirements, giving the highest degree of confidence; understanding that meeting the requirements of the next employee in the work flow process is just as important as meeting the needs of the external client.
- Providing thorough documentation and explanation to qualify reported data that may not meet all requirements and specifications, but is still of use to the client; understanding this occurs only after discussion with the client on the data limitations and acceptability of this approach.
- Responding immediately to indications of questionable data, out-of-specification occurrences, equipment malfunctions, and other types of laboratory problems, with investigation and applicable corrective action; documenting these activities completely, including the reasons for the decisions made.
- Providing a work environment that ensures accessibility to all levels of management and encourages questions and expression of concern on quality issues to management.

We each take personal responsibility to provide this quality product while meeting the company’s high standards of integrity and ethics, understanding that improprieties, such as failure to conduct the required test, manipulation of test procedures or data, or inaccurate documentation will not be tolerated. Intentional misrepresentation of the activities performed is considered fraud and is grounds for termination.

I understand the expectations and commit to implementation of all applicable policies and procedures and to providing quality data.

1.3. Statement of Values

Eurofins Lancaster Laboratories Environmental is a team of people who work together to serve the health and environmental needs of society through science and technology.

At Eurofins Lancaster Laboratories Environmental, our mission is to provide independent laboratory services in the chemical and biological sciences with excellent quality and service. We fulfill our mission by incorporating our values into our work every day.

As a corporate community, we embrace our heritage of integrity and strive to live by the following principles:

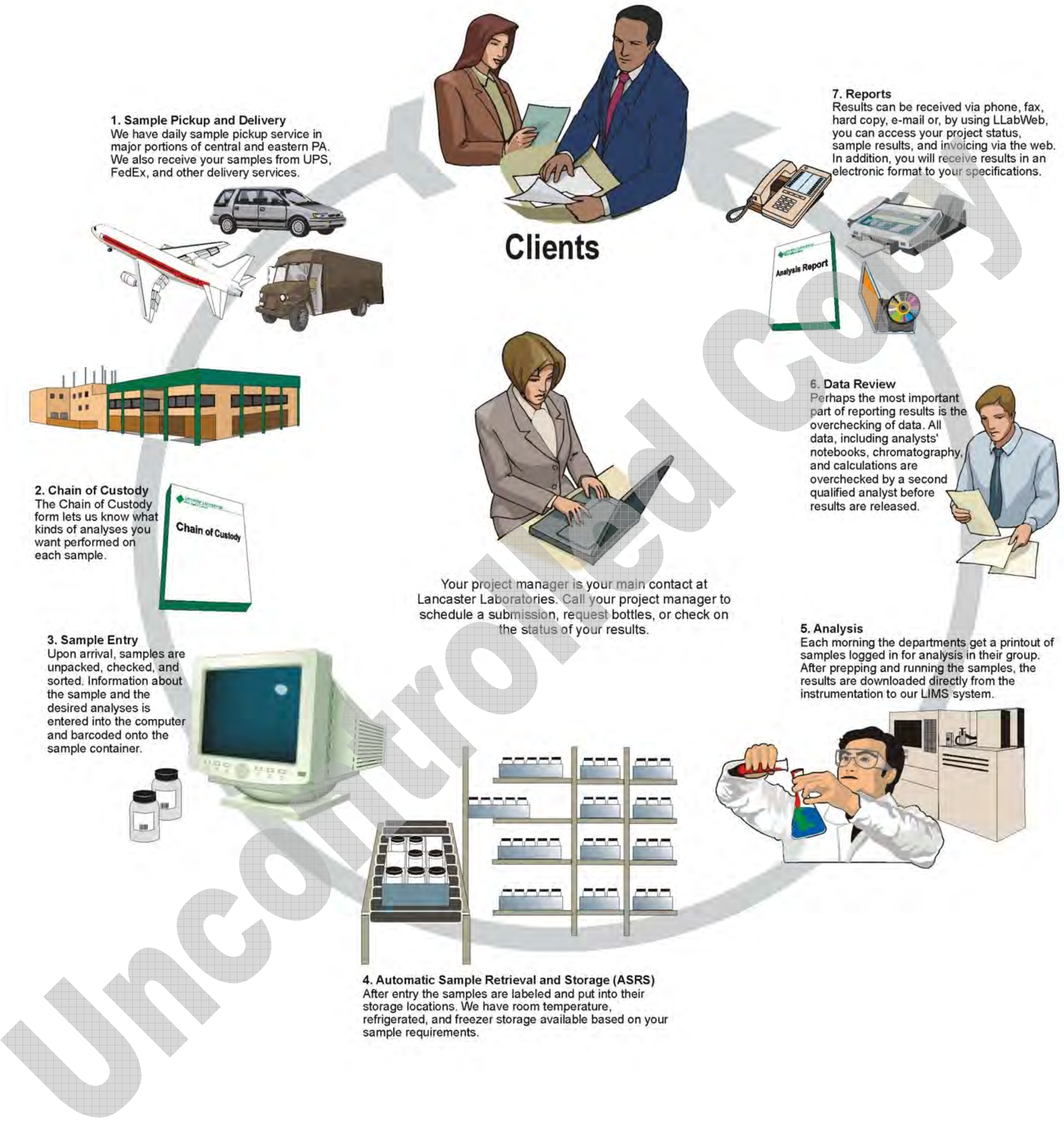
- Fairness and honesty in all our relationships
- Mutual trust
- A respect for ourselves and others
- A sense of caring that leads us to act responsibly toward each other and society, now and in the future
- Loyalty to our clients and one another
- A spirit of open-mindedness as we deal with all
- Dedication to service
- Good stewardship of our resources
- A commitment to flexibility and continuous improvement

We are committed to:

- Delivering quality by fully understanding and always meeting the requirements of those we serve.
- Living our values by relating to our clients, coworkers, shareholders, suppliers and community in a fair and ethical manner.
- Managing our growth and financial resources so we can serve our clients well, provide a satisfactory return to shareholders and maintain our meaningful and enriching workplace.

At Eurofins Lancaster Laboratories Environmental, we each take personal responsibility to live these values in all of our dealings, knowing full well that our pledge may involve difficult choices, hard work and courage.

1.4. Sample Flow-Through Diagram



1. Sample Pickup and Delivery
We have daily sample pickup service in major portions of central and eastern PA. We also receive your samples from UPS, FedEx, and other delivery services.

2. Chain of Custody
The Chain of Custody form lets us know what kinds of analyses you want performed on each sample.

3. Sample Entry
Upon arrival, samples are unpacked, checked, and sorted. Information about the sample and the desired analyses is entered into the computer and barcoded onto the sample container.

4. Automatic Sample Retrieval and Storage (ASRS)
After entry the samples are labeled and put into their storage locations. We have room temperature, refrigerated, and freezer storage available based on your sample requirements.

5. Analysis
Each morning the departments get a printout of samples logged in for analysis in their group. After prepping and running the samples, the results are downloaded directly from the instrumentation to our LIMS system.

6. Data Review
Perhaps the most important part of reporting results is the overchecking of data. All data, including analysts' notebooks, chromatography, and calculations are overchecked by a second qualified analyst before results are released.

7. Reports
Results can be received via phone, fax, hard copy, e-mail or, by using LLabWeb, you can access your project status, sample results, and invoicing via the web. In addition, you will receive results in an electronic format to your specifications.

Your project manager is your main contact at Lancaster Laboratories. Call your project manager to schedule a submission, request bottles, or check on the status of your results.

1.5. Certifications, Accreditations, and Registrations

Accreditation/Certification is the process by which an agency or organization evaluates and recognizes a laboratory as meeting certain predetermined qualifications and/or standards. It is the one generally accepted method by which a laboratory such as ours can demonstrate its capability of generating acceptable, professional, quality test results in those areas in which it claims competence. To this end, we have actively sought accreditation by organizations offering it in those areas relevant to our technical expertise. We strive to ensure that the facilities, equipment, procedures, records, and methods used by the laboratory in the testing of environmental samples are in compliance with the requirements of these standards.

Although organizations offering accreditation differ somewhat in the details of their programs, they generally evaluate laboratories in four basic areas: personnel (adequate staffing, education, training, and experience), physical facilities, instrumentation/equipment, and quality assurance program. This evaluation is performed by one or more of the following procedures: periodic on-site inspections of the laboratory by assessors experienced in technical operations, quality systems, and management; periodic analysis of proficiency test samples; and periodic updating of the laboratory's file to reflect changes in personnel, equipment, or services offered. Some states offer reciprocity with other state programs.

Appendix B lists accreditations and registrations held by the laboratory in support of environmental work. Current copies of all scopes of accreditation are available on the laboratory website and are kept on file in the Quality Assurance Department.

2. ORGANIZATION AND PERSONNEL

2.1. Company Overview and History

The laboratory was founded in 1961 by Dr. Earl Hess in response to a need for high quality technical services by the agricultural and industrial communities in southeastern Pennsylvania. Nourished in a culture of quality and caring about all those associated with the business, the corporation became an industry leader known for innovative business practices and people-friendly policies. The company was independently owned until the retirement of Dr. Hess in 1995. At that time, the laboratory was acquired by a publicly held company, Thermo TerraTech, Inc., a Thermo Electron company. Ownership changed in September 2000, when the laboratory was acquired by Goldner, Hawn, Johnson, and Morrison, Inc. (GHJ&M), a private equity investment firm. In August 2005, the laboratory was acquired by Fisher Scientific under their BioPharma Division. On November 9, 2006, Thermo Electron and Fisher Scientific merged to form Thermo Fisher Scientific. In April 2011, Thermo Fisher Scientific sold the laboratory to Eurofins Scientific. Effective July 1, 2013, the Pharmaceutical and Environmental Divisions were split into separate business entities and the company name became Eurofins Lancaster Laboratories Environmental, LLC. The laboratory continues to operate as an independent laboratory and is incorporated by the State of Delaware.

The laboratory provides a wide array of laboratory services to clients working in environmental industries. We strive to offer high quality technical services in the chemical and biological sciences with personal attention to client needs. These services include chemical analyses, microbiological testing, and analytical method development. We are, therefore, a technical service company and do not manufacturer or distribute goods. Our "product" is accurate and timely technical information and our continued existence depends on the quality of the services we offer and efficiency with which we deliver them.

2.1.1 Business Continuity and Contingency Plans

Various policies and practices are in place to address continuity of business and contingency plans to ensure continued operations or minimal disruption in operations should unplanned events (natural disasters, unexpected management changes, etc.) occur.

Section 2.2 of this document explains the identification of deputies for key management positions. Section 3.3 discusses the disaster recovery plan. Section 6.5 addresses the security and backup of our computer systems. Section 10.8 addresses handling of client records should the company have a change in ownership or go out of business.

2.2. Organizational Structure

The laboratory Vice-President/Technical Director, Duane Luckenbill, is responsible for the daily operations of the laboratory.

The Executive Management Group is defined as the Eurofins Environment Testing US Chairman of the Board and President and Eurofins Lancaster Laboratories Environmental, LLC Vice-President.

The management staff includes directors, managers and group leaders. Organizational charts are presented in Appendix C. A list of key personnel is also provided. The Vice-President and Quality Assurance (QA) Director have identified deputies for all key management personnel.

2.2.1 Technical Director

The Technical Director ensures that the laboratory's policies and objectives for quality of testing services are documented in this quality manual. The Technical Director must assure that the manual is communicated to, understood, and implemented by all personnel concerned.

2.2.2. Quality Assurance Director

The Quality Assurance Director ensures that the quality system is followed at all times. The QA Director reports directly to the Vice-President thus ensuring corrective actions to quality issues are taken promptly and are separate from business decisions. The QA Director has no direct supervisory responsibility for the generation of technical data to avoid any conflict of interest in administrating the QA program. The QA Director has the final authority to stop work that compromises our integrity or data quality. The situation must be investigated and appropriate corrective action must be put in place before the QA Director will authorize the resumption of work. The specific duties of the QA Director are communicated in job plan format.

2.3. Management Responsibilities

Laboratory management duties are outlined for supervisory personnel using a job plan format, which details each individual's responsibilities along with expected results. Typically, management duties include, but are not limited to:

- Personnel hiring and training
- Supervision of personnel
- Providing resources to ensure a work environment free from commercial, financial, and other undue pressures that may adversely affect the quality of their work
- Providing resources to ensure a safe work environment
- Directing daily work operations, including scheduling of work
- Ensuring compliance with the TNI Standards, ISO 17025, Department of Defense Quality Systems Manual, state agency programs, analytical methods, and client requirements.
- Assessing laboratory capacity and workload
- Resource allocation
- Ensuring quality of data produced
- Contributing to the continuous improvement of the laboratory operation
- Ensuring that corrective actions are carried out in an appropriate and agreed upon time-frame.
- Communicating problems and concerns to Senior and Executive Management to enlist a higher level of support for corrections and continuous improvements.
- Maintaining awareness of technical developments and regulatory requirements

2.4. Overview of the Quality Assurance Program

Quality Assurance (QA) is responsible for developing planned activities whose purpose is to provide assurance to all levels of management that a quality program is in place within the laboratory, and that it is functioning in an effective manner that is consistent with the requirements of NELAP, ISO 17025, DoD, and any other regulatory agencies (i.e. states) in which we hold accreditation. Although the laboratory is a wholly owned subsidiary of Eurofins Scientific, the Quality Assurance and Quality Systems operations described in this manual are specific to the Lancaster site and associated service centers.

The administration of the QA program is the responsibility of the QA Director in cooperation with all levels of management.

The QA program, as directed by executive management, was established to:

- Ensure accountability, accuracy, and traceability of all analytical data generated.
- Ensure that current regulatory, agency, and client requirements are being met.
- Ensure that operating procedures are in place to minimize the possible loss, damage, and tampering with data, in addition to ensuring that raw data is stored in a secured area and is maintained by designated archivists and/or system administrators.
- Ensure that curriculum vitae (CVs) and training records are maintained to document that staff members have the necessary education, training, and experience to perform their job responsibilities and functions.
- Ensure that regulatory training is provided to applicable employees on a routine and ongoing basis.
- Ensure that all procedures are available, controlled, and current.
- Ensure that documentation demonstrates that procedures are carried out in a compliant and effective manner.
- Ensure that all equipment and instrumentation is qualified, maintained, and calibrated, as appropriate, in accordance with written standard operating procedures.

- Ensure that all significant laboratory problems are investigated, evaluated for root cause and corrective action is put in place as documented
- Ensure that an internal audit program is in place to provide on-going monitoring and confirm that laboratory personnel are adhering to standard operating procedures and applicable regulations.
- Ensure that quality issues are brought to the attention of management in a timely manner.

2.5 Quality Assurance Responsibilities

The QA Director assigns tasks with input from the company Vice President. The primary responsibilities of QA include, but are not limited to the following:

- Oversee the laboratories' internal audit program which consists of various audit types and applies to all laboratory activities (technical and administrative).
- Review and approve standard operating procedures and analytical methods.
- Review and approve validation documentation.
- Review non-conforming quality control data
- Perform tracking and trending of quality measurements and report the status and effectiveness of the quality system to management.
- Approve investigation and corrective action reports (ICARs) and audit responses to ensure that they are completed in a timely manner, evaluated for root cause, that corrective actions are implemented as needed and to monitor corrective action for effectiveness.
- Host client and regulatory agencies during facility audits and follow-up to any cited deficiencies.
- Provide regulatory guidance to the laboratory and support areas.
- Monitor Good Laboratory Practice (GLP) regulatory activities.
- Communicate quality issues to management in a timely manner
- Provide and/or coordinate on-going regulatory training (e.g., GLP).
- Participate in the vendor and supplier approval process, including subcontractors.
- Review analytical data for compliance with our procedures.
- Prepare and review QA project plans (QAPPs) as required by EPA and client projects.
- Maintain and update this *Quality Policy Manual*.
- Maintenance of the Laboratory's accreditations, including but not limited to, administration of the proficiency test sample programs, both single and double blinds.
- Communicate (within 30 days) to the relevant state authorities when there are management or facility changes that impact the laboratory. Changes in the technical director must be communicated within 20 days.

2.6. Communication of Quality Issues to Management

The QA Department is responsible for preparing reports to Management to keep them apprised of outstanding quality issues. Reports to management foster communication, review, and refinement of QA activities to ensure that the QA program is adequate to meet regulatory and the laboratory's quality objectives. The following reports are used to communicate quality issues and include, but are not limited to:

- Internal, client, and agency audit reports and corrective action plans
- Proficiency test reports
- Investigation and corrective action reports
- Monthly quality status reports
- Plans for corrective action

Upon review of quality issues, management and/or QA may issue a stop work notice if an issue indicates the potential for a problem on a broader scale with an analysis. The investigation would need to be completed and the issue resolved before work could continue. The information is tracked through our Investigation and Corrective Action Report (ICAR) process.

2.7. Personnel Qualifications and Responsibilities

Full resumes and responsibilities of key personnel are provided in Appendix D.

Due to the number of analysts on staff, entry level chemists, technicians, and support personnel are not included in the resume section. However, all employees have job plans that define their responsibilities. Duties for these personnel typically include:

- Sample storage
- Sample preparations
- Performance of tests
- Calibration, operation, and maintenance of instruments
- Data entry
- Standard and reagent preparation
- Glassware preparation
- Data deliverables preparation

2.8. Relationship of Functional Groups and the Quality Assurance Program

In addition to this *Quality Policy Manual*, aspects of the QA program are documented in a series of standard operating procedures that support the proper execution of this document. Technical operation procedures with required quality components are also in place. A list of the titles of relevant SOPs is provided in Appendix E. There are a variety of mechanisms used to communicate requirements and verify compliance with the QA program, including:

- Management requires that all employees read and be trained in the policies and SOPs that are pertinent to their jobs.
- Employee job plans define individual responsibilities. All job plans include QA aspects, and performance is reviewed annually.
- Laboratory audit findings are circulated to management and require a response and follow-up to items needing corrective action.

- Cross-functional meetings, including representatives from QA, Client Services, Marketing, management, and technical operations are held regularly to review specific projects and quality issues.

2.9. Balancing Laboratory Capacity and Workload

Evaluating laboratory capacity to perform specific projects is the responsibility of the Vice-President, laboratory directors and managers, and the Client Services director and manager. These responsibilities are documented in the individual job plans for these positions.

The laboratory facilities and staff size are very large compared to other laboratories serving the environmental industry. Many analysts are cross-trained to perform a variety of tests, and there is redundant equipment available in case of malfunctions. This minimizes the need to evaluate small and medium size projects against capacity available to complete them. Large projects are reviewed against capacity estimates before bids are submitted to ensure that the client's analysis schedule is met.

Regularly scheduled meetings are held with upper management, laboratory middle management, Client Services and QA personnel to review progress with current projects, as well as special requirements of new work scheduled for the laboratory.

Laboratory capacity and backlog is tracked on a continuous basis using information from the Laboratory Sample Information System (LIMS) including turnaround time, and work in-house.

2.10. Identification of Approved Signatories

All data is reviewed and verified prior to release to the client. Based on complexity or regulatory needs, some projects are designated for secondary (technical and/or QA) review of the Analysis Reports and/or data deliverables. Approved signatories for these secondary reviews are defined in the SOP on Data Entry, Verification, and Reporting. Directors, managers, group leaders, and other designated employees (such as QA, project managers, and senior technical staff) are designated to approve/release Analysis Reports. Request for approval of an employee to approve/release reports must be made through the QA Department. These authorized personnel are designated with an asterisk in the personnel list provided in Appendix C.

2.11. Personnel Training

The experience and training received by personnel is of great importance to our clients and regulatory agencies. Curricula Vitae (CVs) and on-going training documentation are available to demonstrate how personnel have been prepared for the tasks they routinely perform. To ensure the highest quality of services at the laboratory, training programs and plans are developed to match skills with job functions. Accurate training documentation is the responsibility of both the employee and their supervisor. On a routine basis, the supervisor reviews and approves training documentation to verify that it is complete and current.

Training requirements can be met through education, prior job experience, internal and external training classes, on-the-job training, TRN training modules, procedure reading, or any combination thereof, to enable the person to perform assigned job functions and meet regulatory compliance.

Each analyst training to perform a new analysis is required to perform an initial demonstration of capability and meet the requirements for accuracy and precision before working independently on the test method. Typically, this is accomplished by the successful analysis of four known samples. However, there are certain tests performed that are not required by the mandated test method or regulation to perform the above procedure (i.e., EPA 1010, 9095). In this case, the analyst's documentation of proficiency is satisfied by the sign-off of having read, understood, and agreed to follow the SOP as written, on-the-job training and observation by a senior analyst.

Management personnel are responsible for planning ongoing professional growth and development activities for an employee through on-the–job training and/or internal and external training courses so an employee can maintain a current skill set to match job responsibilities.

An annual performance review based on job accountabilities, objective measures, and pre-defined standards is completed by management personnel for each employee. This assessment is documented and maintained. Input is obtained from other managerial personnel as needed.

2.11.1. New Hire Training

New employees are oriented as part of a year-long process that is designed to make the employee feel welcome and comfortable by defining our culture, traditions, philosophies, and work practices. During the orientation process an employee learns about personnel and safety policies and business strategies in addition to quality, ethics, and customer satisfaction expectations through a formal process administered by our Human Resources Department.

New employees are required to attend "core" technical orientation, as applicable, which can entail the participation in training module exercises, short session attendance, and/or other skill training specific to their assigned department or job function. Additional job-specific training required for an employee is based upon their assigned duties and is identified by their supervisor. Technical orientation occurs during the first few weeks of employment.

Note: Seasonal and temporary employees have reduced "core" training requirements based on the assigned tasks and as defined by QA, Safety, and the assigned department management.

The orientation process is designed to enable employees to initiate and take responsibility for their personal and professional career growth at the laboratory. The orientation process is conducted without regard to employee race, color, creed, national origin, sex, age, or disability in accordance with the laboratory's Employee Equal Opportunity (EEO) policy.

2.11.2. Ongoing Training

Refresher and ongoing training occurs through various means, which include but are not limited to, training in or independently review new/updated standard operating procedures and TRN training procedures; on-going regulatory training; in-house or off-site classes or seminars. The goal of this training is to ensure that employees remain current with changes to laboratory systems and practices, as applicable to their job function. Retraining and re-qualification activities occur as directed by procedures or regulations. Employees are retrained if an issue or investigation warrants that retraining is a necessary corrective action. Management directs when employee re-training is required, and the extent of the re-training.

2.12. Regulatory Training

The QA Department is responsible for coordinating and conducting initial and ongoing regulatory training (i.e., GLP) for all applicable laboratory and support personnel. It is the responsibility of management within each department to ensure that personnel attend the required training sessions.

The choice of training format and topics covered for ongoing regulatory training is left to the discretion of QA and the trainer. All training sessions reinforce the concepts in the regulations as they are relevant to the laboratory.

Whenever possible, after training is completed, a demonstration of proficiency of the training topic is given. The demonstration of proficiency is generally in the form of a quiz although other demonstrations of proficiency are acceptable depending on the scope and content of the training. If necessary, training is presented and/or repeated one-on-one with individuals who do not demonstrate proficiency in the training topic. This is performed by QA in conjunction with applicable laboratory management personnel.

2.13. Employee Safety

The laboratory, being mindful of its responsibilities as an employer and active corporate citizen, has established the following objectives of its safety program:

- Provide a safe environment for its employees, visitors, and the community surrounding its place of business.
- Provide ongoing safety training for employees.
- Provide all necessary facilities and equipment to ensure the safety of its employees and to minimize all chemical exposure during the normal performance of their required tasks, and to take all necessary precautions to safeguard the surrounding environment.
- Provide periodic health physicals for employees.
- Foster and encourage safe operations and a proper safety attitude on the part of our employees through general operations and systems, training, and the *Chemical Hygiene Plan* (CHP).

The CHP addresses various aspects of our safety program in greater detail.

A Safety Committee works to enhance our overall safety program. The committee meets on a routine and ongoing basis and its specific responsibilities are detailed below:

- Review accident and incident reports. Make recommendations for methods of prevention to eliminate further accidents.
- Promote safety awareness and distribute safety information by various means (e.g., posters, videotapes, pamphlets, and books). Use internal communication channels to promote safety awareness.
- Enhance and recommend safety-training programs for all employees, as necessary.
- Maintain up-to-date information on employee concerns that are safety related. Offer input and information to the Chemical Hygiene Officer and/or Safety Officer, as needed.

2.14. Client Services/Project Management Responsibilities

Members of the laboratory Client Services/Project Management Group are responsible for organizing and managing client projects. Clients are assigned a project manager (a.k.a. "CSR") who serves as their primary contact at the laboratory. It is the project manager's responsibility to act as the client advocate by communicating client requirements to laboratory personnel and ensuring that clients provide complete information needed by the laboratory to meet those requirements. All client verbal communications are documented by the project manager in a controlled notebook. In addition to information management, Project Management responsibilities include:

- Coordinating and preparing proposals in conjunction with technical staff.
- Confirming certification status.
- Hosting client visits and audits.
- Coordinating and communicating turnaround time (TAT) requirements for high priority samples/projects.
- Answering common technical questions, facilitating problem resolution.
- Providing clients with sample status report or results (partial reports) prior to receipt of the final Analysis Reports (e.g., fax, e-mail, phone).
- Scheduling sample submissions, sample containers, and sample pick-up via the laboratory courier service.
- Informing the client of deviation from their contract.

2.15. Confidentiality

Strict confidentiality is maintained in all of our dealings with clients. Confidentiality agreements, therefore, are willingly provided.

All employees are required to protect company technical data, including client names and test results from disclosure to any third party. This policy, as described in the *Eurofins Lancaster Laboratories Employee Handbook*, is provided and presented to employees during their orientation period and whenever revisions are made.

Intellectual property associated with the testing that we perform under contract for a client is the property of the client.

In an attempt to ensure the confidentiality of our systems and procedures within our laboratory, it is our policy to restrict the distribution of our internal procedures to clients. Clients are permitted to review our procedures while on-site as part of an audit or visit. Based on this policy, we would request that any documents viewed would not be shared or made available to any third parties without the permission of the laboratory.

2.16. Business Conduct

Our business conduct policy applies to all operations of the company. All employees must avoid involvement in any activities that would diminish confidence in their competence, impartiality, judgment, or operational integrity. All employees must further avoid any relationship with other individuals or organizations that might impair, or even appear to impair, the proper performance of their company-related responsibilities. Employees must avoid any situation that might affect their independence of judgment with respect to any business dealings between the company and any other organization or individual. Any employee who believes that they have such a conflict, whether actual or potential, or who is aware of any conflict involving any other employee must report all pertinent details to the Vice-President or President of the company. The company's management vigorously enforces this policy and takes prompt and appropriate action, including termination, against any employee found to be in violation.

2.17. Operational Integrity

All employees review and sign the Employee Ethics Statement on their first day of employment and annually thereafter. Employees responsible for generating, handling, or reviewing laboratory data understand that the laboratory mission is to perform all work with the highest level of integrity. Under no circumstances are shortcuts or generating results to suit a client's purpose rather than good scientific practice considered acceptable. Any violation of the laboratory ethics policy results in a detailed investigation that could lead to termination.

All levels of management consider the following activities unacceptable:

- Knowingly recording inaccurate data.
- Fabrication of data without performing the work needed to generate the information. This includes creating any type of fictitious data or documentation.
- Time travel or adjusting clocks on computerized systems to make it appear that data was acquired at some time other than the actual time.
- Manipulation of data for the express purpose of passing system suitability or quality control criteria.
- Selective use of data generated, or not using data that was legitimately generated and has an impact on the outcome of the test.
- Executing significant deviations from approved test methods and procedures without prior approval from the laboratory management and/or the client.

If an issue does arise which could compromise data integrity, personnel are instructed to perform the following activities:

- Clearly document the situation and maintain all data generated. There is a big difference between poor judgment and fraud. Fraud usually involves intent to conceal an action taken. Therefore, the more documentation that is maintained, the less likely an action is considered fraudulent if further scrutinized.
- When out-of-specification results or quality type issues are detected, all supporting data and relative background information must be documented and presented for management review. Problem resolution and client contact, as applicable, must also be documented.
- Review any questionable situations and decisions with a supervisor.

- Bring a questionable or uncomfortable issue directly to the QA Director or a member of the QA Department as part of our QA open door policy.
- Utilize the company's anonymous Ethics hotline service. See Section 12.4 of this manual.

3. BUILDINGS AND FACILITIES

3.1. Facility

The laboratory is located at 2425 New Holland Pike, Lancaster PA. The facility consists of two campuses with multiple buildings located on the North and South sides of Route 23. The two campuses are connected by a pedestrian bridge that spans Route 23.

Building A resides on a commercial plot measuring 13.6 acres on the north side of Route 23. Building A is a three-story building of concrete and steel construction which houses both laboratory space and administrative offices. It is approximately 108,000 square feet and consists of approximately 47,000 square feet of laboratory space; 29,000 square feet of office space; and 32,000 square feet of storage, mechanical, and common areas. On this parcel, adjacent to Building A, sit two chemical storage buildings (Buildings I and L) with a total space of 2500 square feet. In addition, a 10,500 square foot storage building houses stability chambers (Building J). The bottles packing area, which includes preservation of bottles being sent to clients for sampling, is located in a separate 3100 square foot building (Building K). In addition, there are two other buildings (Buildings G and H) with a total square footage of 20,000 square feet that host recycling, storage, workshop and facilities maintenance areas.

The remaining buildings reside on a commercial plot measuring 35.7 acres on the south side of Route 23. These building are connected to the north campus buildings via a pedestrian walkway over the highway.

Building B is a three-story building of steel and concrete construction. It is approximately 56,000 square feet and consists of approximately 17,000 square feet of laboratory space; 14,000 square feet of office space; and 25,000 square feet of storage, mechanical, and common areas.

Building C resides between buildings B and D and consists of a three-story building of steel and concrete construction. It is approximately 47,000 square feet and consists of approximately 25,000 square feet of laboratory space; 6,900 square feet of office space; and 15,100 square feet of storage, mechanical, and common areas. The first floor houses the main lobby and visitor's entrance.

Building D is connected to building C. It is a 78,000 square foot, four-story building of steel and concrete construction and provides approximately 35,000 square feet of laboratory space, 19,000 square feet of office space, and 24,000 square feet of storage, mechanical, common area.

Two small support buildings (Buildings E and F) with a combined space of approximately 800 square feet are used for chemical and waste storage on the south campus.

The Lancaster campus also utilized an adjacent parcel for a technical training center. This space is approximately 6,500 square feet.

There is an automatic fire alarm and security system hooked up at the facility. This system is monitored offsite by Choice Security. The entire campus and all exterior doors are monitored by video surveillance.

This facility is serviced by public sewer. Drinking water comes from a private well while the facility sprinkler system is fed by the public water supply. The closest surface water is the Conestoga Creek.

3.2. Security

The laboratory is considered a secure facility. All outside doors except the main lobby entrance are locked during normal business hours to prevent unauthorized entry. An attendant monitors this entrance at all times.

During evenings, weekends, and holidays, all doors are locked and Security personnel are on site to prevent unauthorized entry into the building. Video cameras are utilized by Security personnel to monitor the facility grounds.

Every employee is issued a photo ID badge which also serves as a building access card. This badge must be worn at all times while on laboratory property so that employees are easily identified. Access to secured/designated areas within the building is limited to only applicable employees through the building security system. This system is administered by Security staff.

All visitors must register with the lobby attendant and are issued a visitor badge. A staff person must accompany visitors while in the facility. Additional visitor rules are outlined in the *Visitor Security and Safety Rules* pamphlet which is provided to all guests.

Building access cards are issued on a temporary basis to contractors or service technicians (e.g., electricians and plumbers) who need access to the building to work on a project. These cards provide the contractor with limited access during the normal workday and must be returned when the work is complete.

3.3. Disaster Recovery

A disaster recovery plan is in place to provide direction for situations where normal operations of the laboratory are not possible. In the event that the building or information technology (IT) systems would be severely challenged, a designated disaster recovery team, which includes Physical Services, Maintenance, Safety, Corporate Management, Public Relations, IT, QA and other applicable personnel depending on the scope of the disaster, would assemble at a designated area to assess the situation and formulate a plan.

The plan addresses, in general terms, how to approach the following issues: electrical failures, heating/air conditioning failures, fire/building evacuation, computer failures, hazardous material spills, injury to employees, pandemic flu, disruption of phone service, and stability chamber failures.

3.4. Environmental Monitoring

The air handling system for the main laboratory is specially designed to protect sensitive instruments from harmful vapors to ensure that samples are not contaminated. The Physical Services/Maintenance Group is responsible for maintaining the HVAC and exhaust hood systems. This is particularly important in our instrumentation rooms and computer center where a controlled environment, positive pressure system is maintained.

Most refrigerators, freezers, incubators, and ovens used for analysis are monitored by a computerized system equipped with stationary thermometer temperature probes linked to a master panel that is accessed through a computer. If a unit is outside of a predefined temperature range for a specified period of time, the system alarms. Units not on the computerized system must be monitored manually by recording thermometer temperature readings twice daily.

The laboratory is set up so that there is effective separation between neighboring areas in which there is potential for contamination. Laboratory storage blanks are also used to evaluate conditions under which samples for volatile analysis are stored to monitor for cross-contamination potential. QA provides oversight of the environmental monitoring system.

QA and technical management, in consultation with facilities management as needed, evaluate any issues with environmental conditions that could have adverse effects on data to determine if alternative operational plans (moving testing to alternate laboratories, temporary shutdowns, etc.) need to be employed.

3.5. Water Systems

Well water and the public sewer system service the facility. The water system is monitored to meet the permit requirements of the Pennsylvania Department of Environmental Protection.

Reagent water is available to analysts for sample preparation (including dilution) and glassware cleaning. Two reverse-osmosis deionized water systems deliver highly purified water to a sealed fiberglass storage tank. From the storage tank the water is delivered to an ion-exchange-carbon filter system for further polishing. The water is also exposed to an in-line ultraviolet sterilization lamp before being circulated to taps throughout the laboratory.

Daily monitoring and preventive maintenance for the system is the responsibility of the Physical Services Department. Monthly and annual testing is performed as required by regulatory guidance. QA provides oversight of the water system monitoring. In addition, method blanks are tested with each batch (≤20) of samples.

3.6. Housekeeping/Cleaning

The laboratory is dedicated to providing a clean workplace. A third party professional cleaning service provides routine cleaning of “common areas” that include lavatories, drinking fountains, floors, and windows. Technical staff are responsible for the cleaning (or the contract of cleaning) of specific laboratory work areas.

Detergents used for cleaning contain no to very low levels of metals, pesticides/herbicides/ fungicides, or volatile solvents.

3.7. Insect & Rodent Control

Steps are taken to prevent, monitor, and control insect and rodent infestation. The coordination of this program is the responsibility of the Physical Services Department under the direction of QA. An outside service firm is contracted to perform routine and ongoing monitoring of the facility to ensure that preventive measures which are in place are effective and are working as intended.

No insect or rodent control chemical agents in a liquid or vapor form are applied or sprayed in any laboratory building, unless there is no other option, in which case department management must be contacted for approval.

3.8. Emergency Power Supply

The laboratory is located at the junction of two power grids that supply electrical service to the facility. If one of the power grids fails, we have the ability to work with the power company to have service switched to the other grid. Various types of diesel and natural gas generators are also available on a standby basis to supply power to selected areas of the laboratory in case of a power outage.

To reduce spikes and spurious line voltage changes to laboratory instruments that can affect results or damage electronic equipment, “conditional power” is fed to these sensitive instruments. All essential computer systems are on uninterrupted power supply (UPS) which is a battery system that provides continuous conditional power for a limited time period in the event of a short power outage.

3.9. Facility Changes

Procedures are in place to manage change, ensure communication, and to minimize negative consequences through active participation of personnel involved in a facility change. The goal is to ensure that physical and environmental condition changes are adequately evaluated for impact and reduction of risk to quality, safety, health, employee, environment, property, analytical services, and business operations before and after the change is implemented.

4. DOCUMENT CONTROL

The administration of the document control system including tracking, filing, updating, and archiving of historical copies is the responsibility of the Office Services (OS) Department.

It is our policy to restrict the distribution of our internal procedures to clients and we discourage the distribution of company confidential documents outside of the facility. Clients are permitted to review our procedures while on-site as part of an audit or visit. Any documents that are distributed are only sent with the approval of QA.

The goals of the document control process are:

- Format documents according to consistent and defined standards
- Review and approve new documents
- Schedule review of existing documents
- Control of document versions and effective dates
- Review and approval of document changes
- Control document distribution and removal of obsolete documents
- Archive and protect obsolete documents

4.1. Hierarchy of Internal Operating Procedures

The hierarchy of controlled procedures at the laboratory is defined. These procedures and documentation are made available to promote consistency throughout the organization and to meet regulatory requirements. A list of relevant methods and procedures is located in Appendix E. The development of new procedures and the updating and reclassification of current procedures is an ongoing project.

4.1.1. Level 1 – *Quality Policy Manual* and Company Policies

The intent of these documents is to define "what" we do with emphasis on Executive and Management's responsibility for quality.

The purpose of the *Quality Policy Manual* is to provide a framework to outline the quality systems at the laboratory. Organizational charts, list of SOPs, a list of equipment, instrumentation, and personnel resumes are included as attachments to this manual.

- Executive Management is responsible for ensuring that adequate personnel, resources, and support are available to carry out the requirements of this *Quality Policy Manual*.
- Management is responsible for ensuring that SOPs or other appropriate documents are written and available to personnel to define the practices and systems which support these policies.
- All employees are responsible for conducting business in a manner which is compliant with quality and company policies and associated SOPs or other appropriate documents. Review of these policies and procedures must be documented.

Additional company policies are written to support and expand upon this *Quality Policy Manual*. These policies contain more detailed information about a subject with approval signatures executed at the Executive and/or Management level.

4.1.2. Level 2 – Standard Operating Procedures

The intent of these standard operating procedures is to define "who, what, where, and when." These procedures provide specific information for a process or topic so that the requirements outlined in this *Quality Policy Manual* and company policies can be achieved. The review and approval of these SOPs is performed at the director/manager/group leader level, including QA review and signoff, and the responsibility of these SOPs lies with the area or person directing the operation.

SOPs can apply to site-wide operations, the entire company, across multiple departments, or a specific operating area.

4.1.3. Level 3 – Work Instructions (at a departmental level)

The intent of these procedures or documents is to define in greater detail the specific "how to". The level of detail in these documents must be sufficient so any appropriately trained person can perform the task accurately. Examples include, but are not limited to standard operating procedures (SOPs); maintenance and calibration procedures; and the laboratory analytical methods. Departmental level procedures/documents are reviewed and approved at the manager or group leader level including QA review and signoff.

4.1.4. Level 4 – Quality Records

The intent of these documents is to provide documented evidence to support our quality systems and operations. Examples include but are not limited to, data notebooks/logbooks, and preformatted data recording forms.

4.2. Document Approval, Issue, Control, and Maintenance

The document control process ensures that documents are approved and adequate for use. It ensures that documents are readily available to personnel and at locations where essential operations are performed.

Procedures are available in electronic form on the company's intranet site through our document management system. The Document Control Group maintains this system in a current and accurate state. These procedures can be printed from this system for reference by employees as the corresponding task is being performed. Prior to using a printed document, the employee must ensure that it is the current version.

Each procedure is uniquely identified and includes effective date, revision identification, and page numbering (total number of pages). All documents are searchable and uniquely identified in the document management system.

Controlled policies, procedures, and work instructions are reviewed and approved by appropriate individuals and are formally issued and administered through the Office Services Group. The review and approval signatures are applied as electronic signatures through the document control interface. Application of the signature is through secure log-in and password and can only be applied by those designated for the review or approval of the individual document.

Word versions of each procedure can be accessed within the document management system by designated personnel within the Document Control group. A PDF copy is maintained on a separate limited access server as a back up to the system.

Procedures undergo scheduled periodic review to ensure that they are accurate, current, and compliant. The frequency of review is either annual or biennial, depending on the procedure. QA is the final signature on procedures which gives QA the authority to implement the procedure; the exception is the Quality Assurance procedures for which the Vice President or his designee is the final signature. Upon the effective date of new or updated documents, all copies of obsolete documents are removed from service. The original historical copy of each outdated/obsolete procedure is clearly identified as a historical version and maintained in a permanent archive file separate from any current versions. (Note: OH EPA is required to review all revised documents applicable to its certification prior to the document being made effective).

Interim amendments to procedures are not allowed. Any needed changes require a revision to the document.

4.3. Client-Supplied Methods and Documentation

Client documentation to support environmental testing at the laboratory is maintained in a centralized area. This information is organized by client/project in the Client Services/Project Management Group. Client documentation includes the following information depending on project size and scope:

- Client supplied analyte lists
- Client supplied project plans
- Client contract quality manuals with specified limits, QC criteria, etc.
- Communication/correspondence records which relate to testing requirements, interpretation of results, or reporting formats

4.4. Laboratory Notebooks, Logbooks, and Forms

Procedures are in place to ensure that all data is traceable, authentic, complete, and retrievable. The following general requirements outline our system for the issuing, control, and archival of laboratory notebook and logbooks.

- The administration of notebooks and logbooks is controlled by the Office Services Group. They maintain a master index to uniquely number and identify each book distributed.
- Notebooks and logbooks can contain blank or preformatted pages.
- Notebooks and logbooks are bound, uniquely identified and have sequentially pre-numbered pages.
- If notebooks or logbooks contain preprinted laboratory form pages:
  - A unique identification number is assigned to each form
  - Forms are approved by appropriate management personnel before they are put into use
  - Forms are reviewed on a routine basis to ensure they are still accurate and current
- Completed notebooks are returned to an archivist. Incomplete books are returned to Document Control:
  - Two years from the issue date
  - for employee specific notebooks – when the employee leaves the company
  - for project specific notebooks – when the project for which it was used is complete
- In specific situations, records are bound to create books at the time of archival (e.g., temperature charts).
- At the time of archival any page(s) in the notebook or logbook that does not contain data documentation is crossed-out or a statement is written on the last page used to note that the book is complete to prevent data from being entered at a later date.
- Notebooks and logbooks identified as requiring permanent archival are assigned a designated qualifier.

4.5. Control of External Documents

Hard copy versions of external documents are controlled through the form system.

External documents such as copies of the 40 CFR and ASTM methods are stored exclusively in the QA Department. QA also keeps applicable agency documents on file, these include, but are not limited to, the TNI (The NELAC Institute) and ISO 17025 standards.

Environmental methods from the EPA or Standard Methods are available in the QA Department, but the technical areas also have copies that pertain to the tests that they perform. Any external document that is maintained in these areas must be inventoried and listed on a controlled form. Some methods are available on-line and are accessed through the Internet.

It is the laboratory's understanding that the need to control external documents is to ensure that the most current version of a method is referenced or appropriate manual is being used. Regulatory methods are used as references by the laboratory and testing is performed as per written SOPs that fall under our existing document control system and have scheduled reviews. The scheduled review of SOPs is used to ensure that the proper version of a method is referenced. While using the most current version of an analytical method is our typical practice, there are specific client needs and accreditation rules that require previous versions of a method to be used.

The technical areas are responsible for ensuring that all manufacturers' manuals are current and available to analysts. The vendor provides instrument manuals when new equipment is purchased or existing instruments are updated. These manuals are kept with the instruments to which they are associated.

5. SAMPLE HANDLING

5.1. Sample Collection

It is the responsibility of the client to send us representative and/or homogeneous and properly preserved samples of the system from which they are drawn. The laboratory assumes that all multiple sample containers with the same designator/description and bottle type contain a homogeneous, representative sample. We also assume that it is acceptable to deplete one container and move to the next, without implications unless otherwise indicated by the client.

The laboratory provides the appropriate sample containers, required preservative, chain-of-custody (COC) forms, shipping containers, labels, and custody seals. The laboratory also provides trip blanks and analyte-free water for field blanks. Preparation of methanol containers for field preservation of volatile soil samples is available.

Sample containers are purchased pre-cleaned by the supplier. For pre-preserved bottles, each lot of preservative is checked for contaminants before use. This also serves as a check on the associated containers. An annual bottle lot check is performed to evaluate the cleanliness of any containers not already covered by the preservative checks. The evaluation is to assess cleanliness to the laboratories' detection limits. These checks are processed through the LIMS as samples. Results are documented through the LIMS Analysis Report.

The laboratory provides instructions with all bottle orders that define how to sample, preserve, store, and ship the samples prior to their delivery at the laboratory. These instructions inform the client of the importance of proper sampling and advise them that non-compliant samples are rejected or reported with a qualifier.

If samples are collected by the laboratory personnel, applicable sampling methods are in place to perform the sampling operation.

As samples are analyzed at the laboratory, there are times when additional sample volume is necessary to complete testing or perform retesting. If this situation arises, "additional sample" is requested by the laboratory and/or submitted by a client to supplement current work being performed within our facility. Additional sample received is either assigned a new laboratory sample ID number and/or a comment noted on the final report to state that additional sample was received, depending on the situation. It is our goal to provide accurate traceability between sample submission and when testing is performed.

5.2. Sample Receipt and Entry

5.2.1. Sample Receipt

Samples can be received at the laboratory 24 hours a day, 7 days a week, 365 days of the year. Receipt can occur in one of three ways:

- The laboratory courier services (i.e., Transportation Department)
- Personal delivery
- Commercial courier

All samples received for testing are delivered to the Sample Administration Department immediately upon arrival. This group is responsible for the unpacking and organizing of the samples. This process includes checking custody seals if present, paperwork agreement, signing the chain of custody, recording cooler temperatures, documenting the condition of containers, accounting for all sample bottles, and observing any safety hazards, and reporting any problems to Client Services for communication to the client. This receipt process is documented in the LIMS.

5.2.2. Sample Entry

As soon as practical after sample receipt, all samples are entered into our LIMS. Samples awaiting log-in are stored in temporary holding areas, at appropriate storage conditions to maintain sample integrity. Samples scheduled for Volatile analysis are stored separately. If there is doubt about the suitability of items received or if items do not conform to the description provided or the testing required is not clear or specified, the client is contacted and the conversation documented.

At the time of entry, the LIMS assigns a unique laboratory sample number to each sample. This number is sequentially assigned and a label is generated and is attached to the sample container.

Samples are tracked to the minute upon arrival. This allows the client to see exactly how long it took the samples to pass through receipt, unpacking, and entry.

A sample acknowledgement is generated from the LIMS per sample entry group. Upon request, a copy of the Acknowledgement may be sent to the client on the day following sample log-in to confirm sample receipt and entry. Internally, appropriate personnel audit all applicable sample entry and client paperwork.

5.2.3. Sample Preservation Check

Support personnel check and document preservation of non-volatile liquid samples after the samples have been entered into the LIMS and before they are placed into storage. Any checks of volatile samples are performed and documented at the time of analysis.

5.2.4. Sample Rejection Policy

Any time a sample is received in a condition that does not meet the method, regulatory, or client requirements, the condition of the sample is clearly documented through the LIMS on a sample administration documentation log or sample problem form. This information is forwarded to the CSR and the client is contacted to discuss the best course of action. The client is given the option to resample or have the sample analyzed and reported with a comment.

5.3. Sample Identification and Tracking

A sample label is generated for each sample and, in addition to the assigned unique sample number, the following information is displayed on the label: client name, sample identification assigned by the client, sample collection information, bottle code ID, analyses requested, and any applicable notes to laboratory personnel. The label includes a barcode that is used to track this information about the sample/container and to trace each container's storage location.

To ensure accountability of results, the unique sample number assigned is used to identify the sample in all laboratory data documentation, including notebooks, instrument printouts, and final reports. The sample number is also used to identify additional containers of the sample that are created during sample preparation and analysis (e.g., subsamples, extracts, digests). Each container for a sample is tracked through the bottle code and an A.B.C… designator when there are multiple containers of the same type received. The link of the bottle code and sample number is used to identify which specific container was used for testing.

Routine sample tracking is documented using the Laboratory Sample Analysis Record (LSAR) which captures the date, time and analyst for each sample preparation and analysis. The information is compiled in the LIMS using electronic record tracking from the data upload and entry functions. This displays, per sample, on each Analysis Report.

5.4. Sample Storage

After sample entry, samples are placed in an assigned and identified storage location until needed for analysis. Room temperature, refrigerated, and frozen storage are available and samples are stored in accordance with regulatory, method, or client direction. The LIMS is used to assign storage locations, which assists in the orderly storage of samples. Sample storage locations are secured and monitored for accurate temperature control. Samples are stored separately from standards and reagents.

The central locked storage facility contains 3430 square feet of refrigerated space, including 2740 square feet equipped for automated sample retrieval. Samples are stored in the laboratory's automated storage and retrieval system (ASRS) or other assigned storage locations (separate volatiles areas) within the laboratory until completion of all analytical work.

When a sample is scheduled for analysis, the analyst requisitions it through the LIMS from the storage area. Barcode readers are used for LIMS documentation of the movement of the samples between storage and the laboratories. To maintain the integrity and security of the sample(s), the aliquot needed for analysis is removed and the sample(s) returned to storage as soon as possible

5.5. Sample Return/Disposal

Samples remain in the storage area following analysis until the testing results have been verified and the analysis report has been generated. On a regular basis, a list is generated from the LIMS that summarizes samples that can be removed from the storage area. At a minimum, water samples are held for 1 week and soil samples for 2 weeks after reporting before they would be eligible for disposal. Samples are either returned to the client or disposed of in accordance with local, state, and federal regulations. Removal of the containers from storage for permanent discard is also documented in the LIMS using the barcode reader.

Due to the variety of waste generated at the laboratory, several general categories of wastes and waste streams have been identified. Identification of waste occurs through information provided by the client, historical information, and/or analytical testing. The laboratory uses a sophisticated, computerized LIMS, which includes programming to assist in the identification of hazardous wastes at time of discard.

For reasons of environmental liability, client confidentiality, proprietary product formulation protection, etc., wastes generated by the laboratory are disposed of via incineration at EPA licensed facilities. The three exceptions include bulk neutralized acid waste, COD analysis waste, and lab pack waste containing mercury. None of these exceptions involve containers with client information.

5.6. Legal Chain of Custody

Samples being tested for litigation require locked storage and documentation of the time and personnel responsible when the sample was not in storage. This level of documentation is available upon client request and procedures to define these activities are in place and include the following:

- A chain-of-custody document is initiated for each bottle type submitted by the client.
- The chain of custody is signed each time the sample is stored, removed from storage, or changes hands.
- Clients requesting internal chain-of-custody documentation receive the completed forms after the analysis is complete.

5.7. Representativeness of Samples

Each analytical method provides specific procedures for ensuring that a representative aliquot of the sample is used for testing. These procedures include shaking water samples and mixing solid samples prior to removing an aliquot for testing. Analysts are also instructed in sampling techniques that prevent contamination of samples.

6. TECHNICAL REQUIREMENTS – TRACEABILITY OF MEASUREMENTS

6.1. Reagents and Solvents

The reliability of our analytical results can be directly affected by the quality of reagents used in the laboratory. Procedures are in place to address labeling, storage, and evaluation of these materials. Reagents and solvents include acids, bases, indicators, buffer solutions, colorimetric solutions (CS), test solutions (TS), and volumetric solutions (VS). The *Chemical Hygiene Plan* provides safety information in regard to the storage and handling of laboratory chemicals. All reagents are stored separately from samples.

Each analytical method includes a list of reagents needed to perform the test. Reagents/solvents are fully described, including chemical name, purity, and description of preparation. Where applicable, shelf life and storage conditions are also listed. The laboratory is responsible for checking that new supplies meet the method requirements. These checks are documented and maintained.

Departmental management ensures that an adequate inventory of reagents needed to perform testing is maintained. Reagents received at the laboratory funnel through the Shipping and Receiving Department and deliveries are verified and labeled with the date of receipt. Large volume reagents (e.g., solvents, acids) are stored in a building outside of the laboratory until needed for use.

In addition to the name and concentration of the reagent, all reagents are labeled with the manufacturer/vendor, storage conditions, the date opened, and an expiration or re-evaluation date. Before using any reagent, the analyst must ensure that the material was properly stored and labeled. If a reagent has passed its expiration date or shows signs of deterioration, the material is not to be used in the laboratory and must be discarded or segregated as expired. In some method development or research work, expired reagents may be used. These must be labeled as such or stored in a designated location.

If a re-evaluation date is reached before a reagent is completely consumed, the reagent will be inspected by physical observation for signs of degradation. Physical signs include, but are not limited to, color changes, clumping or other texture changes for solids and formation of precipitate in solutions. This evaluation is performed by an experienced chemist or microbiologist.

Subsequent reagent solutions or mixtures prepared at the laboratory are fully documented in a logbook and labeled to include: unique name, concentration, date prepared, name of analyst who prepared the reagent, storage conditions or reference to the logbook containing these details, and expiration/re-evaluation date. The information recorded allows these solutions to be traced to the original stock solution. The reference to the logbook is intended for use on containers that are too small to clearly document all of the information.

All reagent certificates and MSDSs are retained by the laboratory.

6.2. Media

Within the microbiology laboratory, procedures are in place to address preparation, labeling, storage, expiration, documentation, and quality/sterility evaluation requirements for these materials. These procedures are described in Appendix K.

6.3. Calibration Standards

Written calibration procedures are required, where applicable, for all instruments and equipment used in the laboratory. The source and accuracy of standards used for calibration purposes are integral to obtaining quality data. Requirements for calibration are provided in each analytical method including specifications for the standards used. Where available and practicable, calibration measurements made by the laboratory must be traceable to national standards of measurement (e.g., NIST). Certificates of Analysis (C of As) are maintained for each material, as applicable.

The laboratory's ISO 17025 and DoD accreditations require calibration materials to be certified and purchased from a reference material producer accredited to ISO Guide 34 and ISO 17025, when available. A list of accredited suppliers is maintained by QA. This is applicable to the tests under these scopes of accreditation and can be met through the stock standards used for calibration; a standard processed under the calibration such as an ICV or LCS; or comparison to a separate reference material at a frequency defined by at the test level (i.e. annually).

Standards are usually purchased from commercial supply houses either as neat compounds or as solutions with certified concentrations. Upon receipt at the laboratory, the material must be labeled with the date of receipt. The accuracy and quality of these purchased standards is documented on a C of A and these certificates are maintained on file in the laboratory. .

Most solutions and all neat materials require subsequent dilution to an appropriate working range. Records of all standard preparations include the dilution(s) made and a reference to the original and any intermediate mixtures. Solutions are labeled according to laboratory procedures and assigned unique names or code numbers that provide traceability to the original components.

All standards are stored separately from samples and in conditions as stipulated by the method or vendor (refrigerator, freezer, room temperature, etc.).

Each new preparation of standard is tested for integrity by comparison to standards from another source or previously prepared solutions. Standards are not used for sample analyses in the laboratory past their expiration date. In some method development or research work, expired standards may be used. These must be labeled as such or stored in a designated location.

6.4. Equipment and Instrumentation

The laboratory is equipped with all equipment and instrumentation required for testing the scope of work which it supports. All equipment and instrumentation is maintained in proper working order. A master list of our equipment and instruments is maintained by our accounting department and includes the date received and the condition at receipt (new v. used). Our major equipment and instrumentation capabilities are summarized in Appendix F. In addition, we have numerous other instruments including pH meters along with support equipment such as ovens, incubators, centrifuges, balances, etc.

6.4.1. General Requirements

- Equipment/instrumentation is assigned a unique designation. This unique number or system identification is used to track the equipment or instrument within data documentation.
- A maintenance logbook is established in conjunction with installation and is readily available to document all incidents and/or routine maintenance processes that pertain to the equipment or instrument as they occur. The corrective action taken, the date that the equipment/instrument is returned to service, and performance checks performed is documented.
- All test, measuring, and inspection of laboratory systems, equipment, and instrumentation used at the laboratory is routinely calibrated and maintained in accordance with applicable standard operating procedures.
- A member of the technical group, or designated individual, performs routinely scheduled maintenance and calibration of laboratory equipment and instruments as required by laboratory procedures. These activities are documented.
- If appropriate standards or expertise for calibration or maintenance are not available in-house, the operation is conducted by an outside service firm, with appropriate accreditation. Certificates or other data generated by the service firm are reviewed by applicable the laboratory personnel to verify acceptability. This information is maintained on file.

- All equipment or instruments taken out of service are tagged "DO NOT USE". The following minimum information is documented on the tag:
    - Date taken out of service
    - Employee who took the equipment/instrument out of service
    - Reason for tag-out

6.4.2. Standard Operating Procedures

Information regarding operation, maintenance, and calibration of equipment and instrumentation is found in the respective SOPs. The procedures include, where applicable, a routine schedule for preventive maintenance and calibration along with acceptance criteria and remedial action to be taken in the event of failure. These procedures are maintained in the document control system and reviewed on a regular basis to verify they remain current and accurate. Vendor supplied manuals are also available to provide additional information in regard to operation and maintenance.

6.4.3. Maintenance

- Instrument and equipment maintenance is performed as either a preventive or corrective operation.
- Preventive maintenance procedures and schedules are developed for each instrument or piece of equipment, where applicable. Preventive maintenance operations are performed by an analyst, equipment maintenance specialist, or contracted (manufacturer's representative or service firm personnel). Documentation is maintained in the associated maintenance log for the procedure(s) performed as part of the preventive maintenance operation. It is the responsibility of departmental management to ensure that a preventive maintenance schedule is addressed by a procedure where appropriate and is followed.
- Corrective maintenance is performed by an analyst, equipment maintenance specialist, or contracted (manufacturer's representative or service firm personnel) in response to indications of equipment or instrument malfunctions. The unit must be clearly tagged as out of service. All corrective actions taken to bring the unit back into service are documented in the associated maintenance log. After repair, further notation is made in the log regarding the functional status. Calibration activities are performed, as applicable, and documented in the log before the unit is placed back into service.
- A supply of commonly needed replacement parts is maintained by the laboratory.
- A preventive maintenance schedule for major instruments is given in Appendix G. Maintenance of equipment used in microbiological testing is documented in Appendix K.

6.4.4. Calibration

- Calibration is the establishment of, under specified conditions, the relationship between the values/response indicated by a measuring instrument or system and the corresponding known/certified values associated with the standards used. Some types of calibrations are performed with a set frequency (e.g. daily) while others provide intermediate checks to ensure that the instrument response has not changed significantly.
- All measuring and testing instruments and equipment having an effect on the accuracy, precision, or validity of calibrations and tests are calibrated and/or verified on an on-going and routine basis. Methods for calibration of instruments and equipment vary widely with the nature of the device and the direction given by analytical procedures, departmental procedures, manufacturer recommendations, or regulatory requirements. Frequency of calibration can also depend on additional factors including ruggedness of the instrument or equipment and the frequency of use.
- Departmental management is responsible for developing or acquiring written calibration procedures for the types of instruments and equipment employed within their area, as applicable. Procedures address the following aspects: description of the calibration method, frequency/schedule for calibration, acceptance criteria, and corrective actions if failure occurs.
- Calibration information is recorded in a logbook that is associated with the instrument/equipment and/or a calibration certificate is maintained and/or data is generated and filed to document the activity.
- Calibration measurements are traceable to national standards of measurement (e.g., NIST) where available. Physical standards, such as NIST certified weights or thermometers are re-certified on a routine basis. Calibration certificates are maintained on file, where applicable, to indicate the traceability to national standards of measurement. These physical standards are used for no other purpose than calibration.
- Calibration failures are documented in the associated logbook and/or within the data generated from the instruments or equipment. Management personnel perform an evaluation and review of failures and assess any potential impact the failure might have on previously generated data. The laboratory utilizes “real-time” controls to ensure the accuracy of the data. These controls are used to assist in assessing the impact of the situation.
- After repair, adjustments, or relocation that could affect instrument response, calibration/verification activities are performed, as applicable, before the unit is returned to service.
- Analytical data is not reported from instrumentation or equipment with noncompliant calibration unless the client has agreed to receipt of the data and appropriate comments are applied to the final Analysis Report.
- A summary of the calibrations for most major instruments and equipment is given in Appendix H.
- Procedures for calibration of equipment used in microbiological testing are documented in Appendix K.

6.5. Computerized Systems and Computer Software

6.5.1. Computer Usage

The laboratory provides computer equipment for employees to use as a tool in performing their work. Computer equipment is the property of the laboratory and used in accordance with defined terms and conditions. Our goal is to provide standard hardware and software that meets the needs of the user. The majority of desktop PCs in use are standardized using cloning software.

6.5.1.1. Physical security of computer systems – It is company policy to protect computer hardware, software and data documentation from misuse, theft, unauthorized access and environmental hazards. The corporate computer area and computer "Hot-Site" is locked and requires identification/building card access. All vendors, contractors, or other visitors must be escorted into this area. Controlled access of the laboratory buildings is outlined in Section 3.2.

6.5.1.2. Passwords – Passwords are important for the security of company data and resources. The laboratory's primary network operating system is Windows and each employee must have a user ID and password combination to access the system. Other computer systems also require a user ID password combination for access. The following procedures apply regardless of which system(s) is being utilized:

- Passwords must be created as strong passwords in accordance with Eurofins Password Policy and must be kept confidential.
- Users must log-out of a system when not in use to prevent unauthorized access. In addition, the network access will automatically timeout after a set period of inactivity, requiring a user to log-in to access the system.
- Forgotten passwords can only be reset by the IT Department or by an appropriate System Administrator.
- Network and LIMS passwords automatically expire every 90 days. The computer prompts a user to change the password when the expiration date nears.

6.5.1.3. Computer viruses – The laboratory centrally and continuously monitors the computer network for computer viruses. Employees are prohibited from using the company's computer equipment to propagate any virus. Anti-virus software is employed to detect viruses on the Windows network. A notification is sent when there is a particularly dangerous or virulent data destructive program that employees need to be aware of. However, employees are instructed to always be cautious and observant even if there are no current warnings. Employees must report any virus concerns to the anti-virus administrator or IT Management as soon as possible. Employees who share files between their home computer and the laboratory should install anti-virus software on their home computer. If an employee does not have such software, the laboratory can suggest various no-cost anti-virus software products.

6.5.1.4. Internet and e-mail system – The e-mail system is used primarily for the laboratory's business purposes. The *Eurofins Lancaster Laboratories' Employee Handbook* provides additional information in regard to system usage. Employee access to the internet is restricted to those employees who have a business need for it. All employees have access to e-mail. Access to the internet is configured through a user's Windows network account. All internet and e-mail activity is subject to monitoring. All messages created, sent or received over the internet are company property and can be regarded as public information. E-mail and website filtering software is utilized.

6.5.1.5. The laboratory's Intranet (LabLinks) – The Intranet is designed to be a useful tool for employees to acquire company information and to provide a company communication system. The *Eurofins Lancaster Laboratories' Employee Handbook* provides additional information in regard to usage.

6.5.1.6. Software policy

- Copyright laws protect software, and the laboratory's intent is to abide by all software agreements.
- Software purchases must be formally requested and approved by management and/or validation personnel, as necessary.
- All software is used in accordance with applicable license agreements.
- Employees are not to install any software on computer(s) unless authorized by the IT Department.
- Software upgrades must occur in accordance with applicable change control procedures.
- Employees must not give software to outsiders (e.g., clients, contractors), unless approval is granted by management.
- Users must not make copies of any licensed software or related documentation without permission. Any user that illegally reproduces software is subject to civil and criminal penalties including fines and imprisonment.

6.5.1.7. Computer system backup, data restoration, and data archival – Mission critical data is stored on several computers throughout the laboratory. These computers are connected through the local area network. Selected files on these computers are backed up using an enterprise-level backup software program. The objective of this backup is to have the ability to restore data after a total loss (e.g., theft, fire, natural disaster). Procedures are in place to perform data backups and restores.

6.5.1.8. Remote access to computer systems – Employees are able to remotely connect to the laboratory computer systems through an encrypted (SSL) login. When logging in, users are authenticated with their Windows Active Directory account and password.

6.5.1.9. Electronic data – Instrument software used for processing data must, when available, have password access and audit trails enabled. All data processed through the LIMS includes tracking features to document who and when data was entered and/or changed.

6.5.2. System and Software Verification – The laboratory LIMS is an in-house developed program. The design and updates to the system are written following typical Software Development Life Cycle (SDLC) processes for initial planning through testing and implementation. Before a new computer system/program or significant modification of an existing system/program is implemented in our laboratory, it is necessary to generate a plan to specify the level of documentation required for the new or updated application. Developers, affected area management, and QA personnel review and approve the documentation.

The following are the typical documents that are compiled for these updates:

- System Change Request document – used for documenting/tracking changes in the programming
- Requirements documents – Describe the required system functionality and specifications
- Design documents – System overview, screen design, report layout, data description, system configuration, file structure and module design
- Testing documentation for system development/verification – Structural testing of the internal mechanisms and user testing of the installation and system qualification
- Periodic Review documents – periodic retesting of the programs is performed to ensure that the systems remain in a validated state.
- Retirement documents – used for documenting when a program is taken out of service
- Standard operating procedures and/or manuals

6.6. Change Control

Procedures are in place to define how to maintain facilities, processes, instrumentation, equipment, computerized systems, and computer software in a validated or controlled state through a plan of change control. Successful changes require a thorough evaluation and testing for potential consequences prior to implementation. Planning, authorizing, testing, and reviewing of proposed changes are documented throughout the change process. Changes are planned or could be made in response to an emergency situation. The following “general” elements apply to changes, as appropriate:

- Request to perform a change
- Evaluation of a change
- Authorization of a change request
- Preparation for an authorized change
- Execution and testing of the change
- Documentation of the change
- Approval of the change
- Change implementation and follow-up (Formal approval of the change is performed by designated responsible individuals and QA.)

6.7. Labware Cleaning

Dedicated washroom personnel support the laboratory operations in regard to labware preparation, washing, rinsing, and drying. Labware can include, but is not limited to glassware, plastic ware, utensils, and pipettes. Procedures are in place to outline the washing process for each type of labware. Most labware is cleaned using a Miele glass washing machine. Some labware is still washed by hand and either air-dried or dried in specifically designed ovens.

Most of the labware used in the laboratory is “common or non-dedicated” labware (common to a department), but some of the labware used in the laboratory may be identified as “dedicated” labware and exclusively used for certain analyses. Examples of dedicated labware include glassware used for high resolution mass spectrometer (HRMS) and low level mercury testing. This labware is isolated and cleaned only with “like” labware.

All glassware is class A and 100% visually inspected for breakage (e.g., cracks, chips), cleanliness, and dryness before being returned to the laboratory for use.

Generally, each test has controls in place to ensure that results are not adversely affected by unclean labware. These controls include blanks to detect positive interferences and recovery controls to detect negative interferences.

7. PURCHASING EQUIPMENT AND SUPPLIES

7.1. Procurement

It is the responsibility of management personnel within each department to ensure that the appropriate supplies are available and/or ordered with sufficient lead-time to perform analytical testing or to provide support to the testing areas. The individual technical departments have trained personnel who enter the supply order into the company’s requisition software system. The selection of these products is based on technical input at the analyst level and authorized by technical departmental management. The Purchasing Department maintains an ordering system in which purchase requisitions are managed. Common laboratory items (e.g., beakers, flasks, reagents) are ordered directly through the Purchasing Department. Purchase orders over a specified dollar amount require verification from the appropriate member(s) of the Executive Management Group before an order can be placed.

Upon receipt of an order, the Purchasing Department checks the order to ensure that all items were received as specified. Products that have specific storage requirements are taken to the technical area upon receipt. It is the technical area’s responsibility to ensure that the product is stored in the appropriate manner. Any checks on the quality of the materials received for use in a specific test are the responsibility of the laboratory using them. This is based upon the experience of the laboratory with the usability of the product. Generally, each test has controls in place to ensure that test results are not adversely affected by the materials.

Any problems encountered when using a material in the laboratory must be brought to the attention of the Purchasing Department and/or Quality Assurance, as applicable, to ensure that follow-up and corrective action occur.

7.2. Supplier Evaluation

Procedures are in place to evaluate vendors who supply us with: new equipment, instrumentation, computerized systems and computer software; commercially purchased glassware, including sample bottleware, reagents, chemicals, solvents, gases, media, and standards; and contracted and subcontracted services.

The laboratory strives to ensure that our suppliers continually improve their quality systems and we reserve the right to purchase from suppliers of our choice in order to best fulfill the needs of our clients and our business. When directed by a client to purchase from a specific supplier, we will do so. In this instance it is the client's responsibility to "qualify" the specified supplier. We attempt to purchase from businesses that we have an established purchase history or have previously acquired information regarding the supplier's quality programs.

The laboratory does not evaluate every supplier. Risk assessment is taken into consideration when making this decision. The risk assessment analysis includes system, material, services, and number of samples or operations the purchase may affect or support. Evaluations are not required for computer operating systems, utilities, toolsets, or systems software. They also are not required for any off-the-shelf configurable software package that has an extensive market performance history (e.g., Microsoft Word, Excel, Access).

Additional quality systems are also in place within the laboratory to further verify and support the materials used:

- C of A for every lot of purchased prepared microbiological media and for purchased chemicals, where available, are reviewed and maintained on file.
- For most chemical analyses a blank and a recovery check are routinely analyzed and serve as real time suitability testing of the reagent being used.
- Microbiological testing often employs positive and negative controls, which serve as real time control checks.

8. ANALYTICAL METHODS

8.1. Scope of Testing

Samples are analyzed in accordance with official published methods, standard methods, client-supplied methodology, or validated in-house methods. We recognize the importance of providing verifiable results and, therefore, use methods accepted and approved by a broad range of federal and state regulatory agencies. In order to meet the needs of our clients as well as regulatory agencies, the laboratory sometimes needs to support different versions of the same method (i.e. SW-846 8081A and 8081B). The laboratory can also assist in developing and validating analytical methods for specific products and matrices. All methods submitted for our review, as well as all analytical results, are considered confidential.

The laboratory performs a wide variety of environmental testing in support of the Safe Drinking Water Act (SDWA); Clean Water Act (CWA); Resource Conservation and Recovery Act (RCRA); Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA/Superfund); and the Clean Air Act (CAA). Methods approved by ASTM are also used in testing. Potable water, wastewater, soil, sediment, sludge, oils, biota, tissue, soil gas, and air are among the matrices typically analyzed.

Our areas of expertise include:

Standard Services	**Specialty Services**
• Volatiles • Semivolatiles • Metals • Pesticides/PCBs/Herbicides • Petroleum Analysis • Waste Characterization • Non-potable Water Testing • Drinking Water • Soil and Surface Water Testing • Vapor and Air Analysis • Sediment and Tissue Testing • Method Development • Shale Oil & Gas Analysis •	• Low-Level Mercury • Dioxins & Furans • Hydrazines and NDMAs • Perchlorate • 1,4-Dioxane • Pharmaceutical Manufacturing Industry (PMI) Wastewater • EPA Method 25D • PCB Congeners • Explosives • Alkyl PAHs, Alkanes, Biomarkers • PFC (PFOA) • Organic Acids • Aldehydes •

A list of tests covered under the laboratory's NELAP accreditation can be found in Appendix I. All current certificates and scopes of accreditation are available on the laboratory's website at http://www.eurofinsus.com/environment-testing/laboratories/eurofins-lancaster-laboratories-environmental/resources/certifications/. A complete list of the tests routinely performed by the laboratory can be found in the *Schedule of Services*.

8.2. Analytical Test Methods

Each laboratory is required to establish and maintain analytical procedures for all the methods referenced in standard testing. The sources for these methods include the most recent versions of these compendia:

- Test Methods for Evaluating Solid Waste, SW-846
- Standard Methods for the Examination of Water and Waste
- Code of Federal Regulations, Chapter 40
- EPA 100 through 600 and 1600 series methods
- ASTM

The test methods used are re-written into a laboratory standard format, which provides consistency in content and allows the analysts to locate the information they need quickly. Procedures are in place to define the format, required approvals, and the control system for these method documents. Elements to address in SOPs are based on TNI and DoD required sections. The format requirements include, but are not limited to, the following:

- Uniquely assigned method number, which is used extensively for scheduling and documentation purposes.
- Reference to the original source of the method (e.g. SW-846)
- Scope
- Basic Principles
- Apparatus and Reagents
- Personnel Training and Qualifications
- Safety and Waste Disposal
- Detailed procedure (including any method modifications)
- Calculations
- QA/Quality Control
- Revision Log
- Approval signatures from technical management and QA personnel

Analytical methods are maintained as controlled documents to ensure that analysts are always working with the most current version and are reviewed periodically for accuracy.

8.3. Client Supplied Methods

Most of the client-supplied method requirements presented to us involve achieving specific quality control criteria, limits of quantitation (LOQ), and/or method detection limits (MDL) using standard EPA methods. These requirements are communicated to the appropriate technical groups prior to the project start up. Each technical group evaluates the scope of work and the requirements to ensure the criteria can be met using the standard EPA method. The data is monitored to ensure the criteria are met throughout the project. The CSR notifies the client if there is a more appropriate method available or if the client's criteria cannot be achieved on a certain sample matrix (i.e., due to matrix or dilutions).

Occasionally, we are asked to transfer a non-standardized method from a client into our lab or to develop a new method, when one is not available. In the case of a method transfer, we set up the client's method and perform some initial evaluation. After the initial evaluation, we may make recommendations on how to improve method performance. If the method appears to be adequate, we determine linearity, specificity, precision, accuracy, MDL, and LOQ by performing calibrations, analyzing method blanks, and carrying out method detection limit and quad studies.

In the case of method development, we work with the client and/or data user to determine the level of validation required ensuring that the method meets its intended purpose. In addition to the elements above, we also determine standard and sample stability and robustness depending on the scope of the project. Typically, a standard operating procedure is written and submitted to the client with the results of the validation. These steps are completed prior to analysis of field samples. Data related to the setup of the method are archived.

8.4. Method Validation

Before new or revised analytical methods are authorized for routine use in the laboratory, validation data is required to demonstrate that the method as performed in our laboratory and analysts performing it are capable of meeting data quality objectives for precision and accuracy. A procedure is in place to outline this process.

Many methods published by USEPA include instructions for performing an initial demonstration of capability, which typically consist of determining the method detection limit and analyzing fortified samples in quadruplicate. This demonstration is performed and compared to acceptance limits for precision, accuracy, and detection limits, when available.

Methods that do not include specific validation requirements are validated by analyzing fortified samples or standard reference materials in replicate. The results of these analyses are used to assess accuracy and precision. Results of validation studies are documented and subject to review and approval by technical and QA management.

8.5. Procedural Deviations

Analysts are required to follow a documented method for all tests performed. Procedures are in place to ensure that deviations from analytical methods are documented, approved, and justified in an appropriate and consistent manner (Note: Deviation from the OH EPA approved SOPs is not permitted). We classify method deviations as either being a planned deviation or an unplanned deviation. In general, the following information is captured to document both types of situations:

- Description of the deviation
- Reason or justification for the deviation
- Impact the deviation had on the testing
- Signature/date of analyst performing the test
- Signature/date of Quality Assurance and Laboratory Management approving the deviation
- Signature/date of client approval, if necessary

Deviations to written procedures are documented in raw data records or through the ICAR (Investigation and Corrective Action Report) system. Both types of documentation require management and QA review and approval.

9. INTERNAL QUALITY CONTROL CHECKS

9.1. Laboratory Quality Control Samples and Acceptance Criteria

Quality control (QC) samples are analyzed with each batch of samples to demonstrate that all aspects of the analysis are in control within established limits of precision and accuracy. Management is responsible for ensuring that QC is analyzed as required by the referenced method. Each analytical SOP specifies (or cross-references another procedure) the type of QC sample, frequency of analysis, acceptance criteria for QC sample results, and corrective action to be taken if QC sample results fall outside of the acceptable range.

QA staff, at the direction of the technical department, must program the LIMS with the acceptance criteria for each QC type (other than blanks). The acceptance criteria are based on statistically generated limits from historical laboratory data, on method defined limits, government agency recommendations, or on client/project specific limits.

These limits are used to flag samples that are out of specification.

The types of QC samples and the information each provides are discussed in the following paragraphs.

Quality control checks used for microbiological tests can be found in Appendix K.

9.1.1. Blanks - A blank is a designated sample designed to monitor for sample contamination during the analysis process. The blank consists of a clean matrix (i.e. reagent water, Ottawa sand, glass beads, Teflon chips) taken through the entire sample preparation and analysis process. The blank and field samples are treated with the same reagents, internal standards, and surrogate standards. Ideally, blanks demonstrate that no artifacts were introduced during the analysis process. The specific acceptance criteria for each test are usually based on the required reporting limit (MDL or LOQ).

9.1.2. Surrogates - Surrogates are organic compounds, which are chemically similar to the analytes of interest but are not naturally occurring in environmental samples. When required by the analytical method, surrogates are spiked into all the field and QC samples to monitor analytical efficiency by measuring recovery on an individual sample basis. The percent recovery is determined and compared to the acceptance criteria.

9.1.3. Matrix Spikes - A matrix spike sample is created by fortifying a second aliquot of a water or soil sample with some or all of the analytes of interest. Blanks are not used for matrix spike QC. The concentration added is known and compared to the amount recovered to determine percent recovery. Matrix spike recoveries provide information about the potential matrix effects on the data. Matrix effects can cause results to be outside of the acceptance criteria.

9.1.4. Laboratory Control Samples - Laboratory control samples (LCS) are samples of known composition that are analyzed with each batch of samples to demonstrate laboratory accuracy. Laboratory fortified blank (LFB) is another term used to describe a LCS. The samples are clean samples fortified with known concentrations. Percent recovery is calculated and compared to acceptance criteria.

9.1.5. Duplicates and Matrix Spike Duplicates and Laboratory Control Sample Duplicates - A duplicate is a second aliquot of a sample that is treated identically to the original to determine precision of the test. To compare the values for each analyte, the relative percent difference (RPD) is calculated by dividing the difference between the numbers by their average. Precision for analytes that are not typically found in environmental samples (i.e., organic contaminants) is determined by analyzing a pair of matrix spike duplicates, defined as two spiked samples and comparing the RPD for the spiked compounds. The acceptance criteria are described as a maximum for the RPD value.

9.1.6. Internal Standards - Internal standards are organic compounds, which are chemically similar to the analytes of interest but are not naturally occurring in environmental samples. When required by the method, internal standards are added to every field and QC sample after extraction but prior to analysis. Comparison of the peak areas of the internal standards is used for quantitation of target analytes. Internal standard peak area and retention time also provide a check for changes in the instrument response. The acceptance criteria are stipulated in the analytical method.

9.1.7. Serial Dilutions - A serial dilution is the dilution of a sample with sufficiently high concentration by a factor of five to check for the influence of interferents. This QC check is performed for inorganics analyzed by ICP or ICP-MS. When corrected by the dilution factor, the diluted sample result must agree with the original sample within method specified limits.

9.1.8 Interelement Correction Standard – Analyzed to verify interelement and background correction factors. A solution containing both interfering and analyte elements of known concentration is analyzed at the beginning and end of each analytical run or a minimum of twice per 8 hours.

9.1.9. Second Source Check - A second source check is analyzed using either the LCS and/or an Initial Calibration Verification (ICV). The second source is a standard that is made from a solution or neat purchased from a different vendor than that used for the calibration standards. For some custom mixes, the same vendor but a different lot and preparation is used. This ensures that potential problems with a vendor supply would be evident in the analysis. Some tests use the continuing calibration verification standards as a second source from the initial calibration.

9.2. Quality Control Sample Frequency and Corrective Action

Each analytical method defines the frequency for the required QC samples and the corrective action required when a QC result fails to meet the acceptance criteria. A summary is provided in Appendix J.

The QC acceptance criteria are available to analysts in the laboratory. If the method reference requires the use of specific limits then the laboratory uses the published limits that are documented as part of the analytical method. Many methods require that each laboratory determine their own acceptance criteria based on statistical data obtained from performance of the method. In these cases, the limits are available to the analysts and are entered into the LIMS described below. Statistically determined acceptance criteria are subject to change as the laboratory recalculates its control limits. Due to their dynamic nature, acceptance criteria are not included in this manual.

The results of all quality control samples are entered into the LIMS in the same way as the results of client samples. The LIMS compares the individual values with the acceptance limits and identifies quality control sample results that are out of specification. If the results are not within the acceptance criteria, corrective action suitable to the situation must be taken. This includes, but is not limited to, checking calculations, examining other quality control analyzed with the same batch of samples, qualifying results with a comment stating the observed deviation, and reanalysis of the samples in the batch.

Each month, a summary of all QC entries (except blanks and surrogates) is generated from the LIMS. This summary is reviewed by QA staff and evaluated for changes in data that may indicate that an analysis is trending towards an out-of-control situation. The technical department is notified if a trend is observed.

The laboratory allows for marginal exceedances based on the number of analytes in the LCS. The exceedances are carefully monitored so that any systemic problems would be identified and corrective action taken. If the LCS is being reported based on the marginal exceedance allowance, a comment is added to the analytical report. Note: The use of marginal exceedance is not allowed for OH VAP work.

9.3. Quality Control Charts

The LIMS quality control system is used to report QC data to clients, to collect data for assessment of precision and accuracy statistical limits, and to generate control charts. Control charts are accessible to all employees through the LIMS interface. The system charts results from blanks, surrogates, matrix spike/matrix spike duplicates, duplicates, and laboratory control samples/laboratory control samples duplicate. These charts provide a graphical method for monitoring precision and bias over time. They can be used to detect quality problems by observation of patterns. QA staff uses the charts in conjunction with a LIMS generated monthly QC trend report to evaluate potential data trends.

9.4. Measurement Uncertainty

(ISO 17025) "All uncertainty components which are of importance in a given situation shall be taken into account using appropriate methods of analysis" (5.4.6.3). This means the laboratory must determine the uncertainty contribution of all steps in the testing process such as equipment, calibration, standards, reagents, preparation, cleanups, etc. Since, in most methods, the laboratory control sample (LCS) goes through the entire process of preparation to analysis; all factors that would contribute to uncertainty is evident through the LCS results. LCSs are performed with every batch of samples where appropriate for the method. Tests that do not have LCSs (i.e. TCLP; paint filter test), are evaluated on a case-by-case basis by taking into account the uncertainty of each of the steps taken to perform the test.

Measurement Uncertainty reports are generated by each technical department on an annual basis using a LIMS program and submitted to QA. Measurement Uncertainty is calculated as two times the standard deviation of the LCS recoveries for the group and date range of data points selected for all applicable methods. This is reported as a percentage. It is not necessary to apply or report the uncertainty value with sample results. When a client requests the measurement uncertainty it is applied by multiplying the determined analyte concentration by the uncertainty percentage.

10. ASSURING QUALITY OF TEST RESULTS

10.1. Data Management

At a minimum, data management is initiated when the laboratory receives the samples from the client. More often the process begins with client communication of their needs and requirements for a specific project and/or testing. When requested, bottle orders for the client's sampling efforts are generated through the LIMS by the CSR. The CSRs are responsible for entering the information in the sample set up function of the LIMS. Upon receipt of the samples a unique tracking number for the sample group and the samples within the group is generated based on this information. At this point, the LIMS becomes an integral part of tracking the samples through laboratory operations. The flow of data from the time samples enter the laboratory until the data is reported is summarized in the following table:

Sample and Data Flow

Action	Personnel Involved
Bottle orders generated upon request • Bottles packed and shipped to the client under chain of custody documentation	Client Service Representative Bottles Preparation
Sample received at Lancaster Labs • Unpacked and reconciled against the client paper work or COC • Sample Entry Documentation log completed	Sample Registration
Sample is entered into the LIMS • Lab ID number assigned • Analyses entered • Storage location assigned • Electronic record of sample number • Labels generated • Acknowledgement printed (record of samples received and analyses entered)	Sample Registration
Preservation checks performed Sample stored in assigned location (refrigerator, freezer, etc.) • Electronic record of sample #, bottle code, and location	Sample Registration
Acknowledgment sent to client (when requested)	Sample Registration
Samples requisitioned and removed from storage for analysis • Electronic requisition of sample number by bottle code • Necessary aliquot taken • Remaining sample returned to storage	Sample Registration Technical Personnel
Analysis is performed according to selected analytical method • Raw data recorded • Data Reviewed • Data uploaded to the LIMS from the instrument or manually entered by the analyst* (This is tracked by the unique sample number and batch number.)	Technical Personnel
LIMS performs calculations as programmed according to methods	Data Processing
Designated analyst or supervisor verifies raw data	Technical Personnel
Generation/release of reports (automated through LIMS)	Billing and Reporting Group
Data package deliverables are assembled, reviewed and released to client Electronic copy saved in the LIMS	Data Package Group
Electronic Data Deliverables (EDDs) are generated	EDD Group
Designated Data packages are overchecked by QA prior to release	QA
Hard copy of batch raw data is archived Electronic files are backed up and archived	Technical Personnel, Data Package Personnel, Office Services, IT

*Analyses requiring the analyst's interpretation may involve manual data reduction before entry into the LIMS.

10.2. Data Documentation

Analytical data generated in the laboratory is collected from the instruments or associated data system or is manually documented in bound notebooks. Analysts review data as it is generated to determine that the instruments/systems are performing within specifications. If any problems are observed during an analytical run or the testing process, corrective action is taken and documented.

Procedures are in place to ensure that all data is traceable, authentic, and complete. Electronic data records are maintained and tracked through the LIMS, requiring authorized, password protected user access. The following general requirements outline our system for notebook, logbook, and documentation recording:

- Observations, data, and calculations are recorded at the time they are made and are identifiable to the specific task.
- Entries must be legible, signed, and dated. The signature may be a wet or electronic signature.
- Errors are corrected in a manner that does not obliterate the original entry, initialed and dated, and coded with an explanatory identifier. Changes to electronic data are tracked through audit trail functions.
- Blank pages or substantial portions of pages which are left blank are crossed-out to eliminate the possibility of data entry at a later date.
- Notebook pages and instrument printouts are signed/dated to indicate second party data review; this may be a wet or electronic signature.
- At periodic intervals a supervisor or data reviewer checks equipment/instrument logbook entries and temperature recordings for completeness, legibility, and conformance to procedures.
- At a minimum, the following information is recorded as part of data documentation:
    - Date of analysis/operation
    - Signature/date of analyst performing test/operation
    - Identification of client sample(s) and material(s) analyzed
    - Materials, reagents, standards used to perform the testing/operation
    - Method used to perform testing/operation (including version number and/or effective date)
    - Equipment/instrumentation used to perform testing/operation
    - Calculations and how they were derived
    - Departures, planned or unplanned, from the analytical method
    - Signature/date of person reviewing data documentation
- For computer generated data, the following information is recorded:
    - Sample(s) analyzed/operations performed
    - Date of analysis/operation
    - Unique instrument identification
    - Name/date of person operating the instrument
    - Name/date of person reviewing data
    - Any manual notations or interpretations made on instrument printouts are signed, dated, and reviewed

10.3. Data Calculations

Most instruments either include or are connected to a data system programmed to perform calculations to reduce the raw data to a reportable form. All calculations are maintained in the instrument manuals and/or as part of the analytical method.

In many cases, the data from the local instrument system are uploaded directly to the LIMS for review and reporting. This direct upload eliminates the need to retype data and an associated source of transcription errors from the analytical scheme.

Some instruments report data that require application of additional factors before the data is in final form. For example, an extract concentration may be reported by the instrumental data system, but additional dilution and preparation factors may be needed before the result represents the concentration of analyte in the sample. Analysts input these additional factors into the LIMS, where final calculations are performed.

Analysts manually enter collected data, such as titration data, into the LIMS, which is programmed to perform calculations for final reporting. Documentation of the programming for each calculation performed by the LIMS is maintained.

10.4. Reporting Limits

It is important to ascertain the limit of quantitation (LOQ) that can be achieved by a given method, particularly when the method is commonly used to determine trace levels of analyte. The Environmental Protection Agency has set forth one method for determining method detection limits (MDLs) from which LOQs can be extrapolated. This process is summarized in a laboratory procedure.

MDLs are verified or determined annually on each instrument and are the basis for the LOQ used in the default reporting format. Because MDLs change each time they are re-evaluated, they are not included in this manual, but are available in each laboratory and available to clients upon request.

The reporting limit used to determine whether a result is significant and reported as detectable is dependent upon agency and client requirements. A variety of formats are available and include use of the MDL, LOQ, method specified limits, and project specific limits. The MDL and LOQ for each analyte are programmed into the LIMS for reporting purposes.

Under the DoD program, the laboratory must establish a Detection Limit (DL) and Limit of Detection (LOD). As defined by the DoD program, the DL is the smallest analyte concentration that can be demonstrated to be different from zero or a blank concentration with 99% confidence. The laboratory determines the DL using the calculated value from the MDL Study. The DL can be derived from pooled MDL values obtained across instruments. The LOD is the smallest amount of a substance that must be present in a sample in order to be detected at the DL with 99% confidence. It is established by spiking a quality system matrix at a concentration of 2-4 times the DL. The LOD must be verified on a quarterly basis or with each batch of samples.

10.5. Data Review

Final review and verification of the data are performed by designated employees using the sample results, quality control information, method criteria and Project Notes entered into the LIMS. Data are initially evaluated by the analyst and then a second designated employee knowledgeable in the test, other than the employee responsible for performing the test, reviews the data. The reviews include checks for correct transcription, calculations, passing calibrations, compliant quality control results, holding time compliance, and project specific requirements. Any issues or errors identified during this stage are addressed, corrected, and reviewed with the responsible person.

After determining that all necessary requirements for valid data and for the project are met, the reviewer electronically approves the data by changing the LIMS status of the data from “complete” to “verified”. The LIMS is programmed with a list of approved reviewers for each test, and the system is password protected to ensure that only qualified individuals verify the data.

10.6. Data Qualification

Data qualifiers are used to provide additional information about the results reported. The most typical use for data qualifiers is for results that fall below the quantitation limit, in the region where it becomes more difficult to distinguish a positive result from the background instrument signal. The data systems used to generate and report results are programmed to flag values in this range as estimates.

Other qualifiers are applied to advise data users of any validation issues associated with the data. The laboratory makes every effort to meet all of the requirements for generation of data. Occasionally, generation of data that does not meet all the method requirements occurs due to sample matrix or other analytical problems. If the test cannot be repeated or reanalysis would not yield better quality data, qualified data is reported. Qualifiers can be in the form of comments on the analytical report or flags applied to the results.

10.7. Data Reporting

When all analyses are completed, reviewed and verified, a report is generated by the LIMS. The client receives a copy of the report containing the results of the analysis, associated QC data, and where necessary, explanatory comments to address non-conformances. To avoid ambiguity in interpreting results, a summary page that contains an explanation of all symbols and units used in reporting data is included with the Analysis Report submitted to clients. Some regulatory agencies also require the laboratory accreditation identification on the Analysis Reports. Where required, this information is added. The current list of agencies can be accessed in the LIMS. Copies of reports and associated supporting raw data are retained in our archives. The report contains the signature of the assigned client service representative who is the key contact for any questions concerning the results. Personnel authorized to review, sign, and release Analysis Reports are noted in the key personnel list provided in Appendix C.

The laboratory offers a variety of data reporting .levels and formats, from a basic report of sample and QC results only, to a comprehensive data package of QC/calibration information and raw data. The client and any agency involved direct the selection of report type. A summary of report formats and data packages types is provided in the laboratory *Schedule of Services*. Various electronic formats are also available formatted to client-specified file structure and sent via e-mail, direct upload, web-site access (LLabWeb), or common courier. LLabWeb is used for clients that require secure transfer of electronic data.

Client confidentiality of LLabWeb data is ensured by the use of a secured firewall internet environment coupled with the use of a user ID and password to gain login access to the system. User accounts are configured to only allow access to specific data associated with the user's business account number.

Amendments to a final report after issue are in the form of an additional document or data transfer and include a reference to the original report. When a completely new final report is required, it is uniquely identified and includes a reference to the original report it replaces.

10.7.1. Reporting the Results

Analytical reports are generated with a cover page that summarizes all samples in that group. This page lists the laboratory assigned sample number and the corresponding client description. The cover page identifies the laboratory contact person's name and phone number if there is a question about the report. Within this package, each page is uniquely identified and paginated. Analytical test results for methods listed on the laboratories' accreditation scope meet all requirements of NELAP accreditation and ISO 17025 unless noted otherwise. Ohio EPA VAP requires that a signed, notarized affidavit accompany each analytical report.

10.8. Data Storage, Security, and Archival

The laboratory has documented procedures and instructions for the identification, collection, access, indexing, filing, storage, maintenance, and disposition of data records. Records are in the form of paper records, electronic data files, magnetic tape, and CD-ROMs.

All data records are maintained in a confidential manner in an environment to minimize deterioration or damage and to prevent loss. Some records are stored in off-site facilities, in such a way that they are readily retrievable. Retention time for records is in accordance with specific procedures or instructions. Prior to the destruction of data/records, and if requested by a client or agency, the laboratory will notify the client/agency that their data is scheduled for destruction so arrangements can be made to have the original data sent to the client.

If specified in client contract(s), archived records are transferred according to their instructions in the event of a change in laboratory ownership or if the laboratory goes out of business. If not specified by the client, the sale agreement must require that archived records be maintained as scheduled by the new owners. In the case of bankruptcy, appropriate regulatory and state legal requirements concerning laboratory records must be followed.

The laboratory maintains all documentation which is necessary for historical reconstruction of data:

- Analysis reports
- Data notebooks
- Data logbooks
- Instrument output
- Correspondence and client files
- Instrument and equipment logbooks
- QA records
- Corporate documents
- Electronic records

11. AUDITS AND INSPECTIONS

11.1. Internal Quality Assurance Audits

The QA Department, which is independent of laboratory activities, performs routine and on-going system, traceability, and observation audits to objectively review current systems, operations, and procedures as well as automated data integrity audits of electronic data records. The goal of the audits is to ensure that the quality system activities are effective and in compliance with regulatory programs, including NELAP. ISO 17025, DoD, and state agencies, as well as internal policies and procedures. Audits are documented and tracked in a QA database.

Audits are scheduled and conducted following a predefined schedule, based on criticality of operation and prior audit results, with the goal of evaluating systems and technologies across the operation. If warranted, additional audits are performed to follow up on promised corrective action or areas of concern.

Results of an audit are documented in a report format and distributed to applicable management personnel responsible for the area(s) under audit. Management is responsible to address all non-conformances found during an audit with root cause analysis and application of a corrective action plan.

Audit reports and responses are circulated to Management to communicate the outcome of the audit and the proposed plan(s) for corrective action, if warranted. If any of the audit findings cast doubt on the validity of the results, the clients must be notified within three business days of the investigation. Should an audit issue present a major concern regarding validity of laboratory methods, QA personnel can issue a stop work notice.

All records maintained as part of an audit are kept on file for three years.

On an annual basis, an audit of the QA Department is performed as directed by the laboratory's Executive Management. The auditors assigned to carry out this operation are qualified staff members independent of the QA Department.

The specific content and findings of internal audits are considered company confidential and are not shared with clients.

11.2. Review of the Quality Assurance Program

All levels of management are continually updated on the status of quality and compliance by circulation of pertinent documents. Management review is documented by signatures on the documents, electronic records of each person's review, along with any comments or request for additional follow-up. The types of documents circulated real-time include:

- Internal, client, and agency audit reports and responses
- Proficiency test results
- Investigation and corrective action reports
- Monthly QA status reports

Executive management reviews the elements of the total QA program on an annual basis to ensure its continuing suitability and effectiveness in meeting the stated objectives outlined in Section 2.4 of this manual. The evaluation entails review of reports to management, all audit findings, client complaints, laboratory investigations, staff adequacy and training, and projected growth in workload. Patterns or trends in any of these areas are reviewed as a means to continually improve the quality system. This review also includes an evaluation of any audit findings resulting from the audit of the QA Department. At the conclusion of this quality system review, executive management determines the need to introduce changes or improvements into the quality systems at the laboratory. The minutes from the meeting and any recommendations for improvement are documented and a copy is forwarded to the QA staff for review and follow-up.

11.3. Good Laboratory Practice Critical Phase Inspections

Any project that is subject to Good Laboratory Practice (GLP) regulations is audited by the QA Department, as required by the regulations, at intervals adequate to ensure the integrity of the study. Inspections of a GLP project include direct observation of analysts as they perform various phases of the study. Data documentation is reviewed as part of the inspection. The purpose of this type of audit is to ensure that there are no deviations from written methods, procedures, or study protocols.

Results of inspections are documented in a report format and distributed to applicable management personnel responsible for the area(s) under audit. Management is responsible to address all non-conformances found during an inspection. Inspection reports and responses are circulated to applicable laboratory management and an off-site study director, as applicable, to communicate the outcome of the inspection and the proposed plan(s) for corrective action, if warranted.

All records maintained as part of an inspection are kept on file.

11.4. Client Audits

Because clients place great importance on compliance with applicable regulations, data quality, and project requirements, they may audit our facility as assurance that their objectives are being met. QA, management staff, CSRs, and the analytical laboratories play a key role in these audits. Visits by clients can range anywhere from a tour (to verify laboratory facilities and instrumentation) to an intensive inspection of technical operations, procedures, regulatory compliance, and/or review of specific project(s).

- Audits are scheduled directly with the CSR or QA. The request to audit is communicated to all applicable laboratory departments.
- In accordance with our policy on client confidentiality, a client is permitted to review only data and results that apply to their work, or which have been approved by laboratory management.
- An escort (designated laboratory employee) remains with an auditor at all times.

Responsibilities are assigned to the following groups in regard to client audits:

11.4.1. QA Department

- Research previous audit reports and laboratory responses to past deficiencies.
- Follow-up with the applicable analytical laboratory areas to ensure action items were completed from the last audit, as necessary.
- Work with client to set audit agenda.
- Function as an escort during the audit
- Answer questions the auditor has in regard to laboratory and quality systems.
- Take notes of areas where corrective action or suggestions are recommended during the audit.
- Communicate audit issues to management at the completion of the audit.
- Respond to client audit reports.
- Ensure follow-up to cited items are addressed in a timely manner.

11.4.2. CSRs

- Gather and organize relevant information (e.g., client correspondence, analysis/project requests, copies of analytical data from archives).
- Be knowledgeable about client-specific project requirements and issues.
- Function as an escort during the audit.
- Communicate issues/problems to appropriate personnel.

11.4.3. Laboratories

- Gather and organize laboratory data and documentation in preparation for client review.
- Assure corrective action was implemented from past audit findings, if necessary.
- Be prepared to discuss project data/testing results during the audit.
- Be familiar with client-specific project requirements and be prepared to answer client questions.
- Be familiar with the location of routine laboratory information and equipment (e.g., SOPs, data notebooks, calibration data, etc.).
- Be prepared to answer specific technical questions in regards to laboratory procedures and instrumentation within the area.
- Functions as an audit escort within the department during the audit.
- Laboratory managers may function as an escort during the audit

11.5. Agency Inspections

It is laboratory policy to cooperate to the fullest extent and maintain cordial relations with all government agencies. The QA Department is assigned the responsibility of hosting and working with agency representatives. Their role includes, escorting the investigator(s); ensuring all questions are answered promptly and accurately; making note of all unresolved issues; informing management of the audit status and outcome; responding to the audit report and ensuring that appropriate corrective action is completed.

Inspections can be performed by investigators or auditors from the EPA, states, third-party accreditation bodies (i.e. A2LA, United States Department of Agriculture (USDA), or other regulatory agencies.

Government agencies have the right to investigate and inspect the laboratory during normal business hours and permission to inspect is granted by Executive Management.

Designated members of the QA Department are primary contacts for announced inspections. The QA Director is the primary contact for all unannounced agency inspections. If the QA Director is unavailable, Executive Management is notified, in addition to a member of the QA Department. The QA Director, or their designee, must obtain evidence of the investigator’s authority either in the form of a letter or examination/explanation of credentials.

Inspections include the examination of records or the inspection of facilities. Investigators are usually concerned only with the records relating to their responsibilities. As a general rule, they are given copies of records and documents, if requested. The laboratory must have a record of all items provided to an investigator.

Investigators must be escorted through the laboratory. The laboratory is not obligated to show an investigator the following types of information: sales, financial or pricing information, or any personnel data other than training or qualification documentation. On a case-by-case basis, internal QA audit reports and investigation reports are made available for agency review. Any questions or concerns about a request made by an investigator in regard to recording devices or photographs must be reviewed with legal counsel.

The laboratory personnel are not permitted to sign affidavits. If an affidavit is presented during an inspection, all personnel are directed not to sign it, read it, nor listen to it being read. The only document that is acceptable to sign is an acknowledgement that an inspection report has been received. If there is any doubt as to what should be signed, legal counsel must be consulted.

11.6. Proficiency Testing

Many of the organizations that certify our laboratory to perform various analyses require proof of our competency. Laboratory performance is checked regularly by participation in a variety of proficiency testing (PT) programs. When available, blind samples are obtained from vendors that are accredited to provide PT samples under the TNI and/or ISO 17025 standards for all test and matrices routinely tested at the laboratory. In addition, some individual certification programs require analysis of specific sets of proficiency samples. The laboratory also chooses to participate in a double blind program.

Generally, the PT programs consist of samples or ampulated spiking solutions used to fortify laboratory samples. The laboratories analyze the samples in the same manner as a client sample and the data is sent to the agency or vendor for evaluation. After the study results are returned to the laboratory, any data falling outside the acceptance criteria is investigated, root cause is identified, and corrective action is implemented, if needed. Results are circulated to management. No PT samples or portion of a PT sample are sent to another laboratory for analysis.

Double blind samples are submitted to the laboratories by the Client Services Department using a fictitious client name so that the analysts are not aware that the samples are PTs. The samples are submitted quarterly and include a cross-section of organic and inorganic tests. The acceptance criteria for these double blind samples are developed statistically using data from participating laboratories, providing a source of inter-laboratory comparison. Results are reviewed, investigated as needed, and circulated to management.

If a trend in PT failures is identified, additional blind samples are ordered for that specific test as corrective action.

Clients routinely submit blind and double blind samples to evaluate the laboratory's performance. If a report is issued to the laboratory, it is handled in the same manner as a scheduled PT study evaluation and follow-up.

12. CORRECTIVE AND PREVENTIVE ACTION

12.1. Laboratory Investigations and Corrective Action

Due to the technical nature of laboratory work and the broad scope of our QA program, a wide variety of laboratory issues can require investigation, root cause analysis, documentation, and corrective action. Prompt investigation and implementation of corrective action ensure that only data of known quality are reported and prevent the recurrence of errors. The following list provides "examples" of the type of issues that warrant investigation:

- Noncompliant QC results*
- Failed PT samples
- Reporting incorrect results
- Contamination issues
- Client technical complaints
- Procedural errors
- Missed holding times
- Systematic problems that compromise the accuracy or compliance of the data generated
- Problems with instrumentation and equipment which could compromise the data generated

These investigations must include the following:

- Identification of the problem
- Steps taken to investigate the problem
- Explanation of probable root cause(s) of the problem
- Steps taken to prevent future occurrence
- Determination of samples or systems affected by the problem

*Note: individual QC noncompliance does not require in depth investigation. Actions are taken as defined in the corresponding method and documented in the data. An adverse trend with noncompliance would be investigated.

Management is informed of problem situations. The QA staff track documentation, the status of the investigation activities, evaluates investigations for completeness and appropriateness, and monitors corrective action for follow-up/closure. Technical management and/or QA may issue a stop work notice if issues indicate the potential for problems on a broad scale or present a critical concern regarding the validity of the laboratory methods. The goal is to identify root cause, have the corrective action implemented promptly, and to the degree appropriate for the magnitude and risk of the problem. Tracking and trending of laboratory issues is performed by QA staff and reported to management on a monthly basis or immediately upon detection of a trend with potential for putting the laboratory or our clients at risk.

12.2. Investigation Processes

All results from quality control (QC) samples are logged into the LIMS quality control system, which is programmed to alert analysts to unacceptable results. Analysts are required to review the results and determine the source of the problem. The source of the problem and proposed corrective action must be documented. Corrective action may include, but is not limited to, re-analysis, re-extraction or re-digestion, instrument maintenance, or re-calibration. If these actions do not yield compliant data within the required hold time, a Nonconformance Form is initiated to document actions and communication with the client. The original form is archived with the associated raw data. Nonconformance Forms are reviewed by the technical department's management, or designee. A copy of the form is reviewed by QA.

Missed holding times are investigated and documented using a Missed Holding Time form. The form includes documentation of the affected samples, reason the hold was missed and corrective actions taken, if applicable. Each form also has documented review and approval by the department manager, department director and the QA Director. Clients are informed of any problems involving holding time.

Other types of problems having potential impact on data quality or involve deviations to our processes are investigated and documented using an Investigation and Corrective Action Report (ICAR). This process was developed to ensure that laboratory problems are investigated, evaluated for root cause, corrective action is put into place to prevent recurrence, laboratory management review and QA approval occurs, and all steps are documented. These investigations are initiated and managed through a workflow interface (Jira). Any employee can initiate an ICAR through this system to document a laboratory problem. The investigation must be completed by designated members of management and approved/closed by QA. Each investigation has a unique tracking number assigned by Jira. Closed investigations are routed to the laboratory Vice-President, associated laboratory Director and the QA Director. Follow-up to ensure effective corrective action is managed by QA staff.

If a laboratory error is identified from the outcome of the investigation that impacts validity of client data, the client must be immediately notified in writing of the situation and corrected data provided as soon as possible. If the root cause of the problem has affected any other client sample results, all affected clients are notified immediately of the problem.

12.3. Client Feedback

The laboratory is in the business of providing high quality analytical testing services. The data that we supply to our clients must be technically complete, accurate, and compliant with applicable regulations. Complaints can be received via letter, phone call, e-mail, or face-to-face meeting.

When a complaint is received, it is our responsibility to determine, to the best of our ability, the extent of the issue and what data is in question. The person receiving the complaint documents this information and promptly forwards it to the appropriate management personnel where the work in question was performed. If a data reporting error is discovered, the final report and/or data must be regenerated with the correct value(s).

The CSR is responsible for entering client concerns into the LIMS and an automated summary report is sent to QA on a weekly basis for review. In some cases, an ICAR is initiated to address and document the situation. While an individual issue may not warrant a formal investigation, QA monitors these issues for potential trends and will issue an ICAR if a trend is evident.

On an annual basis, the laboratory sends a client satisfaction survey to all clients. The results of these surveys are compiled, routed to the laboratory Vice-President, technical and operations directors and the QA Director, and used to identify areas of improvement for the laboratory.

12.4. Preventive Actions

All employees are empowered and encouraged to use the concept of Preventive Action to avoid a problematic situation. The company supports, embraces and drives the process for continuous quality improvement by several means, such as: Ethics Hotline, the Suggestion Box (accessible to all employees on the company’s Intranet 'LabLinks'), and training classes that include “Making Quality a Science" and Ethics. If an employee identifies a potential problem or an area of concern or it should be brought to the attention of his/her supervisor, Human Resources, QA Director or the Ethics Hotline.

The laboratory also utilizes a formal program to encourage preventive action through development of lean processes. The goal of this program is to optimize processes to ensure efficiency and operational improvements while maintaining compliance. The efficiency gains are inherently coupled with minimizing errors and rework. Teams of employees learn the tools and techniques to evaluate a process, identify potential sources of errors, delays or problems in an operation, determine system changes that will minimize these and work to implement the improvements. Each project includes thorough documentation of the evaluation, measurement, and implementation phases. The process is continually monitored to ensure that the anticipated results are sustained.

Employees are also encouraged to communicate to their supervisor any area(s) or operation(s) that they believe could be streamlined, make their job easier, would provide a quality improvement, or could provide a cost savings to the company.

Described below are some of the systems available to employees to assist with building quality and efficiency into their daily jobs. They stress a proactive approach/environment to problem solving and to review quality systems and operational efficiencies.

- “Making Quality a Science” is an introductory total quality management (TQM) course required for all employees to teach why quality is important and to explain the laboratory’s quality philosophy and processes, and how to apply quality thinking and techniques on the job. Topics discussed include: communication, teamwork, serving the client, measurement, quality tools, and continuous process improvement. To foster continuous improvements of laboratory systems, process improvement teams are formed, as needed, if an employee needs help in solving a problem or addressing an issue. The goal of these groups is to have representation from various areas of the laboratory work together to look at a problem, evaluate the need for a temporary fix, brainstorm root causes, plan process improvement, implement the process improvement, evaluate and follow-up to the corrective action.

- “Putting our Values to Work” (Ethics) is a seminar required for all employees to teach the laboratory’s Statement of Values by examining how it translates to our everyday jobs and ethical decision making. Topics discussed include: Statement of Values, ethical paradigms, and ethical decision making. Mandatory ethics training refresher seminars are offered on an annual basis.

- The laboratory has contracted with an Ethics Hotline to provide an anonymous means of reporting ethics concerns or issues. The issue is forwarded by the service to the QA Director who will communicate internally with those who need to address the issue. All communication and actions are documented in a secure web interface managed by the hotline service company.

- The QA staff prepares monthly program status reports for management. The reports include a variety of metrics and graphs which are used to evaluate trends in laboratory performance across all quality and compliance areas. Management responds to any negative trends by developing a corrective action plan.

- The laboratory uses a Project Cycle process (further described in section 13.2) to proactively review and prepare for client projects in an effort to ensure full understanding by all laboratory staff of the client’s needs and resolve any concerns in advance of receiving the work.

13. SERVICE TO CLIENTS

13.1. Service to Clients

We value our client relationships and support these partnerships through the following principles:

- Honesty and Fairness – Our corporate culture is founded on the principles of professionalism and high ethical standards in dealing with our clients. This may mean declining to provide the service requested (if we are convinced that to do so would be meaningless) or it may mean referring clients outside of our laboratory if we believe that another company can better meet their needs.

- Complete Service – We will give our clients full value on every service provided. We will provide detailed information on our methods, procedures, and QA programs if requested, and take a personal interest and initiative in helping solve our client’s problems within the area of our professional expertise.

- Trustworthiness – All data and information developed for a client will be held confidential and not disclosed to a third party except on written request of the client. If information is subpoenaed, we must, by law, release it, but the client will be informed of the release.

- Commitment to Quality – We constantly strive to improve our service in quality, flexibility, and dependability, to keep our competitive edge. We will achieve this through: meeting the requirements of those we serve, staying apprised of regulatory and industry expectations, and providing prompt responses to client concerns.

- Basics of Superlative Service – Our focus is on our client's success. Through proactive collaborative communication, our leadership ensures we understand our client's expectations and strives to exceed them. We foster a service culture in our training, reward and recognition, and performance management process so each employee takes ownership to deliver superlative service to our clients. Feedback from clients, whether positive or negative, is an important part of our continuous improvement system. Ways in which feedback is gathered can include, but is not limited to, customer satisfaction surveys, client audits, and the customer complaint system, which is described within section 12.3.

We also view our fellow employees as our clients since they frequently receive the results of our labor. Meeting the requirements of the next employee in the workflow process is just as important as meeting the needs of an external client.

13.2. Review of Work Requests, Tenders, and Contracts

The laboratory places great importance on understanding and meeting client requirements for a project. We ensure, to the best of our ability, that client/project requirements are identified and communicated through the laboratory. Project evaluation can be achieved in various ways, including the review of analytical methods, protocols, business contracts, and quality project plans (QAPPs). The project review encompasses our Project Cycle process and individual topics to be evaluated for a project include, but are not limited to: scope of testing; required accreditations (i.e. individual state agencies, NELAP, DoD, and ISO 17025) held by the laboratory; appropriate and current testing methods; ability to meet project required reporting limits and QC (if applicable); inconsistencies clarified; and nonstandard work requests.

Project kick-off meetings can be arranged through the CSR or Business Development Group. These meetings allow the client and key technical personnel to discuss project issues and requirements prior to project initiation. Any differences between laboratory processes and the project requirements are discussed and addressed with the client and the laboratory staff before the project is accepted and samples arrive. Testing that cannot be performed at the laboratory may be subcontracted to another laboratory (see 13.4).

A key client contact, the CSR, is assigned to oversee the project. Communication between the client and laboratory staff is available and is coordinated through the CSR.

As a project continues, the CSRs provide continuous communication and status reports (if requested) about the project to the client. The CSR relays any project changes or modifications to the technical groups. If the client submits revised project documents (QAPPs, etc.) then the Project Cycle review process is repeated. The CSR also communicates any issues encountered by the technical laboratories back to the client and vice-versa.

13.3. Timely Delivery

Evaluating laboratory capacity and ability to perform specific projects is a joint responsibility between the Technical Director, Business Development, and the laboratory managers. We recognize that one of the most important aspects of the service we offer is turnaround time.

Many analysts are cross-trained to perform a variety of tests, and there is redundant equipment available in the laboratory area creating operation flexibility for routine work. Larger projects are reviewed against capacity estimates before bids are submitted to ensure that the client's schedule is met. Turnaround time is continually measured.

Regularly scheduled meetings are held with technical and support management, and project management personnel to review progress with current projects, as well as special requirements of new work scheduled for the laboratory.

Management receives a daily report of the status of all samples in the lab, including those with priority status or those that have exceeded a preset turnaround time. This enables the planning and organizing of the workload through efficient scheduling.

Any changes to the established timeline by the client or the laboratory must be communicated to the client or laboratory as soon as possible. Upon communication of changes, a new timeline is established and agreed upon by both parties. If a client requires a change in the scope of the project (e.g., number of samples submitted, change in analyses, revised protocol) the laboratory must be informed in writing and a new timeline and cost estimate is be provided.

13.4. Subcontracting

The laboratory may subcontract tests to other laboratories if the requested testing is not routinely performed in our laboratory. To a lesser extent, samples may need to be subcontracted to an overflow laboratory to ensure hold times and/or turn-around-times (TAT) are met.

Testing is only subcontracted with the client's knowledge and approval. The CSR must notify the client in writing when any of their requested analyses will be subcontracted to another lab. Client approval must be obtained in writing before samples are shipped.

Subcontract laboratories are selected based on their qualifications and accreditations. The subcontractor is requested to sign a Laboratory Analytical Services Subcontract. See form 9033100 to review details of the contract terms and information requested from the subcontract laboratory. If projects require a specific agency certification (i.e. individual state agencies, National Environmental Laboratory Accreditation Program (NELAP), Department of Defense (DoD) Environmental Laboratory Accreditation Program (ELAP), and ISO 17025), only an appropriately accredited laboratory is used. The client may also have a list of laboratories to be used for subcontracting. In these cases, the evaluation of the subcontract laboratory is made by the client.

Data obtained from subcontract laboratories is clearly marked as such when reported by the laboratory. The data are submitted to the client in the format obtained from the subcontractor.

13.5. Use of NELAP and A2LA logo

It is not laboratory policy to use these logos on any company letterhead, including analytical reports.

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Procedure Cross Reference List

NOTE: SOPs and Forms are indicated in the table with the unique Document Control Database number starting with “90…”. The topic of the document is given in parentheses.

Section #	Title	Procedure(s)
1	Introduction	
1.1.	Mission Statement	Employee Handbook
1.2.	Quality Policy	9007879 (Quality Statement) Employee Handbook
1.3.	Statement of Values	Employee Handbook
1.5.	Certifications, Accreditations, and Registrations	9007852 (Cert Summary) Company website
2	Organization and Personnel	
2.1.1	Business Continuity and Contingency Plans	9017347 (Incident Response Plan) 9017681 (Preparedness, Contingency) 9017358 (Archiving SOP) 9021762 (Deputies form)
2.2.	Organizational Structure	Organization Charts
2.3.	Management Responsibilities	PQDs (job descriptions) PMDs (individual job plans)
2.4.	Overview of the Quality Assurance Program	Dept 4052 SOP Series
2.5.	Quality Assurance Responsibilities	Dept 4052 SOP Series
2.6.	Communication of Quality Issues to Management	9020717 (QA Reports)
2.7.	Personnel Qualifications and Responsibilities	9017379 (Employee Training) PQDs (job descriptions) PMDs (individual job plans) Task Specific Training
2.8.	Relationship of Functional Groups and the Quality Assurance Program	Quality Orientation TQM Training PMDs (individual job plans) Dept 4052 SOP Series 9017338 (Project Cycle)
2.9.	Balancing Laboratory Capacity and Workload	PMDs (individual job plans) LIMS reports for mgt
2.10.	Identification of Approved Signatories	9017322 (Date Entry, Verification and Reporting)
2.11.	Personnel Training	9017379 (Employee Training) 9015390 (DOCs) PQDs (job descriptions) PMDs (individual job plans) Task Specific Training
2.12.	Regulatory Training	9022322 (GLP)

Section #	Title	Procedure(s)
2.13.	Employee Safety	Analytical Methods Chemical Hygiene Plan 9017681 (Preparedness) Dept 6098 SOP Series PMDs (individual job plans)
2.14.	Client Services/Project Management Responsibilities	Dept 4039 SOP Series 9017338 (Project Cycle)
2.15.	Confidentiality	Employee Handbook 9017360 (E-mail System) 9022134 (Client and Agency Audits)
2.16.	Business Conduct	Employee Handbook
2.17.	Operational Integrity	9017675 (Manual Integration) 9017333 (Chromatographic Integration) 9017679 (Ethics Policy) 9007879 (Quality Statement)
3	Buildings and Facilities	
3.1.	Facility	Floor Plans
3.2.	Security	9017366 (Building Security)
3.3.	Disaster Recovery	9017347 (Incident Response Plan)
3.4.	Environmental Monitoring	9017311 (VOA Storage) 9021509 (ETM)
3.5.	Water Systems	9017368 (Reagent Water)
3.6.	Housekeeping/Cleaning	9017373 (Housekeeping)
3.7.	Insect & Rodent Control	9017367 (Insect & Rodent Control)
3.8.	Emergency Power Supply	9017347 (Incident Response Plan)
3.9.	Facility Changes	9017364 (Facility Change Control) 9028515 (Change Control)
4	Document Control	
4.1.	Hierarchy of Internal Operating Procedures	9017356 (Writing SOPs)
4.2.	Document Approval, Issue, Control, and Maintenance	9017357 (Document Control) 9017329 (Method Validation)
4.3.	Client-Supplied Methods and Documentation	9021833 Analytical Decision Making) 9022599 (QA review of QAPPs) 9017338 (Project Cycle) 9015436 (Auditing Paperwork)
4.4.	Laboratory Notebooks, Logbooks, and Forms	9017357 (Document Control) 9021767 (Notebooks)
4.5.	Control of External Documents	9017357 (Document Control) Departmental “Controlled Documents” forms

Section #	Title	Procedure(s)
5	Sample Handling	
5.1.	Sample Collection	Dept 4031 SOP Series
5.2.	Sample Receipt and Entry	Dept 6042 SOP Series
5.3.	Sample Identification and Tracking	Dept 6042 SOP Series 9017318 (LSAR)
5.4.	Sample Storage	Dept 6055 SOP Series
5.5.	Sample Return/Disposal	9015512 (Sample Discard) 9017352 (Hazardous Wastes - Lab) 9017756 (Hazardous Wastes – Storage)
5.6.	Legal Chain of Custody	9017335 (Legal COC)
5.7.	Representativeness of Samples	Analytical Methods 9017334 (Representative Solid Samples)
6	Technical Requirements - Traceability of Measurements	
6.1.	Reagents and Solvents	9017328 (Reagents and Standards) Analytical Methods
6.3.	Calibration Standards	9017328 (Reagents and Standards) Analytical Methods
6.4.	Equipment and Instrumentation	9017325 (Inst. & Equip M&C) 9015389 (Balance, Syringe, Pipette Verification)
6.5.	Computerized Systems and Computer Software	9028515 (Change Control) 9017361 (Network Accounts) 9017360 (E-mail System) 9017710 (Computer Backup) Employee Handbook 9017712 (Computer Viruses)
6.6.	Change Control	9028515 (Change Control)
6.7.	Labware Cleaning	Departmental Procedures
7	Purchasing Equipment and Supplies	
7.1	Procurement	9021705 (Procurement) 9018236 (Receipt of Lab Supplies)
7.2	Supplier Evaluation	9021705 (Procurement) 9017310 (Subcontracting) 9017328 (Reagents and Standards) 9015516 Preservative Checks)

Section #	Title	Procedure(s)
8	Analytical Methods	
8.1.	Scope of Testing	Schedule of Services Company website
8.2.	Analytical Test Methods	9017329 (Method Validation) 9023483 (Writing Procedure Guidance)
8.3.	Client Supplied Methods	9017329 (Method Validation)
8.4.	Method Validation	9017329 (Method Validation)
8.5.	Procedural Deviations	9017331 (ICARs)
9	Internal Quality Control Checks	
9.1.	Laboratory Quality Control Samples and Acceptance Criteria	9017313 (QC Limits) Analytical Methods
9.2.	Quality Control Sample Frequency and Corrective Action	9017315 (Noncompliant Data) Analytical Methods
9.3.	Quality Control Charts	9018253 (End of Month QC Reports)
9.4.	Measurement Uncertainty	9017313 (QC Limits)
10	Assuring Quality of Test Results	
10.1.	Data Management	9021767 (Notebooks)
10.2.	Data Documentation	9021767 (Notebooks) 9017322 (Date Entry, Verification and Reporting) 9007879 (Quality Statement)
10.3.	Data Calculations	9017322 (Date Entry, Verification and Reporting) Analytical Methods
10.4.	Reporting Limits	9017309 (MDLs & LOQs)
10.5.	Data Review	9021767 (Notebooks) 9017322 (Date Entry, Verification and Reporting)
10.6.	Data Qualification	9017315 (Noncompliant Data)
10.7.	Data Reporting	9017322 (Date Entry, Verification and Reporting) 9017330 (MCL Exceedance)
10.8.	Data Storage, Security, and Archival	9017358 (Data Archiving) 9017710 (Computer Backup)
11	Audits and Inspections	
11.1.	Internal Quality Assurance Audits	9020535 (Internal Audits) 9022322 (GLP) 9008821 (Internal Audit Checklist)
11.2.	Review of the Quality Assurance Program	9020535 (Internal Audits) 9020717 (QA Reports)
11.3.	Good Laboratory Practice Critical Phase Inspections	9022322 (GLP)
11.4.	Client Audits	Employee Handbook 9022134 (Client and Agency Audits)

Section #	Title	Procedure(s)
11.5.	Agency Inspections	Employee Handbook 9022134 (Client and Agency Audits)
11.6.	Proficiency Testing	9017321 (PT Program) 9018237 (PT Entry)
12	Corrective and Preventive Action	
12.1.	Laboratory Investigations and Corrective Action	9017315 (Noncompliant Data) 9017331 (ICARs) 9017332 (Client Complaints)
12.2.	Investigation Processes	9017326 Missed Hold Procedure) 9007810 (Missed Hold form) 9017331 (ICARs)
12.3.	Client Feedback	9017332 (Client Complaints) Annual Client Survey
12.4.	Preventive Actions	Corporate Training Lean Projects 9017338 (Project Cycle) 9028515 (Change Control) 9020535 (Internal Audits)
13	Service to Clients	
13.1.	Service to Clients	Employee Handbook Ethics Statement 9007879 (Quality Policy) TQM Training
13.2.	Review of Work Requests, Tenders, and Contracts	9015436 (Client Paperwork) 9017338 (Project Cycle) 9018254 (QAPP Review)
13.3.	Timely Delivery	9015434 (Tracking Rush Samples) 9015437 (Scheduling Rush Samples) Departmental LIMS reports
13.4.	Subcontracting	9033100 (Subcontractor Checklist) 9017310 Subcontracting) 9017338 (Project Cycle)

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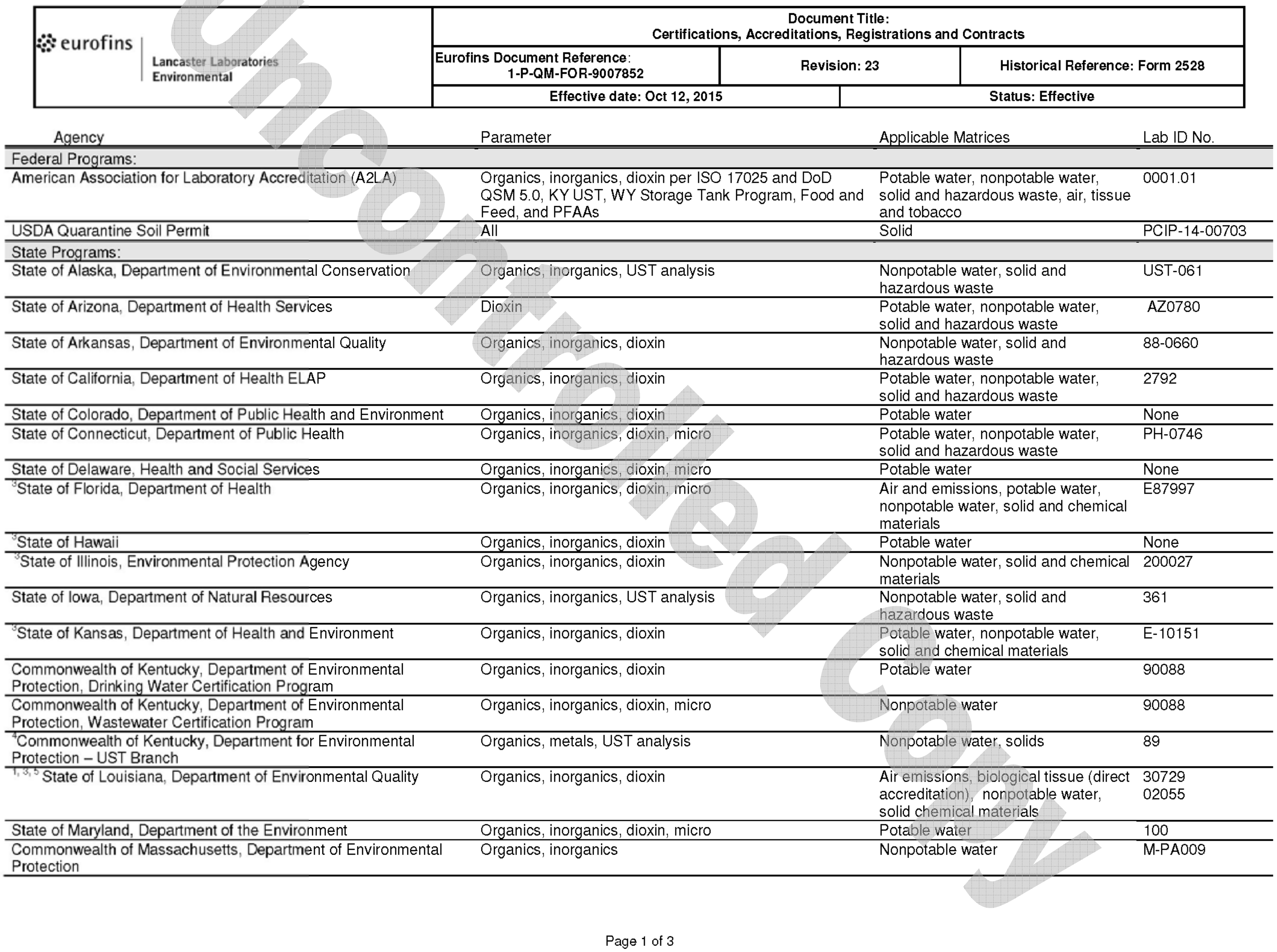

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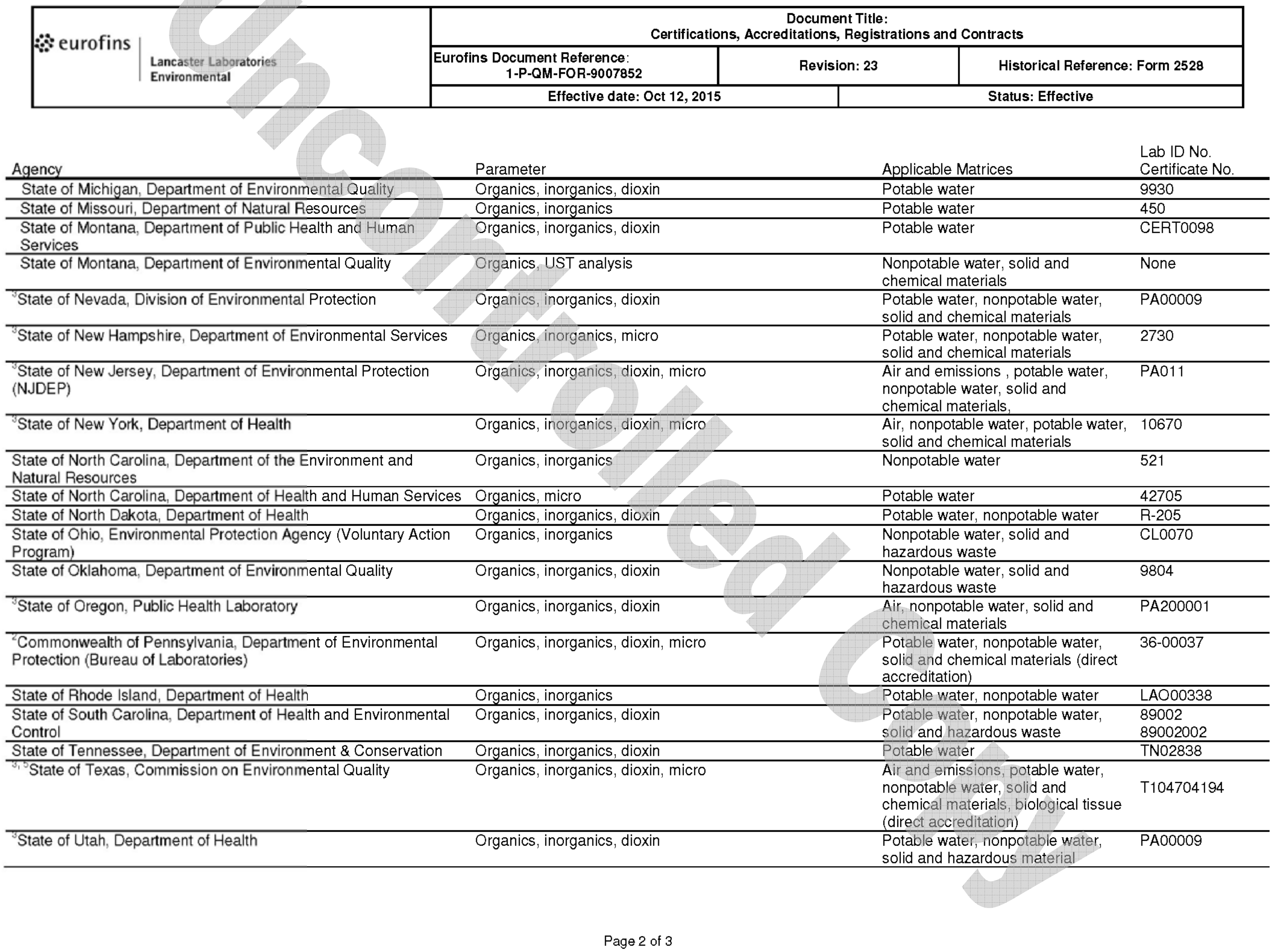
Agency	Parameter	Applicable Matrices	Lab ID No.
Federal Programs:			
American Association for Laboratory Accreditation (A2LA)	Organics, inorganics, dioxin per ISO 17025 and DoD QSM 5.0, KY UST, WY Storage Tank Program, Food and Feed, and PFAAs	Potable water, nonpotable water, solid and hazardous waste, air, tissue and tobacco	0001.01
USDA Quarantine Soil Permit	All	Solid	PCIP-14-00703
State Programs:			
State of Alaska, Department of Environmental Conservation	Organics, inorganics, UST analysis	Nonpotable water, solid and hazardous waste	UST-061
State of Arizona, Department of Health Services	Dioxin	Potable water, nonpotable water, solid and hazardous waste	AZ0780
State of Arkansas, Department of Environmental Quality	Organics, inorganics, dioxin	Nonpotable water, solid and hazardous waste	88-0660
State of California, Department of Health ELAP	Organics, inorganics, dioxin	Potable water, nonpotable water, solid and hazardous waste	2792
State of Colorado, Department of Public Health and Environment	Organics, inorganics, dioxin	Potable water	None
State of Connecticut, Department of Public Health	Organics, inorganics, dioxin, micro	Potable water, nonpotable water, solid and hazardous waste	PH-0746
State of Delaware, Health and Social Services	Organics, inorganics, dioxin, micro	Potable water	None
[3]State of Florida, Department of Health	Organics, inorganics, dioxin, micro	Air and emissions, potable water, nonpotable water, solid and chemical materials	E87997
[3]State of Hawaii	Organics, inorganics, dioxin	Potable water	None
[3]State of Illinois, Environmental Protection Agency	Organics, inorganics, dioxin	Nonpotable water, solid and chemical materials	200027
State of Iowa, Department of Natural Resources	Organics, inorganics, UST analysis	Nonpotable water, solid and hazardous waste	361
[3]State of Kansas, Department of Health and Environment	Organics, inorganics, dioxin	Potable water, nonpotable water, solid and chemical materials	E-10151
Commonwealth of Kentucky, Department of Environmental Protection, Drinking Water Certification Program	Organics, inorganics, dioxin	Potable water	90088
Commonwealth of Kentucky, Department of Environmental Protection, Wastewater Certification Program	Organics, inorganics, dioxin, micro	Nonpotable water	90088
[4]Commonwealth of Kentucky, Department for Environmental Protection – UST Branch	Organics, metals, UST analysis	Nonpotable water, solids	89
[1, 3, 5] State of Louisiana, Department of Environmental Quality	Organics, inorganics, dioxin	Air emissions, biological tissue (direct accreditation), nonpotable water, solid chemical materials	30729 02055
State of Maryland, Department of the Environment	Organics, inorganics, dioxin, micro	Potable water	100
Commonwealth of Massachusetts, Department of Environmental Protection	Organics, inorganics	Nonpotable water	M-PA009



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Agency	Parameter	Applicable Matrices	Lab ID No. Certificate No.
State of Michigan, Department of Environmental Quality	Organics, inorganics, dioxin	Potable water	9930
State of Missouri, Department of Natural Resources	Organics, inorganics	Potable water	450
State of Montana, Department of Public Health and Human Services	Organics, inorganics, dioxin	Potable water	CERT0098
State of Montana, Department of Environmental Quality	Organics, UST analysis	Nonpotable water, solid and chemical materials	None
[3]State of Nevada, Division of Environmental Protection	Organics, inorganics, dioxin	Potable water, nonpotable water, solid and chemical materials	PA00009
[3]State of New Hampshire, Department of Environmental Services	Organics, inorganics, micro	Potable water, nonpotable water, solid and chemical materials	2730
[3]State of New Jersey, Department of Environmental Protection (NJDEP)	Organics, inorganics, dioxin, micro	Air and emissions , potable water, nonpotable water, solid and chemical materials,	PA011
[3]State of New York, Department of Health	Organics, inorganics, dioxin, micro	Air, nonpotable water, potable water, solid and chemical materials	10670
State of North Carolina, Department of the Environment and Natural Resources	Organics, inorganics	Nonpotable water	521
State of North Carolina, Department of Health and Human Services	Organics, micro	Potable water	42705
State of North Dakota, Department of Health	Organics, inorganics, dioxin	Potable water, nonpotable water	R-205
State of Ohio, Environmental Protection Agency (Voluntary Action Program)	Organics, inorganics	Nonpotable water, solid and hazardous waste	CL0070
State of Oklahoma, Department of Environmental Quality	Organics, inorganics, dioxin	Nonpotable water, solid and hazardous waste	9804
[3]State of Oregon, Public Health Laboratory	Organics, inorganics, dioxin	Air, nonpotable water, solid and chemical materials	PA200001
[2]Commonwealth of Pennsylvania, Department of Environmental Protection (Bureau of Laboratories)	Organics, inorganics, dioxin, micro	Potable water, nonpotable water, solid and chemical materials (direct accreditation)	36-00037
State of Rhode Island, Department of Health	Organics, inorganics	Potable water, nonpotable water	LAO00338
State of South Carolina, Department of Health and Environmental Control	Organics, inorganics, dioxin	Potable water, nonpotable water, solid and hazardous waste	89002 89002002
State of Tennessee, Department of Environment & Conservation	Organics, inorganics, dioxin	Potable water	TN02838
[3,5]State of Texas, Commission on Environmental Quality	Organics, inorganics, dioxin, micro	Air and emissions, potable water, nonpotable water, solid and chemical materials, biological tissue (direct accreditation)	T104704194
[3]State of Utah, Department of Health	Organics, inorganics, dioxin	Potable water, nonpotable water, solid and hazardous material	PA00009

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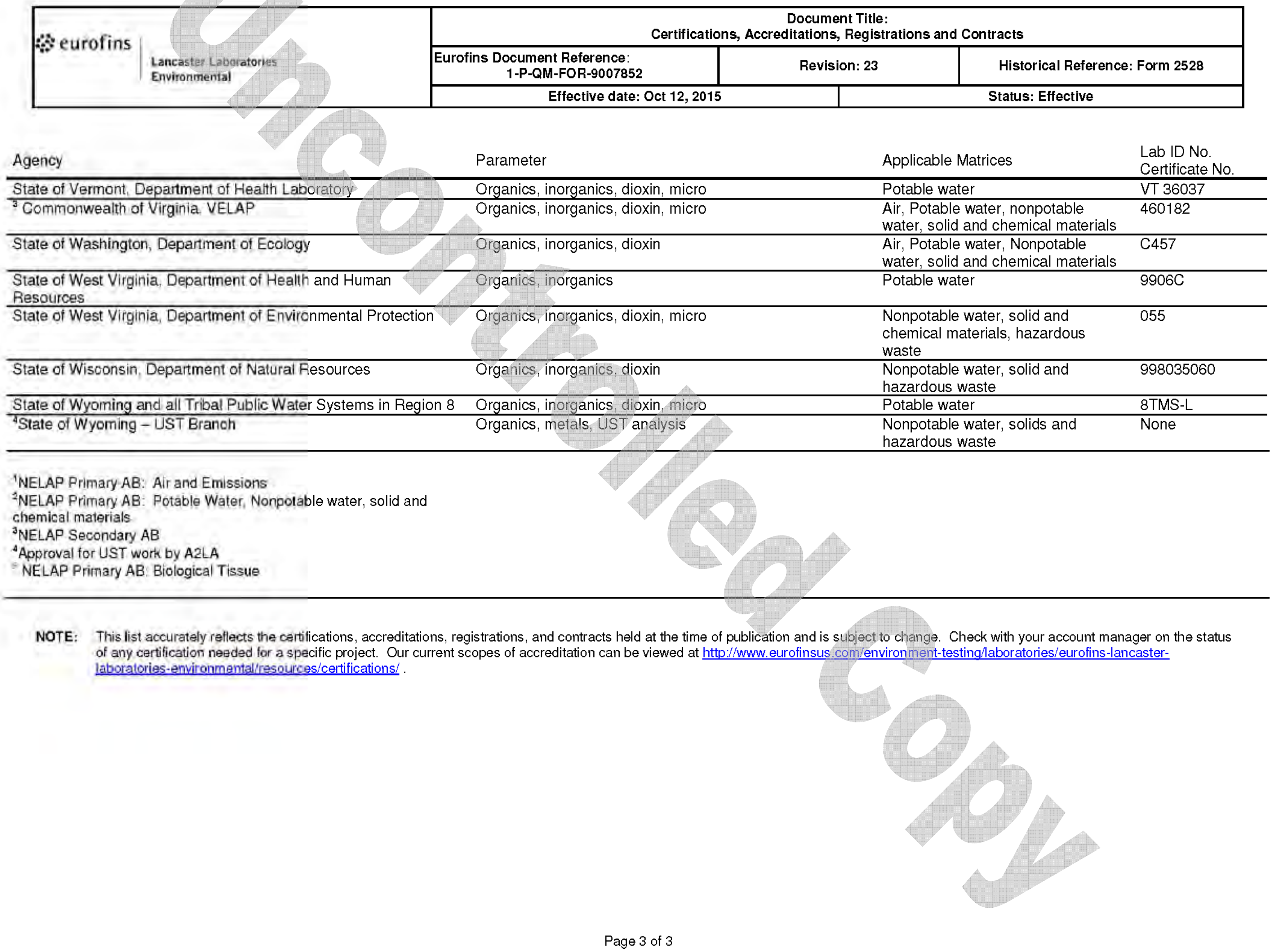

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	Eurofins Document Reference: 1-P-QM-FOR-9007852	Revision: 23	Historical Reference: Form 2528
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Agency	Parameter	Applicable Matrices	Lab ID No. Certificate No.
State of Vermont, Department of Health Laboratory	Organics, inorganics, dioxin, micro	Potable water	VT 36037
[3] Commonwealth of Virginia. VELAP	Organics, inorganics, dioxin, micro	Air, Potable water, nonpotable water, solid and chemical materials	460182
State of Washington, Department of Ecology	Organics, inorganics, dioxin	Air, Potable water, Nonpotable water, solid and chemical materials	C457
State of West Virginia, Department of Health and Human Resources	Organics, inorganics	Potable water	9906C
State of West Virginia, Department of Environmental Protection	Organics, inorganics, dioxin, micro	Nonpotable water, solid and chemical materials, hazardous waste	055
State of Wisconsin, Department of Natural Resources	Organics, inorganics, dioxin	Nonpotable water, solid and hazardous waste	998035060
State of Wyoming and all Tribal Public Water Systems in Region 8	Organics, inorganics, dioxin, micro	Potable water	8TMS-L
[4]State of Wyoming – UST Branch	Organics, metals, UST analysis	Nonpotable water, solids and hazardous waste	None

[1]NELAP Primary AB: Air and Emissions
[2]NELAP Primary AB: Potable Water, Nonpotable water, solid and chemical materials
[3]NELAP Secondary AB
[4]Approval for UST work by A2LA
[5] NELAP Primary AB: Biological Tissue

NOTE: This list accurately reflects the certifications, accreditations, registrations, and contracts held at the time of publication and is subject to change. Check with your account manager on the status of any certification needed for a specific project. Our current scopes of accreditation can be viewed at http://www.eurofinsus.com/environment-testing/laboratories/eurofins-lancaster-laboratories-environmental/resources/certifications/ .

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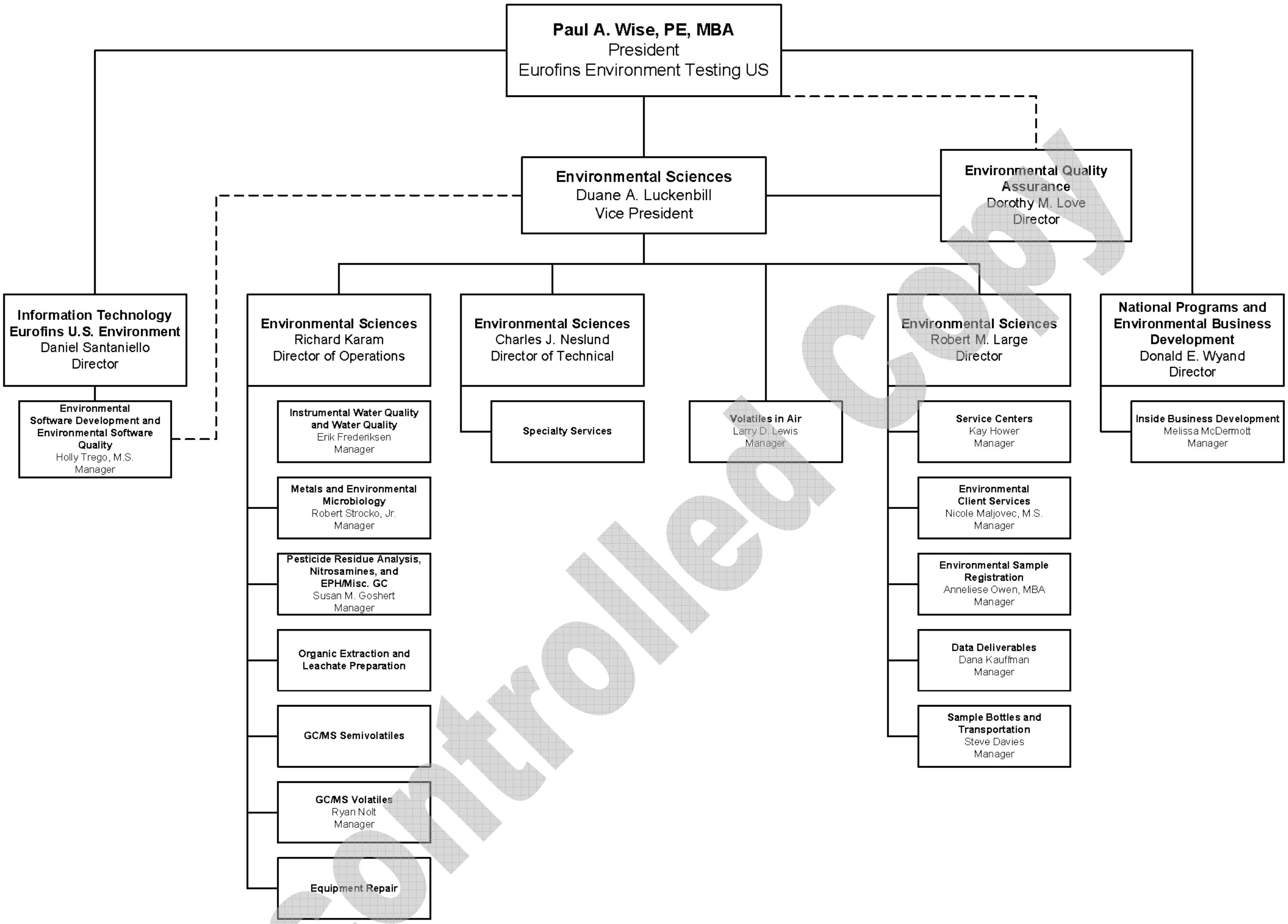

Name	Degree	Title
Quality Assurance		
Dorothy Love*	B.S.	Director Scientific Support
Barbara Reedy*	B.S.	Senior Specialist
Christiane Sweigart	B.S.	Senior Specialist
Kathryn Brungard*		Senior Specialist
Environmental Sciences		
Duane Luckenbill	B.S.	Vice President
Donald Wyand	B.S.	Director Sales
Robert Large*	B.S.	Director Operations Support
Richard Karam*	B.S.	Director Scientific
Charles Neslund*	B.S.	Director Scientific
Allon Hull	B.S.	Sr Account Manager
Christine Jampo	M.S.	Sr Account Manager
David Velasquez		Sr Account Manager
Irene Dodd*	M.S.	Operations Sup Pr Specialist I
Jane Huber	B.S.	National Sales Manager
Jenifer Lewis	B.S.	Pr Account Manager
Jeremy Young	B.S.	Sr Account Manager
Joseph Garzio	M.S.	Sr Account Manager
Kevin Moran	M.B.A.	Sr Account Manager
Laura Caulfield	B.S.	Operations Support Spec I
Laura Jovanovic	B.A.	Pr Account Manager
Marianne Bragg*	B.S.	Operations Sup Pr Specialist I
Melissa McDermott*	B.A.	Inside National Sales Manager
Susan Wike	A.S.	Specialist II
Tara Laroche	M.S.	National Sales Manager
Tara Spaide*		Operations Support Sr Spec I
Environmental Client Services and Inside Business Development		
Nicole Maljovec*	M.S.	Manager Operations Support
Wendy Kozma*	B.S.	Principal Specialist Group Leader
Alison Bainbridge	B.A.	Operations Support Spec I
Angela Miller*	B.S.	Operations Support Spec I
Barbara Weyandt*	M.S.	Operations Support Spec I
Deanna Wyand	B.S.	Specialist I
Kaitlin Plasterer*	B.S.	Operations Support Sr Spec I
Katherine Klinefelter*	M.S.	Operations Sup Pr Specialist I
Loran Carter*	B.S.	Operations Support Spec I
Lynn Frederiksen*	B.S.	Operations Sup Pr Specialist I
Lyssa Longenecker*	B.S.	Operations Support Sr Spec I
Megan Moeller*	B.S.	Operations Support Sr Spec I
Melanie Duszynski*		Operations Support Spec I
Nancy Bornholm*	B.S.	Operations Sup Pr Specialist I
Natalie Luciano*	B.A.	Operations Support Sr Spec I
Stacy Butt*	B.S.	Operations Support Spec I

Name	Degree	Title
Taylor Luckenbill	B.A.	Specialist I
Teresa Cunningham*	B.S.	Operations Sup Pr Specialist I
Additional support personnel in this group: 1		
Data Deliverables		
Dana Kauffman*		Manager
F. Bradley Ayars		Principal Scientist GL
Grace Salm		Specialist I
Audrey McClune		Specialist I
Betty Umble		Specialist I
Grace Salm		Specialist I
Jessica Baron		Specialist I
Judi Brown		Specialist I
Kathy Fair		Specialist I
Lydia Steinke	B.S.	Specialist I
M Susan Kreider		Specialist II
Patricia Madrigal-Kauffman	A.S.	Specialist I
Tina McNeil		Specialist I
Tracy Pang-Ward		Specialist I
Additional support personnel in this group: 5		
Service Centers		
Kay Hower*	B.A.	Manager Operations Support
Larry Starkey		Sr Project Manager GL
Ana Spencer*	B.S.	Project Manager
Cassandre Revell*	B.S.	Project Manager
Karen Lopez		Project Manager
Stefanie Mielnicki*	B.S.	Project Manager
Stephen Gordon*	B.S.	Project Manager
Additional support personnel in this group: 2		
Environmental Microbiology		
Robert Strocko*	B.S.	Manager
Hannah Cottman	B.S.	Scientist
Extractable Petroleum Hydrocarbons (EPH)/Miscellaneous GC		
Susan Goshert*	B.S.	Manager
Michele Hamilton*	B.S.	Senior Scientist Group Leader
Christine Dolman	B.S.	Scientist
Heather Williams	B.S.	Senior Scientist
Nicholas Rossi	B.S.	Senior Scientist
Tracy Cole*		Senior Specialist
Tyler Griffin	B.S.	Scientist
Additional support personnel in this group: 1		
Field Sampling		
Samuel Huber	B.S.	Manager
Jeffrey Allen		Courier/Sample Support Spe GL
Timothy Hauck		Courier/Sample Support Spec

Name	Degree	Title
GC/MS Semivolatiles		
Richard Karam*	B.S.	Director
Rachel Cochis*	B.A.	Senior Specialist Group Leader
Ankitaben Patel	M.S.	Scientist
Beth Rubino	B.S.	Senior Specialist
Brian Graham	B.A.	Senior Scientist
Catherine Bachman	B.S.	Scientist
Holly Ziegler	B.S.	Senior Scientist
Joseph Gambler	B.S.	Principal Scientist
Linda Hartenstine	B.A.	Senior Scientist
Mark Ratcliff*	B.A.	Senior Specialist
Matthew Barton*	B.S.	Senior Specialist
William Saadeh	B.S.	Scientist
GC/MS Volatiles		
Ryan Nolt	B.S.	Manager
Kathrine Muramatsu	B.S.	Senior Scientist Group Leader
Kenneth Boley*	B.S.	Senior Scientist Group Leader
Roy Mellott	B.S.	Senior Scientist Group Leader
Amanda Richards		Scientist
Angela Sneeringer	B.S.	Senior Scientist
Anita Dale		Scientist
Brett Kenyon	B.S.	Scientist
Chad Moline*	B.S.	Senior Specialist
Chelsea Stong	B.S.	Senior Specialist
Christine Dulaney*	B.S.	Senior Specialist
Christopher Torres	B.S.	Scientist
Daniel Heller	B.S.E.	Senior Scientist
Jason Long	B.S.	Senior Scientist
Jeremy Giffin	B.S.	Scientist
Kelly Keller		Scientific Support Spec I
Kerri Legerlotz	B.S.	Senior Scientist
Kevin Sposito	B.S.	Senior Scientist
Linda Pape	B.A.	Senior Scientist
Marie Beamenderfer	B.S.	Senior Scientist
Marla Brewer*	B.S.	Senior Specialist
Robin Runkle*	B.S.	Senior Specialist
Sara Johnson	B.S.	Senior Scientist
Sarah Guill	B.S.	Scientist
Stephanie Selis	B.S.	Senior Scientist
Additional support personnel in this group: 6		

Instrumental Water Quality		
Erik Frederiksen*	B.A.	Manager
Nicole Veety		Senior Scientist Group Leader
Clinton Wilson	B.A.	Scientist
Drew Gerhart	B.S.	Scientist
James Mathiot		Scientist
Joseph McKenzie		Scientist
Sandra Miller		Scientist
Additional support personnel in this group: 4		
Metals		
Robert Strocko*	B.S.	Manager
Nina Haller*		Senior Specialist Group Leader
Choon Tian	B.A.	Scientist
Damary Valentin		Scientist
Deborah Krady	B.S.	Scientific Support Spec I
Debra Bryan		Operations Support Spec I
Eric Eby	B.S.	Senior Scientist
Jennifer Moyer	B.S.	Senior Specialist
Katlin Cataldi	B.S.	Scientist
Parker Lindstrom	B.S.	Senior Scientist
Suzanne Will	B.S.	Scientist
Tara Snyder	B.S.	Scientist
Additional support personnel in this group: 7		
Organic Extraction		
Richard Karam*	B.S.	Director
Joseph Feister		Senior Scientist Group Leader
Wanda Oswald		Senior Scientist Group Leader
Darin Wagner	B.A.	Scientist
David Hershey		Scientist
David Schrum		Technician II
Heidi Roberts*	B.S.	Senior Scientist
Jessica Velez	B.S.	Scientist
JoElla Rice		Technician II
Joseph Feister		Senior Scientist Group Leader
Justin Bukeavich		Technician
Kailah Ortiz		Technician
Robert Vincent	B.S.	Principal Scientist
Ryan Schafran	B.S.	Scientist
Shawn McMullen	B.A.	Scientist
Additional support personnel in this group: 20		

Pesticide Residue Analysis		
Susan Goshert*	B.S.	Manager
James Place	B.S.	Senior Scientist
Jamie Brillhart	B.S.	Senior Scientist
Jessica Miller	B.S.	Senior Scientist
Lisa Reinert	B.S.	Scientist
Monica Souders	B.S.	Scientist
Richard Shober	B.S.	Principal Scientist
Valerie Tomayko*	B.S.	Pr Scientific Sup Spec I
Additional support personnel in this group: 1		
Specialty Services Group		
Charles Neslund*	B.S.	Director
Christine Ratcliff	B.S.	Pr Scientific Sup Spec I GL
Brett Weidman	B.S.	Scientist
Deborah Zimmerman		Scientist
Ginelle McQuaid		Scientist
Joseph Anderson	B.S.	Senior Scientist
Meng Yu	M.S.	Principal Scientist
Michael Ziegler	B.S.	Senior Scientist
Michele Smith*	B.S.	Senior Specialist
Paul Cormier	B.A.	Pr Scientific Sup Spec I
Robert Brown		Principal Scientist
Timothy Trees	A.S.	Principal Scientist
Additional support personnel in this group: 3		
Volatiles in Air		
Larry Lewis	B.S.	Manager Scientific
Jeffrey Smith	B.A.	Senior Scientist Group Leader
Jacob Bailey	B.S.	Scientist
Additional support personnel in this group: 1		
Water Quality		
Erik Frederiksen*	B.A.	Manager Scientific
Kenneth Bell*	B.S.	Principal Scientist GL
Hannah Royer	B.A.	Scientist
Michele Graham	B.S.	Scientist
Michelle Lalli		Scientist
Robert Heisey*	B.A.	Senior Specialist
Susan Engle		Scientist
Susan Hibner	B.S.	Scientist
Yolunder Bunch		Scientist
Additional support personnel in this group: 6		

Environmental Software Development		
Holly Trego	B.S.	Manager IT Support
Andrew Strebel		IT Development Pr Spec II
Bret Winey	B.S.	IT Development Sr Specialist
Catherine Holt	B.S.	IT Development Pr Spec II
Chadwick Hershey	B.S.	IT Development Sr Specialist
Christopher Stauffer	B.S.	IT Development Sr Specialist
Diana Holmes	M.S.	IT Development Sr Specialist
Eric Walker		IT Development Specialist
John Riggs	B.S.	IT Development Sr Spec GL
Joshua Peters	B.S.	IT Development Specialist
Tiffany Betz	B.S.	IT Development Pr Spec II
Timothy Weaver	B.A.	IT Development Sr Specialist
Environmental Sample Administration		
Anneliese Owen	M.B.A.	Manager Scientific Support
Carolyn Cyms	B.S.	Senior Specialist Group Leader
Tamara Helsel		Senior Specialist Group Leader
Christine Knoedler	B.A.	Scientific Support Spec I
Deborah Neslund		Specialist II
Katherine Metzger	B.A.	Scientific Support Spec I
Katie Hartlove		Scientific Support Spec I
Kristin Zeigler	B.S.	Scientific Support Spec I
Additional support personnel in this group: 5		
Equipment Maintenance & Repair		
Robert Allison		Facilities Specialist I
Training		
Beth DiPaolo	M.A.	Vice President of PSS & Recruiting/Organizational Development
Kimberly Davies	M.B.A.	Director
Lindsay Deibler-Wallace	M.S.	Senior Specialist Group Leader
Barbara Weaver	M.S.	Pr Scientific Sup Spec I
Harry Ward	PHD	Pr Scientific Sup Spec I
Julia Matesich	B.S.	Scientific Support Spec I
Michael Salgado	B.S.	Senior Specialist
Sample Bottles		
Steven Davies	B.S.	Manager
Karen Guito		Courier/Sample Support Spec
Samantha DeFalcis		Courier/Sample Support Spec
Sandra Muckle		Courier/Sample Support Spec
Additional support personnel in this group: 3		

Sample Support		
Anneliese Owen	M.B.A.	Manager Scientific Support
Chad Wettig		Senior Specialist Group Leader
Lisa Cooke		Scientist
Stephanie Sanchez		Scientist
Additional support personnel in this group: 10		
Transportation		
Steven Davies	B.S.	Manager Operations Support
Christopher Winters		Courier/Sample Support Spec
L Kenneth Miller		Courier/Sample Support Spec
Leon Wolf		Courier/Sample Support Spec
Timothy Miller		Courier/Sample Support Spec
Additional support personnel in this group: 17		
Safety		
Rachel Brady	B.S.	Senior Specialist Group Leader
Beth Rich		Operations Support Sr Spec I
Stephen Nowakowski	B.S.	Senior Specialist
Additional support personnel in this group: 7		

*Denotes those employees who are authorized to release Analysis Reports.

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Jeffrey S. Allen, Courier/Sample Support Group Leader, Field Sampling
Information not available at time of printing

Joseph D. Anderson, B.S., Senior Chemist, Specialty Services Group
Education:
- B.S. General Science, Pennsylvania State University (2004)

Professional Experience:
- ALSI, GC GC/MS Analyst (2004-2010)
    - Responsibilities included preparing, running, and reviewing samples according to client and industry methods using various instrumentations including GC and GC/MS; performing analysis for various departments as determined by work volume and staffing needs; reviewing and reporting data within client specified criteria
- With Lancaster Laboratories since 2010
    - Senior Chemist, Flexible Staffing (2010)
        - Responsibilities included preparing, running, and reviewing samples according to client, compendia, and industry methods using various wet chemistry techniques and instrumentation, which may include but is not limited to, gas chromatography, liquid chromatography, IC, and TOC instrumentation; performing analysis for various departments as determined by work volume and staffing needs
    - Senior Chemist, Specialty Services Group (2012)
        - Responsibilities include maintaining instrumentation; tuning and calibrating instrument daily; analyzing quality control and client samples; reviewing and assembling data in an efficient manner with a high degree of quality; evaluating current organizational and analytical systems; diagnosing complex problems and offering solutions with a high degree of independence; suggesting and implementing improvements to maximize quality and productivity; acting as technical resource for internal problems and projects; assisting in “brainstorming” client problems and projects; training new employees in all aspects of instrumentation; researching new and emerging technologies

F. Bradley Ayars, Principal Specialist Group Leader, Data Deliverables
Continuing Education:
- Environmental Law & Policy, Franklin & Marshall College (1991)

Professional Experience:
- With Eurofins Lancaster Laboratories since 1988
    - Client Services Specialist (1992)
    - Environmental Project Management (1994)
    - Senior Specialist Coordinator, Electronic Data Deliverables (1997)
        - Responsibilities included supervising EDD staff; developing and maintaining EDD formats; overchecking lab data for EDDs; primary contact for EDD issues
    - Senior Specialist Group Leader, Electronic Data Deliverables (2005)
        - Responsibilities included supervising EDD staff; developing and maintaining EDD formats; overchecking lab data for EDDs; primary contact for EDD issues
    - Principal Specialist Group Leader, Electronic Data Deliverables (2014)
        - Responsibilities include supervising EDD staff; developing and maintaining EDD formats; overchecking lab data for EDDs; primary contact for EDD issues

Duane A. Luckenbill, B.S., Vice President, Eurofins Lancaster Laboratories Environmental
Education:
- B.S. Chemistry, Clarion University of PA (1989)

Continuing Education:
- Introduction to Mass Spectral Interpretation, Hewlett-Packard (1995)
- Technical Training, OI Analytical (1995)

Professional Experience:
- ATEC Associates, Inc., GC/MS Analyst (1989)
- With Eurofins Lancaster Laboratories since 1989
    - Chemist (1991)
    - Chemist/Coordinator (1993)
    - Group Leader (1997)
    - Manager (2001)
        - Responsibilities included client satisfaction, safety and quality systems administration, and all aspects of financial, personnel, and operations management of the GC/MS Volatiles and GC/MS Semivolatiles groups
    - Director, Environmental Sciences (2005)
        - Responsibilities included client satisfaction, safety and quality systems administration, and all aspects of financial, personnel, and operations management of the GC/MS Volatiles, GC/MS Semivolatiles, Volatiles in Air, Organic Extraction, Leachate Preparation, Field Sampling, Pesticide Residue Analysis, Volatiles by GC, and EPH/Miscellaneous GC groups

Vice President, Eurofins Lancaster Laboratories Environmental (2013)

Responsibilities include all aspects of financial, personnel, and operations management of all Technical areas, Environmental Quality and Compliance, Computer Application/Development, and Environmental Support Services while continually focusing on client satisfaction, safety, and quality systems administration; collaborating with other Eurofins US environmental companies to expand national testing capabilities and grow market share in the US

Awards, Citations, Honorary Societies & Publications:

Undergraduate Award in Analytical Chemistry, American Chemical Society (1988)
Department of Chemistry Competitive Award, Clarion University (1988-1989)
Outstanding Senior Chemistry Award, American Institute of Chemists Foundation (1989)
Senior College Award for Chemistry, Society for Analytical Chemists of Pittsburgh (1989)
One publication on mass spectrometry

Matthew Rusty E. Barton, B.S., Senior Specialist, GC/MS Semivolatiles

Education:

B.S. Biochemistry, East Stroudsburg University (1991)

Professional Experience:

With Lancaster Laboratories since 1991

Senior Chemist (1998)

Senior Chemist/Coordinator (1999)

Responsibilities included: supervise personnel; schedule lab work; perform purge and trap gas chromatography testing; operate O.I. 4560/4551, Tekmar 3000, Archon 5100, and HP5890 Series II OC instruments; review and approve data; and developing and evaluating new methods.

Senior Chemist, Nitrosamines (2003)

Responsibilities included: Analysis of nitrites in tobacco samples

Senior Chemist, EPH/Misc. GC (2004)

Responsibilities include: Analysis of environmental samples for diesel range organics via gas chromatography

Senior Specialist, GC/MS Semivolatiles (2008)

Responsibilities include: audit and upload of departmental data

Marie D. Beamenderfer, B.S., Senior Chemist, GC Volatiles

Education:

B.S. Biology, The Pennsylvania State University (2006)

Professional Experience:

With Eurofins Lancaster Laboratories since 2006

Chemist, GC Volatiles (2006)

Responsibilities included maintaining GC instrumentation; calibrating instruments as needed; analyzing quality control and client samples; reviewing and assembling data in an efficient manner with a high degree of quality; evaluating current organizational and analytical systems; suggesting and implementing the necessary corrective action to ensure the above can be performed in alignment with client and/or regulatory requirements; performing all duties with minimal supervision; training new employees; tracking inventory of instrument parts and standards and entering them into the standards database as received; verifying data on an as needed basis

Senior Chemist, GC Volatiles (2012)

Responsibilities include maintaining GC instrumentation; calibrating instruments as needed analyzing quality control and client samples; reviewing and assembling data in an efficient manner with a high degree of quality; evaluating current organizational and analytical systems; suggesting and implementing the necessary corrective action to ensure the above can be performed in alignment with client and/or regulatory requirements; performing all duties with minimal supervision; training new employees; tracking inventory of instrument parts and standards and entering them into the standards database as received; working on special assignments; diagnosing complex problems and offering solutions with a high degree of independence; assisting in “brainstorming” client problems and projects; completing assigned projects on time; verifying data on an as needed basis

Kenneth A. Bell, B.S., Principal Chemist Group Leader, Water Quality

Education:
  B.S. Chemistry, Millersville University (1997)
Professional Experience:
  Johnsons Chemical, Laboratory Assistant (1989-1992)
      Responsibilities included collecting samples and performing testing on raw material
  With Eurofins Lancaster Laboratories since 1994
    Senior Laboratory Technician, Water Quality (1994)
      Responsibilities included routinely performing analytical testing using wet chemistry methods
    Chemist/Coordinator, Water Quality (1994)
      Responsibilities included performing wet chemistry analyses, sample verification, and coordinating workflow
    Senior Chemist/Coordinator, Water Quality (1994)
      Responsibilities included coordinating workflow, performing sample verification, back-up report signing, training new employees, revising standard operating procedures, writing annual job plans and reviews
    Senior Chemist Group Leader, Water Quality (2005)
      Responsibilities included coordinating workflow, performing sample verification, back-up report signing, training new employees, revising standard operating procedures, writing annual job plans and reviews
    Principal Chemist Group Leader, Water Quality (2014)
      Responsibilities include coordinating workflow, performing sample verification, back-up report signing, training new employees, revising standard operating procedures, writing annual job plans and reviews

Tiffany D. Betz, B.S., Principal Specialist, Environmental Software Development

Education:
  B.S. Computer Science, Millersville University (2001)
Continuing Education:
  Oracle Exam #1Z0-007, Introduction to Oracle 9i: SQL (May 17, 2004)
  Oracle Exam #1Z0-147, Oracle 9i: Program with PL/SQL (August 4, 2004)
Professional Experience:
  With Eurofins Lancaster Laboratories since 2000
    Specialist, Computer Applications Development (2000)
      Responsibilities included performing computer applications development and maintenance.
    Senior Specialist, Computer Applications Development (2006)
      Responsibilities included performing computer applications development and maintenance.
    Principal Specialist, Environmental Software Development (2012)
      Responsibilities include analyzing, designing, developing, documenting, validating, and deploying custom software in a regulated environment; conforming to FDA guidelines and CFR Part 11 in all duties; strictly adhering to Lancaster Laboratories Software Development Lifecycle (SDLC) policies and procedures; preparing and executing software test plans for custom developed Laboratory Information Management System (LIMS) and other software in accordance with internal procedures; spending a large portion of time writing documentation in support of various software development stages and in accordance with SDLC procedures; spending some portion of time supporting and assisting users with new software applications; at times, conducting formal training sessions with a small group of users to familiarize them with a new computer system

Kenneth L. Boley, Jr., B.S., Senior Chemist Group Leader, GC/MS Volatiles

Education:
  B.S. Chemistry, Messiah College (1995)
Professional Experience:
  Heritage Custom Kitchens, Inc., Face Frame Assembler (1997–2001)
      Responsibilities included reading and interpreting job orders; overseeing daily production of department; performing various manufacturing duties daily; member of the safety committee, first aid team, and security team
  With Lancaster Laboratories since 2001
    Chemist, GC/MS Volatiles (2001)
      Responsibilities included analyzing samples and QC by purge and trap GC/MS; generating and reviewing raw data; performing maintenance on GC/MS, purge and traps, and various autosamplers; following methods and SOPs
    Senior Chemist, GC/MS Volatiles (2005)
      Responsibilities included performing routine and non-routine analyses; diagnosing and solving technical problems; maintaining and troubleshooting instrumentation; writing and revising SOPs; training new analysts; auditing and uploading data as work load deems necessary

Senior Chemist Group Leader, GC/MS Volatiles (2009)

Responsibilities include maintaining GC/MS instrumentation; tuning and calibrating instrument daily; analyzing quality control and client samples; reviewing and assembling data in an efficient manner with a high degree of quality; evaluating current organizational and analytical systems; suggesting and implementing corrective action and system improvements when necessary; performing all duties with minimal supervision; working on special assignments; diagnosing complex problems and offering solutions with a high degree of independence; assisting in “brainstorming” client problems and projects; completing assigned projects on time; researching new and emerging technologies; producing written and oral reports on research activities; performing both technical and personnel aspects of group operations; performing work within the department or other areas as required; acting as a technical resource, trainer, and troubleshooter to specific department; making recommendations for operational and/or technical improvements; communicating effectively within the group; coaching and developing direct reports; planning and monitoring workflow

Nancy J. Bornholm, B.S., Principal Specialist, Environmental Client Services

Education:

B.S. Chemistry (magna cum laude), Muhlenberg College (1981)

Continuing Education:

Instrumental Analysis of Paints and Polymers, FBI Academy (1984)
Analytical Chemistry of Contaminants in Surface and Groundwater, ACS Short Course (1986)

Professional Experience:

University of Connecticut Health Center, Laboratory Technician (1977-1980)
Institute for Cancer Research, Research Technician (1981)
Baltimore City Crime Laboratory, Mobile Crime Unit Trainee (1981-1982)
Maryland State Police Crime Laboratory, Forensic Chemist III (1982-1985)
With Lancaster Laboratories since 1985

Senior Specialist, Environmental Client Services (1987)

Responsibilities included project management; audit sample entries; answer client questions; communicate client requirements to lab areas; and schedule sample submissions and provide sampling containers

Principal Specialist, Environmental Client Services (2004)

Responsibilities include performing project management for large clients/projects; auditing sample entries for accuracy; providing price quotes; answering client questions; understanding and communicating client requirements to lab personnel; scheduling sample submissions; ordering sampling containers and providing pre-printed COCs; serving as a technical resource to both internal and external clients and notifying management of any client issues

Awards, Citations, Honorary Societies, and Publications:

Quarterly Impact Award (2008)
Superlative Service President’s Award (2008)

Rachel A. Brady, B.S., Senior Specialist Group Leader, Safety

Education:

B.S. Environmental Biology, Millersville University (2002)

Professional Experience:

TIER Environmental, Lab Pack Chemist (2005-2006)

Responsibilities included preparing shipments/paperwork for hazardous/residual waste disposal

Clean Harbors, InSite Supervisor (2010-2014)

Responsibilities included overseeing Hazardous Waste disposal program; all residual waste; waste water treatment plant operations

With Eurofins Lancaster Laboratories since 2014

Specialist, Safety (2014)

Responsibilities included implementing and performing hazardous, biologic, and chemotherapeutic waste removal

Senior Specialist, Safety (2015)

Responsibilities include overseeing waste team; RSO; oversee all Environmental Programs

Marla S. Brewer, B.S., Senior Specialist, GC/MS Volatiles

Education:

B.S. Industrial Hygiene, Purdue University (2000)

Continuing Education:

OSHA 8-Hour (2000)
Comprehensive GC/MS Seminar, Restek (2002)
Practical Process Improvement Facilitator Training (2010)

Professional Experience:

ALCOA, Industrial Hygiene Intern (1999)

Responsibilities included performing air sampling for a variety of substances; conducting noise survey including area and personal sampling; testing plant environment for heat stress and evaluated reports; assisting in formulation of written program

BP-Amoco Refinery/Orr Professional Services, Industrial Hygiene Technician (2000)

Responsibilities included performing air sampling to reevaluate Benzene Exposure Surveillance Program; conducting noise surveys including area and personal monitoring to reevaluate Hearing Conservation Program

With Eurofins Lancaster Laboratories since 2000

Senior Technician, Volatiles by GC (2000)

Responsibilities included performing prescreen analysis, sample prep, GC maintenance, and data review

Chemist, GC/MS Volatiles (2001)

Responsibilities included analyzing samples and QC by purge and trap GC/MS; generating and reviewing raw data; performing maintenance on GC/MS, purge and traps, and various autosamplers

Senior Specialist, GC/MS Volatiles (2006)

Responsibilities include performing GC/MS volatile data interpretation; reviewing and approving data; signing reports; analyzing samples; generating raw data; sample verification; SOP revisions and updates

Jamie L. Brillhart, B.S., Senior Chemist, Pesticide Residue Analysis

Education:

B.S. Physical Science, York College of Pennsylvania (2003)

Professional Experience:

B-H Laboratories Inc./Analytical Laboratory Services Inc., Inorganic Laboratory Technician/Inorganic Chemist (2003-2005)

Responsibilities included performing wet chemistry testing on drinking waters and waste water; being responsible for analyses included fluoride, cyanide, phosphorus, nitrate/nitrite, cadmium reduction, and grease and oil testing when needed; prepping and analyzing for mercury on a mercury analyzer; analyzing for various metals on a graphite furnace; prepping leachates; prepping standards as needed

Hercon Laboratories, Inc., QC Analyst I (2005-2007)

Responsibilities included performing Quality Control Testing on Transdermal Systems; performing assays, dissolutions, degradation, residual solvents, and raw material testing; prepping necessary standards and performing instrument maintenance as needed

With Lancaster Laboratories since 2007

Chemist, Pesticide Residue Analysis (2007)

Responsibilities included analyzing soils for PPL Pesticides using 5890 and 6890 GCs with ECD detectors; performing instrument maintenance; prepping standards; auditing calibrations as necessary; being able to analyze for OPPAs, ACMOs, EDBs, PCBs, and Herbicides as needed

Senior Chemist, Pesticide Residue Analysis (2011)

Responsibilities include analyzing soils for PPL Pesticides using 5890 and 6890 GCs with ECD detectors; performing instrument maintenance; prepping standards; auditing calibrations as necessary; being able to analyze for OPPAs, ACMOs, EDBs, PCBs, and Herbicides as needed

Marianne L. Bragg, B.S., Principal Specialist, Business Development, Environmental Sciences

Education:

- B.S. Biology, Millersville University (1987)

Professional Experience:

- With Eurofins Lancaster Laboratories since 1985
  - Coordinator
  - Group Leader (1990)
  - Principal Specialist (1994)
    - Responsibilities included advising clients on testing; providing price quotes and proposals; answering client questions; scheduling sample submissions and providing sampling containers; communicating client requirements to lab areas; assisting with client visits to the lab
  - Principal Specialist/Coordinator, Environmental Business Development (2002)
    - In addition to the responsibilities listed above, manage workload and workflow among business development staff
  - Principal Specialist/Group Leader, Environmental Business Development (2005)
    - In addition to the responsibilities listed above, manage workload and workflow among business development staff
  - Principal Specialist, Environmental Business Development (2007)
    - Responsibilities included advising clients on testing; providing price quotes and proposals; answering client questions; scheduling sample submissions and providing sampling containers; communicating client requirements to lab areas; assisting with client visits to the lab
  - Principal Specialist, Business Development, Environmental Sciences (2014)
    - Responsibilities include independently securing new business consistent with operational capabilities and business plan goals; collaborating efforts and activities with those of Outside Sales account managers as needed; focusing on proposal writing for major national accounts; attending face-to-face sales meetings with selected national accounts as needed and maintaining responsibility for their maintenance and growth

Robert Brown, Principal Chemist, Specialty Services Group

Education:

- Attended 2.5 years at Pennsylvania State University towards B.S. in Microbiology (1988)
- Completed 20 credits towards B.S. in Environmental Biology, Millersville University (1993)

Professional Experience:

- With Eurofins Lancaster Laboratories since 1988
  - Chemist (1993)
  - Senior Chemist (1997)
    - Responsibilities included performing extractable petroleum testing; operating multiple Hewlett-Packard gas chromatograph (GC) instruments; data interpretation and entry; developing and evaluating new methods
  - Principal Chemist (2004)
    - Responsibilities included performing extractable petroleum testing; operating multiple Hewlett-Packard gas chromatograph (GC) instruments; data interpretation and entry; developing and evaluating new methods; serving as primary technical contact for client service representatives and their clients
  - Principal Chemist Group Leader, EPH/Misc. GC (2005)
    - Responsibilities included performing extractable petroleum testing; operating multiple Hewlett-Packard gas chromatograph (GC) instruments; data interpretation and entry; developing and evaluating new methods; serving as primary technical contact for client service representatives and their clients
  - Principal Chemist, Specialty Services Group (2011)
    - Responsibilities include: acting as technical resource within the environmental division; developing and validating analytical protocols; troubleshooting and solving analytical chemistry problems; optimizing instrument configuration and performance; evaluating and interpreting analytical results; writing SOPs; assisting in responding to and eliminating ICARs, assisting in optimizing procedures in prep lab; communicating effectively within department; performing routine work as required

Kathryn A. Brungard, Senior Specialist, Environmental Quality Assurance

Continuing Education:

Clinical Laboratory Science, Temple University (1984-1988)

Professional Experience:

Environmental Partners, Inc., Environmental Technician/Health and Safety Coordinator (2003-2005)

Responsibilities included determining personnel health and safety risks on each work site and determining appropriate measures to be taken for personal protection; maintaining and servicing sampling equipment; calibrating meters and analytical equipment; collecting and processing representative samples at each monitoring site following state mandated procedures; routinely measuring field water and soil quality parameters; performing product recovery as part of site remedial measures; evaluating and reporting upon trends and/or results that were out-of-range

Maxwell House Coffee/Kraft Foods, Quality Assurance Technician (2004-2005)

Responsibilities included conducting hourly audits on operating production lines which included weight of product, oxygen content, density, caffeine level by HPLC, moisture content, inspection for foreign or incidental materials, and packaging compliance; performing weekly water testing for level of chlorine and microbial contamination; producing result spreadsheets and accurate logs; notifying upper management of all results in a timely manner

Columbia Analytical Services, Inc, Quality Assurance Program Manager (2005-2009)

Responsibilities included being responsible for the overall coordination of the NELAP certified environmental laboratory program; monitoring laboratory quality systems through audits; identifying potential problem areas, recommending corrective actions, and providing technical assistance and training as necessary; informing management of potential problems and recommending remedial measures in a timely basis both orally and by written communication; maintaining performance evaluation records; maintaining accreditations for regulatory agencies and client programs; providing audit responses and initiating changes in procedures; maintaining the calibration of all weights, balances, and thermometers

With Eurofins Lancaster Laboratories since 2010

Senior Specialist, Environmental Quality Assurance (2010)

Responsibilities include ensuring quality of data being produced in the laboratories by performing data review, auditing laboratories, and reviewing written procedures; ensuring laboratory adherence to government regulations and client requirements; reviewing client and government documents for requirements outside our usual laboratory practices; setting up and testing new analysis in the laboratory sample management system as required by the departments

Memberships and Appointments:

Florida Society of Environmental Analysts (2005-2009)
Society of Women Environmental Professionals, SWEP (2012-present)

Rachel R. Cochis, B.A., Principal Specialist Group Leader, GC/MS Semivolatiles

Education:

B.A. Science, Pennsylvania State University (1992)

Continuing Education:

Introduction to Mass Spec Interpretation, Hewlett-Packard (1995)
Gas Chromatography Principles & Practices (1994)

Professional Experience:

With Eurofins Lancaster Laboratories since 1993

Chemist (1994), GC/MS Semivolatiles (1993)

Responsibilities included performing semvolatiles analysis on water and soil samples

Senior Chemist Coordinator, GC/MS Semivolatiles (1996)

Responsibilities included scheduling lab work; performing data interpretation and entry; reviewing and approving data; revising and updating SOPs and analytical methods; monitoring turnaround time; communicating client requirements to lab areas

Senior Specialist Group Leader, GC/MS Semivolatiles (2005)

Responsibilities included scheduling lab work; performing data interpretation and entry; reviewing and approving data; revising and updating SOPs and analytical methods; monitoring turnaround time; communicating client requirements to lab areas

Principal Specialist Group Leader, GC/MS Semivolatiles (2013)

Responsibilities include scheduling lab work; performing data interpretation and entry; reviewing and approving data; revising and updating SOPs and analytical methods; monitoring turnaround time; communicating client requirements to lab areas

Tracy A. Cole, Senior Specialist, EPH/Miscellaneous GC

Continuing Education:

- Gas Chromatography: Principles and Practice, LLU (1997)

Professional Experience:

- With Lancaster Laboratories since 1991
  - Laboratory Technician, Volatiles in Air (1991)
    - Responsibilities included preparing samples and standards; washing glassware; loading samples on instruments
  - Senior Technician, Volatiles in Air and EPH/Miscellaneous GC (1994)
    - Responsibilities included analyzing routine samples and QC by Gas Chromatography for DRO and miscellaneous organic compounds; preparing direct injection samples for analysis; preparing standards; reviewing chromatography data and uploading to the LIMS
  - Chemist, EPH/Miscellaneous GC (1999)
    - Responsibilities included analyzing routine and nonroutine samples and QC by Gas Chromatography for various organic analyses including DRO, TPH, and other petroleum related methods and miscellaneous organic compounds by direct injection; reviewing chromatography data and uploading to the LIMS; performing instrument maintenance; calibrating instruments for various methods
  - Senior Specialist, EPH/Miscellaneous GC (2008)
    - Responsibilities include reviewing/verifying data for technical correctness including raw chromatography data, initial calibrations, and analytical reports; ensuring that method and project requirements were followed and entry into the LIMS is correct; acting as a technical resource for the department; assisting in reviewing/writing SOPs and other technical documents

Paul R. Cormier, B.A., Principal Specialist, Specialty Services Group

Education:

- B.S. Microbiology, Virginia Tech (1984)
- B.A. Chemistry, Virginia Tech (1984)

Continuing Education:

- Hewlett-Packard GC/MS Advance Operations/System Manager Course (1990)
- Mass Spectral Interpretation, Finnigan MAT Institute (1991)
- Technical Training, OI Analytical (1995)

Professional Experiences:

- Environmental Testing & Certification (1985-1989)
- Analytikem, Inc. (1989-1990)
- With Lancaster Laboratories since 1990
  - Senior Chemist (1990)
    - Responsibilities included: operate GC/MS instruments; data interpretation; review and approve data; repairing instruments; and train other analysts.
  - Senior Specialist (2005)
    - Responsibilities included: operate GC/MS instruments; data interpretation; review and approve data; repairing instruments; and train other analysts.
  - Principal Specialist, GC/MS Volatiles (2006)
    - Responsibilities include: operate GC/MS instruments; data interpretation; review and approve data; repairing instruments; and train other analysts.
  - Principal Specialist, Specialty Services Group (2010)
    - Responsibilities include acting as technical resource within the environmental division; developing and validating analytical protocols; troubleshooting and solving analytical chemistry problems; optimizing instrument configuration and performance; evaluating and interpreting analytical results; writing SOPs; assisting in responding to and eliminating ICARs, assisting in optimizing procedures in prep lab; communicating effectively within department; performing routine work as required

Memberships & Appointments:

- American Chemical Society

Teresa L. Cunningham, B.S., Principal Specialist, Environmental Client Services and Inside Business Development

Education:

- B.S. Biology, St. Joseph's University (1999)

Continuing Education:

- Chemical Monitoring Assistance Program, Pennsylvania Rural Water Association (2000)
- How to Deliver Exceptional Customer Service, Fred Pryor Seminars (2000)
- Organizational Behavior, Penn State University (2005)

Professional Experience:

- With Eurofins Lancaster Laboratories since 1999
  - Specialist, Environmental Client Services (1999-2000)
  - Senior Specialist, Environmental Client Services (2001)
  - Senior Specialist Coordinator, Environmental Client Services (2001)
    - Responsibilities included serving as project manager for clients with petroleum-related testing accounts; coordinating client requests with laboratory groups to ensure that the client's needs are met; scheduling bottle shipments and sample pickups; preparing quotations; coordinating staff
  - Senior Specialist Group Leader, Environmental Client Services (2005)
    - Responsibilities included serving as project manager for clients with petroleum-related testing accounts; coordinating client requests with laboratory groups to ensure that the client's needs are met; scheduling bottle shipments and sample pickups; preparing quotations; coordinating staff
  - Manager, Environmental Client Services (2006)
    - Responsibilities included overseeing implementation of new projects; coordinating client requests with laboratory groups to ensure that the client's needs are met; coordinating staff
  - Principal Specialist, Environmental Client Services and Inside Business Development (2008)
    - Responsibilities include performing project management; training new client service representatives; auditing sample entry; answering client questions; communicating client requirements to lab areas

Carolyn M. Cyms, B.S., Senior Specialist Group Leader, Environmental Sample Administration

Education:

- B.S. Secondary Education/Chemistry, Bloomsburg University of Pennsylvania (1993)
- Post Baccalaureate Certificate, Biology and MS Math, Millersville University (2002)

Continuing Education:

- Accounting I, HACC (1996)
- Introduction to the Internet, PC Focus (1996)
- Self-Discipline & Emotional Control, Franklin-Covey (1997)
- Child Growth & Development, HACC (1998)
- Cell Biology, Millersville University (2000)
- Botany; Genetics; Zoology; Biochemistry; Ecology, and Ecology Lab, Millersville University (2001)
- Immunology; Animal Behavior; Teaching Biological Issues; Entomology, Millersville University (2002)
- Introduction to Computer Programming, Millersville University (2003)

Professional Experience:

- Lancaster Theological Seminary, Field Education Assistant-Special Project Coordinator (1996-1999)
    - Responsibilities included assisting with mailings, organization of the field education program; creating and preparing a student field education manual for the ministerial studies program; acting as liaison between Field Ed Professor, Field Ed sites, and students; preparing all written correspondences for the field ed office; organizing and preparing materials for meetings; tracking student progress through the program; assisting with other special projects requiring computer skills of PageMaker, WordPerfect, Quattro Pro, and Envoy
- Self-Employed, Tutor (1994-2005)
    - Responsibilities included tutoring HACC students in Introduction to Chemistry, Chemistry, Biology, and Algebra
- Millersville University – Biology Department, Assistant (2003)
    - Responsibilities included preparing Power Point presentations for a stream restoration monitoring program; photographing various stages of the project
- With Lancaster Laboratories since 1994
  - Administrator III, Environmental Sample Administration (1994)
    - Responsibilities included receiving samples, entering samples, auditing, filing, noting discrepancies, and unpacking samples
  - Administrator III/Coordinator, Environmental Sample Administration (1995)
    - Responsibilities included relaying technical/client information when it became available; answering questions from clients/technical areas when CSR was unavailable; coordinating/prioritizing entry; supervising and evaluating work of 2nd Shift Environmental Entry Staff; training new personnel in the entry/interpretation process; preparing Job Plans on an as-needed basis

Specialist I, Environmental Sample Administration (1996)
Responsibilities included receiving samples; entering samples; auditing; filing; noting discrepancies; unpacking samples; acting as project coordinator on an as-needed basis
Senior Specialist, Environmental Sample Administration (2000)
Responsibilities included receiving samples; entering samples; auditing; filing; noting discrepancies; unpacking samples; acting as project coordinator on an as-needed basis; training; preparing resource materials; working on special projects as needed
Senior Specialist Coordinator, Environmental Sample Administration (2004)
Responsibilities included receiving samples; entering samples; auditing; filing; noting discrepancies; unpacking samples; acting as project coordinator on an as-needed basis; training; preparing resource materials; working on special projects as needed
Senior Specialist Group Leader, Environmental Sample Administration (2005)
Responsibilities include receiving samples; entering samples; auditing; filing; noting discrepancies; unpacking samples; acting as project coordinator on an as-needed basis; training; preparing resource materials; working on special projects as needed

Awards, Citations, Honorary Societies & Publications:

Residential Life Award of Merit (1990)
Bloomsburg University Dean's List 6 of 8 semesters, graduated cum laude (1990-1993)
Kappa Delta Phi (National Co-Ed Honor Society) (1994)
Spirit of LLI (2001)

Memberships & Appointments:

Elizabethtown Fire Company (1993-present)
Safety Committee (1994-1998)
Alpha Phi Omega (National Co-Ed Service Fraternity) (1991-1993)
NSTA (2000-2008)
Kappa Delta Phi (1994, 2001-2003)

Steven C. Davies, B.S., Manager, Transportation and Sample Bottles

Education:

B.S. Elementary Education, Lancaster Bible College (1987)

Professional Experience:

With Lancaster Laboratories since 1990
Transportation Coordinator (1991)
Transportation Group Leader (1994)
Transportation and Sample Bottles Group Leader (1998)
Responsibilities included supervise personnel; schedule lab work; manage financial resources; answer client questions; communicate client requirements to lab areas; and schedule sample submissions and provide sampling containers.
Transportation and Sample Bottles Manager (2005)
Responsibilities include supervise personnel; schedule lab work; manage financial resources; answer client questions; communicate client requirements to lab areas; and schedule sample submissions and provide sampling containers.

Lindsay C. Deibler-Wallace, M.S., Senior Specialist Group Leader, Training

Education:

B.S. Chemistry, Lebanon Valley College (2002)
M.S. Secondary Science Education, George Mason University (2007)

Professional Experience:

Flint Hill School, Upper School Science Teacher (2002-2013)
Responsibilities included developing and implementing rigorous lessons, laboratory activities and assessments for Physics, Chemistry and Honors Chemistry; created video podcasts for all Chemistry lecture material that students study outside of class time according to the Flipped Learning style; proposed and developed the curriculum to teach a new elective course in Forensic Science; utilized various computer resources to promote interactive learning and to prepare students for future workforce by encouraging group work, problem solving, and critical thinking; differentiated instruction and customized instructional strategies to ensure that all students achieve at high levels; provided a safe and engaging learning environment that encourages student success; analyzed data from formal and informal assessments to improve instruction; chaired bi-weekly grade level faculty meetings
With Eurofins Lancaster Laboratories since 2014
Senior Specialist, Training (2014)
Responsibilities included facilitating Core and Elective training for new employees; conducting orientations, internal courses, and other learning experiences
Senior Specialist Group Leader, Training (2015)
Responsibilities include managing the resources of the technical training group; designing and delivering core and elective technical training

Christine M. Dulaney, B.A., Senior Specialist, GC/MS Volatiles

Education:
B.A. Biology, Meredith College (1984)

Continuing Education:
Waters Fundamentals of HPLC, Compuchem Laboratories (1989)

Professional Experience:
- Compuchem Laboratories (1984-1998)
  - Extraction Technician (1984-1986)
    - Responsibilities included performing extraction of various environmental matrices for pesticide GC analysis and semivolatile GC/MS analysis; extracting quarterly PE samples
  - GC Technician (1986-1989)
    - Responsibilities included performing analysis of environmental extracts for pesticides, PAHs, and volatile organic compounds using GC, HPLC, and purge and trap, respectively; performing routine instrument maintenance
  - Senior Chemist, Pesticide Review (1990-1995, 1996-1998)
    - Responsibilities included performing qualitative and quantitative review of pesticide, PAH, and volatile organic data; reviewing instrument maintenance and standard logbooks
- With Eurofins Lancaster Laboratories since 1998
  - Chemist, Pesticide Residue (1998)
    - Responsibilities included reviewing GC pesticide residue data packages; responding to client inquiries and ICARs
  - Project Management Specialist, Pharmaceutical Client Services (2003)
    - Responsibilities included managing details of various pharmaceutical client accounts using the laboratory information management system; acting as liaison between the client and internal laboratory personnel
  - Senior Specialist, GC/MS Volatiles (2005)
    - Responsibilities include auditing data for various GC and GC/MS volatile analyses; verifying data within the laboratory information management system, communicating and following up on outstanding data issues

Eric L. Eby, B.S., Senior Chemist, Metals

Education:
B.S. Biology, Millersville University (1988)

Continuing Education:
OSHA 40-hour Hazardous Waste Management, Phoenix Safety Associates (1991)
DX500 Maintenance and Troubleshooting, Dionex (1996)
The Chemistry Behind the Techniques, EAS, Inc. (1996)
Cleaning Validation Strategies, Applied Analytical Industries, Inc. (1997)
Gas Chromatography Practical Theory and Applications, Lancaster Laboratories (1998)

Professional Experience:
- With Lancaster Laboratories since 1988
  - Associate Chemist (1993)
    - Responsibilities included environmental wet chemistry testing and field sampling.
  - Chemist (1997)
  - Senior Chemist, Pharmaceutical Raw Materials (1998)
    - Responsibilities included IC, TOC analysis, IC maintenance, USP purified water testing, raw materials testing, USP <661> container closure testing.
  - Senior Chemist, Pharmaceutical Product Testing (2000)
    - Responsibilities included pharmaceutical product testing per client specific methods, IC and HPLC maintenance.
  - Senior Chemist, Metals (2005)
    - Responsibilities include ICP analysis for environmental testing and ICP instrument maintenance.

Joseph S. Feister, Senior Chemist Group Leader, Organic Extraction

Professional Experience:

With Eurofins Lancaster Laboratories since 1993
Laboratory Technician, Pesticide Residue Analysis (1993)
Responsibilities included prepping samples
Senior Technician, Organic Extraction (1996)
Responsibilities included prepping samples
Chemist Group Leader, Organic Extraction (2001)
Responsibilities included prepping samples; supervising employees
Senior Chemist Group Leader, Organic Extraction (2015)
Responsibilities include performing high level, difficult preps (with minimal supervision or guidance) following standard operating procedures (SOPs); self-train in new techniques; entering information into computer; training new or existing employees in extraction techniques or use of equipment; using knowledge to actively improve current processes; developing, enhancing, and validating new extraction methods; keeping work area clean and organized; preparing spikes; repairing equipment; updating departmental SOPs and training manual; disposing of wastes in approved manner; assisting in incident prevention and remediation when necessary; performing both technical and personnel aspects of group operations; performing work within the department or other areas as required; acting as a technical resource, trainer, and troubleshooter to specific department; making recommendations for operational and/or technical improvements; communicating effectively within the group; coaching and developing direct reports; planning and monitoring workflow

Erik J. Frederiksen, B.A., Manager, Water Quality and Instrumental Water Quality

Education:

B.A. Chemistry, University of Virginia (1990)

Continuing Education:

Infrared Spectral Interpretation (1993)

Professional Experience:

With Eurofins Lancaster Laboratories since 1990
Chemist/Coordinator (1993)
Group Leader, Water Quality Department (1994)
Responsibilities included supervising personnel; managing laboratory operations; project management; managing financial resources; reviewing and approving data
Manager, Water Quality and Instrumental Water Quality Departments (2005)
Responsibilities include supervising personnel; managing laboratory operations; project management; managing financial resources; reviewing and approving data

Lynn Frederiksen, B.S., Principal Specialist, Environmental Client Services

Education:

B.S. Conservation and Resource Development, University of Maryland (1981)

Professional Experience:

University of Missouri, Senior Research Lab Technician (1982 – 1984)
GPU Nuclear Corporation, Data Analyst (1985 – 1989)
With Eurofins Lancaster Laboratories since 1989
Senior Specialist (1989)/Team Leader, Environmental Client Services (2006)
Responsibilities included: consult with clients regarding testing needs; revise and update SOPs; provide price quotes; audit sample entry; answer client questions; communicate client requirements to lab areas; provide status reports, including results, to clients; schedule sample submissions and provide sampling containers; assist Group Leader with training of new employees and delegating new projects.
Senior Specialist Group Leader, Environmental Client Services (2007)
Responsibilities included: managing a team of client service representatives, training of new employees, setting up and delegating new projects, serving as primary project manager for several large petroleum clients and consultants.
Principal Specialist Group Leader, Environmental Client Services (2011)
Responsibilities included serving as the primary contact or back-up with the laboratory for a number of assigned clients requiring specialized testing or complex projects; understanding and communicating technical information and client requirements to laboratory personnel, helping to ensure that requirements are met; leading broad-based complex projects to a satisfactory conclusion according to client technical and schedule requirements; developing strong relationships with major accounts resulting in additional sales; advising and training other members of the department; serving as a technical resource both internally and externally; proactively assisting Outside Business Development with client visits, presentations, and internal audits for assigned clients; participating on PPI teams

Principal Specialist, Environmental Client Services (2015)

Responsibilities include serving as the primary contact or back-up with the laboratory for a number of assigned clients requiring specialized testing or complex projects; understanding and communicating technical information and client requirements to laboratory personnel, helping to ensure that requirements are met; leading broad-based complex projects to a satisfactory conclusion according to client technical and schedule requirements; developing strong relationships with major accounts resulting in additional sales; advising and training other members of the department; serving as a technical resource both internally and externally; proactively assisting Outside Business Development with client visits, presentations, and internal audits for assigned clients; participating on PPI teams

Joseph M. Gambler, B.S., Principal Chemist, GC/MS Semivolatiles

Education:

B.S. Chemistry, Millersville University (1996)

Professional Experience:

Wyeth, Biological Manufacturing Technician (1996)

With Eurofins Lancaster Laboratories since 1996

Senior Chemist, GC/MS Semivolatiles (1996)

Responsibilities included training new hires; maintaining GC/MS systems; preparing standards/stocks/spikes; maintaining Helium supply system; performing data interpretation; ordering supplies; auditing; cross trained in Pesticides Department

Principal Chemist, GC/MS Semivolatiles (2015)

Responsibilities include maintaining GC/MS instrumentation; tuning and calibrating instruments daily; analyzing quality control and client samples; reviewing and assembling this data in an efficient manner with a high degree of quality to meet client requirements; working on special projects, research, or IT needs for the group (at the direction of Group Leader or Manager) with little or no supervision

Stephen J. Gordon, B.S., Project Manager, Pittsburgh Service Center

Education:

B.S. Chemistry, Carnegie Mellon University (1996)

Professional Experience:

Alcoa, Inc, Senior Technician (1997-2000)

Responsibilities included analytical chemist specialized in PCB congener analysis by GC-ECD

Clark Laboratories, LLC, Project Manager (2000-2012)

Responsibilities included managing ASTM D02 interlaboratory crosscheck program and working as an analytical chemist

Environmental Data Services, Senior Technical Specialist (2012-2015)

Responsibilities included data validation, laboratory auditing, technical writing

With Eurofins Lancaster Laboratories since 2015

Project Manager, Pittsburgh Service Center (2015)

Responsibilities include serving as the primary contact for a number of assigned clients; understanding technical information and communicating client requirements to laboratory personnel; helping to ensure that requirements are met; managing large/complex projects according to client technical and schedule requirements; developing strong relationships with major accounts resulting in additional sales; training subordinates; delegating routine tasks; resolving issues when problems arise; participating in departmental process improvement; packing bottle orders and delivering bottles/picking up samples as needed

Susan M. Goshert, B.S., Manager, EPH/Miscellaneous GC, Pesticide Residue Analysis, Nitrosamines

Education:

B.S. Chemistry, Juniata College (1988)

Continuing Education:

Advanced Aquarius Report Training, Hewlett-Packard (1989)
How to Handle People with Tact and Skill, Harrisburg Area Community College (1992)
Positive Attitude and Peak Performance, Harrisburg Area Community College (1992)

Professional Experience:

With Lancaster Laboratories since 1988
- Chemist (1990)
- Senior Chemist Coordinator (1997)
  - Responsibilities included supervising personnel; reviewing and approving data; monitoring turnaround time
- Senior Specialist Group Leader, EPH/Misc. GC (2005)
  - Responsibilities included supervising personnel; reviewing and approving data; monitoring turnaround time
- Principal Specialist Group Leader, GC/MS Volatiles (2008)
  - Responsibilities included supervising personnel; reviewing and approving data; monitoring turnaround time
- Manager, EPH/Miscellaneous GC, Pesticide Residue Analysis, Nitrosamines (2012)
  - Responsibilities include supervising personnel; managing laboratory operations and financial resources; project management; reviewing and approving data; consulting with clients regarding testing needs

Brian K. Graham, B.A., Senior Chemist, GC/MS Semivolatiles

Education:

B.A. Mathematics, Millersville University (1996)

Professional Experience:

With Lancaster Laboratories since 1989
- Chemist, GC/MS Semivolatiles (1989-2006)
- Senior Chemist, GC/MS Semivolatiles (2006)
  - Responsibilities include maintaining GC/MS Instrumentation; tuning and calibrating GC/MS; analyzing samples by GC/MS; reviewing and assembling all supporting GC/MS data; preparing standards for calibrations; training new analysts

Nina C. Haller, Senior Specialist Group Leader, Metals

Continuing Education:

State Dairy Lab Cert., State of PA (1993)
Butterfat Testing License, State of PA (1995)
Seminar ICP/ICPMS, Fisons Instruments (1995)
Three-day ICP Trace Training Course, Thermo Jarrell Ash, MA (1996)

Professional Experience:

Hazelton Research Products, Lab Technician (1981-1984)
  - Responsibilities included rabbit production facility, removal of ovaries, care, and maintenance

With Lancaster Laboratories since 1987
- Technical Associate, Foods (1987)
  - Responsibilities included coordinating Listeria Testing Program; performing data entry and verification
- Chemist, Metals (1993)
  - Responsibilities included performing daily tracking of rushes; operating and maintaining ICP instrumentation; reviewing and verifying of ICP data, data package review
- Specialist Group Leader, Metals (2003)
  - Responsibilities included overseeing the ICP/ICPMS personnel and instrumentation workflow; verifying ICP/ICPMS/GFAA/Hg data
- Senior Specialist Group Leader, Metals (2006)
  - Responsibilities included overseeing the ICP/ICPMS personnel and instrumentation workflow; verifying ICP/ICPMS/GFAA/Hg data
- Senior Specialist Group Leader, Metals (2007)
  - Responsibilities include overseeing metals instrument and verification personnel and instrumentation workflow; verifying metals data

Michele D. Hamilton, B.S., Senior Chemist Group Leader, EPH/Misc. GC

Education:

B.S. Chemistry, Temple University (1990)

Continuing Education:

Gas Chromatography: Practical Theory and Applications for LL (1993)
Practice of Modern HPLC, LC Resources (1996)

Professional Experience:

With Eurofins Lancaster Laboratories since 1991
- Senior Chemist (1997)
- Senior Chemist Coordinator (2000)
  - Responsibilities included supervising personnel; coaching and developing new employees; sample tracking; reviewing rush request; communicating client requirements; operating GC and HPLC instruments; data interpretation and entry; calibrating; repairing instruments and verifying data
- Senior Chemist Group Leader, Pesticide Residue Analysis (2005)
  - Responsibilities included supervising personnel; coaching and developing new employees; sample tracking; reviewing rush request; communicating client requirements; operating GC and HPLC instruments; data interpretation and entry; calibrating; repairing instruments and verifying data
- Senior Chemist Group Leader, EPH Misc. GC (2011)
  - Responsibilities include supervising personnel; coaching and developing new employees; sample tracking; reviewing rush request; communicating client requirements; operating GC instruments; data interpretation and entry; calibrating; repairing instruments and verifying data

Linda M. Hartenstine, B.A., Senior Chemist, GC/MS Semivolatiles

Education:

B.A. Chemistry, Millersville University (1994)

Professional Experience:

With Lancaster Laboratories since 1994
- Associate Chemist (1994)
- Chemist (1997)
- Senior Chemist, GC/MS Semivolatiles (1998)
  - Responsibilities include performing GC/MS semivolatiles testing; operating GC/MS instruments; data interpretation; developing and evaluating new methods; calibrating and repairing instruments; preparing standards; revising and updating SOPs and analytical methods; training other analysts

Robert G. Heisey, Jr., B.A., Senior Specialist, Water Quality

Education:

B.A. Chemistry, Millersville State College (1972)

Professional Experience:

RCA Corp., Engineering Technician (1972-1987)
With Lancaster Laboratories since 1988
- Chemist Coordinator (1989)
- Senior Chemist Coordinator (1997)
  - Responsibilities included: supervise personnel; schedule lab work; review and approve data; develop and evaluate new methods; prepare test standards.
- Senior Chemist Group Leader (2005)
  - Responsibilities included: supervise personnel; schedule lab work; review and approve data; develop and evaluate new methods; prepare test standards.
- Senior Specialist, Water Quality (2006)
  - Responsibilities include: review and approve data; develop and evaluate new methods; prepare test standards; order laboratory supplies; maintain department's chemical inventory.

Daniel H. Heller, B.A., Senior Chemist, GC/MS Volatiles

Education:
- A.S.T. Machine Technology, Stevens State College (1998)
- B.A. Secondary Education Biology, Millersville University (2003)

Professional Experience:
- Tyco Electronics, Machinist B (1998-2004)
  - Responsibilities included machining various materials using various machines
- Columbia Junior/Senior High School, Teacher (2005)
  - Responsibilities included teaching 9th and 10th grade biology
- Penn State Cooperative Extension, Biologist (2005-2006)
  - Responsibilities included treating and surveying mosquito populations
- With Lancaster Laboratories since 2006
  - Chemist, GC/MS Volatiles (2006)
    - Responsibilities included evaluating water samples for volatiles using GC/MS instrumentation
  - Senior Chemist, GC/MS Volatiles (2012)
    - Responsibilities include evaluating water samples for volatiles using GC/MS instrumentation

Tamara J. Helsel, Senior Specialist Group Leader, Environmental Sample Administration

Professional Experience:
- Willow Valley Retirement Communities, Certified Nursing Assistant (2000-2001)
  - Responsibilities included assisting nursing home residents with their daily activities and personal hygiene
- Bayada Nurses, Certified Nursing Assistant (2000-2001)
  - Responsibilities included assisting people with disabilities in their homes with their personal hygiene and daily activities
- With Eurofins Lancaster Laboratories since 2001
  - Senior Administrator, Environmental Sample Administration (2001)
    - Responsibilities included performing sample receipt, interpretation, and entry
  - Specialist, Environmental Sample Administration (2001)
    - Responsibilities included performing sample receipt, interpretation, and entry
  - Senior Specialist, Environmental Sample Administration (2007)
    - Responsibilities included performing sample receipt, interpretation, and entry
  - Senior Specialist Group Leader, Environmental Sample Administration (2013)
    - Responsibilities include performing sample receipt, interpretation, and entry

Memberships and Appointments:
- Lancaster Laboratories Safety Committee (2003-2007)

Chadwick J. Hershey, B.S., Senior Specialist, Environmental Software Development

Education:
- B.A. Economics, Millersville University (2001)
- B.S. Computer Science, Millersville University (2001)

Continuing Education:
- Mastering Microsoft Visual Basic 6 Development, IntelliMark (2001)
- Oracle Exam #120-007, Introduction to Oracle 9i: SQL (2004)

Professional Experience:
- With Eurofins Lancaster Laboratories since 1999
  - Intern, Computer Applications Development (1999-2001)
    - Responsibilities included maintaining and developing departmental computer systems
  - Specialist, Computer Applications Development (2001)
    - Responsibilities included maintaining and developing departmental computer systems
  - Senior Specialist, Environmental Software Development (2006)
    - Responsibilities include maintaining and developing departmental computer systems

Catherine M. Holt, B.S., Principal Specialist, Environmental Software Development

Education:
B.A. Mathematics, Franklin & Marshall College (1984)
B.S. Computer Science, Millersville University (1987)

Continuing Education:
Novell Network Seminar, Novell (1989)
Clarion Database Management Seminar, Clarion Software (1991)
Operations Process Optimization, Penn State University (1992)
Fast Track to Powerbuilder Seminar, Actium (1997)
Mastering Visual Basic 6 Development, Microsoft Corporation (1999)
Introduction to Oracle9I: SQL, Online Testing (2004)
Programming with the Microsoft .NET framework using Microsoft Visual Studio 2005 (2008)
Windows Forms 3.5 Programming for Experienced VB .NET Programmers (2010)

Professional Experience:
R.R. Donnelley & Sons Company, Technician (1985-1987)
Responsibilities included scanning and developing photographs for use in catalogs
Shared Medical Systems, Programmer (1987-1989)
Responsibilities included customizing and installing software at hospitals
With Eurofins Lancaster Laboratories since 1989
Principal Specialist, Computer Applications Development (1989)
Responsibilities included developing and maintaining computer systems/programs for laboratory use
Principal Specialist/Coordinator, Computer Applications Development (1995)
Responsibilities included supervising personnel; developing and maintaining computer systems/programs for lab use; communicating with clients about disk requirements
Principal Specialist, Environmental Software Development (1997)
Responsibilities include developing and maintaining computer systems in VB6 and VB.net for use within Parallax shell

Diana G. Holmes, M.S., Senior Specialist, Environmental Software Development

Education:
B.A. Physics, Cornell University (1983)
M.S. Computer Science, Rensselaer Polytechnic Institute (1985)

Professional Experience:
AT&T Bell Laboratories, Technical Staff Member (1985-1986)
Responsibilities included developing software for testing software
Prime Computer, Software Engineer II (1986-1988)
Responsibilities included designing, implementing, and testing software for PRIMOS and mini-supercomputers
Banyan Systems, Principal Software Engineer (1988-1999)
Responsibilities included developing, enhancing, and maintaining suite of services for VINES mail service; worked with 3rd party developers; third line customer support
Progressive Systems/Cobalt Networks, Senior Software Engineer (1999-2000)
Responsibilities included managing and leading software releases; designed and implemented software features; third line customer support
Sun Microsystems, Project Manager (2000-2005)
Responsibilities included project manager for Linux Operation System releases
Innovative Emergency Management, Inc., Applications Systems Engineer (2005-2006)
Responsibilities included providing system administration support, development of software tools for deployment
Pennington Biomedical Research Center, IT Applications Developer III (2006-2013)
Responsibilities included analyzing, designing, developing, executing, documenting, and supporting software applications for the Basic Science labs
With Eurofins Lancaster Laboratories since 2013
Senior Specialist, Environmental Software Development (2013)
Responsibilities include providing technical support for maintenance of installed software applications and assistance with development, installation, and maintenance of new applications for general use; assistance in development, implementation, and maintenance of software intended to improve quality and efficiency of work performed

Kay G. Hower, B.S., Manager, ELLE Service Centers

Education:

B.S. Animal Science, University of Delaware (1988)

Professional Experience:

U.S. Fish and Wildlife Service, Research Assistant (1990-1991)
RMC Environmental Services, Biological Technician (1992-1994)
Lancaster Laboratories
Senior Specialist, Project Manager, Environmental Client Services (1994-2001)
Responsibilities included managing client projects; auditing sample entry; communicating client requirements to lab areas; providing status reports, including results, to clients; scheduling sample submissions and providing sampling containers.
Principal Specialist, Environmental Business Development (2001-2007)
Responsibilities included providing price quotes and proposals; advising clients on testing; assisting on client visits/audits; answering client questions; communicating client requirements to lab areas
Principal Specialist, Pharmaceutical Client Services (2007-2008)
Responsibilities included acting as the pharmaceutical client liaison within the laboratory by communicating client's requirements to the technical staff by maintaining project-related documentation, communicating desired turnaround times, and managing information flow; other duties include facilitating and organizing client audits, visits, and conference calls; monitoring ongoing projects and providing status updates as needed; auditing client sample paperwork and resolving discrepancies; overseeing the general administration of pharmaceutical projects (issuing quotations, answering billing and reporting questions, and scheduling sample pickups)
Urological Associates of Lancaster, Surgical Coordinator (2010-2012)
Responsibilities included coordinating surgical procedures for seven urologists at four facilities; meeting with patients to explain procedure details including pre-hospital testing, day-of timeline and post-op appointments and testing; obtaining insurance authorizations
With Eurofins Lancaster Laboratories since 2012
Principal Specialist Group Leader, Bay Area Service Center (2012)
Responsibilities included serving as the primary contact with the laboratory for a number of assigned clients; communicating technical information and conveying client requirements to laboratory personnel, ensuring that those requirements are met; managing large/complex projects according to client technical and schedule requirements; developing strong relationships with major accounts resulting in additional sales; performing both technical and personnel aspects of group operations; performing work within the department or other areas as required; acting as a technical resource, trainer, and troubleshooter to specific department; making recommendations for operational and/or technical improvements; communicating effectively within the group; coaching and developing direct reports; planning and monitoring workflow
Manager, ELLE Service Centers (2014)
Responsibilities include overseeing all managerial operations of the service centers; managing the service centers in an efficient and financially sound manner; providing leadership and coaching to assigned individuals; participating in long-term and short-term planning and goal-setting for the group; coordinating functions and responsibilities of assigned department members to provide consistent service; relaying corporate information appropriately; traveling to existing service centers on a quarterly basis and assisting in set-up and training as new centers are opened; serving as the primary contact with the laboratory for assigned clients; communicating technical information and conveying client requirements to laboratory personnel

Sara E. Johnson, B.S., Senior Chemist, GC/MS Volatiles

Education:

B.S. Chemistry, Biochemistry option, Millersville University (2006)

Professional Experience:

With Lancaster Laboratories since 2006
Chemist, Flexible Staffing (2006)
Responsibilities included flexing to various departments as needed and performing analysis ranging from GC/MS to SDS-PAGE Electrophoresis with colloidal blue or silver staining
Chemist, GC/MS Volatiles (2008)
Responsibilities included performing GC/MS analysis of water and soil samples along with other matrices by various analytical methods such as EPA 624, 8260B, and CLP; evaluating analytical data generated; calibrating and troubleshooting GC/MS instrumentation
Senior Chemist, GC/MS Volatiles (2010)
Responsibilities include performing GC/MS analysis of water and soil samples along with other matrices by various analytical methods such as EPA 624, 8260B, and CLP; evaluating analytical data generated; calibrating and troubleshooting GC/MS instrumentation; assisting other employees with any questions that may arise and helping to train new employees

Laura A. Jovanovic, B.A., Principal Specialist Account Manager, Environmental Business Development/Sales

Education:

B.A. History/Russian, Indiana University (1986)

Professional Experience:

Environmental Services of America, Senior Account Manager (1991-1996)

Responsibilities included sales and management of Midwest Accounts for a treatment, storage and disposal facility; field supervisor and sampling

HazChem Environmental, Account/Project Manager (1997-2005)

Responsibilities included development and maintenance of industrial accounts, field sampling, project management and emergency response

TestAmerica, Senior Account Executive (2005-2014)

Responsibilities included Midwest Laboratory Sales for a nationwide environmental laboratory network

With Eurofins Lancaster Laboratories since 2014

Principal Specialist Account Manager, Environmental Business Development/Sales (2014)

Responsibilities include Field Sales for Illinois, Wisconsin, and Indiana

Richard H. Karam, B.A., Director of Operations, Eurofins Lancaster Laboratories Environmental

Education:

B.A. Environmental Studies, Green Mountain College (2000)

Professional Experience:

Severn Trent Laboratories

Analytical Chemist (2000-2005)

Responsibilities included analyzing environmental samples for various general chemistry parameters, metals by ICP/ICPMS, pesticides/PCBs/herbicides by GC, and semivolatiles by GC/MS

Project Manager (2005-2006)

Responsibilities included managing environmental projects; writing case narratives; project set up

With Eurofins Lancaster Laboratories since 2006

Group Leader, GC/MS Semivolatiles (2006)

Responsibilities included coordinating production in GC/MS Semivolatiles; reviewing and signing reports

Manager, GC/MS Semivolatiles (2007)

Responsibilities included ensuring the accuracy and acceptability of all data generated by the GC/MS Semivolatiles group; coordinating daily prioritization of workload and monitoring the holding time and turnaround time status of samples; responding to client questions regarding GC/MS Semivolatiles data and methods and communicating technical issues or concerns about samples to project managers for clarification or resolution with the client

Manager, Organic Extraction/Leachate Preparation/GC/MS Volatiles/GC/MS Semivolatiles (2008)

Responsibilities included ensuring the accuracy and acceptability of all data generated by the groups; coordinating daily prioritization of workload and monitoring the holding time and turnaround time status of samples; responding to client questions regarding data and methods and communicating technical issues or concerns about samples to project managers for clarification or resolution with the client

Director of Operations, Eurofins Lancaster Laboratories Environmental (2014)

Responsibilities include leading departments in accordance with vision, values, and strategic goals of company; overseeing and facilitating efficient operations and systems, sound business practices, consistent client service, and motivated staff

Dana M. Kauffman, Manager, Sample Support and Data Deliverables

Continuing Education:

Introduction to Electronics, Lancaster County Career & Technology Center, Brownstown (1994)
AC/DC Electronics, Lancaster County Career & Technology Center (1995)
Entry Level Management (1997)
Gas Chromatography: Principles and Practices, Lancaster Labs University (2003)
Practical Process Improvement Facilitator Training (2009)
Practical Process Improvement Process Manager Training (2011)

Professional Experience:

With Lancaster Laboratories since 1994
- Lab Technician (1995)
- Senior Technician (1996)
- Sample Support Coordinator (1997)
- Group Leader, Sample Support (1999); Group Leader, Volatiles by GC (2002)
  - Responsibilities included supervising personnel; managing laboratory operations; project management; sample preparation; developing and evaluating new methods; reagent preparation; revising and updating SOPs; ordering supplies; training other analysts; running the automated storage and retrieval system; lab cleaning and maintenance; monitoring laboratory activities; performing internal audits; enforcing regulatory compliance requirements; maintaining required certifications; communicating client requirements to lab areas
- Manager, Sample Support and Data Deliverables (2005)
  - Responsibilities include overseeing all upfront sample handling requirements including storage, preservation, homogenization, moisture determination, volatile prescreen, and volatile soil prep; supervising group leader personnel; project management; revising and updating SOPs; performing internal audits; enforcing regulatory compliance requirements; maintaining required certifications; communicating client requirements to lab areas; data package and EDD TAT monitoring; overseeing all data package processes including data assembly, review, and processing; Practical Process Improvement (PPI) process manager responsible for facilitating PPI project team training and PPI efforts within LLI

Katherine A. Klinefelter, M.S., Principal Specialist, Environmental Client Services

Education:

B.S. Chemistry, Rutgers University (1983)
M.S. Physiology, Rutgers University (1985)

Continuing Education:

Additional graduate work in Physiology, Rutgers University (1985-1989)
Practical Process Improvement (Team Member Training), Lancaster Labs University (2009)

Professional Experience:

Rutgers University, Research and Teaching Assistant (1984-1989)
M. S. Hershey Medical Center of Penn State University, Senior Research Technician (1990-1993)
With Lancaster Laboratories since 1993
- Environmental Project Management
- Senior Specialist, Environmental Client Services (1993)
- Senior Specialist/Coordinator, Environmental Client Services (1996)
- Senior Specialist, Environmental Client Services (2000)
- Principal Specialist, Environmental Client Services (2007)
  - Responsibilities include project management; training new client service representatives; auditing sample entry; answering client questions; communicating client requirements to lab areas

Awards, Citations, Honorary Societies & Publications:

Dean's Graduate Student Dissertation Research Award, Rutgers University
Dean's Graduate Student Travel Award, Rutgers University
Steinetz Memorial Fund Award, Department of Biological Sciences, Rutgers University
10 abstracts and 3 scientific papers on membrane transport physiology
4 presentations on membrane transport physiology
Quarterly Impact Award for Practical Process Improvement (2009)

Wendy A. Kozma, B.S., Principal Specialist Group Leader, Environmental Client Services

Education:

B.S. Environmental Science, Allegheny College (1991)

Professional Experience:

Roy F. Weston, Inc. (1992-1993)

With Lancaster Laboratories since 1993

Senior Specialist, Environmental Client Services (1996)

Responsibilities included performing project management; advising clients on testing; providing price quotes; monitoring turnaround time; auditing sample entries; answering client questions; communicating client requirements to lab areas; providing status reports, including results, to clients; scheduling sample submissions; ordering sampling containers

Principal Specialist, Environmental Client Services (2004)

Responsibilities included performing project management; advising clients on testing; providing price quotes; monitoring turnaround time; auditing sample entries; answering client questions; communicating client requirements to lab areas; providing status reports, including results, to clients; scheduling sample submissions; ordering sampling containers

Principal Specialist Group Leader, Environmental Client Services (2006)

Responsibilities include performing project management; advising clients on testing; providing price quotes; monitoring turnaround time; auditing sample entries; answering client questions; communicating client requirements to lab areas; providing status reports, including results, to clients; scheduling sample submissions; ordering sampling containers

M. Susan Kreider, Senior Specialist, Data Deliverables

Continuing Education:

Chemistry and Psychology courses, F&M College

Professional Experience:

General Cigar Co., R&D Center, Laboratory Technician (1963-1966)

Responsibilities included testing tobacco products; smoke analysis; nicotine and tar analysis; preparing samples for gas chromatography

Company F. Weaver, Inc., Laboratory Technician (1966-1967)

Responsibilities included performing microbiological testing of food products, both raw materials and finished products; training factory employees in sterile food handling

Microbiological Associates, Inc., Stock Line/Sterile Technician (1968-1969)

Responsibilities included performing cancer research; dissection of animal and human tissue for cell line production; freezing of live cells; all phases of sterile lab work

Warner Lambert Co., Assistant Microbiologist/Organic Chemistry Technician (1970-1975)

Responsibilities included performing microbiological and chemical testing of raw material and finished products

Julia Winifred & Co. (Jacks III), Sales Clerk (1982-1983)

Responsibilities included retail sales; preparing windows and displays in store

With Lancaster Laboratories since 1983

Laboratory Technician, ExpressLAB (1983)

Responsibilities included performing sample prep and analyses

Senior Technician, ExpressLAB (1986)

Responsibilities included performing sample prep and analyses

Chemist, ExpressLAB (1988)

Responsibilities included performing sample prep and analyses

Specialist, Pesticide Residue Analysis (1998)

Responsibilities included performing sample prep and analyses

Specialist, EPH/Misc. GC (2003)

Responsibilities included performing sample prep and analyses

Specialist, Data Deliverables (2005)

Responsibilities included validating and sending data deliverables

Senior Specialist, Data Deliverables (2006)

Responsibilities include validating and sending data deliverables

Robert M. Large, B.S., Director, Environmental Support Services: Client Services/Inside Business Development, Sample Administration, Data Deliverables, Sample Support, Transportation, Sample Kits, Various Service Centers

Education:

- B.S. Zoology, Pennsylvania State University (1973)

Continuing Education:

- Chromatography/Mass Spectral Interpretation, Finnigan MAT Institute (1981)
- Foundations of Management, Gilbert Associates (1982)
- M.B.A. Program, St. Joseph's University (1984-1987)
- How to Market Professional Services, ACIL (1990)

Professional Experience:

- Gilbert Associates, Inc., Program Manager (1977-1984)
- Spotts, Stevens, & McCoy, Director of Client Services (1984-1990)
- With Eurofins Lancaster Laboratories since 1990
  - Marketing Specialist, Environmental Client Services (1990)
  - Group Leader, Environmental Client Services (1994)
  - Manager, Environmental Client Services (1995)
    - Responsibilities included supervising personnel; project management; various office tasks; reviewed contract terms; interpreted QC implications to data quality; advised clients on testing; set up and managed the Bay Area Service Center in Richmond, CA (2001); managed Environmental Sample Administration (2002); managed Inside Business Development (2003)
  - Director, Environmental Support Services: Client Services, Inside Business Development, Sample Administration, Data Deliverables, Sample Support, Transportation, Sample Kits (2005)
    - Responsibilities included supervising personnel; project management; various office tasks; interpreting QC implications to data quality; advising clients on testing; assisting setting up Professional Scientific Staffing (PSS) for a major biotech client (2004); managing Data Deliverables and Sample Support (2010)
  - Director, Environmental Support Services: Client Services, Inside Business Development, Sample Administration, Data Deliverables, Sample Support, Transportation, Sample Kits, Various Service Centers (2012)
    - Responsibilities include supervising personnel; project management; various office tasks; reviewing contract terms; interpreting QC implications to data quality; advising clients on testing; setting up and managing service centers across the United States

Tara D. Laroche, M.S., National Program Manager, Business Development/Sales, Environmental Sciences

Education:

- A.S. Science, Navarro College (1998)
- M.S. Science - Biology, University of Texas at Arlington (2001)
- B.S. Science, University of Louisiana at Monroe (2001)

Professional Experience:

- Eichrom Technologies, Technical Sales Chemist (2008-2009)
    - Responsibilities included launching new product offering for a bio-assay for dioxin analysis to E/C firms and laboratories
- AirToxics Laboratories, Technical Sales Representative (2009-2010)
    - Responsibilities included covering Great Lakes and East Coast calling on E/C firms
- TestAmerica Laboratories, Account Executive (2011-2014)
    - Responsibilities included Covered Oklahoma, Colorado, Wyoming, and Utah calling on E/C firms and commercial/industrial clients.
- With Eurofins Lancaster Laboratories since 2014
  - National Program Manager, Business Development/Sales, Environmental Sciences (2014)
    - Responsibilities include managing sales

Memberships and Appointments:

- Colorado Oil & Gas Association
  - General Member (2011-present)
- Rocky Mountain Association of Environmental Professionals
  - Vice President (2012-present)
- Women's Energy Network
  - General Member (2014-present)
- Marcellus Shale Coalition
  - Water Resources & Waste Management Committee member (2014-present)
- Western Energy Alliance
  - Environmental & Regulatory Committee Member (2014-present)

Kerri E. Legerlotz, Senior Chemist, GC/MS Volatiles
Education:
B.S. Chemistry, Houghton College (2005)
Professional Experience:
Pfizer, Chemist (2005-2006)
Responsibilities included performing raw material, finished product, and stability testing; wet chemistry, pH, viscosity, IR, Karl Fischer, specific gravity
With Lancaster Laboratories since 2006
Chemist, GC/MS Volatiles (2006)
Responsibilities included testing for volatile compounds using GC/MS by purge and trap; preparing working standards from neat compounds
Senior Chemist, GC/MS Volatiles (2013)
Responsibilities include analyzing water and soil samples by purge and trap GC/MS; generating and reviewing raw data; performing maintenance on GC/MS, purge and traps, and various autosamplers; troubleshooting problems on GC/MS, purge and traps, and autosamplers; formulating and diluting analytical reference materials

Jenifer E. Lewis, B.S., Principal Specialist Account Manager, Environmental Business Development/Sales
Education:
B.S. Chemistry, University of Delaware (1984)
Continuing Education:
21 credits towards M.B.A., University of Delaware
Professional Experience:
J. M. Huber Corporation, Research Chemist (1984-1985)
With Eurofins Lancaster Laboratories since 1985
Chemist/Coordinator, Pesticide Residue Analysis (1989)
Group Leader, Pesticide Residue Analysis (1992)
Responsibilities included supervising personnel; managing laboratory operations and financial resources; project management; reviewing and approving data; consulting with clients regarding testing needs
Manager, Pesticide Residue Analysis (1992)
Responsibilities included supervising personnel; managing laboratory operations and financial resources; project management; reviewing and approving data; consulting with clients regarding testing needs
Manager, Pesticide Residue Analysis, EPH/Miscellaneous GC (1996)
Responsibilities included supervising personnel; managing laboratory operations and financial resources; project management; reviewing and approving data; consulting with clients regarding testing needs
Manager, Pesticide Residue Analysis, EPH/Miscellaneous GC, Nitrosamines (1998)
Responsibilities included supervising personnel; managing laboratory operations and financial resources; project management; reviewing and approving data; consulting with clients regarding testing needs
Manager, Pesticide Residue Analysis, EPH/Miscellaneous GC, Nitrosamines, Volatiles by GC (2005)
Responsibilities included supervising personnel; managing laboratory operations and financial resources; project management; reviewing and approving data; consulting with clients regarding testing needs
Manager, Pesticide Residue Analysis, EPH/Miscellaneous GC, Nitrosamines (2011)
Responsibilities included supervising personnel; managing laboratory operations and financial resources; project management; reviewing and approving data; consulting with clients regarding testing needs
Principal Specialist Account Manager, Environmental Business Development/Sales (2012)
Responsibilities include developing new business revenue for LL by performing account management duties for existing accounts and prospects in the commercial and DOD markets; identifying and securing sales opportunities through phone calls, sales visits, presentations, team selling, quotes, and proposals; generating new business opportunities consistent with our operational capabilities and capacity

Larry Lewis, B.S., Manager, Volatiles in Air
Information not available at time of printing

Parker D. Lindstrom, B.S., Senior Chemist Metrology, Metals

Education:

B.S. Chemical Oceanography, Millersville University (2002)

Continuing Education:

Comprehensive Gas Chromatography Seminar, RESTEK (2002)
Comprehensive GC/MS Seminar, RESTEK (2002)
Statistics at Lancaster Laboratories, LLU (2005)
24-hour HAZWOPER, LLU (2006)

Professional Experience:

Fred Fiorentino, Assistant Laborer (1997-2002)
Responsibilities included roofing, painting, general construction, clean-up, installation of windows, doors, stairs, decking
Dr. Kerper, Office Assistant (2000-2002)
Responsibilities included filing, cataloging children's books
Millersville University IMC/IMS, Media/Education Assistant (2000-2002)
Responsibilities included assisting teachers in creating media for the classroom, editing video and audio projects
With Eurofins Lancaster Laboratories since 2002
Associate Chemist/Senior Chemist, GC/MS Volatiles (2002)
Responsibilities included running purge and trap and GC/MS to analyze samples and QC for VOCs; performing purge and trap and GC/MS maintenance
Senior Chemist, Metals (2006)
Responsibilities included running ICP/MS; verifying samples; performing maintenance; prepping samples; general troubleshooting for metals department; installation, maintenance and operation of CVAF low level Mercury; maintenance and operation of AA Mercury; providing general computer help to Computer Services department
Senior Chemist Metrology, Metals (2009)
Responsibilities include helping the instrument (Metrology) group maintain and qualify HPLCs, GCs, and other pharmaceutical instruments; helping with other qualifications as needed (hoods, storage units, etc); for a short time in 2009 verifying data in Water Quality department

Memberships and Appointments:

Emergency Response Team (Spill Team), Lancaster Laboratories (2006)

Jason M. Long, B.S., Senior Chemist, GC/MS Volatiles

Education:

B.S. Chemistry, Shippensburg University (2004)

Professional Experience:

EA Engineering Science & Technology, Lab Tech (2004)
Responsibilities included setting up and running tests in toxicology lab; cleaning glassware used in performing tests; titrating for alkalinity and pH of water samples
With Lancaster Laboratories since 2004
Chemist, GC/MS Volatiles (2004)
Responsibilities included analyzing water and soil samples by purge and trap GC/MS; generating and reviewing raw data; performing maintenance on GC/MS, purge and traps, and various autosamplers
Senior Chemist, GC/MS Volatiles (2007)
Responsibilities include analyzing water and soil samples by purge and trap GC/MS; generating and reviewing raw data; performing maintenance on GC/MS, purge and traps, and various autosamplers; troubleshooting problems on GC/MS, purge and traps, and autosamplers

Lyssa M. Longenecker, B.S., Senior Specialist, Environmental Client Services

Education:

B.S. Biology, Millersville University of PA (2010)

Professional Experience:

With Eurofins Lancaster Laboratories since 2011

Specialist, Environmental Client Services (2011)

Responsibilities included serving as the primary laboratory contact to clients; communicating technical information to the client in a comprehensible manner; deciphering the clients' testing needs; conveying the clients' requirements to the laboratory; ensuring clients' requirements and needs are met

Senior Specialist, Environmental Client Services (2014)

Responsibilities include serving as the primary laboratory contact to clients; communicating technical information to the client in a comprehensible manner; deciphering the clients' testing needs; conveying the clients' requirements to the laboratory; ensuring clients' requirements and needs are met

Karen P. Lopez, B.S., Project Manager, Bay Area Service Center

Education:

B.S. Environmental Science, University of California Riverside (2005)

Professional Experience:

Eurofins Air Toxics, Inc.

Account Manager (2008-2010)

Responsibilities included generating quotes for clients by gathering critical project information and coordinating with the sales and project management to determine product offering and price point; follow-up on quotes to gather sales and market intelligence; schedule client visits for sales and management; facilitate conference details and follow-up as needed; provide back-up for the Project Management team during staff absences or times of high workload

Project Manager (2010-2015)

Responsibilities included performing all project liaison functions needed for goal achievement between the clients, sales team, laboratory, and finance team; project management from A to Z, including contract execution, project set-up, project execution, and result achieved evaluation; respond professionally and timely to client inquiries, handle simple to complicated technical explanations

With Eurofins Lancaster Laboratories since 2015

Project Manager, Bay Area Service Center (2015)

Responsibilities include serving as the primary contact for a number of assigned clients; understanding technical information and communicating client requirements to laboratory personnel; help to ensure that requirements are met; managing large/complex projects according to client technical and schedule requirements; developing strong relationships with major accounts resulting in additional sales

Dorothy M. Love, B.S., Director, ELLE and Eurofins Environment Testing US, Quality Assurance

Education:

B.S. Environmental Health, Indiana University of Pennsylvania (1981)

Professional Experience:

Sun Transport, Inc., Safety Assistant (1980-1981)
Texas A & M University, Research Assistant (1982-1984)
Texas Water Commission, Chemist (1984-1986)
GHR Analytical, Chemist (1986-1987)
Clean Harbors, Inc., Senior Chemist (1987-1989)
With Eurofins Lancaster Laboratories since 1989

Senior Specialist (1989)
Senior QA Specialist (1998) Coordinator (2000)
Principal Specialist/Coordinator, Quality Assurance (2003)

Responsibilities included supervising personnel; training other QA staff; revised and updated analytical methods; monitored laboratory activities and corrective action for quality issues; performed internal audits; worked with external auditors; reviewed lab data and procedures; enforced regulatory compliance requirements; reviewed/wrote client/lab Quality Assurance Project Plans (QAPP)

Principal Specialist Group Leader, Quality Assurance (2005)

Responsibilities included supervising personnel; training other QA staff; revised and updated analytical methods; monitored laboratory activities and corrective action for quality issues; performed internal audits; worked with external auditors; reviewed lab data and procedures; enforced regulatory compliance requirements; reviewed/wrote client/lab Quality Assurance Project Plans (QAPP)

Manager, Environmental Quality Assurance (2013)

Responsibilities included supervising the Environmental QA department; monitoring regulatory activities; reviewing procedures and data; interacting with clients and agencies; performing regulatory and client document review; enforcing regulatory compliance; quality improvement; staff training; QA policy development and maintenance

Director, ELLE and Eurofins Environment Testing US, Quality Assurance (2015)

Responsibilities include supervising the ELLE QA department; monitoring regulatory activities; reviewing procedures and data; interacting with clients and agencies; performing regulatory and client document review; enforcing regulatory compliance; quality improvement; staff training; QA policy development and maintenance; overseeing QA programs at all Eurofins Environment BUs in order to harmonize quality and ethics systems across the environmental business

Memberships and Appointments:

Society of Women Environmental Professionals (SWEP (2007-present)
TNI Quality Systems Committee (2009-2014)
NJ Environmental Laboratory Advisory Committee (2012-present)

Natalie R. Luciano, B.A., Senior Specialist, Environmental Client Services

Education:

B.A. Biology, Bridgewater College (2006)

Continuing Education:

Safe Drinking Water Regulations Revisions, PaAAEL & PA DEP (2010)
PA Regulatory Update Bureau of Safe Drinking Water, PaAAEL (2013)
PA DEP Regulatory Update, PA DEP (2013)

Professional Experience:

With Eurofins Lancaster Laboratories Environmental, LLC since 2007

Specialist, Environmental Client Services and Inside Business Development (2007)

Responsibilities included performing project management; serving as the primary contact for external clients; communicating client requirements to laboratory areas; auditing entries and reviewing sample data

Senior Specialist, Environmental Client Services and Inside Business Development (2013)

Responsibilities include performing project management; serving as the primary contact for external clients; communicating client requirements to laboratory areas; auditing entries and reviewing sample data

Nicole L. Maljovec, M.S., Manager, Environmental Client Services & Inside Business Development

Education:

B.S. Chemistry, St. Bonaventure University (2004)
M.S. Adolescence Education, D'Youville College (2005)

Professional Experience:

CYTEC Industries, Industrial Hygiene Internship (2003-2004)

Responsibilities included performing air monitoring and sampling; complying with OSHA standards; assisting R/D lab with the identification of unknown chemicals and wastes

Niagara Wheatfield, Environmental Science Teacher (2005-2006)

Responsibilities included teaching chemistry, chemistry lab, and environmental science; developing special education plans to assist students with learning disabilities

With Lancaster Laboratories since 2006

Specialist, Environmental Client Services (2006)

Responsibilities included performing project management; advising clients on testing; providing price quotes; monitoring turnaround time; auditing sample entries; answering client questions; communicating client requirements to lab areas; providing status reports, including results, to clients; scheduling sample submissions; ordering sampling containers

Senior Specialist Group Leader, Environmental Client Services (2007)

Responsibilities included performing project management; advising clients on testing; providing price quotes; monitoring turnaround time; auditing sample entries; answering client questions; communicating client requirements to lab areas; providing status reports, including results, to clients; scheduling sample submissions; ordering sampling containers; managing a team of client service representatives and administrative assistants, training of new employees, setting up and delegating new projects, serving as primary project manager for several large clients and consultants

Principal Specialist Group Leader, Environmental Client Services (2012)

Responsibilities included serving as the primary contact or back-up with the laboratory for a number of assigned clients requiring specialized testing or complex projects; understanding and communicating technical information and client requirements to laboratory personnel, helping to ensure that requirements are met; leading broad-based complex projects to a satisfactory conclusion according to client technical and schedule requirements; developing strong relationships with major accounts resulting in additional sales; advising and training other members of the department; serving as a technical resource both internally and externally; proactively assisting Outside Business Development with client visits, presentations, and internal audits for assigned clients; participating on PPI teams

Manager, Environmental Client Services & Inside Business Development (2014)

Responsibilities include overseeing all managerial operations of the department; managing the department in an efficient and financially sound manner; providing leadership and coaching to assigned individuals; participating in long-and short-term planning and goal-setting for the group; coordinating functions and responsibilities of assigned department members to provide consistent service; coordinating internal efforts between Environmental Client Services and other departments; relaying corporate information appropriately

Melissa McDermott, B.A., Inside National Sales Manager, Business Development, Environmental Sciences

Education:

- B.A. Biology, Millersville University (1992)
- Elementary Education Certification, PA (May 2009)
- Middle School Science Certification, PA (July 2009)

Continuing Education:

- Gas Chromatography Principles and Practices (1995)
- Conflict Resolution and Confrontation Skills Seminar (1996)
- Coaching Skills for Supervisors Seminar (1996)
- Waste Testing and Quality Assurance Symposium (1996)
- Entry Level Management (1997)
- How to Deliver Exceptional Customer Service Seminar (1997)
- Statistics at Lancaster Laboratories (2006)

Professional Experience:

- With Eurofins Lancaster Laboratories since 1992
  - Chemist, EPH/Misc. GC (1993)
    - Responsibilities included performing analysis of environmental samples for metals by AA flame and cold vapor generation; assembling client data packages
  - Chemist Coordinator, EPH/Misc. GC (1996)
    - Responsibilities included coordinating rush work; communicating with client service representatives regarding sample status; answering client questions; generating employee job plans; conducting employee evaluations
  - Senior Chemist, EPH/Misc. GC (1997)
    - Responsibilities included performing analysis of environmental samples for DRO and interpretive TPH analyses; verifying analyses performed by other analysts; preparing standards; revising departmental SOPs; method development; reviewing data packages
  - Senior Specialist, Environmental Client Services (1997)
    - Responsibilities included auditing sample entry; answering client questions; communicating client requirements to lab areas; providing status reports, including results, to clients; scheduling sample submissions and providing sampling containers
  - Senior Chemist, EPH/Misc. GC (2002)
    - Responsibilities included reviewing and approving data; writing departmental methods; reviewing and approving data packages; acting as technical resource within department; answering client questions; monitoring and performing QA metrics
  - Senior Specialist, Environmental Client Services (2007)
    - Responsibilities included acting as technical resource between client services and laboratories; scheduling sample submissions and providing sampling containers; communicating client requirements to lab areas
  - Senior Chemist, EPH/Misc. GC (2009)
    - Responsibilities included reviewing and approving data; writing departmental methods; reviewing and approving data packages; acting as technical resource within department; answering client questions; monitoring and performing QA metrics
  - Senior Chemist Group Leader, Pesticides (2011)
    - Responsibilities included performing routine and non-routine instrumental analyses of QC and clients' samples for pesticides, PCBs, herbicides, and other related compounds in accordance with departmental methods and standard operating procedures (SOPs); assisting in implementing special client requests; identifying and offering solutions to correct instrument problems and causes of QC problems; reviewing data for accuracy and completeness (for both routine and non-routine analyses, reports, or data packages); serving as a technical resource for the department; performing both technical and personnel aspects of group operations; performing work within the department or other areas as required; acting as a technical resource, trainer, and troubleshooter to specific department; making recommendations for operational and/or technical improvements; communicating effectively within the group; coaching and developing direct reports; planning and monitoring workflow
  - Principal Specialist, Environmental Business Development (2014)
    - Responsibilities included using company literature, verbal discussions, formal written quotes, proposals, tours, and audits to independently secure new business consistent with operational capabilities and business plan goals; collaborating efforts and activities with those of Outside Sales account managers as needed; focusing on proposal writing for major national accounts; attending face-to-face sales meetings with selected national accounts as needed and maintaining responsibility for their maintenance and growth
  - Inside National Sales Manager, Business Development, Environmental Sciences (2015)
    - Responsibilities include overseeing all managerial operations of the department; managing the department in an efficient and financially sound manner; providing leadership and coaching to assigned individuals; participating in long-and short-term planning and goal-setting for the group; coordinating functions and responsibilities of assigned department members to provide consistent service; relaying corporate information appropriately

Roy R. Mellott Jr., B.S., Senior Chemist Group Leader, GC/MS Volatiles

Education:

B.S. Biology, Millersville University (1993)

Continuing Education:

Hazardous Waste Disposal, LLU (1996)
GC: Principles & Practices, LLU (1997)
GC/MS: Applications/Troubleshooting Seminar, ECS/MDL Systems, Inc. (1999)
Introduction to Interpretation of Mass Spectra, LLU (2005)
Interpretation of Mass Spectra, Intermediate, LLU (2005)
Role of the Leader 1 – Giving Recognition, LLU (2007)
Role of the Leader 2 – Clarifying Performance Expectations, LLU (2007)
Role of the Leader 3 – Developing Others, LLU (2007)
Role of the Leader 4 – Providing Constructive Feedback, LLU (2007)
PPI Team Training, LLU (2010)
PPI Facilitator Workshop, LLU (2010)
Targeted Selection, LLU (2010)
Role of the Leader Building Team Pride and Purpose, LLU (2011)
Role of the Leader Resolving Conflicts with Your Peers, LLU (2011)

Professional Experience:

With Eurofins Lancaster Laboratories since 1995

Senior Lab Tech I, GC/MS Volatiles (1995)

Responsibilities included requisitioning samples; performing sample storage, prescreening, discard, hazardous waste disposal; tracking down missing samples by various means

Chemist/Auditor, GC/MS Volatiles (1996)

Responsibilities included performing analysis of waters, soils, and other matrices for VOCs via various analytical methods; evaluation of analytical data; calibrating and troubleshooting various GC/MS equipment; evaluation/review of analyst-generated data; corresponding with analysts about possible trends (whether analyst- or system-related) in generated data; evaluation/review of corrections of problems with generated data

Senior Chemist, GC/MS Volatiles (2002)

Responsibilities included performing analysis of waters, soils, and other matrices for VOCs via various analytical methods; evaluation of analytical data; setting up, calibrating, and troubleshooting various GC/MS equipment; evaluation/review of analyst-generated data; corresponding with analysts about possible trends (whether analyst- or system-related) in generated data; evaluation/review of corrections of problems with generated data; updating/correcting SOPs and laboratory and analytical procedures; preparation, tracking and documentation of analytical standards used in the laboratory; training of new employees to the department

Senior Chemist Group Leader, GC/MS Volatiles (2005)

Responsibilities include performing analysis of waters, soils, and other matrices for VOCs via various analytical methods; evaluation of analytical data; setting up, calibrating, and troubleshooting various GC/MS equipment; evaluation/review of analyst-generated data; corresponding with analysts about possible trends (whether analyst- or system-related) in generated data; evaluation/review of corrections of problems with generated data; updating/correcting SOPs and laboratory and analytical procedures; preparation, tracking and documentation of analytical standards used in the laboratory; training of new employees to the department

Memberships & Appointments:

Nature Conservancy (1998-present)
Eurofins Lancaster Laboratories
    Ethics Committee (1999-2003)
Lancaster Herpetological Society
    Treasurer (2005-present)
HabitatMT (2011-present)

Jessica L. Miller, B.S., Senior Chemist, Pesticide Residue Analysis

Education:

B.S. Chemistry, Cedar Crest College (2011)

Continuing Education:

Gas Chromatography Principles and Practice (2011)
Agilent Breaking Bad Chromatography Habits Seminar (2014)

Professional Experience:

- With Eurofins Lancaster Laboratories since 2011
  - Chemist, Pesticide Residue Analysis (2011)
    - Responsibilities included performing pesticide residue analysis; prescreening samples; calibrating, reviewing, and uploading data
  - Senior Chemist, Pesticide Residue Analysis (2014)
    - Responsibilities include performing pesticide residue analysis; prescreening samples; calibrating, reviewing, and uploading data

Memberships and Appointments:

- Psi Chi
  - Member (2009)
- Gamma Sigma Epsilon
  - Member (2011)

Megan A. Moeller, B.S., Senior Specialist, Environmental Client Services

Education:

B.S. Environmental Science, University of Delaware (1999)

Professional Experience:

- With Lancaster Laboratories since 1999
  - Sample Administration/Client Service Specialist, Environmental Client Services (2003)
    - Responsibilities included Interpretation and entry of incoming samples. Route samples to the correct locations. Assist Client Service representatives with auditing, reviewing reports, and reviewing invoices.
  - Specialist, Environmental Client Services (2004-2006)
    - Responsibilities included managing projects, prepare quotations, audit sample entries, answer client questions, communicate client requirements to lab areas, schedule sample submissions, and provide sample containers.
  - Senior Specialist, Environmental Client Services (2006)
    - Responsibilities include managing projects, prepare quotations, audit sample entries, answer client questions, communicate client requirements to lab areas, schedule sample submissions, and provide sample containers.

Chad A. Moline, B.S., Senior Specialist, GC/MS Volatiles

Education:

B.S. Environmental Studies, Slippery Rock University (1998)
Teaching Certification, Secondary Education, Millersville University (2003)

Professional Experience:

- Centre Analytical Laboratories, Lab Technician (1999-2000)
    - Responsibilities included running various wet chemistry analyses
- Lancaster Laboratories, Chemist/Senior Chemist (2000-2005)
    - Responsibilities included maintaining GC/MS instrumentation
- Warwick School District, Science Teacher (2005-2006)
    - Responsibilities included teaching chemistry and physics to 8th grade students
- Conestoga Valley School District, Science Teacher (2006-2007)
    - Responsibilities included teaching chemistry and earth science to 8th grade students
- With Eurofins Lancaster Laboratories since 2007
  - Senior Chemist Group Leader, GC/MS Semivolatiles (2007)
    - Responsibilities included monitoring workflow; meeting client turnaround times
  - Senior Chemist, GC/MS Semivolatiles (2012)
    - Responsibilities included maintaining and operating GC/MS instrumentation
  - Senior Specialist, GC/MS Volatiles (2014)
    - Responsibilities include performing technical audit of GC/MS volatiles data in a timely manner with zero defects as a goal; acting as a technical resource to department; evaluating issues in technical data and suggesting possible solutions; performing sample/QC verification in the LIMS; reviewing analytical reports; evaluating and interpreting analytical results; writing and revising SOPs; assisting in responding to and eliminating ICARs; making recommendations for technical improvements; communicating effectively within department; completing assigned tasks on time; assisting in "brainstorming" client problems and projects; performing all duties with minimal supervision

Jennifer L. Moyer, B.S., Senior Specialist, Metals

Education:
- B.S. Chemistry, Lock Haven University (2000)

Professional Experience:
- Lock Haven University, Lab Tech (1996-1998)
    - Responsibilities included setting up labs; stocking and setting up stock rooms; helping professors with projects
- Croda Inc., Process Development Chemist (1998-2000)
    - Responsibilities included developing and improving procedures on existing products
- With Lancaster Laboratories since 2000
    - Chemist, Metals (2000)
        - Responsibilities included running and maintaining ICP instruments
    - Chemist, Metals (2002)
        - Responsibilities included running and maintaining Graphite Furnace Atomic Absorption instruments
    - Group Leader/Specialist, Metals (2003)
        - Responsibilities included overseeing Graphite Furnace Atomic Absorption and Mercury analysts
    - Senior Specialist, Metals (2007)
        - Responsibilities include verifying ICP, GFAA, Mercury, and ICP-MS

Kevin T. Moran, M.B.A., Senior Specialist Account Manager, Environmental Business Development/Sales

Education:
- B.S. Marine Engineering, U.S. Merchant Marine Academy (1972)
- M.B.A. Marketing, Babson College (1981)

Professional Experience:
- SAIC, Regional Sales Manager (1994-1999)
    - Responsibilities included selling process treatment equipment for groundwater remediation to environmental consulting companies and industrial end users; managing a staff of seven engineers and technicians engaged in operating and constructing groundwater treatment systems
- Mantech Environmental, Marketing Manager (1999-2000)
    - Responsibilities included developing strategy to target industrial customers with multiple sites for an innovative groundwater remediation technology
- Hazleton Environmental, Marketing Manager (2000-2003)
    - Responsibilities included developing marketing strategy for sales of process treatment equipment to industrial and municipal users; aiding company in breaking into DOD market for treatment equipment
- With Eurofins Lancaster Laboratories since 2003
    - Senior Specialist Account Manager, Environmental Business Development/Sales (2003)
        - Responsibilities include managing and growing revenue at assigned industrial accounts; using selling skills to add new industrial and environmental consulting firms for analytical services in New York, New Jersey, and New England

Kathrine K. Muramatsu, B.S., Senior Chemist Group Leader, GC/MS Volatiles

Education:
- B.S. Chemistry, University of Colorado (2005)

Continuing Education:
- Forensic Science and DNA Testing Certification (2006)
- 24-Hour Emergency Response (HAZWOPER), Lancaster Laboratories (2009)
- American Heart Association (AHA)/American Red Cross certified, Lancaster Laboratories (2009)

Professional Experience:
- With Eurofins Lancaster Laboratories since 2007
    - Chemist, Analytical Chemistry, Professional Scientific Staffing – CO (2007)
        - Responsibilities included ensuring compliance with cGMPs; performing analysis of system water, clean in place (CIP) samples, clean out of place (COP) samples, and other sample types; methods used were total organic carbon (TOC), pH, conductivity, Limulus Amebocyte Lysate (LAL), and UV spectroscopy
    - Chemist, GC/MS Volatiles (2007)
        - Responsibilities included analyzing environmental samples of various sample matrices using purge and trap GC/MS; generating and reviewing raw data; performing instrument maintenance as needed
    - Chemist Group Leader, GC/MS Volatiles (2009)
        - Responsibilities included supervising and mentoring personnel; coordinating daily workload through prioritizing and scheduling; processing monthly metrics for the department; verifying sample data; analyzing environmental samples of various sample matrices using purge and trap GC/MS; generating and reviewing raw data; performing instrument maintenance as needed

Senior Chemist Group Leader, GC/MS Volatiles (2014)

Responsibilities include supervising and mentoring personnel; coordinating daily workload through prioritizing and scheduling; processing monthly metrics for the department; verifying sample data; analyzing environmental samples of various sample matrices using purge and trap GC/MS; generating and reviewing raw data; performing instrument maintenance as needed

Awards, Citations, Honorary Societies, and Publications

Dean's List (2002)
Colorado Scholars (2002-2005)
Superlative Service Award (2010)
Two publications in the Journal of Organic Chemistry

Memberships and Appointments:

American Chemical Society

Charles J. Neslund, B.S., Technical Director, Volatiles in Air and Specialty Services Group, Eurofins Lancaster Laboratories Environmental

Education:

B.S. Chemistry, University of Pittsburgh (1982)

Continuing Education:

Graduate studies in organic chemistry, University of Pittsburgh (1983)

Professional Experience:

Lancaster Laboratories (1984-1996)
- Chemist (1986)
- Group Leader (1987)
- Chemist (1991)

OI Analytical, Sales Representative (1996)

With Eurofins Lancaster Laboratories since 1997

Group Leader, GC/MS Semivolatiles (1997)

Responsibilities included supervising personnel; scheduling lab work; managing laboratory operations and financial resources; project management; data interpretation; reviewing and approving data; developing and evaluating new methods; consulting with clients regarding testing needs; revising and updating SOPs and analytical methods

Manager, GC/MS Semivolatiles and Volatiles in Air (2005)

Responsibilities included supervising personnel; scheduling lab work; managing laboratory operations and financial resources; project management; data interpretation; reviewing and approving data; developing and evaluating new methods; consulting with clients regarding testing needs; revising and updating SOPs and analytical methods

Manager, Volatiles in Air and Specialty Services Group (2007)

Responsibilities included supervising personnel; scheduling lab work; managing laboratory operations and financial resources; project management; data interpretation; reviewing and approving data; developing and evaluating new methods; consulting with clients regarding testing needs; revising and updating SOPs and analytical methods; marketing specialty services capabilities; conducting technical presentations

Technical Director, Volatiles in Air and Specialty Services Group, Eurofins Lancaster Laboratories Environmental (2014)

Responsibilities include leading departments in accordance with vision, values, and strategic goals of company; overseeing and facilitating efficient operations and systems, sound business practices, consistent client service, and motivated staff

Awards, Citations, Honorary Societies & Publications:

Dawson-Grundmann Innovation Award (1995)

Memberships & Appointments:

American Chemical Society (ACS)
Chromatography Forum of the Delaware Valley (CFDV)
- Past member of Executive Committee of the Chromatography Forum of the Delaware Valley

Air & Waste Management Association (A&WMA)
Society of Environmental Toxicology and Chemistry (SETAC)
Sediment Management Workgroup (SMWG)

Deborah A. Neslund, Senior Specialist, Environmental Sample Administration

Professional Experience:

- Lancaster General Hospital, Phlebotomist (1976-1977)
- Fairfax Hospital, LPN (1978)
- Lancaster General Hospital, Phlebotomist/EKG Technician (1980-1986)
- With Eurofins Lancaster Laboratories since 1986
  - Senior Specialist Coordinator, Environmental Sample Administration (1986)
    - Responsibilities included supervising personnel; directed flow of samples to include prioritization to meet hold times and standards set for rush and other samples; developed and improved systems for efficiency within SA; represented SA in communications with Technical Groups, Client Services, and other support areas; logged-in samples
  - Senior Specialist Group Leader, Environmental Sample Administration (2005)
    - Responsibilities included supervising personnel; directed flow of samples to include prioritization to meet hold times and standards set for rush and other samples; developed and improved systems for efficiency within SA; represented SA in communications with Technical Groups, Client Services, and other support areas; logged-in samples
  - Senior Specialist (2013)
    - Responsibilities include directing flow of samples to include prioritization to meet hold times and standards set for rush and other samples; developing and improving systems for efficiency within SA; representing SA in communications with Technical Groups, Client Services, and other support areas; logging-in samples

Ryan V. Nolt, B.S., Manager, GC/MS Volatiles and Equipment Maintenance & Repair

Education:

- B.S. Chemistry, Millersville University (1997)

Professional Experience:

- With Eurofins Lancaster Laboratories since 1996
  - Clerk II, Sample Support (1996)
    - Responsibilities included performing ASRS operations, preserving incoming samples, homogenizing samples, packing bottle orders, and performing sample discard
  - Senior Technician, ExpressLAB (1997)
    - Responsibilities included performing sample dilutions, preparing standards, prepping samples, and setting up new instruments
  - Chemist, GC/MS Volatiles (1998)
    - Responsibilities included performing purge and trap and GC/MS maintenance; tuning and calibrating GC/MS system; analyzing samples; reviewing, working up, and assembling all supporting data; and preparing new standards
  - Senior Chemist Coordinator, GC/MS Volatiles (2000)
    - Responsibilities included performing routine and non-routine laboratory analysis; diagnosing and solving technical problems; implementing improvements to maximize quality; maintaining and troubleshooting instruments; writing and revising SOPs; validating new methods and equipment; assigning new work to instrument groups and monitoring productivity; training new analysts
  - Principal Chemist Group Leader, GC/MS Volatiles (2005)
    - Responsibilities included performing routine and non-routine laboratory analysis; diagnosing and solving technical problems; implementing improvements to maximize quality; maintaining and troubleshooting instruments; writing and revising SOPs; validating new methods and equipment; assigning new work to instrument groups and monitoring productivity; training new analysts
  - Manager, GC/MS Volatiles (2014)
    - Responsibilities included performing a variety of technical and administrative tasks to develop, evaluate, and supervise staff; planning and monitoring work flow; designing, implementing, and utilizing departmental operations systems; promoting safety; remaining current on technical developments in the area of GC/MS volatiles; communicating with clients; maintaining a strong commitment to quality
  - Manager, GC/MS Volatiles and Equipment Maintenance & Repair (2015)
    - Responsibilities include performing a variety of technical and administrative tasks to develop, evaluate, and supervise staff; planning and monitoring work flow; designing, implementing, and utilizing departmental operations systems; promoting safety; remaining current on technical developments in the area of GC/MS volatiles; communicating with clients; maintaining a strong commitment to quality

Stephen Nowakowski, B.S., Senior Specialist, Safety

Information not available at time of printing

Wanda Oswald, Senior Scientist Group Leader, Organic Extraction

Information not available at time of printing

Anneliese H. Owen, M.B.A., Manager, Environmental Sample Administration

Education:

B.S. Molecular and Cell Biology, Pennsylvania State University (1986)
M.B.A. Pennsylvania State University (1993)

Professional Experience:

With Lancaster Laboratories since 1986
- Coordinator (1987)
- Client Services Specialist (1988)
- Business Development Specialist (1990)
- Group Leader, Environmental Sample Administration (1992)
  - Responsibilities included: supervise personnel; manage laboratory operations and financial resources; sample interpretation and entry; and monitor corrective action for quality issues.
- Manager, Environmental Sample Administration (2005)
  - Responsibilities include: supervise personnel; manage laboratory operations and financial resources; sample interpretation and entry; and monitor corrective action for quality issues.

Linda C. Pape, B.A., Senior Chemist, GC/MS Volatiles

Education:

B.A. Business Administration, Milsaps College (1985)

Professional Experience:

Rite Aid Pharmacy, Store Manager (1985-1989)
- Responsibilities included being responsible for overall maintenance and security of merchandise, store, and property; ordering and display of all merchandise; auditing daily cash and inventory reports; scheduling employees; payroll accounting; training of new and prospective personnel

With Lancaster Laboratories since 1993
- Chemist, Volatiles by GC (1993)
  - Responsibilities included analyzing client-submitted samples and their associated quality control samples by purge-and-trap gas chromatography; reviewing and uploading the corresponding data in an efficient manner with a high degree of accuracy and quality; evaluating current organizational and analytical systems; suggesting and implementing necessary corrective action to ensure the above can be performed in alignment with client and/or regulatory requirements; initiating and leading technical projects to a timely, accurate, and efficient conclusion while meeting client and/or regulatory requirements with a high degree of quality
- Chemist, Water Quality (2000)
  - In addition to responsibilities listed above performed CN distillation, PO_4 digestion, and phenol distillation during a 3-month time frame
- Senior Chemist, Volatiles by GC (2007)
  - Responsibilities included analyzing client-submitted samples and their associated quality control samples by purge-and-trap gas chromatography; reviewing and uploading the corresponding data in an efficient manner with a high degree of accuracy and quality; performing final review (verification) of data for clients (adding appropriate comments as necessary); evaluating current organizational and analytical systems; suggesting and implementing necessary corrective action to ensure the above can be performed in alignment with client and/or regulatory requirements; initiating and leading technical projects to a timely, accurate, and efficient conclusion while meeting client and/or regulatory requirements with a high degree of quality; training new employees in Volatiles by GC soils
- Senior Chemist, Volatiles by GC/MS (2008)
  - Responsibilities included analyzing client-submitted samples and their associated quality control samples by purge-and-trap gas chromatography/mass spectrometry; reviewing and uploading the corresponding data in an efficient manner with a high degree of accuracy and quality; performing final review (verification) of data for clients (adding appropriate comments as necessary); evaluating current organizational and analytical systems; suggesting and implementing necessary corrective action to ensure the above can be performed in alignment with client and/or regulatory requirements; initiating and leading technical projects to a timely, accurate, and efficient conclusion while meeting client and/or regulatory requirements with a high degree of quality; training new employees
- Senior Chemist, GC/MS Volatiles (2009)
  - Responsibilities include analyzing client-submitted samples and their associated quality control samples; reviewing and uploading the corresponding data in an efficient manner with a high degree of accuracy and quality; performing final review (verification) of data for clients (adding appropriate comments as necessary); evaluating current organizational and analytical systems; suggesting and implementing necessary corrective action to ensure the above can be performed in alignment with client and/or regulatory requirements; initiating and leading technical projects to a timely, accurate, and efficient conclusion while meeting client and/or regulatory requirements with a high degree of quality; training new employees

James H. Place, B.S., Senior Chemist, Pesticide Residue Analysis

Education:

B.S. Physical Science, York College of Pennsylvania (1997)

Professional Experience:

AMZ Corporation, Laboratory Technician (1998-2000)

Responsibilities included performing analysis and maintenance of chemical compositions pertaining to electroplating baths

Nichia America Co., Laboratory Technician (2000-2001)

Responsibilities included performing analysis of phosphorus for composition of pigments; performing sample screening and AA analysis

AMZ Corporation, Laboratory Technician (2001-2003)

Responsibilities included performing analysis and maintenance of chemical compositions pertaining to electroplating baths; conducting inventory and ordering chemicals

With Lancaster Laboratories since 2003

Chemist, Pesticide Residue Analysis (2003)

Responsibilities include performing routine and non-routine instrumental analyses of QC and clients' samples for pesticides, PCBs, herbicides, and other related compounds in accordance with departmental methods and SOPs; achieving quality results within the time-frame expected by our clients with minimal daily supervision; maintaining the GCs or HPLCs used for routine analyses; identifying and correcting common instrument or QC problems

Senior Chemist, Pesticide Residue Analysis (2008)

Responsibilities include performing routine and non-routine instrumental analyses of QC and clients' samples for pesticides, PCBs, herbicides, and other related compounds in accordance with departmental methods and SOPs; assisting in implementing special client requests; identifying and offering solutions to correct instrument problems and causes of QC problems; reviewing data for accuracy and completeness (for both routine and non-routine analyses, reports, or data packages); serving as a technical resource for the department

Kaitlin N. Plasterer, B.S., Senior Specialist, Environmental Client Services

Education:

B.S. Chemistry/Business, Arcadia University (2010)

Professional Experience:

With Eurofins Lancaster Laboratories since 2011

Specialist, Environmental Client Services (2011)

Responsibilities included serving as the primary contact for assigned clients; understanding basic technical issues and working with management to achieve problem resolution with clients; auditing incoming client paperwork for accuracy and making necessary corrections; assisting Senior Specialists with auditing as needed; identifying problems and suggesting solutions; maintaining knowledge of regulatory requirements and changes that may affect clients

Senior Specialist, Environmental Client Services (2014)

Responsibilities include acting as the environmental client liaison within the laboratory by communicating client's requirements to the technical staff by maintaining project-related documentation, communicating desired turnaround times, and managing information flow; facilitating and organizing client audits, visits, and conference calls; monitoring ongoing projects and providing status updates as needed; auditing client sample paperwork and resolving discrepancies; overseeing the general administration of environmental projects (issuing quotations, answering billing and reporting questions, and scheduling sample pickups); managing a combination of routine, non-routine, and complex client projects; initiating improvements to drive efficiencies; assisting in training; updating training documents and SOPs as appropriate

Awards, Citations, Honorary Societies, and Publications:

Phi Beta Delta Honors Society for Excellence in international education (2010)

Christine M. Ratcliff, B.S., Principal Specialist Group Leader, Specialty Services Group

Education:

B.S. Chemistry, Shippensburg University (1988)

Continuing Education:

Mass Spectral Interpretation, Finnigan MAT Institute (1990)

Professional Experience:

With Eurofins Lancaster Laboratories since 1988
- Chemist (1991)
- Coordinator (1994)
- Group Leader (1996)
- Senior Chemist/Coordinator (1997)
- Senior Chemist (2002)
  - Responsibilities included reviewing and approving data; revising and updating SOPs and analytical methods; reviewing lab data
- Senior Specialist, GC/MS Semivolatiles (2005)
  - Responsibilities included reviewing and approving data; revising and updating SOPs and analytical methods; reviewing lab data
- Principal Specialist, GC/MS Semivolatiles (2009)
  - Responsibilities included reviewing and approving data; revising and updating SOPs and analytical methods; reviewing lab data; performing technical audit of GC/MS semivolatiles data in a timely manner
- Principal Specialist, Volatiles in Air (2009)
  - Responsibilities included reviewing and approving data; revising and updating SOPs and analytical methods; reviewing lab data; performing technical audit of Volatiles in Air, GC/MS semivolatiles, and GC/MS volatiles data in a timely manner
- Principal Specialist, Volatiles in Air (2009)
  - Responsibilities included reviewing and approving data; revising and updating SOPs and analytical methods; reviewing lab data; performing technical audit of Volatiles in Air, GC/MS semivolatiles, GC/MS volatiles, and dioxans and furans data in a timely manner
- Principal Specialist Group Leader, Specialty Services Group (2014)
  - Responsibilities include reviewing and approving data; revising and updating SOPs and analytical methods; reviewing lab data; performing technical audit of Volatiles in Air, GC/MS semivolatiles, GC/MS volatiles, and dioxans and furans data in a timely manner; performing both technical and personnel aspects of group operations; performing work within the department or other areas as required; acting as a technical resource, trainer, and troubleshooter to specific department; making recommendations for operational and/or technical improvements; communicating effectively within the group; coaching and developing direct reports; planning and monitoring workflow; monitoring data for and supporting departmental MOS

Mark A. Ratcliff, B.A., Senior Specialist, GC/MS Semivolatiles

Education:

B.A. Physics, Franklin & Marshall College (1988)

Continuing Education:

Finnegan Mass Spectral Interpretation Course (1991)

Professional Experience:

With Eurofins Lancaster Laboratories since 1989
- Chemist (1992)
- Senior Chemist (1996)
  - Responsibilities included performing GC/MS semivolatiles testing; operating GC/MS instruments; data interpretation; calibrating and repairing instruments; preparing standards; revising and updating SOPs; training other analysts
- Senior Specialist, GC/MS Semivolatiles (2005)
  - Responsibilities include performing GC/MS semivolatiles testing; operating GC/MS instruments; data interpretation; calibrating and repairing instruments; preparing standards; revising and updating SOPs; training other analysts

Barbara F. Reedy, B.S., Senior Specialist, Environmental Quality Assurance

Education:

B.S. Environmental Biology, Millersville University (1993)

Continuing Education:

Environmental GC Analysis Seminar, Restek (2001)
The Internet Audit A Quality Tool, PaAAEL (2001)
Advanced Gas Chromatography Mass Spectroscopy Seminar, PaAAEL (2002)
LC/MS/MS System Seminar, Applied Biosystems (2006)
Introduction to Root Cause Analysis, Patton Professional (2007)
When to Initiate Corrective Action, Patton Professional (2007)
Practical Process Improvement Training in the role of Team Member (2008)
GC Pesticide/PCB’s Analysis Training Seminar (2008)
NY/PAAAEL Annual Meeting - Internal & Electronic Audits: Satisfying Regulatory Requirements, Corrective and Preventive Actions, Ethics and Data Integrity Training (2009)
Environmental Laboratory Assessment Basic Assessor Training – TNI Standard 2009 (2012)

Professional Experience:

Department of Environmental Resources, Division of Rivers and Wetlands, Scientific Intern (1993)

Responsibilities included reviewing wetland permits applications; inspecting and photographing wetland mitigation sites; determining hydrology, soil type, and the consistency of the mitigation with the approved project plans; researching records of the sites

With Eurofins Lancaster Laboratories since 1993

Associate Chemist/Chemist, Volatiles by GC (1993)

Responsibilities included calibrating Capillary, VOA, BTEX, and FID instruments; performing routine maintenance; interpreting, reviewing, and uploading data

Senior Chemist, Volatiles by GC (1999)

Responsibilities included being primary verifier for the majority of data for Volatiles by GC for the ELCD/PID and FID for both waters and soils; signing of analytical reports; generating statistically determined QC windows; training new analysts to review and upload data into the LIMS

Senior Specialist, Environmental Quality Assurance (2001)

Responsibilities include ensuring quality of data being produced in the laboratories by performing data review, auditing laboratories, and reviewing written procedures; ensuring laboratory adherence to government regulations and client requirements; reviewing client and government documents for requirements outside our usual laboratory practices; setup and testing new analysis in the laboratory sample management system as required by the departments; maintaining documentation of agency certifications

Memberships & Appointments:

Pennsylvania Association of Accredited Laboratories (2013-present)

Beth A. Rich, Senior Specialist, Safety

Professional Experience:

With Eurofins Lancaster Laboratories since 1998

Senior Administrator, Human Resources (1998)

Responsibilities included entering and maintaining employee information in system; photocopying, filing, maintaining personnel files; tracking mid-year and annual job plan completion; following up on exit interviews and other HR admin and support

Specialist, Human Resources (2005)

Responsibilities included maintaining a high level of human resource generalist knowledge to support all personnel in the HR department and to serve all employees

Senior Specialist, Human Resources (2010)

Responsibilities included maintaining a high level of human resource generalist knowledge to support all personnel in the HR department and to serve all employees

Senior Specialist, Safety (2013)

Responsibilities include managing worker's compensation and return to work programs; coordinating annual health screenings, flu shots, and blood bank donations; setting up new site worker's compensation systems as needed; filing incident reports and tracking recordable incidents; coordinating special medical programs as needed

John R. Riggs, Jr., B.S., Senior Specialist Group Leader, Environmental Software Development

Education:

B.S. Professional Studies (Computer Science/Mathematic), Misericordia University (1994)

Continuing Education:

Masters Business Administration, Elizabethtown College (Expected graduation date: 2015)

Professional Experience:

Nissin Foods, Inc., Distribution Supervisor/IT Engineer (1994-1998)

Responsibilities included acting as a liaison between local and corporate management teams; supervised the activities of multiple teams of material handlers engaged in receiving, storing, and shipping finished goods; ensured the accuracy of orders and inventory to meet customer demand; maintained documentation and prepared reports which reflected the effectiveness and efficiency of department activities; Implemented warehouse safety procedures and hold regular safety meetings; established and recommended changes to policies to improve the organization; supported and maintained Novell servers and backups; administered user accounts and email; configured new desktop machines and maintained existing work stations

AVAR, Project Manager/Lead Developer (1998-2014)

Responsibilities included directing the planning, design, production and management of applications and data centers; lead a development team in creating software applications to provide business solutions; acted as a point of contact for vendors, business units, and Information Technology partners during integration of projects, administering schedules and communicating risks; conducted meetings, helping to facilitate communication and maximize productivity; coordinated the work of multiple teams to support applications for data management systems; oversaw creation and maintenance of all unit and system testing plans; supervised the generation of documentation and technical guides for end users; prepared and deliver end-user training

With Eurofins Lancaster Laboratories since 2014

Senior Specialist Group Leader, Environmental Software Development (2014)

Responsibilities include providing technical support for maintenance of installed software applications and assisting with the development, installation, and maintenance of new applications for general use; assisting in development, implementation, and maintenance of software intended to improve the quality and efficiency of work performed

Heidi L. Roberts, B.S., Senior Chemist, Organic Extraction

Education:

B.S. Environmental Science/Biology, Kutztown University (1996)

Continuing Education:

P.E. Spectroscopy Seminar, Perkin Elmer (1998)
Statistics, LLU (1999)
Pharm. Calc. Class, LLU (1999)
LLI Leadership Training (2000)
Practical Process Improvement Team Member Training (2008)
Practical Process Improvement Facilitator Training (2010)

Professional Experience:

M.J. Reider Associates, Lab Technician (1996-1997)

Responsibilities included organics prep/method development for HEM/various wet chemistry analyses

With Eurofins Lancaster Laboratories since 1997

Chemist, Metals (1998)

Responsibilities included performing metals analyses, maintenance of instruments, verification of analyses, analyzed GMP samples, administered quad studies, MDL studies, IDL studies

Coordinator, Metals (1999)

Responsibilities included coordination of GFAA/FAA/Hg group, verification of analyses, instrument maintenance and operation, updating of SOPs, training records, quad studies, MDLs, and IDLs, performed GMP analyses

Coordinator/Specialist, Environmental Client Services (2001)

Responsibilities included supervising Commercial Account Team and administrators, handle miscellaneous and homeowner calls, prepare bottle orders, audit sample paperwork, monitor sample progress, and handle client concerns

Senior Specialist Group Leader, Environmental Client Services (2005)

Responsibilities included supervising Account Management Team and administrator, work with team members on continual process improvement, manage several large client accounts, prepare bottle orders, audit sample paperwork, monitor sample progress, and handle client concerns

Senior Chemist, Organic Extraction (2007)

Responsibilities include performing non-routine extractions, scheduling prep work, verification of prepped batches, processing MOS reports, updating EtQ for DP36, point person for project rollouts

Memberships and Appointments:

Ethics Committee, Lancaster Laboratories (1998)
MOS Process Improvement Team, Lancaster Laboratories (2005)

Nicholas R. Rossi, M.S., Senior Chemist, EPH/Misc. GC

Education:

B.S. Biology, Messiah College (2005)
M.S. Environmental Pollution Control, Penn State Harrisburg (2011)

Professional Experience:

Vermont Agency of Agriculture, Laboratory Technician/Sample Collector (2004-2005)
- Responsibilities included collecting water samples from agricultural sites and extracting samples in the lab

With Eurofins Lancaster Laboratories since 2005
- Chemist, GC/MS Volatiles (2005)
  - Responsibilities included organizing batches of samples, sample preparation, analyzing soil and water samples for volatile organic compounds using purge and trap GC-MS, instrument maintenance, and performing a level II audit on data prior to verification; processing plan improvement (PPI) team to reduce the amount of errors in the prescreen department; evaluating the process, implementing changes, and tracking results
- Chemist, EPH/Misc. GC (2011)
  - Responsibilities included analyzing routine and non-routine samples and their associated quality control samples by gas chromatography; reviewing and reporting the corresponding data; maintaining, optimizing, and calibrating equipment (functions are to be performed in an efficient manner with a high degree of accuracy and quality); assisting in organization of related departmental work and in sample preparation (as required) to consistently meet client turnaround time requirements
- Senior Chemist, EPH/Misc. GC (2013)
  - Responsibilities include performing routine and non-routine instrumental analyses of QC and clients' samples for total petroleum hydrocarbons, diesel range organics, and other miscellaneous organic compounds in accordance with departmental methods and SOPs; assisting in implementing special client requests; identifying and offering solutions to correct instrument problems and causes for QC problems; reviewing data for accuracy and completeness for routine and non-routine analyses, reports, or data packages; serving as a technical resource for the department

Memberships and Appointments:

American Chemical Society (2010)
Pennsylvania Department of Environmental Professionals (2011)

Beth A. Rubino, B.S., Senior Specialist, GC/MS Semivolatiles

Education:

B.S. Environmental Resource Management, Pennsylvania State University (1984)

Professional Experience:

Roy F. Weston, Inc., Chemist (1984-1997)
- Responsibilities included extraction laboratory unit leader. Managed staff, sample flow, and scheduling on organic extractions to meet hold time requirements; trained personnel on extraction methods and SOP's; performed field sampling and field laboratory responsibilities
- Performed GC/MS sample analysis of semi-volatiles, data interpretation, and instrument maintenance

RECRA Environmental, Inc, Senior Chemist (1997-2001)
- Responsibilities included technical support for the GC/MS unit; managed staff, sample flow, and scheduling to meet customer's requirements; conducted training on GC/MS analysis, its software, interpretation, and procedure awareness

Lionville Laboratory, Inc, Data Lead Chemist (2001-2013)
- Responsibilities included technical support for GC/MS data review and logbook quality assurance and quality control; trained personnel on MS systems and SOP's; assured compliance with client requirements; Prepared and provided accurate and timely data to clients

With Eurofins Lancaster Laboratories since 2014
- Senior Specialist, GC/MS Semivolatiles (2014)
  - Responsibilities include performing technical audit of GC/MS semivolatiles data in a timely manner with zero defects as a goal

Robin C. Runkle, B.S., Senior Specialist, GC/MS Volatiles

Education:

B.S. Chemistry, State University of New York at Oneonta (1988)

Continuing Education:

Introduction to Mass Spectral Interpretation, Finnigan Mat (1991)
Gas Chromatography: Practical Theory and Applications for LL (1993)
HP5890 GC Troubleshooting and Maintenance, Hewlett-Packard (1993)
Technical Training, OI Analytical (1995)

Professional Experience:

With Lancaster Laboratories since 1989

Senior Chemist (1993)

Responsibilities included: sample preparation; perform GC/MS volatile testing; operate GC/MS instruments; data interpretation; review and approve data; developing and evaluating new methods; calibrating and repairing instruments; prepare standards; reagent preparation; revise and update SOPs and analytical methods; order supplies; train other analysts; and prepare and test trip blank water.

Senior Specialist, GC/MS Volatiles (2005)

Responsibilities include: data review and verification, review and sign reports, respond to and work on client inquiries and ATF requests.

Michael S. Salgado, B.S., Senior Specialist, Training

Education:

B.S. Biology, Moravian College (2010)

Professional Experience:

Light Knowledge Resources, Scientific Writing Intern (2008-2009)

Responsibilities included researching and composing articles focusing on multiple myeloma, of which many have been published on their website The Myeloma Beacon

Indiana University Bloomington, IN, Undergraduate Researcher (2009-2009)

Responsibilities included researching in a virology lab and used techniques and tools such as SDS gel electrophoresis, PCR, RT-PCR, minipreps, sequence analysis, cell transformations and transfections, sterile microbial techniques, pouring plates and media preparation, streaking, colony counts, trouble shooting skills, mixers, balances, pH meters, laminar flow hoods, autoclaves, pipettes, and maintained cultures; the research aimed to formulate a strategy to analyze the role of the Reovirus µ1 membrane penetration protein in induction of apoptosis; the data compiled will be used in further research on this virus

Godiva Chocolatier, Technical Data Entry Technician (2010-2012)

Responsibilities included analyzing ingredient, allergen, regulatory, processing, SOP, audit, packaging and quality information and then shifted the data into their work-in-progress database to aid in Godiva's product lifecycle management project; validated the data entered for the product lifecycle management project and updated database specifications when changes were made to raw material specifications; aided coworkers in different departments in becoming familiar with the new data base and data entry process; actively participated in sensory testing with the sensory team to aid in product development; took part in editing audit, guideline, specification, and safety standard documents

With Eurofins Lancaster Laboratories since 2012

Biologist, Professional Scientific Staffing – PA or NJ (2012)

Responsibilities included performing tissue culture based potency assays on live vaccine products; process intermediates and related experimental samples; prepare solutions and culture media; maintain multiple cell lines; maintain records and test results following GMP

Senior Specialist, Training (2015)

Responsibilities include facilitating Core and Elective training for new employees; conducting orientations, internal courses, and other learning experiences

Grace M. Salm, Specialist Group Leader, Data Deliverables

Continuing Education:

Introduction to Personal Computers, Lancaster County Career and Technology Center (2000)
Windows, Lancaster County Career and Technology Center (2000)
PC Upgrading & Repair, Lancaster County Career and Technology Center (2000)

Professional Experience:

With Eurofins Lancaster Laboratories since 2000
- Data Package Administrator, GC/MS Semivolatiles (2000)
  - Responsibilities included assembling departmental data in specific order; checking in data; filing batchlogs
- Specialist, GC/MS Semivolatiles/Data Deliverables (2006)
  - Responsibilities included performing data assembly in department 4026; assemblers and reviewers became part of department 4038; reviewing data for departments 4026, 4021, and 4030
- Specialist Group Leader, Data Deliverables (2010)
  - Responsibilities include scheduling for data package assembly/review; following up with corrections; assembly/review for 4032, 4037, and review for 4028; following up on CSR requests; conducting performance reviews for direct reports; updating SOPs

Richard A. Shober, B.S., Principal Chemist, Pesticide Residue Analysis

Education:

B.S. Chemistry, Muhlenberg College (1984)

Continuing Education:

Inductively Coupled Plasma Spectroscopy, Allied Analytical (1985)
ACS Short Course, Analytical Chemistry of Contaminants in Surface and Groundwater (1986)
Gas Chromatography: Practical Theory & Application, Lancaster Laboratories (1994)
Mass Spectral Interpretation, Hewlett-Packard (1995)
Comprehensive HPLC, RESTEK (2010)

Professional Experience:

With Lancaster Laboratories since 1984
- Principal Chemist, Pesticide Residue Analysis (1999)
  - Responsibilities include performing pesticide residue testing; operating gas chromatography instruments; interpreting data; repairing instruments; developing new methods for and operating LC/MS/MS; developing and maintaining computer systems/programs for lab use

Awards, Citations, Honorary Societies & Publications:

Poster paper on computer applications for analytical chemistry
Poster paper on tobacco specific nitrosamine analysis

Biographical Listings:

Who's Who in Environmental Science

Stephanie A. Selis, B.S.E., Senior Chemist, GC/MS Volatiles

Education:

B.S.E. Biology, Chemistry Minor, Millersville University (1996)

Professional Experience:

Access I, Access II, PC Focus (1997)
Emergency Evacuation Coordinator (1998)
Gas Chromatography Principles and Practices, Lancaster Laboratories University (1998)
GC/MS Theories and Applications, MDL Systems (1999)
Statistics, Lancaster Laboratories University (2000)
Enlightened Leadership: Getting to the Heart of Change, Lancaster Laboratories University (2000)
Building Relationship Versatility: Social Styles at Work, Lancaster Laboratories University (2000)
Leadership at Lancaster Laboratories, Lancaster Laboratories University (2000)
Introduction to Interpretation of Mass Spectra, Lancaster Laboratories University (2005)

Professional Experience:

With Lancaster Laboratories since 1996
- Chemist (1996)
- Senior Chemist, Volatiles by GC (2000)
  - Responsibilities included performing sample analysis, troubleshooting, and maintenance; calibrating the system; establishing QC windows for soil analysis; writing SOPs; performing data entry; preparing standards; performing sample verification; training analysts
- Senior Chemist, GC/MS Volatiles (2005)
  - Responsibilities include performing sample analysis; auditing maintenance notebooks; performing troubleshooting, maintenance, and system calibration; preparing standards; performing sample verification; training analysts

Richard A. Shober, B.S., Principal Chemist, Pesticide Residue Analysis

Education:
B.S. Chemistry, Muhlenberg College (1984)

Continuing Education:
Inductively Coupled Plasma Spectroscopy, Allied Analytical (1985)
ACS Short Course, Analytical Chemistry of Contaminants in Surface and Groundwater (1986)
Gas Chromatography: Practical Theory & Application, Lancaster Laboratories (1994)
Mass Spectral Interpretation, Hewlett-Packard (1995)
Comprehensive HPLC, RESTEK (2010)

Professional Experience:
With Lancaster Laboratories since 1984
Principal Chemist, Pesticide Residue Analysis (1999)
Responsibilities include performing pesticide residue testing; operating gas chromatography instruments; interpreting data; repairing instruments; developing new methods for and operating LC/MS/MS; developing and maintaining computer systems/programs for lab use

Awards, Citations, Honorary Societies & Publications:
Poster paper on computer applications for analytical chemistry
Poster paper on tobacco specific nitrosamine analysis

Biographical Listings:
Who's Who in Environmental Science

Jeffrey B. Smith, B.A., Senior Chemist Group Leader, Volatiles in Air

Education:
B.A. Biology, University of Delaware (1991)

Professional Experience:
Roy F. Weston, Inc., Chemist (1991-1997)
Merck, Chemist (1997-2000)
With Lancaster Laboratories since 2001
Senior Chemist, GC/MS Semivolatiles (2001)
Responsibilities included performing GC/MS analysis of semivolatile organics
Senior Chemist Group Leader, Volatiles in Air (2005)
Responsibilities include tracking of all incoming work and scheduling analysts; tracking all incoming summa orders and assigning to analyst; main CSR contact for group; instrument troubleshooting and maintenance; auditing and certifying data as needed

Michele J. Smith, B.S., Senior Specialist, Specialty Services Group

Education:
B.S. Chemistry, St. Mary's College, Notre Dame, Indiana (1998)
22 credits master's study with Penn State University (2000-2002)

Continuing Education:
Gas Chromatography Principles and Practices, Lancaster Laboratories University (1999)
Statistics, Lancaster Laboratories University (2000)

Professional Experience:
St. Mary's College, Laboratory Teaching Assistant (1996-1998)
Responsibilities included: assisted professor in the laboratory—responsible for experiment demonstrations, answered student's questions, and graded lab reports.
With Lancaster Laboratories since 1998
Chemist (1998)
Responsibilities included: maintain GC/MS instrumentation, tune and calibrate GC/MS, analyze samples by GC/MS, review and assemble all supporting GC/MS data, review daily QC outliers.
Senior Chemist (2001)
Responsibilities included: maintain GC/MS instrumentation, tune and calibrate GC/MS, analyze samples by GC/MS, review and assemble all supporting GC/MS data, perform technical audit of GC/MS and HPLC, sign analysis reports, track samples to meet turnaround time.
Senior Chemist Coordinator (2004)
Responsibilities included: maintain GC/MS instrumentation, tune and calibrate GC/MS, analyze samples by GC/MS, review and assemble all supporting GC/MS data, perform technical audit of GC/MS and HPLC, sign analysis reports, track samples to meet turnaround time.
Senior Specialist Group Leader, GC/MS Semivolatiles (2005)
Responsibilities included: review and assemble GC/MS data, perform technical audit of GC/MS and HPLC, sign analysis reports, schedule and track samples to meet turnaround time.

Senior Specialist, Environmental Client Services (2008)
Responsibilities included auditing sample paperwork; setting up standard forms; generating bottle orders; preparing quotes
Senior Specialist, Specialty Services Group (2011)
Responsibilities include maintaining instrumentation; tuning and calibrating instrument daily; analyzing quality control and client samples; reviewing and assembling data in an efficient manner with a high degree of quality; evaluating current organizational and analytical systems; diagnosing complex problems and offering solutions with a high degree of independence; suggesting and implementing improvements to maximize quality and productivity; acting as technical resource for internal problems and projects; assisting in "brainstorming" client problems and projects; training new employees in all aspects of instrumentation; researching new and emerging technologies

Memberships and Appointments:

American Chemical Society (1998-2002)

Angela D. Sneeringer, B.S., Senior Chemist, GC/MS Volatiles

Education:

B.S. Biochemistry, Elizabethtown College (2001)

Professional Experience:

Wyeth, Chemist (2001-2003)
Responsibilities included CIP/SIP of tanks, large volume solution formulation, record review
Cycle Chem, Technical Services Rep (2003-2005)
Responsibilities included shipping documents for hazardous waste transportation; assisting clients with all necessary paperwork; scheduling of waste pickup
With Eurofins Lancaster Laboratories since 2005
Chemist, Pharmaceutical Raw Materials (2005)
Responsibilities included performing TOC of pharmaceutical waters using OI and Sievers analyzers
Chemist, GC/MS Volatiles (2005)
Responsibilities included performing GC/MS of volatile organic compounds using Agilent 5970 series MS and Shimadzu QP5000, also OI 5660 and 5661 concentrators and autosamplers
Senior Chemist, GC/MS Volatiles (2015)
Responsibilities include maintaining GC/MS instrumentation; tuning and calibrating instrument daily; analyzing quality control and client samples; reviewing and assembling data in an efficient manner with a high degree of quality; evaluating current organizational and analytical systems; suggesting and implementing the necessary corrective action to ensure the above can be performed in alignment with client and/or regulatory requirements; performing all duties with minimal supervision; working on special assignments; diagnosing complex problems and offering solutions with a high degree of independence; assisting in "brainstorming" client problems and projects; completing assigned projects on time; researching new and emerging technologies; producing written and oral reports on research activities

Tara M. Spaide, Senior Specialist, Business Development, Environmental Sciences

Continuing Education:

Algebra and Analytical Geometry, Pennsylvania State University (1993)
Chemistry, Pennsylvania State University (1993)

Professional Experience:

With Eurofins Lancaster Laboratories since 1986
Senior Specialist Coordinator, Organic Extraction (1997)
Responsibilities included supervising personnel; scheduling lab work; managing laboratory operations; reviewing and approving data; and revising and updating analytical methods
Senior Chemist Coordinator, Organic Extraction (2003)
Responsibilities included supervising personnel; scheduling lab work; managing laboratory operations; reviewing and approving data; and revising and updating analytical methods
Senior Chemist Group Leader, Organic Extraction (2005)
Responsibilities included supervising personnel; scheduling lab work; managing laboratory operations; reviewing and approving data; and revising and updating analytical methods
Senior Specialist, Environmental Client Services (2007)
Responsibilities included auditing sample paperwork; setting up standard forms; generating bottle orders; preparing quotes
Senior Specialist, Business Development, Environmental Sciences (2015)
Responsibilities include independently securing new business consistent with operational capabilities and business plan goals; collaborating efforts and activities with those of Outside Sales account managers as needed; focusing on proposal writing for major national accounts; attending face-to-face sales meetings with selected national accounts as needed and maintaining responsibility for their maintenance and growth

Kevin A. Sposito, B.S., Senior Chemist, GC/MS Volatiles

Education:

B.S. Forensic Chemistry, York College of Pennsylvania (2009)

Professional Experience:

Analytical Lab Services, Laboratory Technician (2010)

Responsibilities included performing Liquid-Liquid extractions of water sample to isolate organic analytes of interest

With Eurofins Lancaster Laboratories since 2010

Chemist, GC/MS Volatiles (2010)

Responsibilities included maintaining GC/MS instrumentation; tuning and calibrating instruments daily; analyzing quality control and client samples; reviewing and assembling data

Senior Chemist, GC/MS Volatiles (2015)

Responsibilities include maintaining GC/MS instrumentation; tuning and calibrating instrument daily; analyzing quality control and client samples; reviewing and assembling data in an efficient manner with a high degree of quality; evaluating current organizational and analytical systems; suggesting and implementing the necessary corrective action to ensure the above can be performed in alignment with client and/or regulatory requirements; performing all duties with minimal supervision; working on special assignments; diagnosing complex problems and offering solutions with a high degree of independence; assisting in “brainstorming” client problems and projects; completing assigned projects on time; researching new and emerging technologies; producing written and oral reports on research activities

Larry D. Starkey, Senior Specialist Group Leader, Bay Area Service Center and SeaTac Service Center

Professional Experience:

Walnut Creek Honda, Utility (1987-1992)

Responsibilities included performing new car inventory, general maintenance, and vehicle repair; being a service adviser

Star Courier Service, Manager (1992-2008)

Responsibilities included being a dispatcher, accountant (AP-AR-Income Statement-Tax Prep), supervisor, and driver

With Eurofins Lancaster Laboratories since 2008

Senior Administrator, Bay Area Service Center (2008)

Responsibilities included performing courier service; ordering and inventory control of bottling room; performing preservation with acid, bottle prep, packing of samples, packing of bottle orders, sending of rush e-mails to technical department, assisting in STLC threshold, packing and shipping of hazardous materials, sub-contracting of analysis

Specialist, Bay Area Service Center (2012)

Responsibilities included handling the receipt of samples at the Bay Area Service Center; reconciling chains-of-custody and documenting any discrepancies or damages at receipt; picking up samples and delivering bottle kits in the Bay Area; packing and shipping samples via overnight courier to Eurofins Lancaster Laboratories Environmental, LLC; supporting the SeaTac and Fort Collins Service Centers

Senior Specialist Group Leader, Bay Area Service Center and SeaTac Service Center (2014)

Responsibilities include serving as the primary contact with the laboratory for a number of assigned clients; communicating technical information and conveying client requirements to laboratory personnel, ensuring that those requirements are met; managing large/complex projects according to client technical and schedule requirements; developing strong relationships with major accounts resulting in additional sales; providing courier service including bottle delivery and sample pick-up in Bay Area; assisting in start-up and stocking of other service centers; ordering supplies as needed; performing both technical and personnel aspects of group operations; performing work within the department or other areas as required; acting as a technical resource, trainer, and troubleshooter to specific department; making recommendations for operational and/or technical improvements; communicating effectively within the group; coaching and developing direct reports; planning and monitoring workflow

Christopher M. Stauffer, B.S., Senior Specialist, Environment Software Development

Education:

B.S. Computer Science, Millersville University (2013)

Professional Experience:

Lawn Equipment Parts Co., Junior Network Admin (2008-2011)

Responsibilities included monitoring and maintaining network; applying software patches deployed to employees' desktops

With Eurofins Lancaster Laboratories since 2012

Specialist, Computer Application Development (2012)

Responsibilities included performing software development for Parallax

Senior Specialist, Computer Application Development (2015)

Responsibilities include providing technical support for maintenance of installed software applications and assisting with the development, installation, and maintenance of new applications for general use; assisting in development, implementation, and maintenance of software intended to improve the quality and efficiency of work performed

Memberships and Appointments:

Association for Computing Machinery

Member of SIGARCH, SIGMICRO (2011-2013)

Chelsea B. Stong, B.S., Senior Specialist, GC/MS Volatiles

Education:

B.S. Biology, Eastern University (2007)

Professional Experience:

With Eurofins Lancaster Laboratories since 2006

Laboratory Technician, GC/MS Volatiles (2006)

Responsibilities included scanning samples into LIMS; prepping samples for analysis

Chemist, GC/MS Volatiles (2007)

Responsibilities included analyzing water and soil samples using a GC/MS; prepping samples for analysis; working up raw data

Senior Chemist, GC/MS Volatiles (2012)

Responsibilities included maintaining GC/MS instrumentation; tuning and calibrating instrument daily; analyzing quality control and client samples; reviewing and assembling data in an efficient manner with a high degree of quality; evaluating current organizational and analytical systems; suggesting and implementing the necessary corrective action to ensure the above can be performed in alignment with client and/or regulatory requirements; performing all duties with minimal supervision; working on special assignments; diagnosing complex problems and offering solutions with a high degree of independence; assisting in "brainstorming" client problems and projects; completing assigned projects on time; researching new and emerging technologies; producing written and oral reports on research activities

Senior Specialist, GC/MS Volatiles (2015)

Responsibilities include performing technical audit of GC/MS volatiles data in a timely manner with zero defects as a goal; acting as a technical resource to department; evaluating issues in technical data and suggesting possible solutions; performing sample/QC verification in the LIMS; reviewing analytical reports; evaluating and interpreting analytical results; writing and revising SOPs; assisting in responding to and eliminating ICARs; making recommendations for technical improvements; communicating effectively within department; completing assigned tasks on time; assisting in "brainstorming" client problems and projects; performing all duties with minimal supervision

Andrew J. Strebel, Principal Specialist, Environmental Software Development

Continuing Education:

Advanced Aquarius Programmers Course, Hewlett-Packard (1989)
Environmental Applications of GC/MS, Indiana University (1989)
Environmental GC-MS (DOS) Operation, Hewlett-Packard (1995)
Unix Module 1, Albright College (1995)
Unix Module 2, Albright College (1995)
Unix Shell Scripts, Albright College (1995)
Unix AWK Programming, Albright College (1995)
Target Training, Thru-Put Systems, Inc. (1995)
Report Writer Training, Thru-Put Systems, Inc. (1998)
HP-UX System Administration for HP 9000s, Hewlett Packard (1998)
HP-UX Troubleshooting for HP 9000s, Hewlett Packard (1998)
GC/MS Training Course, MDL Systems (1999)
LC/MS/MS 101 Training Course, Basic Mass Spec Solutions, Inc. (2001)
GC-MSD Macro Programming, Agilent Technologies (2012)

Professional Experience:

With Eurofins Lancaster Laboratories since 1986
- Technical Specialist (1991)
- Chemist (1994)
- Senior Chemist (1997)
- Principal Chemist, GC/MS Semivolatiles (2001)
  - Responsibilities included performing routine semivolatile testing; operated GC/MS semivolatile instruments; data interpretation; reviewed and approved data; developing and evaluating new methods; calibrating and repairing instruments; prepared standards; revised and updated SOPs and analytical methods; trained other analysts; developed and maintained computer systems/programs for lab use; computer validation testing
- Principal Specialist, Environmental Software Development (2013)
  - Responsibilities include special project data interpretation and review; developing and evaluating new methods for the Target data system; developing and maintaining computer systems/programs for lab use; and computer validation testing

Robert Strocko, Jr., B.S., Manager, Metals and Microbiology

Education:

B.S. Biology, York College of Pennsylvania (1988)

Continuing Education:

Thermo Jarrel l ASA ICP Course, Thermo Jarrell ASA (1993)

Professional Experience:

Springettsbury Waste Water Treatment Facility, Chemistry Technician (1986-1988)
- Responsibilities included running NPDES tests on wastewater, % solids, NH4, pH, BOD, suspended solids, coliform, dissolved solids, temperature, and Hexa-Chrome testing

Penn Dairies, Laboratory Technician (1988-1989)
- Responsibilities included testing raw milk for coliform bacteria for acceptance; performing milk-fat percent solids on milk products; calculating sugar content in sweetened milk

Pennsylvania Department of Environmental Resources, Chemistry Technician (1989-1992)
- Responsibilities included receiving samples; logging data for analysis to computer; handling field sampling questions; operating flame AA; shipping cooler to field samples

With Eurofins Lancaster Laboratories since 1992
- Chemist, Metals (1992)
  - Responsibilities included setting up, pouring, and running samples on ICP; reviewing and verifying ICP data; performing instrument maintenance; calculating IDLs, MDLs, and linear ranges; writing SOPs
- Chemist/Coordinator, Metals (1996)
  - Responsibilities included overseeing prep room personnel and work flow; scheduling work flow through prep room; writing job plans and job reviews; ordering standards and reagents; overchecking notebooks
- Manager, Metals (1998)
  - Responsibilities include overseeing technical areas in ICP, low-level mercury, ICP-MS, and mercury; writing SOPs, ICARs, etc.; writing job plans and job reviews; handling technical questions for clients/client services; verifying ICP/ICP-MS/Hg data
- Manager, Metals Analysis and Microbiology (2013)
  - Responsibilities included overseeing technical areas in ICP, low-level mercury, ICP-MS, and mercury; writing SOPs, ICARs, etc.; writing job plans and job reviews; handling technical questions for clients/client services; verifying ICP/ICP-MS/Hg data
- Manager, Metals Analysis and Microbiology (2014)
  - Responsibilities include included overseeing technical areas in ICP, low-level mercury, ICP-MS, and mercury; writing SOPs, ICARs, etc.; writing job plans and job reviews; handling technical questions for clients/client services; verifying ICP/ICP-MS/Hg data; overseeing technical area in Microbiology; tests include Colilert (presence/absence), Colilert (Q-tray), Heterotrophic Plate Count (HPC), Fecal Coliform by Membrane Filtration, Yeast and Mold, Hydrocarbon degraders; overseeing writing of SOPs, responding to ICARs; writing job plans and job reviews; handling technical questions for clients/client services; verifying data

Christiane S. Sweigart, B.S., Senior Specialist, Environmental Quality Assurance

Education:

- B.S. Science, Elizabethtown College (1985)
- Medical/Technology Degree, St. Joseph School of Medical Technology (1985)

Continuing Education:

- The Principals of Gas Chromatography (1993)
- Statistics Course (1993)
- Creative Training Techniques Conference (1997)
- SEDD/ADR Implementation Workshop (2008)
- ERPTOOLSX (Environmental Resources Planning Tools) (2010)
- PPI (Practical Process Improvement) - Facilitator Training (2011)

Professional Experience:

- With Eurofins Lancaster Laboratories since 1985
  - Chemist, GC/MS (1985)
    - Responsibilities included GC/MS operation targeting VOA and BNA compounds, instrument maintenance, sample handling, and data handling (interpretation and documentation)
  - Chemist, GC/VOA (1986)
    - Responsibilities included GC operation targeting both aromatic and halogenated compounds, FID operation, instrument maintenance, sample handling, and data handling (interpretation and documentation); training others on FID methods, development of training/reference manual for FID, development of internal Operating Manual, standard documentation, definition and maintenance of statistically defined windows, and temporary coordinator in Department 4025
  - Chemist Coordinator, GC/VOA (1993)
    - Responsibilities included coordination of sample analysis and data management; job plans and feedback for several personnel; communication both internal and external, and data handling (interpretation and documentation; and combination of existing department with another (personnel, instrumentation, and sample volume)
  - Senior Specialist, Human Resources (1997)
    - Responsibilities included recruiting, training, and professional development
  - Senior Specialist, Electronic Data Deliverables (2001)
    - Responsibilities included EDD generation, EDD content review, and communication (internal and external)
  - Senior Specialist, Environmental Quality Assurance (2013)
    - Responsibilities include ensuring quality of operations and data being produced in the laboratories; ensuring laboratory adherence to government regulations and client requirements; independently performing complex work and special projects in addition to routine and non-routine duties

Awards, Citations, Honorary Societies & Publications:

- Recognition for the implementation of a revamped New Hire Orientation (1999)
- Recognition for the development and presentation of the Ethic's Refresher (2001)

Memberships & Appointments:

- LCAHRM (1997-2001)

Valerie L. Tomayko, B.S., Principal Specialist, Pesticide Residue Analysis

Education:

- A.S. Chemical Engineering Technology, Pennsylvania State University (1977)
- B.S. Human Resource Management, Geneva College (1993)

Professional Experience:

- Hercules Inc., Laboratory Technician (1977-1983)
- Antech Ltd., Associate Chemist, (1985-1989)
- Quanterra (formerly Wadsworth/Alert), Chemist, (1989-1997)
- UEC (United States Steel Engineering Consultants), Chemist (1997)
- With Lancaster Laboratories since 1997
  - Senior Chemist, Pesticide Residue Analysis (1997)
    - Responsibilities included: data interpretation; review and approve data; review data packages; and generate statistical QC limits for Pesticide Residue Analysis and Extractable Petroleum Hydrocarbons/MBC GC and Nitrosamines departments.
  - Senior Chemist Coordinator, Pesticide Residue Analysis (2001)
    - Responsibilities included: Monitor turnaround time and status of samples and packages; coordinate work flow; track employees' progress; assist in implementing procedures/protocols for meeting QA requirements, data package requirements, and special client or project-specific requests. In addition to data interpretation; review and approve data; review data packages; and generate statistical QC limits for Pesticide Residue Analysis and Extractable Petroleum Hydrocarbons/MBC GC and Nitrosamines departments.

Senior Specialist Group Leader, Pesticide Residue Analysis (2005)

Responsibilities included: Monitor turnaround time and status of samples and packages; coordinate work flow; track employees' progress; assist in implementing procedures/protocols for meeting QA requirements, data package requirements, and special client or project-specific requests. In addition to data interpretation; review and approve data; review data packages; and generate statistical QC limits for Pesticide Residue Analysis and Extractable Petroleum Hydrocarbons/MBC GC and Nitrosamines departments.

Senior Specialist Group Leader, Volatiles by GC (2006)

Responsibilities included: Monitor turnaround time and status of samples; coordinate work flow; track employees' progress; assist in implementing procedures/protocols for meeting QA requirements, data package requirements, and special client or project-specific requests. In addition to data interpretation; review and approve data; review data packages; and generate statistical QC limits for GC Volatile analysis.

Principal Specialist, Pesticide Residue Analysis (2011)

Responsibilities include reviewing laboratory data for technical compliance to methods, SOPs, client protocols, and regulatory agency requirements; overchecking and verifying data from the analysts performing instrumental analyses, including QC and clients' samples for pesticides, PCBs, herbicides, and other related compounds; reviewing data for accuracy and completeness (for routine and non-routine analyses, analytical reports, and/or data packages); assisting in implementing special client requests that impact data processing and reporting; identifying and offering solutions to correct problems related to data processing and reporting; serving as a technical resource for the department with regard to QA/QC procedures and issues

Timothy J. Trees, A.A.S., Principal Chemist, Specialty Services Group

Education:

Certificate, N.Y.S. Water/Wastewater Treatment Operations, Columbia Greene Community College (1985)
A.A.S. Environmental Control of Hazardous Waste/Water Quality, Ulster County Community College (1988)

Continuing Education:

Water Treatment Operations, NYS License Board (1984)
Wastewater Treatment Operations, NYS License Board (1986)
Varian AA Course (1992)
Service Operations Process Optimization, Pennsylvania State University (1992)
Hitachi GFAA Workshop, Hitachi, CT (1994)
24-hour HAZWOPER (spill response) (1995)
Atomic Spectroscopy Workshop, Perkin-Elmer (1997)

Professional Experience:

York Wastewater Management (1985-1986)
Rider Engineering (1986-1988)
With Eurofins Lancaster Laboratories since 1988

Senior Technician, Metals (1988)

Responsibilities included: operation, maintenance, and sample preparation of mercury cold vapor and hydride generation instrumentation for the determination of mercury, arsenic, and selenium; data entry; troubleshooting instruments; repair of instrumentations' electronic system.

Chemist I, Metals (1990)

Responsibilities included: operation and maintenance of graphite furnace instrumentation; verification of mercury cold vapor and hydride generation data; coaching and training of personnel in the operation of mercury and hydride instrumentation; troubleshooting and repair of instrumentations' mechanical and electronic system.

Chemist I/Coordinator, Metals (1992)

Responsibilities included: operation and maintenance of graphite furnace instrumentation; ICP operation; verification of mercury cold vapor and hydride generation data; coaching and training of personnel in the operation of mercury, hydride, and graphite furnace instrumentation; troubleshooting and repair of instrumentations' mechanical and electronic system; systems operation optimization to increase production; scheduling of personnel for department operation; job plan and review with employees.

Chemist II/Coordinator, Metals (1993)

Responsibilities included: coaching and training of personnel in the operation of mercury, hydride, and graphite furnace instrumentation; assist clients with data interpretation and process improvement; ICP operation; verification of graphite furnace, mercury cold vapor, and hydride generation data; data package review; troubleshooting and repair of instrumentations' mechanical and electronic systems; system operations optimization to increase production; scheduling of personnel for department operation; job plan and review with employees.

Senior Chemist/Coordinator, Metals (1994)

Responsibilities included: operation, maintenance, repair, and troubleshooting of department graphite furnaces; flame atomic absorption, mercury cold vapor, hydride generation, and Inductively Coupled Plasma Instrumentation as well as computer systems used in the operation with these instruments; data qualification, interpretation, and verification of department workload; assist clients with interpretation of data, cause and effect; coaching and training of department personnel in areas of sample preparation, instrument setup, maintenance, and analysis using these instruments; job plan, review, and evaluation with employees; ordering of supplies; maintained operation of Metals Atomic Absorption for the department; method development for both environmental and pharmaceutical divisions for graphite furnace and ICP work; Set up and maintain, all SOPs and documentation for computer systems and instrumentation to comply with GMP regulations; data package review for metals analysis; review and verification of ICP data as needed.

Principal Chemist/Coordinator, Metals (1996)

Responsibilities included: operation, maintenance, repair, and troubleshooting of department graphite furnaces; flame atomic absorption, mercury cold vapor, hydride generation, and Inductively Coupled Plasma Instrumentation as well as computer systems used in the operation with these instruments; data qualification, interpretation, and verification of department workload; assist clients with interpretation of data, cause and effect; coaching and training of department personnel in areas of sample preparation, instrument setup, maintenance, and analysis using these instruments; job plan, review, and evaluation with employees; ordering of supplies; maintained operation of Metals Atomic Absorption for the department; method development for both environmental and pharmaceutical divisions for graphite furnace and ICP work; Set up and maintain, all SOPs and documentation for computer systems and instrumentation to comply with GMP regulations; data package review for metals analysis; review and verification of ICP data as needed.

Senior Chemist, GC/MS Semivolatiles (1998)

Responsibilities included: operation, maintenance, and troubleshooting of GC/MS instrumentation; HP5890, 6890 GC, 5971, 5972, 5973 Mass Spec; review and data interpretation of various analyses including but not limited to, 8270C, Appendix IX, 625, CLP 3/90, and 2/88; standards preparation for various methods; data interpretation and data package assembly of batch data; evaluation and review of system procedures.

Principal Chemist, GC/MS Semivolatiles (2001)

Responsibilities included: operation, maintenance, and troubleshooting of GC/MS instrumentation; HP5890, 6890 GC, 5971,5972, 5973 Mass Spec; method development, research, and development of GC/MS procedures; review and data interpretation of various analyses including but not limited to 8270C, Appendix IX, 625, CLP 3/90 and 2/88; standards preparation for various methods; data interpretation and data package assembly of batch data; evaluation and review of system procedures; analysis and troubleshooting of HPLC and analysis of PAHs; coaching and training of analysts to assist with troubleshooting; working in Pharmaceutical Method Development and Validation, operating LC/MS, LC/MS/MS, and GC/MS instrumentation, and performing instrument qualifications since June 2003

Principal Chemist, Flexible Staffing (2006)

Responsibilities included working in GC/MS Volatiles in Air department; operation, maintenance, and troubleshooting GC/MS instrumentation; HP5890, 6890 GC, 5971, 5972, 5973 Mass Spec; method development, research, and development of GC/MS procedures; review and data interpretation of various analyses including but not limited to TO-15 and TO-14; standards preparation for various methods; data interpretation and data package assembly of batch data; evaluation and review of system procedures; ability to operate a variety of instrumentation and data systems

Principal Chemist, GC/MS Semivolatiles (2007)

Responsibilities included operating, performing maintenance on, and troubleshooting GC/MS instrumentation; HP5890, 6890 GC, 5971,5972, 5973, 5975 Mass Spec; setting up and performing method development of Thermo Fisher TRACE GC and DSQ II MS; performing method development using both EI and CI mode of analysis; method development, research, and development of GC/MS procedures; review and data interpretation of various analyses including, but not limited to, 8270C, Appendix IX, 625, CLP 3/90 and 2/88; standards preparation for various methods; data interpretation and data package assembly of batch data; evaluation and review of system procedures; analysis and troubleshooting of HPLC and analysis of PAHs; coaching and training of analysts to assist with troubleshooting; Including working in GC/MS Volatiles in Air department; operation, maintenance, and troubleshooting GC/MS instrumentation; HP5890, 6890 GC, 5971, 5972, 5973 Mass Spec; method development, research, and development of GC/MS procedures; review and data interpretation of various analyses including but not limited to TO-15 and TO-14; standards preparation for various methods; data interpretation and data package assembly of batch data; evaluation and review of system procedures; ability to operate a variety of instrumentation and data systems

Principal Chemist, Specialty Services Group (2011)

Responsibilities include acting as technical resource within the environmental division; developing and validating analytical protocols; troubleshooting and solving analytical chemistry problems; optimizing instrument configuration and performance; evaluating and interpreting analytical results; writing SOPs; assisting in responding to and eliminating ICARs, assisting in optimizing procedures in prep lab; communicating effectively within department; performing routine work as required. Maintain and operation of Thermo Fisher Scientific TSQ Quantum XLS MS/MS as well as TSQ8000 MS/MS with a Trace 1310 GC; developing methods utilizing GC triple Quad technology in a variety of matrices; utilizing various extraction technologies such as QuEChERS (Quick, Easy, Cheap, Effective, Rugged, and Safe) to effectively extract and cleanup sample matrices

Holly L. Trego, M.S., Manager, Environmental Software Development

Education:

B.S. Computer Science, Millersville University (1998)
M.S. Computer Science, Pennsylvania State University (2004)

Professional Experience:

Millersville University (1994-1998)
Computer Programmer
Responsibilities included organizing meetings with staff of Academic Advising and students; maintained statistics on students' grades in the Undeclared program using SAS; created reports in Cobol to report on the statistics; organized summer orientation for the Undeclared program
Internet Programmer
Responsibilities included creating and maintaining various interactive web pages to allow students to view information; developed web site for students to vote on what classes departments should offer
With Eurofins Lancaster Laboratories since 1996
Senior Specialist, Computer Applications Development (1996)
Responsibilities included write Visual Basic code to general client reports; design Powerbuilder System with customized macros which processes analytical data; develop data acquisition software with SQL*Loader
Senior Specialist/Group Leader, Computer Applications Development (2005)
Responsibilities included managing environmental application development projects, maintenance of existing applications
Manager, Computer Applications Development (2007)
Responsibilities included managing environmental application development projects, maintenance of existing applications
Manager, Environmental Software Development (2013)
Responsibilities include managing application development projects, maintenance of existing applications

Nicole M. Veety, B.S., Senior Chemist Group Leader, Instrumental Water Quality

Education:

AA Psychology, Harrisburg Area Community College (1997)
B.S. Psychobiology, Lebanon Valley College (2000)

Professional Experience:

With Eurofins Lancaster Laboratories since 2000
Senior Technician, Instrumental Water Quality (2000)
Responsibilities included various prep analyses, data entry, TOC and TOX analyses.
Chemist, Instrumental Water Quality (2003)
Responsibilities included performing various analyses, verification, and review and revise SOPs.
Senior Chemist, Instrumental Water Quality (2006)
Responsibilities include performing various analyses, method development, verification, and review and revise SOPs.
Senior Chemist Group Leader, Instrumental Water Quality (2009)
Responsibilities include performing various analyses, method development, verification, and review and revise SOPs; acting as a technical resource, trainer, and troubleshooter; making recommendations for operational and/or technical improvements; coaching and developing direct reports; planning and monitoring workflow.

Awards, Citations, Honorary Societies, and Publications:

Phi Theta Kappa National Honor Society (Alpha Nu Omega) (1996-2000)

David Velasquez, Senior Account Manager, Environmental Sciences

Information not available at time of printing

Robert Todd Vincent, B.S., Principal Chemist, Organic Extraction

Education:

B.S. Chemistry, West Virginia Wesleyan College (2001)

Professional Experience:

With Lancaster Laboratories since 2001
  Chemist, EPH/Misc. GC (2001)
    Responsibilities included analyzing samples; performing equipment repair; GC method development
  Chemist, Organic Extraction (2005)
    Responsibilities included performing method development; equipment repair
  Senior Chemist, Organic Extraction (2007)
    Responsibilities included performing method development; equipment repair; vendor relations; technology evaluation
  Principal Chemist, Organic Extraction (2011)
    Responsibilities include performing high level, difficult preps (with minimal supervision or guidance) following standard operating procedures (SOPs); self-train in new techniques; entering information into computer; training new or existing employees in extraction techniques or use of equipment; using knowledge to actively improve current processes; developing, enhancing, and validating new extraction methods; keeping work area clean and organized; preparing spikes; repairing equipment; updating departmental SOPs and training manual; disposing of wastes in approved manner; assisting in incident prevention and remediation when necessary

Harry D. Ward, Ph.D., Principal Specialist, Training

Education:

B.S. Chemistry, Muhlenberg College (1980)
Ph.D. Organic Chemistry, University of Delaware (1985)

Professional Experience:

Armstrong World Industries, Inc., Research Scientist (1985-2003)
    Responsibilities included performing research and development related to flooring
With Eurofins Lancaster Laboratories since 2003
  Senior Chemist, Pharmaceutical Product Testing (2003)
    Responsibilities included performing pharmaceutical product testing
  Senior Chemist, Method Development & Validation (2005)
    Responsibilities included performing pharmaceutical method development and validation
  Senior Training Specialist, Human Resources (2006)
    Responsibilities included design and delivery of core and elective technical training
  Principal Training Specialist, Human Resources (2008)
    Responsibilities included design and delivery of core and elective technical training
  Principal Specialist Group Leader, Training (2011)
    Responsibilities included managing the resources of the technical training group; designing and delivering core and elective technical training
  Principal Specialist, Training (2015)
    Responsibilities included facilitating all steps associated with technical training

Barbara J. Weaver, M.S., CIH, Principal Specialist, Training

Education:

B.S. Chemistry, Elizabethtown College (1971)
M.S. Analytical Chemistry, Illinois Institute of Technology (2001)

Certifications:

CIH - American Board of Industrial Hygiene - Certified in the comprehensive practice of industrial hygiene (1983), Certification #2719

Continuing Education:

Business Law, Elizabethtown College (1979)
NIOSH Course #553 "Industrial Hygiene Sampling, Decision Making, Monitoring and Record Keeping, Sampling Strategies" (1979)
Industrial Toxicology, 5-Day Workshop, Thomas Jefferson University (1980)
Special Topics: Environmental Analytical Chemistry, Graduate Work, Villanova University (1981)
"Comprehensive Industrial Hygiene Review", University of Cincinnati, NIOSH Education Resource Center (1983)
Environmental Health, Graduate Work, West Chester University (1985)
Chemical Hygiene - The OSHA Laboratory Standard, NEAIHA PDC (1990)
Health and Safety Management for Hazardous Waste Professionals, AIHA PDC #11 (1990)
Financial Accounting, Penn State (1990)
NIOSH Course #582 "Sample and Analysis of Airborne Asbestos Dust", NIOSH Education Resource Center, Cincinnati (1992)
Survey of Management, Penn State University (1993)
Laboratory Safety and Health, American Chemical Society (1994)
24-hour HAZWOPER (spill response) and Refreshers (1995-present)
Health, Safety, and Environmental Auditing, Johns Hopkins (1995)
Managing Ionizing Radiation Programs for Industrial Hygienists, AIHA (1996)
Radiation Safety Officer Training, Radiation Safety Associates, MA (1997)
Presenting Data and Information, Edward R. Tufte, Graphic Press LLC (2005)
IATA/FIATA Dangerous Goods, IATA (2007)
GC/MS Training Seminar, Restek (2008)
IATA Dangerous Goods Refresher Training, DGI (2009)
Exposure Assessment Strategies and Statistics, 4.6 CEUs, AIHA (2009)
Practical Process Improvement, Training in the Role of Facilitator (2010)
DOT (49CFR) Shipper Course, DGI (2011)
IATA Acceptance Training, all inclusive (2011)

Professional Experience:

Warner Lambert, Inc., Quality Control Chemist (1970-1973)

Responsibilities included performing USP/NF and client-specific raw materials and product testing; conducting specific project assignments such as documentation of product-specific alcohol denaturing at supplier's site; pre-market new product quality control testing; serving on panels for testing fragrance and color

Hershey Medical Center, Junior Research Technician (1973-1974)

Responsibilities included developing rubidium-crystal FID-GC (nitrogen sensitive) methods for the low level detection of barbiturates in solution and in blood extracts; performing analysis of blood and spiked blood from rat and monkey; performing analysis of a specific liver enzyme; using preparative fix-angle ultracentrifuge in sample preparation; developing electron microscopy photographs for liver cell mitochondria study

Elizabethtown College, Laboratory Instructor (1977-1978)

Responsibilities included preparing materials for freshman chemistry laboratories; providing basic laboratory instruction for freshmen; conducting research on the separation of linoleic and linolenic acids (omega-3 and omega-6 fatty acids in olive oil) using spinning band distillation; testing flame-retardant cellulose insulation to determine the flame-retardant formulation for industrial client

With Lancaster Laboratories since 1978

Chemist, Air Quality/Industrial Hygiene (1978)

Responsibilities included performing air and miscellaneous chemical analysis using gas chromatography, colorimetric analysis, UV-Vis, spectrophotometry, fiber-counting using phase contrast microscopy, and infrared analysis

Program Manager, Air Quality/Industrial Hygiene (1978)

Responsibilities for the Air Quality and Miscellaneous Chemistry Group included conducting NIOSH, OSHA, and EPA air sampling and analysis; industrial hygiene (air quality and employee exposure in the workplace) consulting services; responsibilities for laboratory work included method development for analysis of pharmaceutical active compounds in air; method development for the FID-GC analysis of cholesterol and fatty acid profiles; infra-red and gas chromatography methods; forensic sample analysis and expert witness testimony; USP/NF testing, some ASTM testing, analytical microscopy using phase contrast, fluorescence and light microscopy; preparing and/or submitting PAT and QA test samples and blanks for analysis; business development, technical writing, proposal, pricing and quote development, and client services for QA/IH; managing the industrial hygiene field sampling/consultation and industrial hygiene/miscellaneous chemistry (client special projects) lab group; maintaining DEA registration; serving as laboratory director for the AIHA analytical laboratory certification for more than 10 years

Marketing and Technical Services Specialist, Business Development (1987)
Responsibilities included inside and external business development including client visits and trade shows; serving as client services/account representative for air quality, foods, and pharmaceutical sciences; creating and tracking quotes and responses to requests for bids and proposals; continued to serve as laboratory director for the AIHA analytical laboratory certification

Principal Specialist reporting to Vice President, Environmental and Pharmaceutical Sciences (1987)
Responsibilities included technical writing, special projects, and performing Graphite Furnace Atomic Absorption for Pb and Cu in water; pesticides data entry verification; coordinating, developing, and providing technical and EHS training; providing technical support to the EHS staff; serving as interim EHS officer and the EHS liaison with our parent company; serving as Lancaster Radiation Safety Officer during the period in which Lancaster held a site NRC license; serving as a permanent member of the safety committee representing EHS training

Principal Specialist, Training (1991)
Responsibilities include coordinating, developing, and providing technical training and environmental health and safety (EHS) training; soliciting and managing grants for training programs; providing coordination for the external and continuing education programs; providing technical support for the EHS staff and continuing to represent EHS training on the safety committee

Awards, Citations, Honorary Societies & Publications:

1 publication on microscopy
1 publication on NMR and Copper-histidine
Book Review - Review of *Guidelines for Laboratory Design: Health and Safety Aspect,* ***The Synergist*** March 2002
Acknowledged in two EPA publications: Pb-Based Paint Laboratory Operations Guidelines: Analysis of Pb in Paint, Dust and Soil (EPA 747-R-92-006 May 1993) and Environmental Management Guide for Small Laboratories (EPA 233-B-98-001 July 1998)
Biographical Listings: *Who's Who in the East*, under Barbara J. Felty; *Who's Who in the Safety Profession*
2014 designated as a Fellow of the American Industrial Hygiene Association

Barbara J. Weaver, M.S., CIH, Principal Specialist, Training (continued)

Memberships and Appointments:

American Board of Industrial Hygiene (1984-present)
American Industrial Hygiene Association (AIHA) Member (1980-present), Fellow (2014 to present)
  Sampling and Laboratory Analysis Committee (2001-present)
  Communication and Training Methods Committee (2006-present)
AIHA - Central Pennsylvania Section, Charter Member (1981-present)
  Treasurer (1981-1984, 2008-present), President-elect (1985-1986, 2002-2005), President (1986-1987, 2005-2006), Secretary (2007-2008), Membership Director (1988-1993), Director (2000-2002)
American Chemical Society (1985-present)
  Chemical Health and Safety Section, Membership Committee (1992-1993)
Lancaster County Industrial Safety Council (Director 1988-1990)
Leadership Lancaster (1995)
  Mentor (1999-2002), Marketing Committee (1999-2000)
Johns Hopkins NIOSH Education Resource Center Continuing Education Advisory Committee (1996-2006)
Penn State University–Lancaster Center Advisory Committee (2002–2006)
Chromatography Forum, Delaware Valley (2002-present/lifetime member)

Timothy S. Weaver, B.A., Senior Specialist, Environmental Software Development

Education:

B.A. Mathematics, Franklin & Marshall College (1996)

Professional Experience:

With Eurofins Lancaster Laboratories since 1996

Computer Specialist, Volatiles by GC (1996)
Responsibilities included programming, maintenance, and updates

Computer Specialist, Environmental Sciences (1997)
Responsibilities included disk format programming initially, followed by pesticides system and database maintenance and programming

Specialist, Computer Applications Development (2002)
Responsibilities included pesticides system and database maintenance and programming; invoice print server maintenance; LLENS program administration

Senior Specialist, Environmental Software Development (2008)
Responsibilities include pesticides system and database maintenance and programming; invoice print server maintenance; LLENS program administration

Chad Wettig, Senior Specialist Group Leader, Sample Support

Continuing Education:
- Leadership at Lancaster Laboratories, LLI (2000)
- Role of a Leader (parts 1-4), LLI (2007)
- PPI Team Training, LLI (2009)
- Microsoft Excel 2003, HACC (2011)

Professional Experience:
- Landis Valley, Waiter (1995)
    - Responsibilities included setting up banquets; serving food; maintenance work
- With Eurofins Lancaster Laboratories since 1995
    - Clerk II, Sample Support (1995)
        - Responsibilities included performing homogenization, Subsampling, preservation; operating ASRS; handling hazardous sample discard
    - Senior Technician, Sample Support (1998)
        - Responsibilities included operating ASRS; performing homogenization, preservation, volatile prep; handling hazardous sample discard
    - Specialist, Sample Support (1999)
        - Responsibilities included being the technical contact between labs and client services; investigating client issues with samples
    - Chemist Group Leader, Sample Support (2000)
        - Responsibilities included acting as a resource for Client Services, Sample Administration, and the technical departments concerning all sample questions, problems, and availability; investigating problems; setting up, and maintaining systems for special projects; assisting in ASRS hardware support; communicating with Environmental Health and Safety office concerning hazardous discard; verifying results for various analysis; performing all jobs in the department as needed including volatile prep, prescreen and dilutions; assisting with ASRS operation, preservation, homogenization, and moisture; performing both technical and personnel aspects of group operations; performing work within the department or other areas as required; acting as a technical resource, trainer, and troubleshooter to specific department; making recommendations for operational and/or technical improvements; communicating effectively within the group; coaching and developing direct reports; planning and monitoring workflow; monitoring data for and supporting departmental MOS
    - Senior Specialist Group Leader, Sample Support (2015)
        - Responsibilities include acting as a resource for Client Services, Sample Administration, and the technical departments concerning all sample questions, problems, and availability; investigating problems; setting up, and maintaining systems for special projects; assisting in ASRS hardware support; communicating with Environmental Health and Safety office concerning hazardous discard; verifying results for various analysis; performing all jobs in the department as needed including volatile prep, prescreen and dilutions; assisting with ASRS operation, preservation, homogenization, and moisture; performing both technical and personnel aspects of group operations; performing work within the department or other areas as required; acting as a technical resource, trainer, and troubleshooter to specific department; making recommendations for operational and/or technical improvements; communicating effectively within the group; coaching and developing direct reports; planning and monitoring workflow; monitoring data for and supporting departmental MOS

Heather E. Williams, B.S., Senior Chemist, EPH/Miscellaneous GC

Education:
- B.S. Forensic and Investigative Science, West Virginia University (2004)

Continuing Education:
- Principles of Gas Chromatography, LLU (2007)

Professional Experience:
- With Lancaster Laboratories since 2006
    - Chemist, EPH/Miscellaneous GC (2006)
        - Responsibilities included analyzing routine samples and their associated QC by gas chromatography for extractable petroleum products such as DRO, TPH, and other related materials; reviewing, calculating, and reporting the corresponding data and results; maintaining, optimizing, and calibrating Gas Chromatographs in an efficient and accurate manner; assisting in organization of department work, track samples, and prepare samples and standards to consistently meet turnaround time requirements
    - Senior Chemist, EPH/Miscellaneous GC (2008)
        - Responsibilities include analyzing routine samples and their associated QC by gas chromatography for extractable petroleum products such as DRO, TPH and other related materials; reviewing, interpreting, calculating, and reporting the corresponding data and results; maintaining, optimizing, and calibrating Gas Chromatographs in an efficient and accurate manner; assisting in organization of department work, tracking samples; preparing samples and standards to consistently meet turnaround time requirements; verifying sample data; corresponding with client service representatives regarding client inquiries and providing answers and solutions when problems arise; SOP writing and revising as new methods are developed; assisting with new instrument installation and set-up; participating in practical process improvements as a member of a team

Bret M. Winey, B.S., Senior Specialist, Environmental Software Development

Education:

B.S. Computer Science, Millersville University (2005)

Professional Experience:

Penn State University, College of Medicine, Programmer/Analyst (2009-2011)

Responsibilities included developing systems responsible for collecting and analyzing medical research data

Weidenhammer Systems Corp., Programmer/Analyst (2011-2012)

Responsibilities included maintaining and implementing functionality on clients' websites, using specification gathered directly from the respective client

Donegal Mutual Insurance Company, Inc., Programmer (2012-2013)

Responsibilities included maintaining existing web presentation and provide aid during transition to new website design

With Eurofins Lancaster Laboratories since 2013

Senior Specialist, Environmental Software Development (2013)

Responsibilities include providing technical support for maintenance of installed software applications and assisting with the development, installation, and maintenance of new applications for general use; assisting in development, implementation, and maintenance of software intended to improve the quality and efficiency of work performed

Meng Yu, M.S., Principal Chemist, Specialty Services Group

Education:

B.S. Chemical Engineering, Zhejiang University of Technology (1986)
Post Graduate, Biogeography and Environmental Assessment, University of Saarland (1995)
M.S. Chemistry, Catholic University of Leuven (1999)

Professional Experience:

Setsco Service Ltd, Executive Chemist (1999-2002)

Responsibilities performing EPA and USDA method development and validation for water, soil, food, and pharmaceutical materials using USP, BP, and AOAC methods; performing pesticide residue analysis using all kinds of GC

Cantest Ltd, Research Chemist (2002-2008)

Responsibilities included performing bioanalytical and food safety method development and validation; performing pesticide and drug residue method validation as per USDA, EPA, CFIA methods; UPLCMSMS, LCMSMS, LCMS and GCMS operation and maintenance

Pharmanet Inc. HSP Laboratory, Research Scientist (2008-2010)

Responsibilities included performing bioanalytical method development and validation for plasma, urine, tissue, etc.; performing LCMSMS operation, tuning, and maintenance

With Lancaster Laboratories since 2010

Principal Chemist, Specialty Services Group (2010)

Responsibilities include developing and validating new testing methods; operating and maintaining LCMSMS instruments; performing sample analyses

Memberships and Appointments:

ASMS (2010)

Holly B. Ziegler, B.S., Senior Chemist, GC/MS Semivolatiles

Education:

B.S. Forensic Chemistry, Buffalo State College (SUNY) (2006)

Professional Experience:

New York State Police, Toxicology Intern (2005-2006)

Responsibilities included performing analysis of alternative medicines using FPIA, SPE, GC/NPD, and GC/MS

With Eurofins Lancaster Laboratories since 2006

Chemist, GC/MS Volatiles (2006)

Responsibilities included analyzing soils and waters for VOAs using purge and trap and GC/MS instrumentation

Senior Chemist, GC/MS Volatiles (2010)

Responsibilities included analyzing performing GC/MS analysis of water and soil samples along with other matrices by various analytical methods such as EPA 8260B and CLP; evaluating analytical data generated; calibrating and troubleshooting GC/MS instrumentation; assisting other employees with any questions that may arise and helping to train new employees

Senior Chemist, GC/MS Semivolatiles (2011)

Responsibilities include maintaining GC/MS instrumentation; tuning and calibrating instruments daily; analyzing quality control and client samples; reviewing and assembling this data in an efficient manner with a high degree of quality to meet client requirements; working on special assignments; running 8270C, 625, THPA, and TEL methods

Memberships and Appointments:

Emergency Response Team (Hazmat technician) – LLI (2006-2011)

Michael A. Ziegler, B.S., Senior Chemist, Volatiles in Air

Education:

B.S. Molecular Biology, Clarion University of PA (2002)

Professional Experience:

With Eurofins Lancaster Laboratories since 2006

- Chemist, GC/MS Volatiles (2006)
  - Responsibilities included maintaining GC/MS instrumentation; tuning and calibrating instrument daily; analyzing quality control and client samples; reviewing and assembling data in an efficient manner with a high degree of quality; evaluating current organizational and analytical systems; suggesting and implementing the necessary corrective action to ensure the above can be performed in alignment with client and/or regulatory requirements; performing all duties with minimal supervision
- Chemist, Volatiles in Air (2010)
  - Responsibilities included maintaining GC and/or GC/MS instrumentation and calibrating GC and/or GC/MS instrument daily; analyzing quality control and client samples; reviewing and assembling data in an efficient manner with a high degree of quality to meet client requirements; performing various Airlab duties associated with sample prep and sample flow (these include, but are not limited to, sample retrieval and entry, Nitrogen tank replacement, summa can cleaning, summa/FC requests, and sample pressurization/prescreen)
- Senior Chemist, Volatiles in Air (2014)
  - Responsibilities include maintaining GC and/or GC/MS instrumentation and calibrating GC and/or GC/MS instrument daily; analyzing quality control and client samples; reviewing and assembling data in an efficient manner with a high degree of quality to meet client requirements; performing various Airlab duties associated with sample prep and sample flow (these include, but are not limited to, sample retrieval and entry, Nitrogen tank replacement, summa can cleaning, summa/FC requests, and sample pressurization/prescreen)

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Level 1			
Environmental Quality Policy Manual	1-P-QM-GDL-9015377	DOD - Environmental Quality Policy Manual	4052 - Environmental Quality Assurance
Procedure Cross Reference List	1-P-QM-GDL-9015378	DOD - Environmental Quality Policy Manual Appendix A	4052 - Environmental Quality Assurance
Certifications, Accreditation, Registrations, and Contracts	1-P-QM-GDL-9015379	DOD - Environmental Quality Policy Manual Appendix B	4052 - Environmental Quality Assurance
Organizational Charts Personnel to Sign Reports	1-P-QM-GDL-9015380	DOD - Environmental Quality Policy Manual Appendix C	4052 - Environmental Quality Assurance
Personnel Qualifications and Responsibilities	1-P-QM-GDL-9015381	DOD - Environmental Quality Policy Manual Appendix D	4052 - Environmental Quality Assurance
SOPs and Analytical Methods	1-P-QM-GDL-9015382	DOD - Environmental Quality Policy Manual Appendix E	4052 - Environmental Quality Assurance
Instrument and Equipment List	1-P-QM-GDL-9015383	DOD - Environmental Quality Policy Manual Appendix F	4052 - Environmental Quality Assurance
Preventative Maintenance Schedules	1-P-QM-GDL-9015384	DOD - Environmental Quality Policy Manual Appendix G	4052 - Environmental Quality Assurance
Calibration Schedules	1-P-QM-GDL-9015385	DOD - Environmental Quality Policy Manual Appendix H	4052 - Environmental Quality Assurance
NELAP Scope of Testing	1-P-QM-GDL-9015386	DOD - Environmental Quality Policy Manual Appendix I	4052 - Environmental Quality Assurance
Quality Control Types, Frequency, and Corrective Action	1-P-QM-GDL-9015387	DOD - Environmental Quality Policy Manual Appendix J	4052 - Environmental Quality Assurance
Microbiological Testing	1-P-QM-GDL-9015388	DOD - Environmental Quality Policy Manual Appendix K	4052 - Environmental Quality Assurance
Manual Integration for ELLE	1-P-QM-GDL-9017675	Policy 0001	4052 - Environmental Quality Assurance
Laboratory Ethics and Data Integrity Policy	1-P-QM-GDL-9017679	Policy 0007	4052 - Environmental Quality Assurance
Chemical Hygiene Plan	1-P-QM-GDL-9015198	Chemical Hygiene Plan	6098 - Safety
Preparedness, Prevention, and Contingency Plan	1-P-QM-GDL-9017681	Policy 0010	6098 - Safety
Exposure Control Plan for Bloodborne Pathogens	1-P-QM-GDL-9017682	Policy 0011	6098 - Safety
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Balance, Syringe, Pipette Verification	1-P-QM-QMA-9015389	DOD - LOM-SOP-ES-235	4052 - Environmental Quality Assurance
Bay Area Service Center Dangerous Goods Shipping Procedure	1-P-QM-QMA-9017337	LOM-SOP-ES-237	50 - Bay Area Service Center
Building Security	1-P-QM-QMA-9017366	LOM-SOP-LAB-212	6043 - Physical Services
Change Control Procedures for ELLE	1-P-QM-QMA-9028515	N/A	4052 - Environmental Quality Assurance

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Chromatography Integration and Documentation	1-P-QM-QMA-9017333	LOM-SOP-ES-232	4052 - Environmental Quality Assurance
Chromatography Integration and Documentation for OH VAP	1-P-QM-QMA-9022815	LOM-SOP-ES-232 (OH VAP)	4052 - Environmental Quality Assurance
Communicating Maximum Contaminant Level (MCL) Exceedances	1-P-QM-QMA-9017330	LOM-SOP-ES-227	4039 – Environmental Client Services
Compliance with Environmental GLP Regulations	1-P-QM-QMA-9022322	LOM-SOP-LAB-204 and LOM-SOP-LAB-224	4052 - Environmental Quality Assurance
Data and Record Storage, Security, Retention, Archival, and Disposal	1-P-QM-QMA-9017358	LOM-SOP-LAB-203	6047 - Office Services
Data Entry, Verification and Reporting	1-P-QM-QMA-9017322	LOM-SOP-ES-218	4052 - Environmental Quality Assurance
Demonstrations of Capability	1-P-QM-QMA-9015390	DOD - LOM-SOP-ES-238	4052 - Environmental Quality Assurance
Determining Method Detection Limits and Limits of Quantitation	1-P-QM-QMA-9017309	LOM-SOP-ES-203	4052 - Environmental Quality Assurance
E-Mail System	1-P-QM-QMA-9017360	LOM-SOP-LAB-205	9013 - Information Technology
Employee Training Program	1-P-QM-QMA-9017379	LOM-SOP-LAB-231	6047 - Office Services
Environmental Project Cycle	1-P-QM-QMA-9017338	LOM-SOP-ES-239	4052 - Environmental Quality Assurance
Establishing Control Limits	1-P-QM-QMA-9017313	LOM-SOP-ES-207	4052 - Environmental Quality Assurance
EtQ System User Account Maintenance	1-P-QM-QMA-9017380	LOM-SOP-LAB-232	6047 - Office Services
Eurofins North America E-Mail and Archiving	1-P-QM-QMA-9020074	NA	9013 - Information Technology
Facilities Operation Manual	1-P-QM-QMA-9017374	LOM-SOP-LAB-223	6043 - Physical Services
Facility Change Control Procedure	1-P-QM-QMA-9017364	LOM-SOP-LAB-209	6043 - Physical Services
Forensic Laboratory Services	1-P-QM-QMA-9017307	LOM-SOP-ES-201	4052 - Environmental Quality Assurance
Guidelines for Analytical Decision Making in Environmental Testing	1-P-QM-QMA-9021833	LOM-SOP-LAB-226	4052 - Environmental Quality Assurance
Guidelines for Writing Technical Reports	1-P-QM-QMA-9017308	LOM-SOP-ES-202	4052 - Environmental Quality Assurance
Handling of Client Technical Complaints (Investigations and Response)	1-P-QM-QMA-9017332	LOM-SOP-ES-231	4052 - Environmental Quality Assurance
HP-UX Target 3.5 Data System Accounts and Electronic Signature Security	1-P-QM-QMA-9017336	LOM-SOP-ES-236	4052 - Environmental Quality Assurance
Implementation of the Computer Services Validation Master Plan (CSVMP)	1-P-QM-QMA-9017425	LOM-SOP-VAL-210	4044 - Environmental Software Development
Insect and Rodent Control	1-P-QM-QMA-9017367	LOM-SOP-LAB-213	6043 - Physical Services
Instrument Maintenance and Calibration	1-P-QM-QMA-9017325	LOM-SOP-ES-222	4052 - Environmental Quality Assurance
Investigation and Corrective Action of Noncompliant Data	1-P-QM-QMA-9017315	LOM-SOP-ES-209	4052 - Environmental Quality Assurance

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Investigation and Corrective Action Reporting for Laboratory Problems	1-P-QM-QMA-9017331	LOM-SOP-ES-230	4052 - Environmental Quality Assurance
Laboratory Housekeeping and Cleaning	1-P-QM-QMA-9017373	LOM-SOP-LAB-221	6043 - Physical Services
Laboratory Notebooks, Logbooks, and Documentation for Environmental Testing	1-P-QM-QMA-9021767	LOM-SOP-LAB-220	4052 - Environmental Quality Assurance
Laboratory Sample Analysis Record (LSAR) Documentation	1-P-QM-QMA-9017318	LOM-SOP-ES-212	4052 - Environmental Quality Assurance
Laboratory/Quality Systems Procedures Summary	1-P-QM-QMA-9033535	N/A	4052 - Environmental Quality Assurance
Legal Chain-of-Custody Documentation	1-P-QM-QMA-9017335	LOM-SOP-ES-234	4052 - Environmental Quality Assurance
Missed Holding Time Reports	1-P-QM-QMA-9017326	LOM-SOP-ES-223	4052 - Environmental Quality Assurance
Monitoring of the Volatile Organics Analysis (VOA) Storage Areas for Contamination	1-P-QM-QMA-9017311	LOM-SOP-ES-205	4052 - Environmental Quality Assurance
Monitoring Temperatures in Refrigerators, Freezers, Incubators, and Ovens Using the ETM	1-P-QM-QMA-9021509	N/A	4052 - Environmental Quality Assurance
Obtaining a Representative Environmental Solid Sample Aliquot	1-P-QM-QMA-9017334	LOM-SOP-ES-233	4052 - Environmental Quality Assurance
Procurement of Environmental Laboratory Supplies	1-P-QM-QMA-9021705	LOM-SOP-LAB-218	4052 - Environmental Quality Assurance
Proficiency Test Samples	1-P-QM-QMA-9017321	LOM-SOP-ES-216	4052 - Environmental Quality Assurance
Quarantine Soils Procedures	1-P-QM-QMA-9017317	LOM-SOP-ES-211	4052 - Environmental Quality Assurance
Reagents and Standards	1-P-QM-QMA-9017328	LOM-SOP-ES-225	4052 - Environmental Quality Assurance
Review of Legal Matters	1-P-QM-QMA-9017371	LOM-SOP-LAB-219	40 - Environmental Sciences
Sample Requisition	1-P-QM-QMA-9017312	LOM-SOP-ES-206	4052 - Environmental Quality Assurance
Subcontracting Analytical Testing	1-P-QM-QMA-9017310	LOM-SOP-ES-204	4052 - Environmental Quality Assurance
Thermometer Use and Calibration	1-P-QM-QMA-9017314	LOM-SOP-ES-208	4052 - Environmental Quality Assurance
Use and Maintenance of Reagent Water Supply	1-P-QM-QMA-9017368	LOM-SOP-LAB-214	4052 - Environmental Quality Assurance
Utilizing the Services and Support of the Computer Systems Group	1-P-QM-QMA-9017362	LOM-SOP-LAB-207	9013 - Information Technology
Validation and Authorization of Analytical Methods	1-P-QM-QMA-9017329	LOM-SOP-ES-226	4052 - Environmental Quality Assurance
Windows Network and Computer Accounts	1-P-QM-QMA-9017361	LOM-SOP-LAB-206	9013 - Information Technology
Writing and Reviewing Lancaster Laboratories Policies and Operating Procedures	1-P-QM-QMA-9017356	LOM-SOP-LAB-201	6047 - Office Services

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Level 3 – Environmental Microbiology			
2% Brilliant Green Bile Broth (for Coliform Test Dept. 02)	1-P-QM-WI -9018027	SOP-PM-001, Media 400	3002 - Environmental Microbiology
Biological Reaction Activity Test	1-P-QM-WI -9032790	Analysis 13697, 13698, 13699	3002 - Environmental Microbiology
Coliform Analysis - Presence/Absence and MPN	1-P-QM-WI -9014018	Analysis 6477, 6479, 8161, 13666, 13668, 13669, 13671	3002 - Environmental Microbiology
EC Medium – for Dept. 02	1-P-QM-WI -9018028	SOP-PM-001, Media 401	3002 - Environmental Microbiology
Free Chlorine Residual Data Records (Optional Total Chlorine Reading)	1-P-QM-WI -9011681	Analysis 0308	3002 - Environmental Microbiology
Hexadecane HC Emulsion (for HC degrading PC study)	1-P-QM-WI -9018016	SOP-PM-001, Media 382	3002 - Environmental Microbiology
Hydrocarbon Degrading Plate Count Study Waters and Solids	1-P-QM-WI -9013997	Analysis 6157, 6158	3002 - Environmental Microbiology
Lauryl Sulfate Tryptose Broth (1x LST) Single Strength – for Dept. 02	1-P-QM-WI -9018025	SOP-PM-001, Media 398	3002 - Environmental Microbiology
Lauryl Sulfate Tryptose Double Strength (2x LST) – for Dept. 02	1-P-QM-WI -9018026	SOP-PM-001, Media 399	3002 - Environmental Microbiology
M-FC (for Dept. 02)	1-P-QM-WI -9018024	SOP-PM-001, Media 397	3002 - Environmental Microbiology
Modification DPD Free Chlorine Residual In Water (Presence/Absence)	1-P-QM-WI -9011686	Analysis 0416	3002 - Environmental Microbiology
Modification Fecal Coliform by Membrane Filtration	1-P-QM-WI -9011598	Analysis 0199, 11028	3002 - Environmental Microbiology
MS/Agar Noble Base (for HC degrading PC study)	1-P-QM-WI -9018021	SOP-PM-001, Media 390	3002 - Environmental Microbiology
MS/Agar Noble Medium (for HC degrading PC study for Dept. 02)	1-P-QM-WI -9018022	SOP-PM-001, Media 391	3002 - Environmental Microbiology
Pour Plate Analysis - Heterotrophic Plate Count and Yeast/Mold	1-P-QM-WI -9011658	Analysis 0307, 4196, 12833, 13667, 13670	3002 - Environmental Microbiology
Quanti-Tray X Sealer	1-P-QM-PRO-9017534	OMC-PM-078	3002 - Environmental Microbiology
Tryptic Soy Broth (TSB) for Dept. 02 Sterility Checks	1-P-QM-WI -9018035	SOP-PM-001, Media 409	3002 - Environmental Microbiology
Tryptic Soy Broth (TSB)—for Dept. 02	1-P-QM-WI -9018023	SOP-PM-001, Media 396	3002 - Environmental Microbiology
Level 3 – Environmental Sciences			
Calibrating the 1-uL Standard Delivery Groove on the Archon Model 5100A and O.I. 4660 Autosampler Systems	1-P-QM-PRO-9017815	SOP-OR-075	4021 - GC/MS Volatiles
Determination of GRO by GC in Waters and Wastewaters by Method 8015B, 8015C, 8015D	1-P-QM-WI -9015131	Analysis DOD - 1635, 1636, 1728, 1729, 2762, 2763, 8229, 8268, 10598	4021 - GC/MS Volatiles
Determination of GRO by GC in Waters and Wastewaters by Method AK101	1-P-QM-WI -9013129	Analysis 1438, 1440	4021 - GC/MS Volatiles
Determination of Volatile Gasoline Range Organics in Soil and Water - Northwest GX Method	1-P-QM-WI -9013411	Analysis 2005, 2006, 8273, 8274	4021 - GC/MS Volatiles
Determination of Volatile Gasoline Range Organics in Soil and Water Maine Method	1-P-QM-WI -9012774	Analysis 10438, 10439	4021 - GC/MS Volatiles

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Level 3 – Environmental Sciences (continued)			
Determination of Volatile Gasoline Range Organics in Soil and Water Oklahoma Method	1-P-QM-WI -9013441	Analysis 2315, 8789	4021 - GC/MS Volatiles
Determination of Volatile Target Compounds and Gasoline Range Organics (GRO) by Capillary Column Gas Chromatography/Mass Spectrometry (GC/MS) in Waters and Wastewaters by Method 8260C	1-P-QM-WI -9013078	Analysis 11996, 11997, 13130	4021 - GC/MS Volatiles
Determination of Volatile Target Compounds and Gasoline Range Organics (GRO) by GC/MS in Soils and Solids by Method 8260B	1-P-QM-WI -9012764	Analysis 10237, 10607, 10949, 10950, 10951	4021 - GC/MS Volatiles
Determination of Volatile Target Compounds and Gasoline Range Organics (GRO) by GC/MS in Soils and Solids by Method 8260C	1-P-QM-WI -9013077	Analysis 11995	4021 - GC/MS Volatiles
Determination of Volatile Target Compounds and Gasoline Range Organics (GRO) by GCMS in Waters and Wastewaters by Method 8260B	1-P-QM-WI -9015141	Analysis DOD - 2898, 10335, 10943, 10945	4021 - GC/MS Volatiles
Determination of Volatile Target Compounds by Capillary Column Gas Chromatography/Mass Spectrometry (GC/MS) in Waters and Wastewaters by Method 6200B	1-P-QM-WI -9015099	Analysis 10460	4021 - GC/MS Volatiles
Gasoline Range Organics (GRO) in Soils using Purge and Trap Gas Chromatography by SW-846, Method 8015B or SW-846, Method 8015C, or SW-846, Method 8015D	1-P-QM-WI -9015132	Analysis DOD - 1637, 1638, 1700, 1725, 1726, 2765, 2766, 5550, 5551, 10599, 12989	4021 - GC/MS Volatiles
GC and GC/MS Instrumentation Maintenance	1-P-QM-PRO-9015467	DOD - SOP-MS-004	4021 - GC/MS Volatiles
GC/MS Volatile Standards Traceability	1-P-QM-PRO-9015469	DOD - SOP-MS-006	4021 - GC/MS Volatiles
GC/MS Volatiles Audit Process	1-P-QM-PRO-9015471	DOD - SOP-MS-012	4021 - GC/MS Volatiles
Glassware Cleaning	1-P-QM-PRO-9015465	DOD - SOP-MS-001	4021 - GC/MS Volatiles
GRO in Soils for South Carolina	1-P-QM-WI -9012790	Analysis 10654	4021 - GC/MS Volatiles
GRO in Water for South Carolina	1-P-QM-WI -9012789	Analysis 10653	4021 - GC/MS Volatiles
Level II Review of GS/MS Volatiles	1-P-QM-PRO-9017810	SOP-MS-017	4021 - GC/MS Volatiles
Low Concentration Waters for Volatile Organic Analysis	1-P-QM-WI -9015153	Analysis DOD - 4914	4021 - GC/MS Volatiles
Method AK101 for the Determination of Gasoline Range Organics in Soil Analysis for the State of Alaska	1-P-QM-WI -9013134	Analysis 1450, 1451	4021 - GC/MS Volatiles
Preparation and Analysis of Cleaning Blanks for GC and GC/MS Volatiles	1-P-QM-PRO-9015470	DOD - SOP-MS-007	4021 - GC/MS Volatiles
Preparation and Testing of Storage Blanks for GC/MS Volatile Analysis	1-P-QM-PRO-9015473	DOD - SOP-MS-015	4021 - GC/MS Volatiles
Preparation and Testing of Trip Blanks for GC/MS Volatile Analyses	1-P-QM-PRO-9015466	DOD - SOP-MS-002	4021 - GC/MS Volatiles
Preparation of Oil Samples	1-P-QM-WI -9015068	Analysis DOD - 0373	4021 - GC/MS Volatiles
Preservation and Residual Chlorine Checks of Samples for GC/MS Volatile Water Analysis	1-P-QM-PRO-9015468	DOD - SOP-MS-005	4021 - GC/MS Volatiles
Purgeable Aromatics in High-Level Soils by Method 8021B	1-P-QM-WI -9015190	Analysis DOD - 8179	4021 - GC/MS Volatiles
Purgeable Aromatics in Water Samples by Method 602	1-P-QM-WI -9014655	Analysis 8241	4021 - GC/MS Volatiles
Purgeable Aromatics in Water Samples by Method 8021B	1-P-QM-WI -9015135	Analysis DOD - 2102, 6464, 8806	4021 - GC/MS Volatiles
Statistical Calculations Used in the Analysis of Samples by EPA Methodology	1-P-QM-PRO-9015491	DOD - SOP-OR-020	4021 - GC/MS Volatiles
Targeted Library Search by GC/MS	1-P-QM-WI -9013053	Analysis 11660	4021 - GC/MS Volatiles

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Level 3 – Environmental Sciences (continued)			
The Determination of 1,2,3- Trichloropropane by Gas Chromatography/ Mass Spectrometry (GC/MS) using Isotope Dilution and Selective Ion Monitoring (SIM)	1-P-QM-WI -9012867	Analysis 11017	4021 - GC/MS Volatiles
The Determination of 1,4-Dioxane by Gas Chromatography/Mass Spectrometry (GC/MS) using Isotope Dilution and Selective Ion Monitoring (SIM)	1-P-QM-WI -9015075	Analysis DOD - 0527, 10326	4021 - GC/MS Volatiles
The Determination of Ethylene Oxide and Crotonaldehyde by Gas Chromatography/Mass Spectrometry (GC/MS) in Water and Soil by SW-846 Method 8260B	1-P-QM-WI -9014003	Analysis 6372, 6377	4021 - GC/MS Volatiles
The Determination of Vinyl Chloride and Carbon Disulfide by Gas Chromatography/Mass Spectrometry (GC/MS) using Selective Ion Monitoring (SIM)	1-P-QM-WI -9013992	Analysis 6008	4021 - GC/MS Volatiles
The Determination of Vinyl Chloride, Trichloroethene and Tetrachloroethene by Gas Chromatography /Mass Spectrometry (GC/MS) using Selective Ion Monitoring (SIM)	1-P-QM-WI -9013082	Analysis 12030	4021 - GC/MS Volatiles
The Determination of Volatile Organic Compounds in Wastewater by Isotope Dilution and Gas Chromatography/Mass Spectrometry (GC/MS)	1-P-QM-WI -9015136	Analysis 2394, 2417	4021 - GC/MS Volatiles
Toxicity Characteristic Leachate Procedure (TCLP); Determination of Volatile Target Compounds by GCMS in Zero Headspace Extractions (ZHE)	1-P-QM-WI -9015142	Analysis DOD - 3636	4021 - GC/MS Volatiles
Use of 40-mL Vials for Volatile Organic Analyses	1-P-QM-PRO-9015474	DOD - SOP-MS-016	4021 - GC/MS Volatiles
Volatile Compounds in Aqueous and Solid Samples by SW-846 8260B for OH VAP	1-P-QM-WI -9012739	Analysis 10237, 10335 OH VAP	4021 - GC/MS Volatiles
Volatile Organics Tentatively Identified Compound Method	1-P-QM-WI -9015084	Analysis DOD - 0890, 0880, 12028	4021 - GC/MS Volatiles
Volatile Organics Tentatively Identified Compound Method (Interpretive)	1-P-QM-WI -9012746	Analysis 0882, 0884, 12027	4021 - GC/MS Volatiles
Waters for Purgeable Organic Compounds by Capillary Column Gas Chromatography Mass Spectrometry	1-P-QM-WI -9015143	Analysis DOD - 3648	4021 - GC/MS Volatiles
Waters for Volatile Organic Compounds by Purge and Trap Gas Chromatography/Mass Spectrometry using EPA Method 624	1-P-QM-WI -9015097	Analysis DOD - 10371	4021 - GC/MS Volatiles
3030 C, Treatment for Acid-Extractable Metals for North Carolina Groundwater Samples	1-P-QM-WI -9013465	Analysis 2812, 10651, 11988, 11989	4022 - Metals
Bottletop Dispensers	1-P-QM-PRO-9015404	DOD - MC-IO-019	4022 - Metals
Digestion of Aqueous Samples by SW-846 3005A for ICP Analysis – OH VAP	1-P-QM-WI -9024237	Analysis 1848 OH VAP	4022 - Metals
Digestion of Aqueous Samples by SW-846 3010A for ICP Analysis – OH VAP	1-P-QM-WI -9024239	Analysis 5705 OH VAP	4022 - Metals
Digestion of Aqueous Samples by SW846 Method 3020A/3010A Modified for Analysis by ICP/MS for OH VAP	1-P-QM-WI -9022821	6050 OH VAP	4022 - Metals
Digestion of Aqueous Samples by SW-846 Method 7470A for OH VAP	1-P-QM-WI -9013986	Analysis 5713 OH VAP	4022 - Metals
Digestion of Aqueous Samples by SW-846 Method 7470A, EPA 254.1	1-P-QM-WI -9015082	Analysis DOD - 5713, 5714	4022 - Metals

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Digestion of Non-Aqueous Samples by SW-846 Method 3050B for OH VAP	1-P-QM-WI -9013983	Analysis 5708, 10637, 11026, 11027 OH VAP	4022 - Metals
Digestion of Solid Samples by SW-846 Method 7471A - OH VAP	1-P-QM-WI -9013985	Analysis 5711 OH VAP	4022 - Metals
Dilute/Run and AVS/SEM Sample Handling for Metals	1-P-QM-WI -9013476	Analysis 4792, 13449	4022 - Metals
Fixed-Volume Hand-Held Pipettes	1-P-QM-PRO-9015403	DOD - MC-IO-003	4022 - Metals
Glassware Cleaning	1-P-QM-PRO-9015463	DOD - SOP-IO-013	4022 - Metals
Langelier Index in Water	1-P-QM-WI -9012744	Analysis 0576	4022 - Metals
Low Level Mercury by EPA Method 1631 Revision E in Waters Using Cold Vapor Atomic Fluorescence Spectrometry	1-P-QM-WI -9013144	Analysis 1573, 1574	4022 - Metals
Maintenance and Calibration of HACH Model 2100N Laboratory Turbidimeter	1-P-QM-PRO-9017427	MC-IO-017	4022 - Metals
Mercury in Aqueous and Solid Samples by SW-846 Method 7470A (Aqueous) and 7471A (Solid) for OH VAP	1-P-QM-WI -9011649	Analysis 0259, 0159 OH VAP	4022 - Metals
Mercury in Aqueous, Solid and Tissue Samples by Cold Vapor AA	1-P-QM-WI -9015067	Analysis DOD - 0259, 0159	4022 - Metals
Metals by ICP for Methods SW-846 6010B/C (aqueous, solid, tissue) and EPA 200.7(aqueous)	1-P-QM-WI -9018442	Analysis 6966, 1643, 6935, 7914, 6946, 6947, 1650, 6949, 6952, 6951, 6953, 1654, 1662, 1656, 1657, 6958, 6960, 1667, 6961,10145, 6955, 6944, 6936, 6969, 7968, …	4022 - Metals
Metals by Inductively Coupled Plasma Mass Spectrometry for SW-846 Methods 6020/6020A (aqueous, solid, tissue) and EPA 200.8 (aqueous)	1-P-QM-WI -9018443	Analysis 6142, 6123, 6125, 10801, 6126, 6127, 6129, 6128, 6132, 6131, 6133, 6134, 6140, 6136, 6137, 6138, 6143, 6139, 6135, 6124, 6141, 6146, 6144, 6147, 6145, …	4022 - Metals
Metals Use of the LLENS System	1-P-QM-PRO-9015464	DOD - SOP-IO-036	4022 - Metals
Sample Prep of Sediments, Sludges, Soils, and Tissues by SW846 3050B for Analysis of Metals by ICP and ICP-MS	1-P-QM-WI -9015160	Analysis DOD - 5708, 10637	4022 - Metals
Sample Preparation of Leachates and Other Wastewater for Analysis of Total Metals by Inductively Coupled Plasma-Mass Spectrometer (ICP-MS)	1-P-QM-WI -9015165	Analysis DOD - 6050, 10639	4022 - Metals
Sample Preparation of Oils for Analysis of Metals by Inductively Coupled Plasma Spectroscopy	1-P-QM-WI -9015091	Analysis DOD - 1015	4022 - Metals
Sample Preparation of Potable Water, Groundwater, Surface Water, and Wastewater for Analysis of Total Recoverable Metals by ICP (5716)	1-P-QM-WI -9013987	Analysis 5716	4022 - Metals
Sample Preparation of Potable Water, Groundwater, Surface Water, and Wastewater for Analysis of Total Recoverable Metals by ICPMS (7050)	1-P-QM-WI -9014042	Analysis 7050	4022 - Metals

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Sample Preparation of Soil, Sediment, Sludge, Oils, and Tissues for Total Mercury Analysis by Atomic Absorption Cold Vapor Technique	1-P-QM-WI -9015161	Analysis DOD - 5711, 10638	4022 - Metals
Sample Preparation of Wastewater and Leachates for Analysis of Total Metals by Inductively Coupled Plasma Atomic Emission Spectrometry	1-P-QM-WI -9015159	Analysis DOD - 5705, 10636	4022 - Metals
Sample Preparation of Waters for Analysis of Total Recoverable Metals by Inductively Coupled Plasma Optical Emission Spectrometry	1-P-QM-WI -9015133	Analysis DOD - 1848, 10635	4022 - Metals
Trace Metals in Aqueous and Non-Aqueous Samples by Method SW-846 6010B for OH VAP	1-P-QM-WI -9022822	7066, 6966, 1743, 1643, 7035, 6935, 7046, 6946, 7047, 6947, 1750, 1650, 7049, 6949, 7052, 6952, 7051, 6951, 7053, 6953, 1754, 1654, 1762, 1662, 7058, 6958, 1767, 1667, 7061, 6961, 7055, 6955, 7044, 6944, 7036, 6936, 7022, 6925, 7071, 6971, 7072,... OH VAP	4022 - Metals
Trace Metals in Aqueous and Non-Aqueous Samples by Method SW-846 6020 for OH VAP	1-P-QM-WI -9022820	6127, 6027, 6131, 6031, 6137, 6037, 6139, 6039, 6133, 6033, 6125, 6142, 6042, 6128, 6028, 6124, 6024, 6126, 6026, 6145, 6045, 6135, 6035 OH VAP	4022 - Metals
Undigested Sample Preparation of Potable Water for Analysis of Total Recoverable Metals by Inductively Coupled Plasma Mass Spectrometry [ICP-MS]	1-P-QM-WI -9013994	Analysis 6051, 5281	4022 - Metals
Analysis of Chlorinated Herbicides by 8151A in Water	1-P-QM-WI -9015088	Analysis DOD - 0952, 10407	4024 - Pesticide Residue Analysis
Analysis of Pesticides by 8081B in Solid Samples using GC-ECD	1-P-QM-WI -9015108	Analysis DOD - 10590	4024 - Pesticide Residue Analysis
Analysis of Polychlorinated Biphenyls (PCBs) by 8082A in Aqueous Samples using GC-ECD	1-P-QM-WI -9015109	Analysis DOD - 10591, 13092	4024 - Pesticide Residue Analysis
Captan and Captafol by Method 8081A in Waters and Solids using GC-ECD	1-P-QM-WI -9013435	Analysis 2257, 2253	4024 - Pesticide Residue Analysis
Chlorinated Acids in Water Using GC-ECD by Method 515.1	1-P-QM-WI -9013405	Analysis 1864	4024 - Pesticide Residue Analysis
Chlorinated Herbicides by 8151A in Solids by GC-ECD	1-P-QM-WI -9015158	Analysis DOD - 10401	4024 - Pesticide Residue Analysis
Common Equations Used During Chromatographic Analyses	1-P-QM-PRO-9015501	DOD - SOP-PP-040	4024 - Pesticide Residue Analysis
Creating Calibration Timed Events in Chrom Perfect	1-P-QM-PRO-9018227	SOP-PP-036	4024 - Pesticide Residue Analysis
Data Audit Procedure for Department 4024	1-P-QM-PRO-9018224	SOP-PP-023	4024 - Pesticide Residue Analysis
Determination of Picric Acid in Soil Samples by HPLC with UV	1-P-QM-WI -9012797	Analysis 10709	4024 - Pesticide Residue Analysis
EDB, DBCP and TCP by Method 8011 in Solids using Microextraction and GC-ECD	1-P-QM-WI -9025366	Analysis 13214	4024 - Pesticide Residue Analysis
EDB/DBCP and TCP by Method 504.1 or 8011 in Waters using Microextraction and GC-ECD	1-P-QM-WI -9015094	Analysis DOD - 1034, 7934, 10398	4024 - Pesticide Residue Analysis
Extraction By Method 8318/8318A for Carbamate and Urea Pesticides in Solids	1-P-QM-WI -9013140	Analysis 1510, 11143	4024 - Pesticide Residue Analysis

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Extraction for Perchlorate by Method 6850 in Solids	1-P-QM-WI -9015167	Analysis DOD - 6568	4024 - Pesticide Residue Analysis
Extraction of Chlorinated Acids and Herbicides in Drinking Water by Method 515.1	1-P-QM-WI -9014002	Analysis 6369	4024 - Pesticide Residue Analysis
Extraction of Chlorinated Herbicides in a Soil Matrix	1-P-QM-WI -9013472	Analysis 4181	4024 - Pesticide Residue Analysis
Extraction of Chlorinated Herbicides in a Water Matrix by SW-846 8151A	1-P-QM-WI -9015078	Analysis DOD - 0816, 11110, 11111	4024 - Pesticide Residue Analysis
Extraction of Formaldehyde and Other Aldehydes in a Water by Method 8315A	1-P-QM-WI -9015090	Analysis DOD - 1013, 11124, 12857	4024 - Pesticide Residue Analysis
Extraction of Nitroaromatics and Nitroamines by Method 8330/A/B in Water	1-P-QM-WI -9015171	Analysis DOD - 6915, 11122, 11125, 13432	4024 - Pesticide Residue Analysis
Extraction Procedure for the Determination of Formaldehyde and Aldehydes in a Solid Matrix	1-P-QM-WI -9015162	Analysis DOD - 5876, 11139	4024 - Pesticide Residue Analysis
Formaldehyde and Other Aldehydes by Method 8315A in Aqueous and Solid Samples using HPLC	1-P-QM-WI -9013471	Analysis 8044, 8045, 12856, 13022, 13031	4024 - Pesticide Residue Analysis
Interpretation of Chromatographic Data	1-P-QM-PRO-9015494	DOD - SOP-PP-011	4024 - Pesticide Residue Analysis
Liquid/Liquid Extraction Procedure for the Determination of Organophosphorous Pesticides in a Wastewater Matrix	1-P-QM-WI -9012765	Analysis 10240	4024 - Pesticide Residue Analysis
Low Level PCBs in Water by Method 8082/8082A using GC-ECD	1-P-QM-WI -9013081	Analysis 12013, 12686	4024 - Pesticide Residue Analysis
Medium Level Sonic Probe Extraction Procedure for the Determination of Pesticides and PCBs in a Solid Matrix	1-P-QM-WI -9012745	Analysis 0819M, 11144	4024 - Pesticide Residue Analysis
Microextraction by Method 504.1 or 8011 for EDB, DBCP, and TCP in Water	1-P-QM-WI -9014309	Analysis 7786, 13715	4024 - Pesticide Residue Analysis
Microextraction of EDB, DBCP, and TCP in Solids by Method 8011	1-P-QM-WI -9025371	Analysis 13218	4024 - Pesticide Residue Analysis
Micromass Quattro Micro Tandem Mass Spectrometer with a Waters 2795 HPLC System (LC/MS/MS)	1-P-QM-PRO-9018230	SOP-PP-042	4024 - Pesticide Residue Analysis
Microwave Extraction Method 3546 for PCBs in a Solid Matrix	1-P-QM-WI -9015104	Analysis DOD - 10497, 11140, 13100	4024 - Pesticide Residue Analysis
Microwave Extraction Method 3546 for Pesticides in a Solid Matrix	1-P-QM-WI -9015103	Analysis DOD - 10496, 11141	4024 - Pesticide Residue Analysis
Microwave Extraction of Pesticides and PCBs in Non-aqueous Samples by SW-846 Method 3546 for OH VAP	1-P-QM-WI -9022433	Analysis 10496, 10497 OH VAP	4024 - Pesticide Residue Analysis
Monitoring QC Data Acceptance Limits	1-P-QM-PRO-9015496	DOD - SOP-PP-025	4024 - Pesticide Residue Analysis
Nitroaromatics and Nitroamines by Method 8330B in Water and Solids using HPLC with UV Detection	1-P-QM-WI -9029396	Analysis DOD - 13395, 13413	4024 - Pesticide Residue Analysis
Nitroaromatics and Nitroamines in Water and Solids by HPLC with UV Detection by Method 8330(A)	1-P-QM-WI -9015172	Analysis DOD - 6916, 6918, 10595, 10596, 10131, 10132	4024 - Pesticide Residue Analysis
Nitrogen and Phosphorus Containing Pesticides by EPA Method 507 in Water using GC-NPD	1-P-QM-WI -9013407	Analysis 1870	4024 - Pesticide Residue Analysis
N-Methylcarbamate Pesticides by Method 8318 / 8318A in Solids	1-P-QM-WI -9013139	Analysis 1509, 10597	4024 - Pesticide Residue Analysis
N-Methylcarbamates by Method 531.1 in Groundwater and Drinking Water using High Performance Liquid Chromatography (HPLC)	1-P-QM-WI -9013126	Analysis 1340	4024 - Pesticide Residue Analysis

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OP Pesticides (Acephate and Methamidophos) by 8141A in Aqueous and Solid Samples using GC-NPD	1-P-QM-WI -9013395	Analysis 1782, 1785	4024 - Pesticide Residue Analysis
Organic Acids in Water by Methods 8015B/D or 8321B using HPLC/UV	1-P-QM-WI -9015063	Analysis 8843, 12737, 13947	4024 - Pesticide Residue Analysis
Organophosphorous Pesticides by Method 8141A/8141B in Solid Samples using GC-NPD	1-P-QM-WI -9015157	Analysis DOD - 5367, 10408, 10594, 13178, 13184	4024 - Pesticide Residue Analysis
Organophosphorous Pesticides by Methods 8141A/8141B/622 in Aqueous Samples using GC-NPD	1-P-QM-WI -9015156	Analysis DOD - 5366, 10410, 10593, 12144, 13182, 13186	4024 - Pesticide Residue Analysis
Passive In-Situ Chemical Extraction Sampler (PISCES) Procedure for the Determination of Polychlorinated Biphenyls (PCBs)	1-P-QM-WI -9013121	Analysis 12801	4024 - Pesticide Residue Analysis
PCBs in Oil by SW-846 Method 8082	1-P-QM-WI -9011597	Analysis 0174	4024 - Pesticide Residue Analysis
Perchlorate by Method 6850 in Waters and Solids by LC/MS/MS	1-P-QM-WI -9015166	Analysis DOD - 6386, 6557	4024 - Pesticide Residue Analysis
Pesticide Extract Cleanup Using Gel Permeation Chromatography	1-P-QM-PRO-9015407	DOD - MC-OE-004	4024 - Pesticide Residue Analysis
Pesticides by Method 8081A in Solid Samples using GC-ECD	1-P-QM-WI -9015128	Analysis DOD - 1363, 1420, 4225, 10738, 13237	4024 - Pesticide Residue Analysis
Pesticides in Aqueous and Non-aqueous Samples by SW-846 Method 8081A for OH VAP	1-P-QM-WI -9022430	Analysis 0177, 1363, 10738 OH VAP	4024 - Pesticide Residue Analysis
Pesticides in Aqueous Samples by Method 608	1-P-QM-WI -9014174	Analysis 7572	4024 - Pesticide Residue Analysis
Pesticides in Water by Method 8081A using GC-ECD	1-P-QM-WI -9015066	Analysis DOD - 0177, 0950, 0180, 1954	4024 - Pesticide Residue Analysis
Pesticides in Water by Method 8081B using GC-ECD	1-P-QM-WI -9015107	Analysis DOD - 10589, 10647	4024 - Pesticide Residue Analysis
Picric Acid in Water by Method 8015B Using HPLC with UV Detection	1-P-QM-WI -9013439	Analysis 2265	4024 - Pesticide Residue Analysis
Polychlorinated Biphenyls (PCBs) by Method 608 or 8082 in Waters	1-P-QM-WI -9015164	Analysis DOD - 6030, 10227	4024 - Pesticide Residue Analysis
Polychlorinated Biphenyls (PCBs) by Method 8082 in Solids and Wipes	1-P-QM-WI -9015126	Analysis DOD - 0042, 1030, 6011, 7512, 10225, 10736, 10906, 12800, 13236	4024 - Pesticide Residue Analysis
Polychlorinated Biphenyls (PCBs) in Aqueous and Non-aqueous Samples by SW-846 Method 8082 for OH VAP	1-P-QM-WI -9022429	Analysis 10225, 10227, 10736 OH VAP	4024 - Pesticide Residue Analysis
Polychlorinated Biphenyls (PCBs) in Solid Samples by 8082A Using GC-ECD	1-P-QM-WI -9015110	Analysis DOD - 10592, 10885, 12718, 13099, 13219, 13713	4024 - Pesticide Residue Analysis
Prescreening Water and Soil Samples for Pesticides and PCBs	1-P-QM-PRO-9018229	SOP-PP-041	4024 - Pesticide Residue Analysis
Preventative and Corrective GC Maintenance	1-P-QM-PRO-9015495	DOD - SOP-PP-013	4024 - Pesticide Residue Analysis
Preventative and Corrective HPLC Maintenance for the Pesticide Residue Analysis Department	1-P-QM-PRO-9015497	DOD - SOP-PP-029	4024 - Pesticide Residue Analysis
QC Data Acceptability and Corrective Action	1-P-QM-PRO-9015493	DOD - SOP-PP-002	4024 - Pesticide Residue Analysis

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Separatory Funnel Extraction by Method 3510C, 608 or 622 for Pesticides and PCBs in a Wastewater	1-P-QM-WI -9015079	Analysis DOD - 6654, 10241, 11112, 11113, 11114, 11116, 11117, 11118, 11119, 11120, 11121, 11123, 11126, 11960, 12026, 12822, 13086, 13093, 13183, 13187	4024 - Pesticide Residue Analysis
Separatory Funnel Extraction of Pesticides and PCBs in Aqueous Samples by SW-846 Method 3510C for OH VAP	1-P-QM-WI -9022427	Analysis 11117, 11118 OH VAP	4024 - Pesticide Residue Analysis
Separatory Funnel Extraction Procedure for the Determination of Chlorinated Pesticides; Nitrogen and Phosphorus Containing Pesticides; and PCBs in a Drinking Water Matrix	1-P-QM-WI -9014001	Analysis 6368, 11127	4024 - Pesticide Residue Analysis
Setting Retention Time Windows	1-P-QM-PRO-9018226	SOP-PP-035	4024 - Pesticide Residue Analysis
Setting Up Analysis Numbers in the Departmental Database	1-P-QM-PRO-9018228	SOP-PP-037	4024 - Pesticide Residue Analysis
Setting Up Single Component Initial Calibrations	1-P-QM-PRO-9015498	DOD - SOP-PP-031	4024 - Pesticide Residue Analysis
Sonic Probe Extraction for the Determination of Pesticides in a Solid Matrix	1-P-QM-WI -9015163	Analysis DOD - 11129, 11131, 11134	4024 - Pesticide Residue Analysis
Sonic Probe Extraction of Pesticides and PCBs in Solid Samples by SW-846 Method 3550C for OH VAP	1-P-QM-WI -9022432	Analysis 0819, 11134 OH VAP	4024 - Pesticide Residue Analysis
Sonic Probe Extraction Procedure for the Determination of Polychlorinated Biphenyls (PCBs) in a Solid Matrix	1-P-QM-WI -9015081	Analysis DOD - 0819, 11128, 11132, 11135	4024 - Pesticide Residue Analysis
Sonication Extraction of Nitroaromatics and Nitroamines by Method 8330/A/B in Soilds	1-P-QM-WI -9015173	Analysis DOD - 6917, 11137, 11138, 13433	4024 - Pesticide Residue Analysis
Soxhlet Extraction (Method 3540C) for Triazine Herbicides and Organophosphorous Pesticides in a Solid Matrix	1-P-QM-WI -9015170	Analysis DOD - 6677, 11130, 11133, 11142, 13181, 13185	4024 - Pesticide Residue Analysis
Standards Preparation, Coding, and Storage	1-P-QM-PRO-9018222	SOP-PP-021	4024 - Pesticide Residue Analysis
Standards Traceability and Monitoring	1-P-QM-PRO-9018220	SOP-PP-003	4024 - Pesticide Residue Analysis
Uploading Data to the LIMS	1-P-QM-PRO-9018225	SOP-PP-027	4024 - Pesticide Residue Analysis
Using "Datalog" Software for Data Acquisition of Multicomponent Pesticides/PCBs	1-P-QM-PRO-9015499	DOD - SOP-PP-032	4024 - Pesticide Residue Analysis
Using "Datalog" Software for Single-component Data Acquisition	1-P-QM-PRO-9015500	DOD - SOP-PP-033	4024 - Pesticide Residue Analysis
Waste Dilution Procedure for the Determination of PCBs in Oil	1-P-QM-WI -9015077	Analysis DOD - 0815	4024 - Pesticide Residue Analysis
Waste Dilution Procedure for the Determination of Pesticides and PCBs in a Non-Water Soluble Leachate Matrix	1-P-QM-WI -9015080	Analysis DOD - 11114DIL	4024 - Pesticide Residue Analysis
Analysis of Chlorinated Herbicides in Water by Selective Ion Monitoring Gas Chromatography/Mass Spectroscopy (SIM/GC/MS)	1-P-QM-WI -9013416	Analysis 2026	4026 - GC/MS Semivolatiles
Determination of Benz(a)pyrene in Smokeless Tobacco by Selective Ion Monitoring Gas Chromatography/Mass Spectrometry (SIM/GC/MS)	1-P-QM-WI -9014169	Analysis 7325, 0089	4026 - GC/MS Semivolatiles

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Determination of N-Nitrosodimethylamine (NDMA) in Water and Soil by EPA 1625C	1-P-QM-WI -9012803	Analysis 10962, 11622	4026 - GC/MS Semivolatiles
Determination of Priority Pollutants by Method 625	1-P-QM-WI -9015093	Analysis DOD - 10334, 2783	4026 - GC/MS Semivolatiles
Determination of Tetraethyl Lead (TEL) and Tetramethyl Lead (TML) by GC/MS Analysis	1-P-QM-WI -9015145	Analysis DOD - 4220, 4221	4026 - GC/MS Semivolatiles
Dioxin Screening (2,3,7,8-TCDD) of Aqueous and Solid Matrices using GC-MS SIM	1-P-QM-WI -9015072	Analysis DOD - 0382, 1196	4026 - GC/MS Semivolatiles
Extraction of Semi-Volatile Organic Compounds by Method 525.2 in Drinking Waters	1-P-QM-WI -9015152	Analysis DOD - 4894	4026 - GC/MS Semivolatiles
Extraction Procedure for the Determination of 2-Chlrorbenzalmalonotrile (CS) and 3-Quinuclidinyl Benzilate (BZ) in Water and Wastewater	1-P-QM-WI -9012779	Analysis 10475	4026 - GC/MS Semivolatiles
Extraction Procedure for the Determination of PAHs in an XAD Air Tube Sample by TO-15A	1-P-QM-WI -9014491	Analysis 7806AIR	4026 - GC/MS Semivolatiles
GC/MS Audit Process	1-P-QM-PRO-9015455	DOD - SOP-EX-009	4026 - GC/MS Semivolatiles
GC/MS Electronic Data Management and Handling	1-P-QM-PRO-9015453	DOD - SOP-EX-006	4026 - GC/MS Semivolatiles
GC/MS Preventative and Corrective Maintenance	1-P-QM-PRO-9015393	DOD - MC-EX-001	4026 - GC/MS Semivolatiles
Liquid/Liquid Extraction Procedure for the Determination of Base-Neutrals and Acid Extractables in a Wastewater Matrix by Method 8270	1-P-QM-WI -9015098	Analysis DOD - 10458	4026 - GC/MS Semivolatiles
Liquid/Liquid Extraction Procedure for the Determination of Neutral Extractables in a Wastewater Matrix	1-P-QM-WI -9013043	Analysis 11629	4026 - GC/MS Semivolatiles
Liquid-Liquid Extraction Procedure for the Determination of Target Compound List Analytes in a Water Matrix	1-P-QM-WI -9015147	Analysis DOD - 4606	4026 - GC/MS Semivolatiles
Low-Level Sonic Probe Extraction Procedure by Method 3550C for the Determination of Semivolatiles in a Solid Matrix	1-P-QM-WI -9015070	Analysis DOD - 0381, 10478, 10480, 10483, 10486, 10487L	4026 - GC/MS Semivolatiles
Low-Level Sonic Probe Extraction Procedure for the Determination of Target Compound List Analytes in a Solid Matrix	1-P-QM-WI -9015148	Analysis DOD - 4607	4026 - GC/MS Semivolatiles
Low-Level Sonication Extraction Procedure for the Determination of Polynuclear Aromatic Hydrocarbons (PAHs) in a Solid Matrix by GC/MS	1-P-QM-WI -9014490	Analysis 7806	4026 - GC/MS Semivolatiles
Microwave Extraction by Method 3546 for Semivolatiles	1-P-QM-WI -9015105	Analysis DOD - 10498, 10809, 10810, 10811, 10812, 10813, 10814, 11630, 11916	4026 - GC/MS Semivolatiles
Microwave Extraction for the Determination of Semivolatiles in a Solid Matrix	1-P-QM-WI -9012780	Analysis 10481, 11598	4026 - GC/MS Semivolatiles
Microwave Extraction of Semivolatiles in Non-Aqueous Samples by SW-846 Method 3546 for OH VAP	1-P-QM-WI -9022475	Analysis 10813 OH VAP	4026 - GC/MS Semivolatiles
Monitoring QC Data Acceptance Limits	1-P-QM-PRO-9015457	DOD - SOP-EX-020	4026 - GC/MS Semivolatiles
Pesticide Extract Cleanup Using Gel Permeation Chromatography for OH VAP	1-P-QM-PRO-9023663	N/A	4026 - GC/MS Semivolatiles
Quality Control Spike Mix Verification	1-P-QM-PRO-9015454	DOD - SOP-EX-008	4026 - GC/MS Semivolatiles

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Semivolatile Compounds by Method 525.2 in Drinking Water using GC/MS	1-P-QM-WI -9015092	Analysis DOD - 10333	4026 - GC/MS Semivolatiles
Semivolatile Extract Cleanup Using Gel Permeation Chromatography	1-P-QM-PRO-9015406	DOD - MC-OE-003	4026 - GC/MS Semivolatiles
Semivolatile Extract Cleanup Using Gel Permeation Chromatography for OH VAP	1-P-QM-PRO-9023664	N/A	4026 - GC/MS Semivolatiles
Semivolatile Organic Compounds by Method 8270D in Aqueous and Non-Aqueous Matrices using GC-MS	1-P-QM-WI -9015100	Analysis DOD - 10461, 10462, 10726	4026 - GC/MS Semivolatiles
Semivolatile Organic Compounds in Aqueous and Non-Aqueous Samples by Method SW-846 8270C for OH VAP	1-P-QM-WI -9022474	Analysis 1309, 10723 OH VAP	4026 - GC/MS Semivolatiles
Semivolatile Organic Compounds, Including DRO/ORO, by Method 8270C in Aqueous and Non-Aqueous Matrices Using GC-MS	1-P-QM-WI -9015087	Analysis DOD - 0949, 1309, 1476, 1536, 1946, 1947, 1953, 2035, 2395, 4615, 4678, 4688, 6387, 6397, 7804, 7805, 10032, 10723, 10724, 10727, 10728, 13615, 13618	4026 - GC/MS Semivolatiles
Semivolatile Organics Tentatively Identified Compound Method	1-P-QM-WI -9015083	Analysis DOD - 0885, 0886, 0887, 0893, 7125, 12126	4026 - GC/MS Semivolatiles
Semivolatile Run/Injection Log Generation	1-P-QM-PRO-9015456	DOD - SOP-EX-019	4026 - GC/MS Semivolatiles
Semivolatile Spiking and Calibration Standards	1-P-QM-PRO-9015452	DOD - SOP-EX-001	4026 - GC/MS Semivolatiles
Semivolatiles by Methods 8270C/D SIM	1-P-QM-WI -9015192	Analysis DOD - 8357, 0038, 0039, 10010, 10137, 10138, 10725, 11915, 11917, 12969, 12970, 12971	4026 - GC/MS Semivolatiles
Separatory Funnel Extraction (Method 3510C) or Waste Dilution (Method 3580A) of Base Neutrals and Acid Extractables in Leachates	1-P-QM-WI -9015149	Analysis DOD - 4731	4026 - GC/MS Semivolatiles
Separatory Funnel Extraction by Method 3510C for BNAs in Wastewater	1-P-QM-WI -9015076	Analysis DOD - 0813, 11010, 11015, 10464, 10467, 10476	4026 - GC/MS Semivolatiles
Separatory Funnel Extraction by Method 3510C for Tetraethyl Lead in Waters	1-P-QM-WI -9015101	Analysis DOD - 10472	4026 - GC/MS Semivolatiles
Separatory Funnel Extraction for the Determination of PAHs in Water by GC/MS Using Method 3510C	1-P-QM-WI -9015185	Analysis DOD - 7807	4026 - GC/MS Semivolatiles
Separatory Funnel Extraction Procedure for the Determination of Base-Neutrals and Acid Extractables by SIM in a Wastewater Matrix	1-P-QM-WI -9015121	Analysis DOD - 11012, 10465, 10466, 10470, 10471, 11912	4026 - GC/MS Semivolatiles
Separatory Funnel Extraction Procedure for the Determination of Base-Neutrals and Acid Extractables in a Wastewater Matrix by Method 625	1-P-QM-WI -9015188	Analysis DOD - 8108, 10463	4026 - GC/MS Semivolatiles
Separatory Funnel Extraction Semivolatile Organic Compounds in an Aqueous Samples by SW-846 Method 3510C for OH VAP	1-P-QM-WI -9022472	Analysis 10464 OH VAP	4026 - GC/MS Semivolatiles
Solid Phase Extraction Procedure for the Determination of THPA, THPI and PA in a Water Matrix	1-P-QM-WI -9012865	Analysis 11011	4026 - GC/MS Semivolatiles
Sonic Probe Extraction Procedure for the Determination of Semivolatiles in a Complex Matrix	1-P-QM-WI -9015189	Analysis DOD - 8108TJ	4026 - GC/MS Semivolatiles

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Sonic Probe Extraction Procedure for the Determination of Semivolatiles in a Solid Matrix by SIM	1-P-QM-WI -9015102	Analysis DOD - 10479, 10484, 10489, 11914	4026 - GC/MS Semivolatiles
Sonic Probe Extraction Procedure for the Determination of Semivolatiles in Non-Aqueous Samples by SW-846 Method 3550C for OH VAP	1-P-QM-WI -9022476	Analysis 0381 10478 OH VAP	4026 - GC/MS Semivolatiles
The Determination of d-Limonene in Plastic by Gas Chromatography/Mass Spectrometry (GC/MS)	1-P-QM-WI -9012761	Analysis 10215	4026 - GC/MS Semivolatiles
The Determination of Semivolatiles by Large Volume Injection (LVI) Gas Chromatography/Mass Spectrometry (GC/MS)	1-P-QM-WI -9014025	Analysis 6570	4026 - GC/MS Semivolatiles
THPA, THPI and PA by 8270C Mod. or CEPH 440 in Waters and Solids Using GC/MS	1-P-QM-WI -9013141	Analysis 1542, 2345	4026 - GC/MS Semivolatiles
Waste Dilution Procedure for the Determination of Acid Extractables and Base-Neutrals in a Non-Water Soluble Leachate Matrix	1-P-QM-WI -9015150	Analysis DOD - 4731DIL	4026 - GC/MS Semivolatiles
Waste Dilution Procedure for the Determination of Acid Extractables and Base-Neutrals in a Non-Water Soluble Matrix	1-P-QM-WI -9015071	Analysis DOD - 0381DIL	4026 - GC/MS Semivolatiles
Accusterilizer - Steam Sterilizer	1-P-QM-PRO-9015400	DOD - MC-IC-008	4027 - Instrumental Water Quality
Automated Determination of Ammonia Nitrogen in Water and Wastewater Using Segmented Flow Analysis and Gas Diffusion by EPA 350.1	1-P-QM-PRO-9020808	Analysis 12892, 13000	4027 - Instrumental Water Quality
Automated Determination of Phenols in Water, Wastewater, and Soils By Automated Flow Analyzer EPA 420.4, EPA 420.2, SW-846, 9066	1-P-QM-WI -9011690	Analysis 0434, 2393, 5912	4027 - Instrumental Water Quality
Automated Determination of Total Kjeldahl Nitrogen in Water, Wastewater, and Solids	1-P-QM-WI -9011633	Analysis 0217, 1511, 0223, 4235, 6165	4027 - Instrumental Water Quality
Department 4027 Chemical Inventory and Review Procedures	1-P-QM-PRO-9015460	DOD - SOP-IC-016	4027 - Instrumental Water Quality
Determination of Hexavalent Chromium by Ion Chromatography in Solids and Waters SW-846 7199 and EPA 218.6	1-P-QM-WI -9013989	Analysis 5892, 6467	4027 - Instrumental Water Quality
Determination of Inorganic Anions by Ion Chromatography	1-P-QM-WI -9011637	Analysis 0224, 0228, 0332, 0368, 1504, 1505, 1506, 7322, 7332, 7333, 7334, 7335, 7336, 7337, 7338	4027 - Instrumental Water Quality
Determination of Inorganic Anions by Ion Chromatography (Department of Defense)	1-P-QM-WI -9015115	Analysis DOD - 10697, 10698, 10699, 10700, 10701, 10702, 10703	4027 - Instrumental Water Quality
Determination of Nitrocellulose in Water and Soil	1-P-QM-WI -9011683	Analysis 0370, 0371, 1105, 1106	4027 - Instrumental Water Quality
Determination of Perchlorate by Ion Chromatography	1-P-QM-WI -9013993	Analysis 6019, 10130, 10147	4027 - Instrumental Water Quality
Determination of TOC and TC in Solids and Sludges by Combustion	1-P-QM-WI -9013418	Analysis 2079, 0383, 6623, 10065, 11356, 11763	4027 - Instrumental Water Quality
Determination of Total and Amenable Cyanide in Water, Wastewater, and Soils, Free Cyanide in Water and Wastewater, Reactive Cyanide of Solids, and Weak Acid Dissociable Cyanide in Waters and Soils	1-P-QM-WI -9011646	Analysis 0237, 1123, 1549, 5895, 5898, 8255, 0241, 4814, 0961, 0957, 0959	4027 - Instrumental Water Quality

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Determination of Total and Available Cyanide in Water using Amperometric Detection by ASTM D 7511-09e2 and Method OIA-1677-09	1-P-QM-WI -9013123	Analysis 12823, 12941, 12999	4027 - Instrumental Water Quality
Determination of Total and Soluble Phosphorus in Water, Wastewater, and Soils (Colorimetric, Ascorbic Acid, Automated)	1-P-QM-WI -9011640	Analysis 0227, 0345, 1546, 5893, 5894, 13463	4027 - Instrumental Water Quality
Determination of Total Carbon in Water and Wastewater	1-P-QM-WI -9013142	Analysis 1550	4027 - Instrumental Water Quality
Determination of Total Cyanide in Water, Wastewater, and Soils (Department of Defense) SW-846 9012B, SW-846 9012A	1-P-QM-WI -9015116	Analysis DOD - 10704, 10705	4027 - Instrumental Water Quality
Determination of Total Organic Carbon in Water and Wastewater (Quadruplicate Studies)	1-P-QM-WI -9011682	Analysis 0354	4027 - Instrumental Water Quality
Determination of Total Organic Carbon, Dissolved Organic Carbon, and Inorganic Carbon in Water and Wastewater	1-P-QM-WI -9011651	Analysis 0273, 6090, 7547	4027 - Instrumental Water Quality
Digestion of Total and Soluble Phosphorus in Water, Wastewater, and Soils EPA 361.1, SM20 4500 P B, and SM20 4500 P E	1-P-QM-WI -9014675	Analysis 8261, 8262, 8263, 8264, 8895, 13464	4027 - Instrumental Water Quality
Hexavalent Chromium (Cr VI) in Aqueous and Non-aqueous Samples by Method SW-846 7199 for OH VAP	1-P-QM-WI -9022443	Analysis 5892, 6467 OH VAP	4027 - Instrumental Water Quality
ICS-1000, ICS 1100, ICS-2000 and ICS-3000 Ion Chromatography Systems	1-P-QM-PRO-9015402	DOD - MC-IC-010	4027 - Instrumental Water Quality
Low Level Hexavalent Chromium by Ion Chromatography in Solids and Waters	1-P-QM-WI -9029677	Analysis 12868	4027 - Instrumental Water Quality
Maintenance and Calibration of A.I. Scientific AIM600 Digestor	1-P-QM-PRO-9015397	DOD - MC-IC-005	4027 - Instrumental Water Quality
Maintenance of Continuous Flow Analyzers	1-P-QM-PRO-9015399	DOD - MC-IC-007	4027 - Instrumental Water Quality
Maintenance of the OI Analytical Model 1030 Total Organic Carbon Analyzer	1-P-QM-PRO-9015398	DOD - MC-IC-006	4027 - Instrumental Water Quality
Maintenance of the OI Analytical Total Organic Carbon Solids Analyzer	1-P-QM-PRO-9015461	DOD - SOP-IC-017	4027 - Instrumental Water Quality
Moisture by Sartorius Moisture Analyzer/Moisture by Mettler Toledo HB43 SM20 2540 G	1-P-QM-WI -9013422	Analysis 2111, 2118, 2121	4027 - Instrumental Water Quality
Nitrate Nitrogen in Water and Wastewater (Colorimetric, Automated Cadmium Reduction)	1-P-QM-WI -9011635	Analysis 0220, 7882, 5992	4027 - Instrumental Water Quality
Nitrite Nitrogen in Water and Wastewater (Colorimetric, Automated)	1-P-QM-WI -9011634	Analysis 0219, 5991	4027 - Instrumental Water Quality
pH Electrodes and Meters	1-P-QM-PRO-9015396	DOD - MC-IC-003	4027 - Instrumental Water Quality
Phenol Distillation (as Preparation for Analysis on the Flow Analyzer)	1-P-QM-WI -9011693	Analysis 0491, 5911, 8123	4027 - Instrumental Water Quality
Quality Control for Auto-Analyzer Analyses Performed in Instrumental Water Quality	1-P-QM-PRO-9015459	DOD - SOP-IC-004	4027 - Instrumental Water Quality
Reagent Water Extraction (as Preparation for Analysis on the Ion Chromatograph or Autoanalyzer)	1-P-QM-WI -9013127	Analysis 1352, 10129	4027 - Instrumental Water Quality
Total and Amenable Cyanide Distillation (As Preparation for Analysis on the Automatic Flow Analyzer)	1-P-QM-WI -9011694	Analysis 0492, 1548, 5896, 5897, 8256, 0956, 0958	4027 - Instrumental Water Quality
Total Cyanide Analysis of Waters and Solids by Massachusetts Contingency Plan (MCP)/NJ DKQP	1-P-QM-WI -9012873	Analysis 11151	4027 - Instrumental Water Quality
Total Cyanide Distillation (Department of Defense)	1-P-QM-WI -9015117	Analysis DOD - 10706, 10707	4027 - Instrumental Water Quality

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Total Kjeldahl Nitrogen Digestion of Solids and Soils (a preparation for Analysis #1511)	1-P-QM-WI -9013138	Analysis 1465	4027 - Instrumental Water Quality
Total Kjeldahl Nitrogen Digestion of Water and Wastewater (A Preparation for Analysis 0217)	1-P-QM-WI -9013136	Analysis 1460	4027 - Instrumental Water Quality
Weak Acid Dissociable Cyanide Distillation (as Preparation for Analysis on the Flow Analyzer)	1-P-QM-WI -9014171	Analysis 7528, 0960	4027 - Instrumental Water Quality
Calibration of the Leachate Tumblers	1-P-QM-PRO-9015416	DOD - MC-TL-002	4028 - Leachate Preparation
Cation Exchange Capacity of Soils (Sodium Acetate) by Method 9081	1-P-QM-WI -9015138	Analysis DOD - 2595	4028 - Leachate Preparation
Food and Tissue Preparation	1-P-QM-WI -9015137	Analysis DOD - 2487	4028 - Leachate Preparation
Glassware Cleaning for Leachate Extractions	1-P-QM-PRO-9015525	DOD - SOP-TL-001	4028 - Leachate Preparation
Leachate Blank Evaluations	1-P-QM-PRO-9015526	DOD - SOP-TL-002	4028 - Leachate Preparation
Manually Pressurized Zero Headspace Extractor (ZHE)	1-P-QM-PRO-9015528	DOD - SOP-TL-004	4028 - Leachate Preparation
pH Meters and Probes	1-P-QM-PRO-9015415	DOD - MC-TL-001	4028 - Leachate Preparation
Procedure for Calculating and Reporting Weighted Average Results for TCLP Extracts	1-P-QM-PRO-9015529	DOD - SOP-TL-005	4028 - Leachate Preparation
Shake Extraction of Solid Waste with Water ASTM Method #D3987-85	1-P-QM-WI -9015074	Analysis DOD - 0447	4028 - Leachate Preparation
Subsampling and Preservation of Leachates	1-P-QM-PRO-9015527	DOD - SOP-TL-003	4028 - Leachate Preparation
Synthetic Precipitation Leaching Procedure (SPLP) for Nonvolatile Leachates	1-P-QM-WI -9015130	Analysis DOD - 1567	4028 - Leachate Preparation
Synthetic Precipitation Leaching Procedure (SPLP) Zero Headspace Leachates	1-P-QM-WI -9015194	Analysis DOD - 8792, 1339	4028 - Leachate Preparation
Toxicity Characteristic Leaching Procedure TCLP Nonvolatile Leachates	1-P-QM-WI -9015086	Analysis DOD - 0947, 1339	4028 - Leachate Preparation
Toxicity Characteristic Leaching Procedure TCLP Zero Headspace Leachates, Method 1311	1-P-QM-WI -9015085	Analysis DOD - 0946, 2573, 0075	4028 - Leachate Preparation
Waste Extraction Test Leaching Procedure for Volatile and Non-volatile Analytes	1-P-QM-WI -9015129	Analysis DOD - 1435, 1436	4028 - Leachate Preparation
#1443 Specific Gravity by SM 2710 F #6569 Bulk Density by ASTM E868-82 Sec 9.9 Modified	1-P-QM-WI -9013131	Analysis 1443, 6569	4029 - Water Quality
Accumet Model AB30 pH/Ion/Conductivity Meter	1-P-QM-PRO-9015419	DOD - MC-WQ-004	4029 - Water Quality
Acid Volatile Sulfide in Solids	1-P-QM-WI -9013392	Analysis 1630	4029 - Water Quality
Adjustable Volume Handheld Pipettes	1-P-QM-PRO-9015426	DOD - MC-WQ-014	4029 - Water Quality
Ammonia Nitrogen by Ion-Selective Electrode Method (ISE) in Solids by EPA 350.3 (Modified) and SM 4500-NH3B-1997	1-P-QM-WI -9012763	Analysis 10222, 10696	4029 - Water Quality
Ammonia-Nitrogen for Soils (Tritrimetric Distillation Procedure) by 4500-NH3 B/C (Modified)-1997, or EPA 350.2 (Modified)	1-P-QM-WI -9012743	Analysis 0573	4029 - Water Quality
Ammonia-Nitrogen for Waters (Titrimetric Distillation Procedure) by 4500-NH3 B/C (Modified)-1997, or EPA 350.2	1-P-QM-WI -9011636	Analysis 0221	4029 - Water Quality

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Analysis of Conductivity, Alkalinity, pH, Temperature of pH, Fluoride, Turbidity, Total Hardness, Carbonate, Bicarbonate, and Ammonia by Either Man-Tech Multi-Parameter System or Manual Technique	1-P-QM-WI -9013112	Analysis 12145, 12146, 12147, 12148, 12149, 12150, 12151, 12152, 12677, 12678, 12679	4029 - Water Quality
Bellack Distillation for Fluoride in Waters and Solids by SM 4500 F B–1997 or EPA 340.1 Procedure 6.1	1-P-QM-WI -9013133	Analysis 1448	4029 - Water Quality
BOD by SM 5210 B-2001 or EPA 405.1 and CBOD by SM 5210 B–2001 in Waters	1-P-QM-WI -9011645	Analysis 0235, 1364	4029 - Water Quality
Calibration of Hach 2100AN Turbidimeter	1-P-QM-PRO-9015423	DOD - MC-WQ-010	4029 - Water Quality
Chemical Oxygen Demand (COD) (Dichromate Reflux Method) (Titrimetric, Mid-Level)	1-P-QM-WI -9011644	Analysis 0234	4029 - Water Quality
Chemical Oxygen Demand (COD) (Dichromatic Reflux Method) (Colorimetric)	1-P-QM-WI -9013470	Analysis 4001	4029 - Water Quality
Chemical Oxygen Demand (Low-Level) by 410.4	1-P-QM-WI -9032852	Analysis 13700	4029 - Water Quality
Chemical Review	1-P-QM-PRO-9015534	DOD - SOP-WQ-016	4029 - Water Quality
Chloride (Titrimetric Determination) by SM 4500-Cl C-1997	1-P-QM-WI -9013035	Analysis 1124	4029 - Water Quality
Chlorine Residual by 4500 Cl F-2000, or EPA 330.4	1-P-QM-WI -9011648	Analysis 0240	4029 - Water Quality
Color by 2120 B-2001, or EPA 110.2	1-P-QM-WI -9011653	Analysis 0277	4029 - Water Quality
Colorimetric Sulfide in Waters (#0230), Sulfide as H2S (#10293 Calculation), Dissolved Sulfide in Waters (#10499) by 4500-S2 B/C/D-2000, 4500-S2 F-2000, or EPA 376.2	1-P-QM-WI -9011642	Analysis 0230, 10293, 10499	4029 - Water Quality
Determination of Flash Point for Liquids and Solids	1-P-QM-WI -9011689	Analysis 0430	4029 - Water Quality
Digestion Procedure for the Determination of Hexavalent Chromium (Cr VI) Digestion of Non-aqueous Samples by Method SW-846 3060A for OH VAP	1-P-QM-WI -9022448	Analysis 7825 OH VAP	4029 - Water Quality
Dissolved Oxygen (Membrane Electrode) by 4500 O G-2001 or EPA 360.1	1-P-QM-WI -9011688	Analysis 0428	4029 - Water Quality
Dissolved Silica (Colorimetric) by SM4500SiO2 C-1997 or EPA 370.1	1-P-QM-WI -9012742	Analysis 0559	4029 - Water Quality
Equipment Incubators and Refrigerators	1-P-QM-PRO-9015420	DOD - MC-WQ-006	4029 - Water Quality
Equipment Muffle Furnaces and Ovens	1-P-QM-PRO-9015422	DOD - MC-WQ-009	4029 - Water Quality
Ferrous Iron By Method 3500-Fe B (Modified) - 1997	1-P-QM-WI -9015060	Analysis 8344	4029 - Water Quality
Fixed Dissolved Solids (Calculation)	1-P-QM-WI -9011628	Analysis 0210	4029 - Water Quality
Fixed Suspended Solids (Gravimetric) (#207) Volatile Suspended Solids (Gravimetric) (#208) by SM 2540 E - 1997	1-P-QM-WI -9011626	Analysis 0207, 0208	4029 - Water Quality
Fixed Volume Hand-Held Pipettes	1-P-QM-PRO-9015425	DOD - MC-WQ-013	4029 - Water Quality
Flash Point for Liquids and Solids by ASTM Method D93-07 - ERPIMS	1-P-QM-WI -9035589	Analysis 0430 ERPIMS	4029 - Water Quality
Hach DR 2800 Spectrophotometer	1-P-QM-PRO-9015427	DOD - MC-WQ-017	4029 - Water Quality
Hexane Extractable Material (HEM) and Silica Gel Treated Hexane Extractable Materials (SGT-HEM) in Waters by EPA Method 1664A and 1664B	1-P-QM-WI -9014492	Analysis 8079, 8078, 0612	4029 - Water Quality
Hexavalent Chromium (Colorimetric) by SW-846 7196A	1-P-QM-WI -9011652	Analysis 0276	4029 - Water Quality

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Hexavalent Chromium (Colorimetric) in Waters by CTRCP	1-P-QM-WI -9013410	Analysis 1968	4029 - Water Quality
Hexavalent Chromium (Colorimetric) in Waters by MCP	1-P-QM-WI -9012870	Analysis 11145	4029 - Water Quality
Hexavalent Chromium (Colorimetric) in Waters by SM846 7196A NJ DKQP	1-P-QM-WI -9029546	Analysis 13447	4029 - Water Quality
Hexavalent Chromium in Soilds (Alkaline Digestion and Analysis Methods) by SW846 3060A, SW846 7196A NJ DKQP	1-P-QM-WI -9029548	Analysis 13431	4029 - Water Quality
Hexavalent Chromium in Solids (Alkaline Digestion and Analysis Methods)	1-P-QM-WI -9011687	Analysis 0425, 7825, 2432	4029 - Water Quality
Hexavalent Chromium in Solids by Alkaline Digestion and Analysis Methods (Department of Defense)	1-P-QM-WI -9015114	Analysis DOD - 10679, 7825	4029 - Water Quality
Hexavalent Chromium in Solids by CTRCP (Alkaline Digestion and Analysis Methods)	1-P-QM-WI -9013409	Analysis 1962, 7825	4029 - Water Quality
Hexavalent Chromium in Solids by MCP (Alkaline Digestion and Analysis Methods)	1-P-QM-WI -9012871	Analysis 11146	4029 - Water Quality
Hexavalent Chromium in Waters (Colorimetric) (Department of Defense)	1-P-QM-WI -9015113	Analysis DOD - 10678	4029 - Water Quality
Ignitability of Solids by 40 CFR, Part 261.21	1-P-QM-WI -9012741	Analysis 0542	4029 - Water Quality
Instructions for Collecting Data on the LLENS System	1-P-QM-PRO-9015533	DOD - SOP-WQ-014	4029 - Water Quality
Low-Level Hexavalent Chromium (colorimetric) by 3500-Cr B-2009	1-P-QM-WI -9013132	Analysis 1446	4029 - Water Quality
Maintenance of Desiccators	1-P-QM-PRO-9015424	DOD - MC-WQ-012	4029 - Water Quality
Maintenance of Hot Plates	1-P-QM-PRO-9015430	DOD - MC-WQ-024	4029 - Water Quality
Methylene-Blue-Active Substances (MBAS) by 5540 C-2000 or EPA 425.1	1-P-QM-WI -9011638	Analysis 0225	4029 - Water Quality
Moisture (Gravimetric), Total Residue (#0521), Volatile Residue (#0522), Total Fixed Residue/Ash (#1029) by SM 2540 G-1997 or SM 2540 E-1997 in Solids	1-P-QM-WI -9014030	Analysis 6866, 0521, 0522, 1029	4029 - Water Quality
n-Hexane Extractable Material (HEM) in Solids and Silica Gel Treated n-Hexane Extractable Material (SGT-HEM)	1-P-QM-WI -9013456	Analysis 2562, 6598	4029 - Water Quality
Orion 960 Autotitration System	1-P-QM-PRO-9015428	DOD - MC-WQ-022	4029 - Water Quality
Orthophosphate by EPA 365.3, or 4500-P E-1999	1-P-QM-WI -9011639	Analysis 0226	4029 - Water Quality
Oxidation-Reduction Potential	1-P-QM-WI -9013403	Analysis 1821	4029 - Water Quality
Paint Filter Liquids Test (Free Liquids Test)	1-P-QM-WI -9013402	Analysis 1820	4029 - Water Quality
Particle Size Distribution of Soils and Solids/Grain Size Classification by ASTM D422-63 (reapproved 2007)	1-P-QM-WI -9014165	Analysis 7103, 11601, 11604	4029 - Water Quality
Percent Solids for GC/MS by EPA 1666	1-P-QM-WI -9013444	Analysis 2365	4029 - Water Quality
pH (SW) (Electrometric)	1-P-QM-WI -9011685	Analysis 0394, 0496	4029 - Water Quality
pH Probes and Meters	1-P-QM-PRO-9015421	DOD - MC-WQ-007	4029 - Water Quality
Quality Control Data for Wet Chemistry	1-P-QM-PRO-9015535	DOD - SOP-WQ-017	4029 - Water Quality
Reactive Sulfide	1-P-QM-WI -9013032	Analysis 1122	4029 - Water Quality
Reactivity of Waste	1-P-QM-WI -9013027	Analysis 1121	4029 - Water Quality
Settleable Solids by 2540 F-1997, or EPA 160.5	1-P-QM-WI -9011631	Analysis 0215	4029 - Water Quality

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Soluble Biochemical Oxygen Demand Determination in Waters by Incubation by 5210 B Modified-2001 or EPA 405.1	1-P-QM-WI -9012740	Analysis 0541	4029 - Water Quality
Specific Conductance (Solids) by SW-846 9050 (Modified), EPA 120.1 (Modified) or 2510B-1997	1-P-QM-WI -9013113	Analysis 1215	4029 - Water Quality
Spectronic Genesys 2 and Genesys 10 Vis Spectrophotometers	1-P-QM-PRO-9015417	DOD - MC-WQ-002	4029 - Water Quality
Standardization of 0.02 and 0.1 Normal Sulfuric Acid	1-P-QM-PRO-9015530	DOD - SOP-WQ-002	4029 - Water Quality
Standardization of 0.02 Normal Sodium Hydroxide	1-P-QM-PRO-9015531	DOD - SOP-WQ-005	4029 - Water Quality
Sulfate (turbidimetric) by EPA 375.4 in Waters	1-P-QM-WI -9013037	Analysis 1125	4029 - Water Quality
Sulfide Titration for Water by 4500 S2 F-2000, EPA 376.1, or SW-846 Method 9034	1-P-QM-WI -9013125	Analysis 1333	4029 - Water Quality
Sulfite by 4500-SO3 B-2000, or EPA 377.1	1-P-QM-WI -9011641	Analysis 0229	4029 - Water Quality
Total Dissolved Solids (Calculation)	1-P-QM-WI -9011627	Analysis 0209	4029 - Water Quality
Total Dissolved Solids by 2540 C	1-P-QM-WI -9014026	Analysis 6649	4029 - Water Quality
Total Dissolved Solids in Waters (Gravimetric) by 2540 C-1997 or EPA 160.1	1-P-QM-WI -9011630	Analysis 0212	4029 - Water Quality
Total Fixed Solids Total Volatile Solids by 2540 E-1997, 160.4 or 2540 G-1997	1-P-QM-WI -9011624	Analysis 0204, 0205	4029 - Water Quality
Total Solids by 2540 B-1997, EPA 160.3 or 2540 G-1997	1-P-QM-WI -9011623	Analysis 0203	4029 - Water Quality
Total Suspended Solids in Waters (Gravimetric) by SM 2540 D - 1997	1-P-QM-WI -9012778	Analysis 10457	4029 - Water Quality
Volatile Dissolved Solids (Calculation)	1-P-QM-WI -9011629	Analysis 0211	4029 - Water Quality
Water Quality Washroom Procedures	1-P-QM-PRO-9015532	DOD - SOP-WQ-006	4029 - Water Quality
YSI Model 5100 Dissolved Oxygen Meter	1-P-QM-PRO-9015429	DOD - MC-WQ-023	4029 - Water Quality
Analysis of Air for Selected Volatile Organic Compounds by Gas Chromatography with Flame Ionization Detector and Photo Using EPA Method 18 and 25	1-P-QM-WI -9015177	Analysis DOD - 7090	4030 - Volatiles in Air
Calibration of Pressure Gauges	1-P-QM-PRO-9015391	DOD - MC-AL-002	4030 - Volatiles in Air
Cleaning and Handling of Flow Controllers	1-P-QM-PRO-9015432	DOD - SOP-AL-002	4030 - Volatiles in Air
Cleaning and Handling of Summa Canisters	1-P-QM-PRO-9015431	DOD - SOP-AL-001	4030 - Volatiles in Air
Helium as a Tracer Gas	1-P-QM-WI -9012770	Analysis 10341	4030 - Volatiles in Air
Oxygen and Carbon Dioxide in Air	1-P-QM-WI -9011592	Analysis 0034	4030 - Volatiles in Air
Preparing Summa Can Order	1-P-QM-PRO-9017690	SOP-AL-005	4030 - Volatiles in Air
Procedure for Compositing Samples from a Tedlar Bag	1-P-QM-PRO-9017689	SOP-AL-004	4030 - Volatiles in Air
Routine Instrument Maintenance for Volatiles in Air by GC and GC/MS	1-P-QM-PRO-9015392	DOD - MC-AL-003	4030 - Volatiles in Air
SIM Analysis of Low-Level Volatile Organic Compounds in Air Collected in Specially Treated Canisters or Tedlar Bags Using Cryogenic Preconcentration and Gas Chromatography with SIM Mass Selective Detection Using EPA Method TO-15	1-P-QM-WI -9015182	Analysis DOD - 7345	4030 - Volatiles in Air
The Determination of Volatile Organic Compounds in Air Collected in Summa Canisters or Tedlar Bags Using Cryogenic Preconcentration and GC/MS Detection Using EPA Method TO-14 or TO-15	1-P-QM-WI -9015155	Analysis DOD - 5265, 5298, 0015, 0037, 7199, 7869	4030 - Volatiles in Air

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Volatiles in Air Audit Process	1-P-QM-PRO-9015433	DOD - SOP-AL-003	4030 - Volatiles in Air
Volatiles in Air Tentatively Identified Compound Method	1-P-QM-WI -9014034	Analysis 6900	4030 - Volatiles in Air
Volatiles in Air Tentatively Identified Compound Method (Interpretive)	1-P-QM-WI -9012747	Analysis 0888	4030 - Volatiles in Air
Calibration, Operation and Maintenance of pH Probes and Meters	1-P-QM-PRO-9017426	MC-FS-002	4031 - Field Sampling
Collecting Potable Water Samples	1-P-QM-PRO-9017759	SOP-FS-004	4031 - Field Sampling
Collecting Water Samples for Regulatory Purposes	1-P-QM-PRO-9015458	DOD - SOP-FS-012	4031 - Field Sampling
Direct Field Readings Using Orion Model 1230 Multi-Parameter Meter	1-P-QM-PRO-9017761	SOP-FS-008	4031 - Field Sampling
Groundwater Monitoring Sampling Procedure	1-P-QM-PRO-9017760	SOP-FS-006	4031 - Field Sampling
Low Level Mercury Sampling	1-P-QM-PRO-9017763	SOP-FS-010	4031 - Field Sampling
Performing Free Chlorine Residual Readings	1-P-QM-PRO-9017764	SOP-FS-011	4031 - Field Sampling
Sampling Swimming Pool Water	1-P-QM-PRO-9018291	SOP-TR-003	4031 - Field Sampling
Soil Sampling Procedures	1-P-QM-PRO-9017758	SOP-FS-003	4031 - Field Sampling
Symphony Multi-Parameter Meter	1-P-QM-PRO-9017762	SOP-FS-009	4031 - Field Sampling
Wastewater Field Sampling Procedures	1-P-QM-PRO-9017757	SOP-FS-002	4031 - Field Sampling
1,6-hexanediamine in by 8015B Modified in Waters and Solids	1-P-QM-WI -9028763	Analysis 8919, 8920	4032 - EPH/Misc. GC
10g Silica Gel Cleanup for Hydrocarbons by GC in Soil and Water Matrices	1-P-QM-WI -9013055	Analysis 11681	4032 - EPH/Misc. GC
3 g Silica Gel Column Cleanup for DRO	1-P-QM-WI -9021425	Analysis 12932	4032 - EPH/Misc. GC
Alumina Column Cleanup by Method 3610B for Solid Samples	1-P-QM-WI -9013040	Analysis 11599, 11600	4032 - EPH/Misc. GC
Analysis of DRO/RRO by Alaska 102/103 in Waters and Soils	1-P-QM-WI -9013394	Analysis 1738, 1741, 1742, 2238, 2244, 2245, 2923	4032 - EPH/Misc. GC
Carbon Dioxide in Water Using Headspace Sampling Techniques and GC-TCD, Method RSK-175 or 8015	1-P-QM-WI -9015187	Analysis DOD - 8097, 13139	4032 - EPH/Misc. GC
CCWE Water Miscible Solvents	1-P-QM-WI -9012748	Analysis 0969	4032 - EPH/Misc. GC
Common Equations Used During Chromatographic Analyses	1-P-QM-PRO-9015448	DOD - SOP-EP-008	4032 - EPH/Misc. GC
Determination of Diesel and Residual Range Organics using Alaska 102/103 Small Volume (SV) Protocols in Aqueous Samples	1-P-QM-WI -9021778	Analysis 13025, 13028, 13222, 13930	4032 - EPH/Misc. GC
Determination of Petroleum Range Organics in Waters and Solids using FL-PRO	1-P-QM-WI -9013420	Analysis 0347, 0359, 2099, 2100	4032 - EPH/Misc. GC
DRO by 8015B and TPH by NWTPH-DX (Modified) in Water using Mini-Extraction and GC-FID	1-P-QM-WI -9021423	Analysis 12899, 12908, 12917	4032 - EPH/Misc. GC
DRO in Waters or Solids by Wisconsin DRO Method using GC-FID	1-P-QM-WI -9014172	Analysis 7553, 7554	4032 - EPH/Misc. GC
DRO/TPH by Method 8015 (B, C, or D) in Waters using Microextraction and GC-FID	1-P-QM-WI -9020899	Analysis 12858, 12879, 13163, 13165	4032 - EPH/Misc. GC
EPH by Massachusetts Protocol (MAEPH) in Waters and Solids Using GC	1-P-QM-WI -9013971	Analysis 5331, 5332, 5944, 5949, 5968, 5969, 10892, 10897	4032 - EPH/Misc. GC
EPH in Waters and Solids Using GC-FID by Method ECY97-602 WA EPH	1-P-QM-WI -9013990	Analysis 5979, 5970	4032 - EPH/Misc. GC

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Extractable Petroleum Hydrocarbons by Method OA-2 (Iowa/Missouri Protocol) in Waters and Solids using GC/FID	1-P-QM-WI -9013421	Analysis 2110, 2112	4032 - EPH/Misc. GC
Extraction of Soils/Solids for Glycol Analysis	1-P-QM-WI -9013039	Analysis 11551, 13121	4032 - EPH/Misc. GC
Extraction of Solids/Soils for Analysis of Alcohols by Method 8015B	1-P-QM-WI -9011684	Analysis 0380	4032 - EPH/Misc. GC
Extraction Procedure for the Determination of Diesel Range Organics in a Water or Wastewater Matrix by Oklahoma Methodology	1-P-QM-WI -9013016	Analysis 11168	4032 - EPH/Misc. GC
Extraction Procedure for the Determination of Total Petroleum Hydrocarbon Organics in a Water or Wastewater Matrix by Texas Methodology	1-P-QM-WI -9013023	Analysis 11192	4032 - EPH/Misc. GC
Extraction Procedure for the Determination of Total Petroleum Hydrocarbons in a Water or Wastewater Matrix by Connecticut Methodology	1-P-QM-WI -9013020	Analysis 11178	4032 - EPH/Misc. GC
Extraction Procedure for the Determination ofTotal Petroleum Hydrocarbons in a Soil or Solid Matrix by Texas Methodology	1-P-QM-WI -9013033	Analysis 11230, 11244	4032 - EPH/Misc. GC
Extraction Procedure for Wisconsin DRO Soils and Solid Waste	1-P-QM-WI -9012868	Analysis 11029	4032 - EPH/Misc. GC
Fractionated EPH using LA RECAP Ranges in Waters and Solids by GC-FID	1-P-QM-WI -9015030	Analysis 8323, 8324, 6976, 7062	4032 - EPH/Misc. GC
GC Routine and Nonroutine Maintenance for Instrumentation Used for VPH Analysis	1-P-QM-PRO-9023979	N/A	4032 - EPH/Misc. GC
Glycols by Method 8015B/8015C in Solids using GC-FID	1-P-QM-WI -9015029	Analysis 8283, 12925, 12934	4032 - EPH/Misc. GC
Glycols in Waters by Method 8015B or 8015C Using GC-FID	1-P-QM-WI -9015028	Analysis 8278, 11099, 12926	4032 - EPH/Misc. GC
Interpretation and Integration of Chromatographic Data	1-P-QM-PRO-9015451	DOD - SOP-EP-011	4032 - EPH/Misc. GC
MA DEP VPH in Waters and Solids Using GC	1-P-QM-WI -9015061	Analysis 8754, 8765, 5869, 5988, 6629, 6630, 10886, 10889	4032 - EPH/Misc. GC
Maintenance and Troubleshooting Procedures for GC-FID Instrumentation	1-P-QM-PRO-9015447	DOD - SOP-EP-006	4032 - EPH/Misc. GC
Microextraction by Method 3511 for the Determination of Diesel Range Organics in Water	1-P-QM-WI -9013110	Analysis 12059, 12897, 13175, 13177	4032 - EPH/Misc. GC
Microwave Extraction Method 3546 for DRO and Saturated Hydrocarbons in a Solid Matrix	1-P-QM-WI -9015120	Analysis DOD - 10942, 11509, 11210	4032 - EPH/Misc. GC
Microwave Extraction Method 3546 for NJ EPH in a Solid Matrix	1-P-QM-WI -9012864	Analysis 10979, 11990	4032 - EPH/Misc. GC
Microwave Extraction Procedure for the Determination of Extractable Petroleum Hydrocarbons in a Solid Matrix by Montana Protocol	1-P-QM-WI -9013028	Analysis 11212	4032 - EPH/Misc. GC
Microwave Extraction Procedure for the Determination of Extractable Petroleum Hydrocarbons in a Solid Matrix by Washington Protocol	1-P-QM-WI -9013029	Analysis 11213	4032 - EPH/Misc. GC
Microwave Extraction, Method 3546, for MA EPH in a Solid Matrix	1-P-QM-WI -9013429	Analysis 2168, 11235	4032 - EPH/Misc. GC
Monitoring QC Data Acceptance Limits	1-P-QM-PRO-9015450	DOD - SOP-EP-010	4032 - EPH/Misc. GC
New Jersey Extractable Petroleum Hydrocarbons (NJEPH) in Waters and Solids using GC-FID	1-P-QM-WI -9012863	Analysis 10967, 10973, 11986, 12997	4032 - EPH/Misc. GC

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PMI VOCs (Direct Injection) by Method 1671A in Waters Using GC/FID	1-P-QM-WI -9013445	Analysis 2366, 2380	4032 - EPH/Misc. GC
QC Data Acceptability and Corrective Action	1-P-QM-PRO-9015449	DOD - SOP-EP-009	4032 - EPH/Misc. GC
Qualitative/Quantitative GC Fingerprint by 8015B Mod/ 8015C Mod/ or 8015D Mod	1-P-QM-WI -9013412	Analysis 2012, 2535	4032 - EPH/Misc. GC
Quick Silica Gel Cleanup for Hydrocarbons by GC in Solid and Water Matrices	1-P-QM-WI -9013430	Analysis 2176	4032 - EPH/Misc. GC
Separatory Funnel Extract Procedure for the Determination of Extractable Petroleum Hydrocarbons (EPH) in a Water or Wastewater Matrix by Tennessee Methodology	1-P-QM-WI -9013021	Analysis 11179	4032 - EPH/Misc. GC
Separatory Funnel Extraction by Method 3510C for DRO in Water by California Methodology	1-P-QM-WI -9013446	Analysis 2376, 11169, 11180, 11187, 11188, 11198, 11199, 12820, 13156	4032 - EPH/Misc. GC
Separatory Funnel Extraction for DRO and RRO by AK 102/103 in a Water Matrix	1-P-QM-WI -9013022	Analysis 11184, 11185, 11242, 13027, 13030	4032 - EPH/Misc. GC
Separatory Funnel Extraction Method 3510C for DRO in Water or Wastewater	1-P-QM-WI -9015175	Analysis DOD - 7003, 10304, 11164, 11167, 11171, 11172, 11176, 11177, 11181, 11183, 11189, 11190, 11191, 11195, 11196, 11201, 11203, 11596, 12820, 12906, 12915, 12923, 13095, 13212	4032 - EPH/Misc. GC
Separatory Funnel Extraction Method ECY 97-602 NWTPH-DX for TPH in a Water or Wastewater Matrix	1-P-QM-WI -9013424	Analysis 2135, 11197, 12007, 12119, 12120, 12907, 12916, 12924	4032 - EPH/Misc. GC
Separatory Funnel Extraction Procedure for the Determination of Diesel Range Organics in a Water or Wastewater Matrix by Maine Methodology	1-P-QM-WI -9013014	Analysis 11165	4032 - EPH/Misc. GC
Separatory Funnel Extraction Procedure for the Determination of Diesel Range Organics in a Water or Wastewater Matrix by Wisconsin Protocol	1-P-QM-WI -9013015	Analysis 11166	4032 - EPH/Misc. GC
Separatory Funnel Extraction Procedure for the Determination of Extractable Petroleum Hydrocarbons in a Water Matrix by Washington Methodology	1-P-QM-WI -9013019	Analysis 11175	4032 - EPH/Misc. GC
Separatory Funnel Extraction Procedure for the Determination of Extractable Petroleum Hydrocarbons in a Water or Wastewater Matrix by Massachusetts or New Jersey Protocol	1-P-QM-WI -9014170	Analysis 7326, 10980, 11200 MA/LA/NJ	4032 - EPH/Misc. GC
Separatory Funnel Extraction Procedure for the Determination of Extractable Petroleum Hydrocarbons in a Water or Wastewater Matrix by Montana Protocol	1-P-QM-WI -9013018	Analysis 11174, 11243	4032 - EPH/Misc. GC
Separatory Funnel Extraction Procedure for the Determination of Total Petroleum Hydrocarbon Organics in a Water or Wastewater Matrix by FL-PRO	1-P-QM-WI -9013017	Analysis 11170	4032 - EPH/Misc. GC
Silica Gel Column Cleanup (Method 3630C Mod) for Hydrocarbons by GC in Aqueous Matrices	1-P-QM-WI -9020897	Analysis 12894	4032 - EPH/Misc. GC
Silica Gel Fractionation for Hydrocarbons by GC in Soil and Water Matrices	1-P-QM-WI -9012711	Analysis 0497	4032 - EPH/Misc. GC

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Sonic Disruption Extraction Procedure for the Determination of GC Fingerprint on Petroleum Products in Soil or Solid Matrix	1-P-QM-WI -9015151	Analysis DOD - 4833, 11227	4032 - EPH/Misc. GC
Sonic Probe Extraction by FL-PRO for Petroleum Range Organics in Solids	1-P-QM-WI -9013026	Analysis 11208	4032 - EPH/Misc. GC
Sonic Probe Extraction for the Determination of Extractable Total Petroleum Hydrocarbons in Soil or Solid Matrix Connecticut Methology	1-P-QM-WI -9013030	Analysis 11216	4032 - EPH/Misc. GC
Sonic Probe Extraction for TPH in Solids by Washington DX	1-P-QM-WI -9014041	Analysis 7024, 11234, 12008, 12117, 12118	4032 - EPH/Misc. GC
Sonic Probe Extraction of Glycols by Method 3550C from a Solid Matrix	1-P-QM-WI -9032542	Analysis 12933	4032 - EPH/Misc. GC
Sonic Probe Extraction Procedure for the Determination of Extractable Petroleum Hydrocarbons in Soil or Solid Matrix Tennessee Methodology	1-P-QM-WI -9013031	Analysis 11217	4032 - EPH/Misc. GC
Sonication Extraction Method 3550C for DRO in Soils or Solids	1-P-QM-WI -9015176	Analysis DOD - 7004, 10303, 11204, 11205, 11209, 11215, 11218, 11219, 11225, 11228, 11229, 11233, 11236, 11237, 11238, 13097	4032 - EPH/Misc. GC
Sonication Extraction Procedure for the Determination of Diesel Organics in Soil or Solid Matrix by Alaska Methodology	1-P-QM-WI -9015123	Analysis DOD - 11222, 11223, 11239, 11248	4032 - EPH/Misc. GC
Sonication Extraction Procedure for the Determination of Diesel Organics in Soil or Solid Matrix Oklahoma Methodology	1-P-QM-WI -9013024	Analysis 11206	4032 - EPH/Misc. GC
Sonication Extraction Procedure for the Determination of Diesel Range Organics in Soil or Solid Matrix California Methodology	1-P-QM-WI -9013025	Analysis 11207, 11214	4032 - EPH/Misc. GC
Terphenyls by Method 8015B in Water and Solids Using GC-FID	1-P-QM-WI -9012769	Analysis 10318, 10319	4032 - EPH/Misc. GC
TNRCC TX Method 1005 - Total Petroleum Hydrocarbons (Gasoline Range, Diesel Range, and Extended Range Organics) in Waters and Solids	1-P-QM-WI -9013442	Analysis 2318, 2321	4032 - EPH/Misc. GC
Total Extractable Hydrocarbons (TEH) by Method 8015B Modified Using GC-FID	1-P-QM-WI -9013137	Analysis 1464, 1469, 10007	4032 - EPH/Misc. GC
Total Petroleum Hydrocarbons with Ranges by Methods 8015B/8015C/8015D in Waters and Solids by GC-FID	1-P-QM-WI -9015186	Analysis DOD - 8093, 8107, 2500, 2516, 2729, 2740, 0071, 0072, 6631, 6635, 10199, 10365, 12952	4032 - EPH/Misc. GC
Total Saturated Hydrocarbons by Method 8015C in Waters and Solids using GC/FID	1-P-QM-WI -9013038	Analysis 11507, 11554	4032 - EPH/Misc. GC
TPH by CT ETPH	1-P-QM-WI -9013462	Analysis 2768, 2769	4032 - EPH/Misc. GC
TPH by Methods 8015B/C/D mod. in Waters and Solids Using GC-FID	1-P-QM-WI -9015154	Analysis DOD - 5256, 5260, 8734, 8735, 13137, 13138	4032 - EPH/Misc. GC
TPH by NWTPH-Dx (modified) in Soils using GC-FID	1-P-QM-WI -9015027	Analysis 8272, 2214, 12006	4032 - EPH/Misc. GC
TPH by NWTPH-Dx (modified) in Waters using GC-FID	1-P-QM-WI -9015026	Analysis 8271, 2211, 12005	4032 - EPH/Misc. GC
TPH by TN EPH in Water and Soil using GC-FID	1-P-QM-WI -9013463	Analysis 2784, 2785	4032 - EPH/Misc. GC
TPH DRO (Diesel Range Organics) by Oklahoma DEQ Method	1-P-QM-WI -9014308	Analysis 7784, 7785, 10024, 10027	4032 - EPH/Misc. GC

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TPH-DRO by 8015B in Water using GC-FID (Diesel Range Organics)	1-P-QM-WI -9020088	1070, 2216, 5867, 6609, 6610, 6884, 6885, 6912, 6913, 8269, 8349, 11918, 12680, 12816, 11346	4032 - EPH/Misc. GC
TPH-DRO by 8015B/8015C/8015D in Solids using GC-FID (Diesel Range Organics)	1-P-QM-WI -9015191	Analysis DOD - 1104, 2222, 5868, 6901, 6902, 8270, 8345, 10941, 12831, 13567	4032 - EPH/Misc. GC
TPH-DRO by 8015C South Carolina Methodology Using GC-FID	1-P-QM-WI -9024963	Analysis 13094, 13096	4032 - EPH/Misc. GC
TPH-DRO by 8015C/8015D in Water using GC-FID (Diesel Range Organics)	1-P-QM-WI -9015111	Analysis DOD - 10600, 13256	4032 - EPH/Misc. GC
TPH-DRO by Methods 8015C or 8015D in Solids using GC-FID	1-P-QM-WI -9015112	Analysis DOD - 10601, 12838	4032 - EPH/Misc. GC
TPH-DX with Fuel Identification in Waters and Solids by NWTPH-DX	1-P-QM-WI -9023949	Analysis 12071, 12082, 12093, 12094	4032 - EPH/Misc. GC
TX 1006 Characterization of C6-C35 Petroleum Hydrocarbons in Waters and Soilds	1-P-QM-WI -9013996	Analysis 6091, 6104	4032 - EPH/Misc. GC
Using "Range Compound Analysis" Software for Range Data Acquisition	1-P-QM-PRO-9017817	SOP-OR-082	4032 - EPH/Misc. GC
Volatile Hydrocarbons in Water by Method RSK-175 Modified and SW-846 8015 Using Headspace Sampling Techniques and GC-FID	1-P-QM-WI -9015178	Analysis DOD - 7105, 10602, 13693	4032 - EPH/Misc. GC
Volatile Organic Concentration of Waste Samples by Method 25D Using FID and ELCD	1-P-QM-WI -9014040	Analysis 7001	4032 - EPH/Misc. GC
VPH in Waters and Solids Using GC-FID by Method ECY 97-602 WA VPH	1-P-QM-WI -9013982	Analysis 5665, 5666	4032 - EPH/Misc. GC
Waste Dilution for the Determination of Saturated Hydrocarbons in an Oil Matrix	1-P-QM-WI -9013051	Analysis 11657	4032 - EPH/Misc. GC
Water Miscible Solvents by Method 8015B/8015C/8015D Using GC-FID	1-P-QM-WI -9015169	Analysis DOD - 6624, 10501, 10603, 10604	4032 - EPH/Misc. GC
Analysis of Nicotine in Tobacco by GC/FID Following Coresta 62	1-P-QM-WI -9014032	Analysis 6878	4035 - Nitrosamines
Analysis of Nicotine in Tobacco by GC/FID for Smokeless Tobacco Products Using the CDC Method	1-P-QM-WI -9011595	Analysis 0097	4035 - Nitrosamines
Analysis of Tobacco Specific Nitrosamines (TSNA) in Tobacco Leaf by LC/MS/MS	1-P-QM-WI -9013802	Analysis 5102	4035 - Nitrosamines
CDC Tobacco Moisture	1-P-QM-WI -9011594	Analysis 0091	4035 - Nitrosamines
Column Cleanup of Tobacco for TSNAs	1-P-QM-WI -9014036	Analysis 6962	4035 - Nitrosamines
Extraction of Nicotine from Tobacco and Tobacco Products	1-P-QM-WI -9014031	Analysis 6870	4035 - Nitrosamines
Extraction of Nicotine from Tobacco Products Using the Centers for Disease Control Protocol	1-P-QM-WI -9011593	Analysis 0088	4035 - Nitrosamines
Extraction of Tobacco for Benzo[a]Pyrene	1-P-QM-WI -9014033	Analysis 6883	4035 - Nitrosamines
Extraction of Tobacco Specific N-Nitrosamines in Tobacco Filler	1-P-QM-WI -9013443	Analysis 2326LC	4035 - Nitrosamines
Nitrate in Tobacco Prep	1-P-QM-WI -9013457	Analysis 2610	4035 - Nitrosamines
Nitrate Nitrogen in Tobacco (Colorimetric, Automated Cadmium Reduction)	1-P-QM-WI -9013464	Analysis 2808	4035 - Nitrosamines
Nitrite in Tobacco Prep	1-P-QM-WI -9013438	Analysis 2264	4035 - Nitrosamines
Nitrite Nitrogen Analysis in Tobacco	1-P-QM-WI -9013440	Analysis 2266	4035 - Nitrosamines
Tobacco Drying and Grinding	1-P-QM-WI -9013801	Analysis 4998	4035 - Nitrosamines

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10g Silica Gel Cleanup for Hydrocarbons by GC in Soil and Water Matrices	1-P-QM-WI -9013055	Analysis 11681	4036 - Organic Extraction
3 g Silica Gel Column Cleanup for DRO	1-P-QM-WI -9021425	Analysis 12932	4036 - Organic Extraction
Alumina Column Cleanup by Method 3610B for Solid Samples	1-P-QM-WI -9013040	Analysis 11599, 11600	4036 - Organic Extraction
Cleanup Procedures for the Extraction of Pesticides and Polychlorinated Biphenyls (PCBs)	1-P-QM-PRO-9015477	DOD - SOP-OE-004	4036 - Organic Extraction
Concentration Using a TurboVap LV Concentration Workstation	1-P-QM-PRO-9015489	DOD - SOP-OE-016	4036 - Organic Extraction
Determination of Percentage Fat Using Accelerated Solvent Extraction (ASE)	1-P-QM-WI -9015144	Analysis DOD - 4193ASE	4036 - Organic Extraction
Determining QC Sample Volume for Organic Extractions	1-P-QM-PRO-9015480	DOD - SOP-OE-007	4036 - Organic Extraction
Electrothermal Heating Mantles	1-P-QM-PRO-9015410	DOD - MC-OE-009	4036 - Organic Extraction
Extraction By Method 8318/8318A for Carbamate and Urea Pesticides in Solids	1-P-QM-WI -9013140	Analysis 1510, 11143	4036 - Organic Extraction
Extraction for Perchlorate by Method 6850 in Solids	1-P-QM-WI -9015167	Analysis DOD - 6568	4036 - Organic Extraction
Extraction of Chlorinated Acids and Herbicides in Drinking Water by Method 515.1	1-P-QM-WI -9014002	Analysis 6369	4036 - Organic Extraction
Extraction of Chlorinated Herbicides in a Soil Matrix	1-P-QM-WI -9013472	Analysis 4181	4036 - Organic Extraction
Extraction of Chlorinated Herbicides in a Water Matrix by SW-846 8151A	1-P-QM-WI -9015078	Analysis DOD - 0816, 11110, 11111	4036 - Organic Extraction
Extraction of Formaldehyde and Other Aldehydes in a Water by Method 8315A	1-P-QM-WI -9015090	Analysis DOD - 1013, 11124, 12857	4036 - Organic Extraction
Extraction of Nitroaromatics and Nitroamines by Method 8330/A/B in Water	1-P-QM-WI -9015171	Analysis DOD - 6915, 11122, 11125, 13432	4036 - Organic Extraction
Extraction of Semi-Volatile Organic Compounds by Method 525.2 in Drinking Waters	1-P-QM-WI -9015152	Analysis DOD - 4894	4036 - Organic Extraction
Extraction Procedure for the Determination of 2-Chlrorbenzalmalonotrile (CS) and 3-Quinuclidinyl Benzilate (BZ) in Water and Wastewater	1-P-QM-WI -9012779	Analysis 10475	4036 - Organic Extraction
Extraction Procedure for the Determination of Diesel Range Organics in a Water or Wastewater Matrix by Oklahoma Methodology	1-P-QM-WI -9013016	Analysis 11168	4036 - Organic Extraction
Extraction Procedure for the Determination of Formaldehyde and Aldehydes in a Solid Matrix	1-P-QM-WI -9015162	Analysis DOD - 5876, 11139	4036 - Organic Extraction
Extraction Procedure for the Determination of PAHs in an XAD Air Tube Sample by TO-15A	1-P-QM-WI -9014491	Analysis 7806AIR	4036 - Organic Extraction
Extraction Procedure for the Determination of Total Petroleum Hydrocarbon Organics in a Water or Wastewater Matrix by Texas Methodology	1-P-QM-WI -9013023	Analysis 11192	4036 - Organic Extraction
Extraction Procedure for the Determination of Total Petroleum Hydrocarbons in a Water or Wastewater Matrix by Connecticut Methodology	1-P-QM-WI -9013020	Analysis 11178	4036 - Organic Extraction
Extraction Procedure for the Determination ofTotal Petroleum Hydrocarbons in a Soil or Solid Matrix by Texas Methodology	1-P-QM-WI -9013033	Analysis 11230, 11244	4036 - Organic Extraction
Extraction Procedure for Wisconsin DRO Soils and Solid Waste	1-P-QM-WI -9012868	Analysis 11029	4036 - Organic Extraction
Glassware Cleaning for Organic Extractions	1-P-QM-PRO-9015475	DOD - SOP-OE-001	4036 - Organic Extraction
Glassware Cleaning using Automatic Washers for non-Organic Extraction Glassware	1-P-QM-PRO-9015487	DOD - SOP-OE-014	4036 - Organic Extraction

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Liquid/Liquid Extraction Procedure for the Determination of Base-Neutrals and Acid Extractables in a Wastewater Matrix by Method 8270	1-P-QM-WI -9015098	Analysis DOD - 10458	4036 - Organic Extraction
Liquid/Liquid Extraction Procedure for the Determination of Neutral Extractables in a Wastewater Matrix	1-P-QM-WI -9013043	Analysis 11629	4036 - Organic Extraction
Liquid/Liquid Extraction Procedure for the Determination of Organophosphorous Pesticides in a Wastewater Matrix	1-P-QM-WI -9012765	Analysis 10240	4036 - Organic Extraction
Liquid-Liquid Extraction Procedure for the Determination of Target Compound List Analytes in a Water Matrix	1-P-QM-WI -9015147	Analysis DOD - 4606	4036 - Organic Extraction
Low-Level Sonic Probe Extraction Procedure by Method 3550C for the Determination of Semivolatiles in a Solid Matrix	1-P-QM-WI -9015070	Analysis DOD - 0381, 10478, 10480, 10483, 10486, 10487L	4036 - Organic Extraction
Low-Level Sonic Probe Extraction Procedure for the Determination of Target Compound List Analytes in a Solid Matrix	1-P-QM-WI -9015148	Analysis DOD - 4607	4036 - Organic Extraction
Low-Level Sonication Extraction Procedure for the Determination of Polynuclear Aromatic Hydrocarbons (PAHs) in a Solid Matrix by GC/MS	1-P-QM-WI -9014490	Analysis 7806	4036 - Organic Extraction
Maintenance and Calibration of the Microwave Accelerated Reaction System	1-P-QM-PRO-9017428	MC-OE-013	4036 - Organic Extraction
Maintenance of Accelerated Solvent Extractor (ASE) and the Pressurized Solvent Extractor (PSE)	1-P-QM-PRO-9015486	DOD - SOP-OE-013	4036 - Organic Extraction
Medium Level Sonic Probe Extraction Procedure for the Determination of Pesticides and PCBs in a Solid Matrix	1-P-QM-WI -9012745	Analysis 0819M, 11144	4036 - Organic Extraction
Microextraction by Method 3511 for the Determination of Diesel Range Organics in Water	1-P-QM-WI -9013110	Analysis 12059, 12897, 13175, 13177	4036 - Organic Extraction
Microextraction by Method 504.1 or 8011 for EDB, DBCP, and TCP in Water	1-P-QM-WI -9014309	Analysis 7786, 13715	4036 - Organic Extraction
Microextraction of EDB, DBCP, and TCP in Solids by Method 8011	1-P-QM-WI -9025371	Analysis 13218	4036 - Organic Extraction
Microwave Extraction by Method 3546 for Semivolatiles	1-P-QM-WI -9015105	Analysis DOD - 10498, 10809, 10810, 10811, 10812, 10813, 10814, 11630, 11916	4036 - Organic Extraction
Microwave Extraction for the Determination of Semivolatiles in a Solid Matrix	1-P-QM-WI -9012780	Analysis 10481, 11598	4036 - Organic Extraction
Microwave Extraction Method 3546 for DRO and Saturated Hydrocarbons in a Solid Matrix	1-P-QM-WI -9015120	Analysis DOD - 10942, 11509, 11210	4036 - Organic Extraction
Microwave Extraction Method 3546 for NJ EPH in a Solid Matrix	1-P-QM-WI -9012864	Analysis 10979, 11990	4036 - Organic Extraction
Microwave Extraction Method 3546 for PCBs in a Solid Matrix	1-P-QM-WI -9015104	Analysis DOD - 10497, 11140, 13100	4036 - Organic Extraction
Microwave Extraction Method 3546 for Pesticides in a Solid Matrix	1-P-QM-WI -9015103	Analysis DOD - 10496, 11141	4036 - Organic Extraction
Microwave Extraction of Pesticides and PCBs in Non-aqueous Samples by SW-846 Method 3546 for OH VAP	1-P-QM-WI -9022433	Analysis 10496, 10497 OH VAP	4036 - Organic Extraction
Microwave Extraction of Semivolatiles in Non-Aqueous Samples by SW-846 Method 3546 for OH VAP	1-P-QM-WI -9022475	Analysis 10813 OH VAP	4036 - Organic Extraction

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Microwave Extraction Procedure for the Determination of Extractable Petroleum Hydrocarbons in a Solid Matrix by Montana Protocol	1-P-QM-WI -9013028	Analysis 11212	4036 - Organic Extraction
Microwave Extraction Procedure for the Determination of Extractable Petroleum Hydrocarbons in a Solid Matrix by Washington Protocol	1-P-QM-WI -9013029	Analysis 11213	4036 - Organic Extraction
Microwave Extraction, Method 3546, for MA EPH in a Solid Matrix	1-P-QM-WI -9013429	Analysis 2168, 11235	4036 - Organic Extraction
Multipette Stream Operation and Calibration	1-P-QM-PRO-9029413	N/A	4036 - Organic Extraction
N-Evap	1-P-QM-PRO-9015411	DOD - MC-OE-010	4036 - Organic Extraction
Organic Extraction Standards Storage and Handling	1-P-QM-PRO-9015490	DOD - SOP-OE-017	4036 - Organic Extraction
Passive In-Situ Chemical Extraction Sampler (PISCES) Procedure for the Determination of Polychlorinated Biphenyls (PCBs)	1-P-QM-WI -9013121	Analysis 12801	4036 - Organic Extraction
Pesticide Extract Cleanup Using Gel Permeation Chromatography	1-P-QM-PRO-9015407	DOD - MC-OE-004	4036 - Organic Extraction
Pesticide Extract Cleanup Using Gel Permeation Chromatography for OH VAP	1-P-QM-PRO-9023663	N/A	4036 - Organic Extraction
Pesticide Extract Concentration Using a Zymark TurboVap II Concentration Workstation	1-P-QM-PRO-9015485	DOD - SOP-OE-012	4036 - Organic Extraction
Pesticides and Polychlorinated Biphenyls (PCBs) Cleanup Procedures for OH VAP	1-P-QM-PRO-9024148	N/A	4036 - Organic Extraction
pH Meters and Electrodes	1-P-QM-PRO-9015478	DOD - SOP-OE-005	4036 - Organic Extraction
Pore Water Generation Procedure	1-P-QM-WI -9015106	Analysis DOD - 10500	4036 - Organic Extraction
Procedure for Containment and Clean Up of Hazardous Materials Spills in Organic Prep Lab	1-P-QM-PRO-9015479	DOD - SOP-OE-006	4036 - Organic Extraction
Quick Silica Gel Cleanup for Hydrocarbons by GC in Solid and Water Matrices	1-P-QM-WI -9013430	Analysis 2176	4036 - Organic Extraction
Refrigerated Recirculators	1-P-QM-PRO-9015409	DOD - MC-OE-008	4036 - Organic Extraction
Routine Maintenance of Miele Glass Washers	1-P-QM-PRO-9015484	DOD - SOP-OE-011	4036 - Organic Extraction
Sampling Equipment Cleaning and Validation for Metals Analysis	1-P-QM-WI -9015089	Analysis DOD - 10068	4036 - Organic Extraction
Scheduling Extraction Batches	1-P-QM-PRO-9015481	DOD - SOP-OE-008	4036 - Organic Extraction
Semivolatile Extract Cleanup Using Gel Permeation Chromatography	1-P-QM-PRO-9015406	DOD - MC-OE-003	4036 - Organic Extraction
Semivolatile Extract Cleanup Using Gel Permeation Chromatography for OH VAP	1-P-QM-PRO-9023664	N/A	4036 - Organic Extraction
Semivolatile Extract Concentration Using a Zymark TurboVap II Concentration Workstation	1-P-QM-PRO-9015488	DOD - SOP-OE-015	4036 - Organic Extraction
Separatory Funnel Extract Procedure for the Determination of Extractable Petroleum Hydrocarbons (EPH) in a Water or Wastewater Matrix by Tennessee Methodology	1-P-QM-WI -9013021	Analysis 11179	4036 - Organic Extraction
Separatory Funnel Extraction (Method 3510C) or Waste Dilution (Method 3580A) of Base Neutrals and Acid Extractables in Leachates	1-P-QM-WI -9015149	Analysis DOD - 4731	4036 - Organic Extraction
Separatory Funnel Extraction by Method 3510C for BNAs in Wastewater	1-P-QM-WI -9015076	Analysis DOD - 0813, 11010, 11015, 10464, 10467, 10476	4036 - Organic Extraction
Separatory Funnel Extraction by Method 3510C for DRO in Water by California Methodology	1-P-QM-WI -9013446	Analysis 2376, 11169, 11180, 11187, 11188, 11198, 11199, 12820, 13156	4036 - Organic Extraction

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Separatory Funnel Extraction by Method 3510C for Tetraethyl Lead in Waters	1-P-QM-WI -9015101	Analysis DOD - 10472	4036 - Organic Extraction
Separatory Funnel Extraction by Method 3510C, 608 or 622 for Pesticides and PCBs in a Wastewater	1-P-QM-WI -9015079	Analysis DOD - 6654, 10241, 11112, 11113, 11114, 11116, 11117, 11118, 11119, 11120, 11121, 11123, 11126, 11960, 12026, 12822, 13086, 13093, 13183, 13187	4036 - Organic Extraction
Separatory Funnel Extraction for DRO and RRO by AK 102/103 in a Water Matrix	1-P-QM-WI -9013022	Analysis 11184, 11185, 11242, 13027, 13030	4036 - Organic Extraction
Separatory Funnel Extraction for the Determination of PAHs in Water by GC/MS Using Method 3510C	1-P-QM-WI -9015185	Analysis DOD - 7807	4036 - Organic Extraction
Separatory Funnel Extraction Method 3510C for DRO in Water or Wastewater	1-P-QM-WI -9015175	Analysis DOD - 7003, 10304, 11164, 11167, 11171, 11172, 11176, 11177, 11181, 11183, 11189, 11190, 11191, 11195, 11196, 11201, 11203, 11596, 12820, 12906, 12915, 12923, 13095, 13212	4036 - Organic Extraction
Separatory Funnel Extraction Method ECY 97-602 NWTPH-DX for TPH in a Water or Wastewater Matrix	1-P-QM-WI -9013424	Analysis 2135, 11197, 12007, 12119, 12120, 12907, 12916, 12924	4036 - Organic Extraction
Separatory Funnel Extraction of Pesticides and PCBs in Aqueous Samples by SW-846 Method 3510C for OH VAP	1-P-QM-WI -9022427	Analysis 11117, 11118 OH VAP	4036 - Organic Extraction
Separatory Funnel Extraction Procedure for the Determination of Base-Neutrals and Acid Extractables by SIM in a Wastewater Matrix	1-P-QM-WI -9015121	Analysis DOD - 11012, 10465, 10466, 10470, 10471, 11912	4036 - Organic Extraction
Separatory Funnel Extraction Procedure for the Determination of Base-Neutrals and Acid Extractables in a Wastewater Matrix by Method 625	1-P-QM-WI -9015188	Analysis DOD - 8108, 10463	4036 - Organic Extraction
Separatory Funnel Extraction Procedure for the Determination of Chlorinated Pesticides; Nitrogen and Phosphorus Containing Pesticides; and PCBs in a Drinking Water Matrix	1-P-QM-WI -9014001	Analysis 6368, 11127	4036 - Organic Extraction
Separatory Funnel Extraction Procedure for the Determination of Diesel Range Organics in a Water or Wastewater Matrix by Maine Methodology	1-P-QM-WI -9013014	Analysis 11165	4036 - Organic Extraction
Separatory Funnel Extraction Procedure for the Determination of Diesel Range Organics in a Water or Wastewater Matrix by Wisconsin Protocol	1-P-QM-WI -9013015	Analysis 11166	4036 - Organic Extraction
Separatory Funnel Extraction Procedure for the Determination of Extractable Petroleum Hydrocarbons in a Water Matrix by Washington Methodology	1-P-QM-WI -9013019	Analysis 11175	4036 - Organic Extraction
Separatory Funnel Extraction Procedure for the Determination of Extractable Petroleum Hydrocarbons in a Water or Wastewater Matrix by Massachusetts or New Jersey Protocol	1-P-QM-WI -9014170	Analysis 7326, 10980, 11200 MA/LA/NJ	4036 - Organic Extraction

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Separatory Funnel Extraction Procedure for the Determination of Extractable Petroleum Hydrocarbons in a Water or Wastewater Matrix by Montana Protocol	1-P-QM-WI -9013018	Analysis 11174, 11243	4036 - Organic Extraction
Separatory Funnel Extraction Procedure for the Determination of Total Petroleum Hydrocarbon Organics in a Water or Wastewater Matrix by FL-PRO	1-P-QM-WI -9013017	Analysis 11170	4036 - Organic Extraction
Separatory Funnel Extraction Semivolatile Organic Compounds in an Aqueous Samples by SW-846 Method 3510C for OH VAP	1-P-QM-WI -9022472	Analysis 10464 OH VAP	4036 - Organic Extraction
Silica Gel Column Cleanup (Method 3630C Mod) for Hydrocarbons by GC in Aqueous Matrices	1-P-QM-WI -9020897	Analysis 12894	4036 - Organic Extraction
Silica Gel Fractionation for Hydrocarbons by GC in Soil and Water Matrices	1-P-QM-WI -9012711	Analysis 0497	4036 - Organic Extraction
Solid Phase Extraction Procedure for the Determination of THPA, THPI and PA in a Water Matrix	1-P-QM-WI -9012865	Analysis 11011	4036 - Organic Extraction
Solvent and Reagent Lot Testing for Organic Extractions	1-P-QM-PRO-9015476	DOD - SOP-OE-002	4036 - Organic Extraction
Sonic Disruption Extraction Procedure for the Determination of GC Fingerprint on Petroleum Products in Soil or Solid Matrix	1-P-QM-WI -9015151	Analysis DOD - 4833, 11227	4036 - Organic Extraction
Sonic Probe Extraction by FL-PRO for Petroleum Range Organics in Solids	1-P-QM-WI -9013026	Analysis 11208	4036 - Organic Extraction
Sonic Probe Extraction for the Determination of Extractable Total Petroleum Hydrocarbons in Soil or Solid Matrix Connecticut Methology	1-P-QM-WI -9013030	Analysis 11216	4036 - Organic Extraction
Sonic Probe Extraction for the Determination of Pesticides in a Solid Matrix	1-P-QM-WI -9015163	Analysis DOD - 11129, 11131, 11134	4036 - Organic Extraction
Sonic Probe Extraction for TPH in Solids by Washington DX	1-P-QM-WI -9014041	Analysis 7024, 11234, 12008, 12117, 12118	4036 - Organic Extraction
Sonic Probe Extraction of Glycols by Method 3550C from a Solid Matrix	1-P-QM-WI -9032542	Analysis 12933	4036 - Organic Extraction
Sonic Probe Extraction of Pesticides and PCBs in Solid Samples by SW-846 Method 3550C for OH VAP	1-P-QM-WI -9022432	Analysis 0819, 11134 OH VAP	4036 - Organic Extraction
Sonic Probe Extraction Procedure for the Determination of Extractable Petroleum Hydrocarbons in Soil or Solid Matrix Tennessee Methodology	1-P-QM-WI -9013031	Analysis 11217	4036 - Organic Extraction
Sonic Probe Extraction Procedure for the Determination of Polychlorinated Biphenyls (PCBs) in a Solid Matrix	1-P-QM-WI -9015081	Analysis DOD - 0819, 11128, 11132, 11135	4036 - Organic Extraction
Sonic Probe Extraction Procedure for the Determination of Semivolatiles in a Complex Matrix	1-P-QM-WI -9015189	Analysis DOD - 8108TJ	4036 - Organic Extraction
Sonic Probe Extraction Procedure for the Determination of Semivolatiles in a Solid Matrix by SIM	1-P-QM-WI -9015102	Analysis DOD - 10479, 10484, 10489, 11914	4036 - Organic Extraction
Sonic Probe Extraction Procedure for the Determination of Semivolatiles in Non-Aqueous Samples by SW-846 Method 3550C for OH VAP	1-P-QM-WI -9022476	Analysis 0381 10478 OH VAP	4036 - Organic Extraction

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Sonication Extraction Method 3550C for DRO in Soils or Solids	1-P-QM-WI -9015176	Analysis DOD - 7004, 10303, 11204, 11205, 11209, 11215, 11218, 11219, 11225, 11228, 11229, 11233, 11236, 11237, 11238, 13097	4036 - Organic Extraction
Sonication Extraction of Nitroaromatics and Nitroamines by Method 8330/A/B in Soilds	1-P-QM-WI -9015173	Analysis DOD - 6917, 11137, 11138, 13433	4036 - Organic Extraction
Sonication Extraction Procedure for the Determination of Diesel Organics in Soil or Solid Matrix by Alaska Methodology	1-P-QM-WI -9015123	Analysis DOD - 11222, 11223, 11239, 11248	4036 - Organic Extraction
Sonication Extraction Procedure for the Determination of Diesel Organics in Soil or Solid Matrix Oklahoma Methodology	1-P-QM-WI -9013024	Analysis 11206	4036 - Organic Extraction
Sonication Extraction Procedure for the Determination of Diesel Range Organics in Soil or Solid Matrix California Methodology	1-P-QM-WI -9013025	Analysis 11207, 11214	4036 - Organic Extraction
Soxhlet Extraction (Method 3540C) for Triazine Herbicides and Organophosphorous Pesticides in a Solid Matrix	1-P-QM-WI -9015170	Analysis DOD - 6677, 11130, 11133, 11142, 13181, 13185	4036 - Organic Extraction
Soxhlet Extraction Procedure for Extractable Matter in Textiles	1-P-QM-WI -9015134	Analysis DOD - 1948, 1949, 1950, 1951, 1952	4036 - Organic Extraction
Spike Solution Testing and Approval	1-P-QM-PRO-9015482	DOD - SOP-OE-009	4036 - Organic Extraction
Steam Bath and N-Evap Usage, Calibration and Maintenance	1-P-QM-PRO-9015408	DOD - MC-OE-007	4036 - Organic Extraction
Ultrasonic Probe Horn Cleaning	1-P-QM-PRO-9015483	DOD - SOP-OE-010	4036 - Organic Extraction
Ultrasonic Processor Maintenance and Tuning	1-P-QM-PRO-9015405	DOD - MC-OE-002	4036 - Organic Extraction
Waste Dilution for the Determination of Saturated Hydrocarbons in an Oil Matrix	1-P-QM-WI -9013051	Analysis 11657	4036 - Organic Extraction
Waste Dilution Procedure for the Determination of Acid Extractables and Base-Neutrals in a Non-Water Soluble Leachate Matrix	1-P-QM-WI -9015150	Analysis DOD - 4731DIL	4036 - Organic Extraction
Waste Dilution Procedure for the Determination of Acid Extractables and Base-Neutrals in a Non-Water Soluble Matrix	1-P-QM-WI -9015071	Analysis DOD - 0381DIL	4036 - Organic Extraction
Waste Dilution Procedure for the Determination of PCBs in Oil	1-P-QM-WI -9015077	Analysis DOD - 0815	4036 - Organic Extraction
Waste Dilution Procedure for the Determination of Pesticides and PCBs in a Non-Water Soluble Leachate Matrix	1-P-QM-WI -9015080	Analysis DOD - 11114DIL	4036 - Organic Extraction
Analysis of Fluorotelomer Alcohols in Water, Wastewater, Soil and Sludges	1-P-QM-WI -9035224	Analysis 13969, 13977	4037 - Specialty Services Group
Determination of Dioxin-like Polychlorinated Biophenyls by HRGC/HRMS in Aqueous and Solid Matrices	1-P-QM-WI -9013071	Analysis 11773, 12416, 12942	4037 - Specialty Services Group
Determination of Diuron, Fenuron and Monuron in Soil Samples by LC/MS/MS	1-P-QM-WI -9013054	Analysis 11663	4037 - Specialty Services Group
Determination of Diuron, Fenuron and Monuron in Water Samples by SPE Extraction and LC/MS/MS	1-P-QM-WI -9013044	Analysis 11639	4037 - Specialty Services Group
Determination of Endothall in Soil Samples by LCMSMS	1-P-QM-WI -9015125	Analysis DOD - 11688	4037 - Specialty Services Group
Determination of Glycols in Waters by Direct Injection LC/MS/MS Method	1-P-QM-WI -9013111	Analysis 12060	4037 - Specialty Services Group
Determination of Hydrazine in Mainstream Smoke via Liquid Chromatography/Tandem Mass Spectrometry	1-P-QM-WI -9020139	NA	4037 - Specialty Services Group

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Determination of Hydrazine, Monomethylhydrazine and 1,1-Dimethylhydrazinein Soil Samples by LC/MS/MS	1-P-QM-WI -9015096	Analysis DOD - 10346	4037 - Specialty Services Group
Determination of Hydrazine, Monomethylhydrazine and 1.1-Dimethylhydrazine in Aqueous Samples by LC/MS/MS Using SW-846 8315A Modified	1-P-QM-WI -9015095	Analysis DOD - 10342	4037 - Specialty Services Group
Determination of Multiple Client Specific APIs in Surface Water by LCMSMS	1-P-QM-WI -9023568	N/A	4037 - Specialty Services Group
Determination of PCB Homologs in Waters and Solids by Method 680	1-P-QM-WI -9034081	Analysis 13716, 13729	4037 - Specialty Services Group
Determination of Percentage Lipids in Animal and Marine Tissue	1-P-QM-WI -9032128	Analysis 13448	4037 - Specialty Services Group
Determination of Perchlorate in Milk and Milk Powder by LCMSMS	1-P-QM-WI -9013074	Analysis 11962, 11964	4037 - Specialty Services Group
Determination of Perfluorinated Compounds (PFCs) in Solids by Method 537 Modified Using LC/MS/MS	1-P-QM-WI -9035864	Analysis 14027	4037 - Specialty Services Group
Determination of Perfluorooctanoic Acid (PFOA) in Aqueous Samples by LC/MS/MS	1-P-QM-WI -9012866	Analysis 11016	4037 - Specialty Services Group
Determination of Selected Perfluorinated Alkyl Acids (PFAAs) in Aqueous Samples by LC/MS/MS by Method 537	1-P-QM-WI -9012802	Analysis 10954	4037 - Specialty Services Group
Determination of Tetra- Through Octa-Chlorinated Dioxins and Furans using HRGC/HRMS by EPA 1613B or SW-846 8290A	1-P-QM-WI -9015119	Analysis DOD - 10915, 11031, 11645, 11650, 12935, 12936, 12937, 13232, 13233	4037 - Specialty Services Group
DFS HRGC/HRMS Preventative and Corrective Maintenance	1-P-QM-PRO-9015412	DOD - MC-SP-001	4037 - Specialty Services Group
Extraction of Vegetation utilizing the QuEChERS (Quick, Easy, Cheap, Effective, Rugged, Safe) Technique for Pesticides	1-P-QM-WI -9013073	Analysis 11911	4037 - Specialty Services Group
Extraction of Water and Soil Samples by Method 680	1-P-QM-WI -9034059	Analysis 13730, 13731	4037 - Specialty Services Group
Extraction of Waters for Fluorotelomer Alcohols	1-P-QM-WI -9035209	Analysis 13976, 13978	4037 - Specialty Services Group
Glassware Cleaning for HRMS Extractions	1-P-QM-PRO-9025452	N/A	4037 - Specialty Services Group
Maintenance and Tuning for Thermo Scientific TSQ Quantum Access Tandem Mass Spectrometer with a Thermo Electron Accela HPLC System (LC/MS/MS)	1-P-QM-PRO-9018268	SOP-SP-001	4037 - Specialty Services Group
ORGANOTINS by KRONE et al. (1989) via GC/MS and Selected Ion Monitoring (SIM)	1-P-QM-WI -9028808	N/A	4037 - Specialty Services Group
PCB Congeners by Method 1668 HRGC/HRMS in Aqueous and Solid Matricies	1-P-QM-WI -9013114	Analysis 12154, 12429	4037 - Specialty Services Group
Processing High Resolution Mass Spectrometry Data Using TargetQuan	1-P-QM-PRO-9018269	SOP-SP-004	4037 - Specialty Services Group
Sample Extract Column Cleanup Procedure for HRMS Analysis	1-P-QM-PRO-9015510	DOD - SOP-SP-003	4037 - Specialty Services Group
Separatory Funnel Sample Extraction Procedure for HRMS Analysis in a Water Matrix	1-P-QM-WI -9015118	Analysis DOD - 10914	4037 - Specialty Services Group
Soxhlet Sample Extraction Procedure for HRMS Analysis in a Solid Matrix	1-P-QM-WI -9015122	Analysis DOD - 11030	4037 - Specialty Services Group
Standards Management in the High Resolution Mass Spectrometry Laboratory	1-P-QM-PRO-9018270	SOP-SP-005	4037 - Specialty Services Group

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The Determination of Pesticides by Gas Chromatography/Tandem Mass Spectrometry (GC/MS/MS)	1-P-QM-WI -9013072	Analysis 11788	4037 - Specialty Services Group
Thermo Scientific Trace Ultra Gas Chromatograph Quantum XLS Tandem Mass Spectrometer (GC/MS/MS) Preventative and Corrective Maintenance	1-P-QM-PRO-9017429	MC-SP-002	4037 - Specialty Services Group
Archiving Department 4025 Raw Sample Data and Other Miscellaneous Data	1-P-QM-PRO-9015445	DOD - SOP-DP-022	4038 - Data Deliverables
Assembly and Review of Environmental Data Packages	1-P-QM-PRO-9017748	SOP-DP-037	4038 - Data Deliverables
Generation and Content Review of GLP Compliant Data Packages	1-P-QM-PRO-9017747	SOP-DP-034	4038 - Data Deliverables
Overchecking the Electronic Data Deliverable	1-P-QM-PRO-9015442	DOD - SOP-DP-009	4038 - Data Deliverables
Preparation of Data Packages on CD ROM	1-P-QM-PRO-9015444	DOD - SOP-DP-014	4038 - Data Deliverables
Processing and Sending Data Packages	1-P-QM-PRO-9015441	DOD - SOP-DP-007	4038 - Data Deliverables
Auditing Client Paperwork	1-P-QM-PRO-9015436	DOD - SOP-CL-007	4039 – Environmental Client Services
Client Concern and ISPD Code Entry	1-P-QM-PRO-9015439	DOD - SOP-CL-015	4039 – Environmental Client Services
Client/Prospects Visits	1-P-QM-PRO-9017799	SOP-MK-104	4039 – Environmental Client Services
Creating Bottle Orders	1-P-QM-PRO-9017701	SOP-CL-016	4039 – Environmental Client Services
Creating Project Information Lists	1-P-QM-PRO-9017702	SOP-CL-017	4039 – Environmental Client Services
Daily or Weekly DEP Reporting	1-P-QM-PRO-9017699	SOP-CL-012	4039 – Environmental Client Services
Monthly DEP Reporting	1-P-QM-PRO-9017700	SOP-CL-013	4039 – Environmental Client Services
Phone Log and Email Documentation	1-P-QM-PRO-9015435	DOD - SOP-CL-006	4039 – Environmental Client Services
Preparing Quotations	1-P-QM-PRO-9017698	SOP-CL-008	4039 – Environmental Client Services
Proposal Preparation	1-P-QM-PRO-9017800	SOP-MK-105	4039 – Environmental Client Services
Sample Set-Up Form Creation Guide	1-P-QM-PRO-9015438	DOD - SOP-CL-014	4039 – Environmental Client Services
Scheduling and Pricing of Rush Samples	1-P-QM-PRO-9015437	DOD - SOP-CL-010	4039 – Environmental Client Services
Tracking and Communicating Rush Results	1-P-QM-PRO-9015434	DOD - SOP-CL-005	4039 – Environmental Client Services
ELLE QA Reports to Management	1-P-QM-PRO-9020717	N/A	4052 - Environmental Quality Assurance
Environmental Quality Assurance Functions for GLP Compliance	1-P-QM-PRO-9018256	SOP-QC-032	4052 - Environmental Quality Assurance
Environmental Quality Assurance Review of Client Project and Bid Documents	1-P-QM-PRO-9022599	N/A	4052 - Environmental Quality Assurance
ETM System Probe Calibration	1-P-QM-PRO-9015418	DOD - MC-WQ-003	4052 - Environmental Quality Assurance
Hosting of Environmental Client and Agency Audits	1-P-QM-PRO-9022134	N/A	4052 - Environmental Quality Assurance
Maintenance of Environmental Certifications and Accreditations	1-P-QM-PRO-9018261	SOP-QC-039	4052 - Environmental Quality Assurance
Performing Electronic Data Audits using Mint Miner Software	1-P-QM-PRO-9018259	SOP-QC-036	4052 - Environmental Quality Assurance

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Performing Environmental Quality Assurance Audits	1-P-QM-PRO-9020535	N/A	4052 - Environmental Quality Assurance
Proficiency Test and Double Blind Samples	1-P-QM-PRO-9018237	SOP-QC-003	4052 - Environmental Quality Assurance
QA Approval of Environmental Analytical Procedures and Standard Operating Procedures	1-P-QM-PRO-9022099	N/A	4052 - Environmental Quality Assurance
QA Processing for Bottle Lot and Preservative Checks	1-P-QM-PRO-9035857	N/A	4052 - Environmental Quality Assurance
Quality Assurance Review of End-of-Month QC Reports	1-P-QM-PRO-9018253	SOP-QC-028	4052 - Environmental Quality Assurance
Sample Pick-Up, Transportation, and Delivery	1-P-QM-PRO-9018293	SOP-TR-018	6041 - Transportation
Transportation Summary SOP	1-P-QM-PRO-9028514	N/A	6041 - Transportation
What to Do in Case of Vehicular Accident or Breakdown	1-P-QM-PRO-9018292	SOP-TR-010	6041 - Transportation
Assigning Sample Delivery Group Numbers and Five-Digit Sample Codes to Sample Groups	1-P-QM-PRO-9015506	DOD - SOP-SA-119	6042 - Environmental Sample Administration
Entry of Environmental Samples Requiring Subcontracting	1-P-QM-PRO-9015507	DOD - SOP-SA-129	6042 - Environmental Sample Administration
Environmental Sample Entry	1-P-QM-PRO-9015502	DOD - SOP-SA-101	6042 - Environmental Sample Administration
Environmental Sample Receipt and Unpacking	1-P-QM-PRO-9015504	DOD - SOP-SA-103	6042 - Environmental Sample Administration
Filing of Sample Information	1-P-QM-PRO-9015505	DOD - SOP-SA-107	6042 - Environmental Sample Administration
Sample Receipt at Sample Receipt Desk	1-P-QM-PRO-9015503	DOD - SOP-SA-102	6042 - Environmental Sample Administration
Taking the Temperature of Environmental Samples Upon Arrival at the Lab	1-P-QM-PRO-9015508	DOD - SOP-SA-138	6042 - Environmental Sample Administration
ASRS Emergency Failure Procedure	1-P-QM-PRO-9015523	DOD - SOP-SS-024	6055 - Sample Support
Automated Storage and Retrieval System (ASRS) Lockout/Tagout Procedure	1-P-QM-PRO-9015518	DOD - SOP-SS-019	6055 - Sample Support
Automated Storage, Retrieval, and Discarding of Samples	1-P-QM-PRO-9015512	DOD - SOP-SS-006	6055 - Sample Support
Bulk Solid Sample Preparation by SW-846 5035A for OH VAP	1-P-QM-WI -9012777	Analysis 11967 OH VAP	6055 - Sample Support
GC/MS - Bulk Solid Matrix Sample Preparation	1-P-QM-WI -9015069	Analysis DOD - 0374, 6646, 10445, 11966, 11967	6055 - Sample Support
Glassware Cleaning	1-P-QM-PRO-9018271	SOP-SS-026	6055 - Sample Support
Hardware Procedures for ASRS	1-P-QM-PRO-9015515	DOD - SOP-SS-015	6055 - Sample Support
Homogenization, Sample Splitting, and Subsampling of Solid Waste Samples from Environmental Sources	1-P-QM-PRO-9015513	DOD - SOP-SS-009	6055 - Sample Support
Instructions for Collecting Data on the LLENS System	1-P-QM-PRO-9015520	DOD - SOP-SS-021	6055 - Sample Support
Liquid Sample Preservation	1-P-QM-PRO-9015511	DOD - SOP-SS-002	6055 - Sample Support
Maintenance of Desiccators	1-P-QM-PRO-9015414	DOD - MC-SS-002	6055 - Sample Support
Moisture (Gravimetric)	1-P-QM-WI -9015065	Analysis DOD - 0111, 6111, 7611, 11624, 12845	6055 - Sample Support
Non-Automated Storage, Retrieval, and Discarding of Samples	1-P-QM-PRO-9015521	DOD - SOP-SS-022	6055 - Sample Support
Outlier Quality Control Data	1-P-QM-PRO-9015519	DOD - SOP-SS-020	6055 - Sample Support
Percent Solids by SM 2540G-1997	1-P-QM-WI -9015183	Analysis DOD - 7400	6055 - Sample Support

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Pipette Dispenser Calibration Procedure	1-P-QM-PRO-9015517	DOD - SOP-SS-018	6055 - Sample Support
Preparation of Soil and Solid Samples for GC Volatile Analyses	1-P-QM-WI -9015124	Analysis DOD - 1150, 6170, 11968, 11969	6055 - Sample Support
Preparation of Soils for Volatile Analysis by EPA SW-846 Method 5035	1-P-QM-WI -9015193	Analysis DOD - 8389, 8390, 6130, 6117, 6174, 7578, 7320	6055 - Sample Support
Preparation of Solid Samples by SW-846 Method 5035A (Field Preserved and EnCores) for OH VAP	1-P-QM-WI -9022845	Analysis 2392, 6171, 6176, 7320, 7578, 7579, 8389, 8390 OH VAP	6055 - Sample Support
Preparation of Vials for Field Preservation of Soils for Volatile Analysis	1-P-QM-WI -9015073	Analysis DOD - 0388, 6119, 6169, 6647, 0405, 1169, 6171, 6172, 6173, 6645, 2392, 6176, 7579, 0069, 11014, 11764	6055 - Sample Support
Prescreening Water and Soil Samples for Volatile Organic Compounds	1-P-QM-PRO-9015522	DOD - SOP-SS-023	6055 - Sample Support
Preservation and Bottles Room Preservative Traceability	1-P-QM-PRO-9015516	DOD - SOP-SS-017	6055 - Sample Support
Sample Preparation of Solid Samples for Extraction and Analysis by SW-846 8330B	1-P-QM-PRO-9030806	N/A	6055 - Sample Support
Sample Support Ovens	1-P-QM-PRO-9015413	DOD - MC-SS-001	6055 - Sample Support
Subsampling for Subcontracted Analyses	1-P-QM-PRO-9015514	DOD - SOP-SS-010	6055 - Sample Support
Tobacco Moisture	1-P-QM-WI -9015168	Analysis DOD - 6611	6055 - Sample Support
Water Content (Moisture) by ASTM D 2216	1-P-QM-WI -9014166	Analysis 7116, 7119	6055 - Sample Support
Bottle Preparation	1-P-QM-PRO-9018263	SOP-SB-003	6059 - Sample Bottles
Packing Bottle Orders	1-P-QM-PRO-9018264	SOP-SB-008	6059 - Sample Bottles
Preparation of Acid Dilutions	1-P-QM-PRO-9018267	SOP-SB-017	6059 - Sample Bottles
Preparation of Trip Blanks	1-P-QM-PRO-9018265	SOP-SB-012	6059 - Sample Bottles
Processing Bottle Orders	1-P-QM-PRO-9018266	SOP-SB-016	6059 - Sample Bottles

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Prepared by	Christiane Sweigart
Reviewed and Approved by	Duane Luckenbill;Review;Sunday, December 13, 2015 10:36:34 PM EST Dorothy Love;Approval;Thursday, December 17, 2015 3:56:52 PM EST

Instrument	# of Units	Manufacturer/Model #
Liquid Chromatography/Gas Chromatography/Mass Spectrometry (LC/GC/MS)		
LC/MS/MS	1	AB Sciex 4000 with Agilent 1100 Series LC
LC/MS/MS	1	Agilent 1200 LC with Agilent 6410 MS/MS
LC/MS/MS	1	Agilent 1290 LC with Micromass Quattro micro MS/MS and Waters 2996 Photodiode Array UV-Vis Detector
LC/MS/MS	1	Thermo Scientific TSQ Quantum Access with Acella LC
LC/MS/MS	2	Waters 2795 LC with Micromass Quattro micro MS/MS
GC/MS	2	Agilent 5972
GC/MS	20	Agilent 5973
GC/MS	10	Agilent 5975
GC/MS	3	Agilent 5977A
GC/MS	2	Shimadzu
GC/MS	1	Thermo Scientific ISQ
GC/MS	1	DSQ II MS with Trace GC Ultra GC
GC/MS/MS	1	Thermo TSQ 8000 MSMS with Trace 1310 GC
GC/MS/MS	1	Thermo TSQ Quantum XLS MSMS with Trace GC Ultra GC
HRGC/HRMS	4	Thermo Scientific DFS
Gas Chromatograph	13	Agilent 5890
Gas Chromatograph	40	Agilent 6890
Gas Chromatograph	2	Shimadzu
Gas Chromatograph	26	Agilent 7890
Gas Chromatograph	1	Varian 3400
Auxiliary Equipment for Gas Chromatographs		
Most of the GC/MS and GC systems include autosamplers and approximately half are fitted with purge and trap concentrators for analysis of volatiles.		
Purge/Trap Concentrators	30	OI 4560/4660
Autosamplers	13	Archon 5100/5100A
Autosamplers	20	Agilent 7673
Autosamplers	21	Agilent 7683
Autosamplers	28	Agilent 7693
Autosamplers	6	OI 4551/4552
Autosamplers	5	EST Centruion
Autosamplers	7	Thermo Scientific AS TriPlus
Autosamplers	3	CTC Combipal Headspace
Automated Sampling System (Tedlar Bags)	1	Tekmar 2016/2032/LSC2000
Automated Sampling System (Summa Canisters)	3	Entech 7016CR Autosamplers
Automated Sampling System (Tedlar Bags/Summa Canisters)	1	Entech 7032A
Automated Sampling System (Tedlar Bags/Summa Canisters)	1	Markes CIA-A HL Satellite Autosampler
Automated Concentrator	3	Entech 7100
Automated Concentrator	1	Markes Unity 2/CIA-A HL
Automated Summa Canister Cleaning System	1	Wasson/TO-Clean
Detectors available for GC: Electron Capture, Flame Ionization, Photoionization, Hall Electrolytic Conductivity, Nitrogen/Phosphorus, and Thermal Conductivity. All of the chromatographs are connected to electronic integration systems.		

High Performance Liquid Chromatography		
High Performance Liquid Chromatograph	2	Agilent 1100 LC
High Performance Liquid Chromatograph	2	Agilent 1200 HPLC
High Performance Liquid Chromatograph	1	Waters alliance 2695
High Performance Liquid Chromatograph	1	Waters alliance 2795
Gel Permeation Chromatography		
Gel Permeation Chromatograph	3	J2Scientific AccuPrep
Ion Chromatography		
Ion Chromatograph	1	Metrohm 881 IC Pro
Ion Chromatograph	1	Dionex ICS1000
Ion Chromatograph	1	Dionex ICS3000
Ion Chromatograph	1	Dionex ICS2000
Ion Chromatograph	4	Dionex ICS1100
Atomic Absorption/Emission Spectrophotometry		
ICAP^{TM} 6000 Duo ICP Analyzer	4	Thermo
ICP/MS	1	P/E Sciex Elan 9000
ICP/MS	1	Agilent 7500ce
ICP/MS	1	Agilent 7700x
Mercury Analyzer	2	Leeman Labs Hydra II
Mercury Analyzer	1	Leeman Labs HYDRA AF$_{GOLD+}$
Prep Station	3	Thomas Cain DEENA 60
UV Vis/IR Spectrophotometry:		
UV-Vis Spectrophotometer	3	Spectronic Genesys
UV-Vis Spectrophotomenter	1	Hach DR2800
Miscellaneous Chemistry Instrumentation		
Auto-titrator System	2	Mantech
Block Digestion Systems	8	Environmental Express SC150
Block Digestion Systems	6	Environmental Express SC154
Centrifuge	5	Various
Chilled water recirculators		Various
Closed Cup Flashpoint Apparatus, Pensky-Martin	1	Fisher Scientific TA6
Cyanide Midi Distillation Kits	3	Various
Dissolved Oxygen Meter	1	YSI Model 59
Flow Solution Autoanalyzer	2	Alpkem
Glassware washer - automated	6	Miele – (2) PG8257 (1) G7827 (1) G7704 (2) G7883
Kjehldal Distillation Apparatus	2	Fisher
Microwave Extractors	3	CEM MarsXpress
pH meters	13	Various
Phenol Midi Distillation	2	Andrews Glass
Pressurized Solvent Extractor	2	Dionex ASE200
Puck Mill	1	ESSA/2000
Sonicators	12	Various
Total Organic Carbon Analyzer	2	O.I. Corp. 1030
Total Organic Carbon Combustion Analyzer	1	O.I. Corp. 1010
Turbidimeter	1	Hach 2100AN
Zero Headspace Extractor	74	Various Models

Microbiology Equipment		
Autoclave	2	Steris – Amsco,
Balance	5	Mettler, PB 3002
Balance	1	Mettler-Toledo, AT200
Balance	2	Mettler-Toledo, PR2002
Balance	1	Sartorius BP4100
Biological Safety Cabinet	4	NuAire NU-425-600 Type A/B 3
Biological Safety Cabinet	1	NuAire NU-435-600 Type B2 Fume Hood
Colony Counter	1	Quebec Dark Field
Incubator	1	PGC 9311-1127
Incubator	1	PS WFY20SAWI
Microscope	1	Stereoscope with Zoom, AO Model 570
Microscope	1	Zeiss
pH Meter	2	Orion Model 410A
Quanti-Tray Sealer	1	IDEXX Model 2X
Water Bath	1	Boekel Grant with Removal Heater Circulator
Water Bath	1	Thermo Electron Corp.
Water Bath	1	Precision Coliform Incubator Bath
Water Bath	1	VWR 1275PC
Water Bath	2	Thermo Scientific Model 2862
UV Light	1	Spectronics

Computer Equipment

Our laboratories make extensive use of computers for business applications, technical operations (e.g., our sample management system), and QA Program (see section on Quality Assurance). The following is a list of the major components of our computer systems.

Numerous physical and virtual servers used to support the systems

Oracle systems run on IBM UNIX servers:

- One IBM Power 740 Server running AIX UNIX with 6 - 3.3 GHz Power7 Cores CPUs, 128GB RAM.
- One IBM P5-520 Server running AIX UNIX with 4-way 1.90GHz CPUs, 24GB RAM.
- 40+ Terra Bytes of disk storage and several SAN devices including V7000, DS4100, HP2000 and Clarion CX4-40.
- Various tape backup systems
- On-line fail over databases are available for all corporate production Oracle databases.

Networks/Telecommunication:

- TCP/IP based network
- Ten Gigabit switch to accommodate company server farm
- Dual Cisco 6506E network cores

Personal Computers/Servers:

- Internet access is provided with an ASA firewall to control incoming and outgoing traffic
- ArcServe backup server
- Microsoft Exchange server
- Dell PowerEdge file and print servers
- More than 30 Network File Servers
- More than 1000 Personal Computers

Power Systems:

- 3 Phase Power Supply
- Backup generators for life safety and sample integrity preservation

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Prepared by	Kathryn Brungard
Reviewed and Approved by	Duane Luckenbill;Review;Tuesday, July 29, 2014 11:01:38 AM EDT Robert Strocko;Review;Wednesday, July 30, 2014 1:13:46 PM EDT Dorothy Love;Approval;Wednesday, July 30, 2014 2:16:10 PM EDT

Preventive Maintenance Schedule

Instrument	Preventive Maintenance	Frequency
GC/MS GC/MS/MS	Change septum	AN* : Min. weekly
	Clean/replace injection port seal & liner	AN
	Check/clean fans	Monthly or AN
	Check/clean cool flow	Monthly or AN
	Clean source and replace parts	Bimonthly or AN
	Change oil in diffusion pump	Annually or AN
	Change oil and service rough pump	Annually
	Change column	AN
GC and GC/MS Purge and Trap Concentrators	Check gas flows and pressures	Prior to calib. or AN
	Replace adsorbent trap in concentrators	AN
	Flush purge pathways	Monthly or AN
	Clean/replace water management	AN
GC	Septum change	AN: Min. weekly
	Column/injection port maintenance	AN
	Clean detector	AN
	Leak check ECDs	Semiannually
	Change/clean PID lamp	AN
	Change/clean/Replace FID parts	AN
	Change column	AN
GC/HRMS	System bakeout	AN
	Replacing the Secondary Electron Multiplier (SEM)	AN
	Adjusting potentials on ion source	AN
	Check sensitivity and resolution on ion source	Daily
	Cleaning ion source	AN
	Replace filament on ion source	AN
	Cleaning reference inlet	AN
	Check oil level on forepumps	monthly
	Change oil on forepumps	Yearly or if oil is cloudy or discolored
	Exchange lubricant reservoir on turbopumps	Yearly or after 5000 hours of operation
	Replace injection port liner	AN
	Clip injection port end of column	AN
	Replace septum	AN
	Clean chiller water/air filters and inspect fluid level	Monthly
	Change column	AN
LC/MS/MS	Change rough pump (vacuum) oil	Annually
	Clean cones and spray chamber	As needed, before each calibration
	Clean source and ion lenses	Annually
	Check electrospray capillary	AN
	Empty waste liquid reservoir	AN
	Tune and calibrate MS	AN

Instrument	Preventive Maintenance	Frequency
HPLC	Pump lubrication	Annually
	Check pump seals	Annually
	Check-valves cleaned or rebuilt	AN
	Replace and/or adjust detector bulb	AN
	Clean detector flow cell	AN
	Replace Teflon lines	AN
	Autosampler septa replacement	AN
	In-line filter sonication/cleaning	AN
	System passivation	AN
	PCRS pump lubrication	AN
	Empty waste liquid reservoir	AN
Cold Vapor AA and Cold Vapor AF	Replace pump tubing	AN
	Lubricate pump head & autosampler	AN
	Clean optical cells and windows	AN
ICP	Replace pump winding	AN
	Lubricate autosampler	AN
	Vacuum instrument airfilters and air intakes	AN
	Clean optics and lenses	AN
	Clean Torch and injector tip	AN
	Clean nebulizer and spray chamber	AN
ICP/MS	Change interface rough pump oil	AN
	Change MS rough pump oil	AN
	Clean cones and ion lenses	AN
	Clean Torch, injector tip, nebulizer and spray chamber	AN
	Change peristaltic tubing	AN
	Vacuum instrument airfilters and air intakes	AN
	Empty waste liquid reservoir	AN
Total Organic Carbon Analyzer	Check for leaks	AN
	Inspect rotary valve	AN
	Clean gas permeation tube	AN
	Check halide scrubber	AN
	Check dessicant tube	AN
	Dust back and clean circuit boards	AN
Autoanalyzer spectrophotometer	Clean sample probe	AN
	Clean proportioning pump	AN
	Inspect pump tubing, replace if worn	AN
	Clean wash receptacles	AN

*AN = as needed. These actions may be performed more frequently as required by the instrument's operational response.

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Prepared by	Barbara F. Reedy
Reviewed and Approved by	Duane Luckenbill;Review;Sunday, December 13, 2015 10:30:21 PM EST Dorothy Love;Approval;Thursday, December 17, 2015 3:57:57 PM EST

Details on method/instrument calibration processes are provided in the individual Analytical Procedures. This appendix provides an overview for representative methodology.
Note: This appendix is not applicable to OH VAP work. See the OH VAP approved SOPs for calibration information.

Calibration Summary for SW-846 Methods

	Initial Calibration			Continuing Calibration Verification		
Instrument	Frequency	# Std Conc	Acceptance Criteria	Frequency	# Std Conc	Acceptance Criteria
GC/MS Volatiles* (8260B)	After C-cal fails	6	RF for SPCCs >0.300 for chlorobenzene and 1,1,2,2-tetrachloroethane, and >0.100 for 1,1-dichloroethene, bromoform and chloromethane %RSD CCCs <30%	Every 12 hours	1	RF for SPCCs >0.300 for chlorobenzene and 1,1,2,2-tetrachloro-ethane, and >0.100 for 1,1-dichloroethene, bromoform and chloromethane %Drift for CCCs <20
GC/MS Volatiles* (8260C)	After C-cal fails	7	RF must meet minimum RF listed in SOP %RSD of <20% for all analytes (10% may fail)	Every 12 hours	1	RF must meet minimum RF listed in SOP %Drift for CCCs <20, 20% can fail if not detected in proceeding samples
GC/MS Semivolatiles (8270C)*	After C-cal fails	6	RF for SPCCs >0.050 Max %RSD for CCCs <30%	Every 12 hours	1	RF for SPCCs 0.050 %Drift for CCCs <20
GC/MS Semivolatiles (8270D)*	After C-cal fails	6	% RSD ≤ 20% for each compound, (no more than 10% of the compounds can exceed 20% RSD); alternate fit must be used for any analyte with RSD >20% (use linear fit if correlation coefficient is 0.990 or greater; if correlation coefficient is < 0.990 then quadratic fit can be used, but the coefficient of determination must be 0.990 or greater). If linear fit is used, it must pass a linear regression check (the low standard must be within 30% of its true concentration)	Every 12 hours	1	%Drift ± 20%; (no more than 20% of the compounds can exceed 20% drift, and all compounds that exceed 20% drift must be ≤ 50% drift)
GC/MS Semi-volatiles SIM	After C-cal Fails	6	% RSD for all compounds ≤20%	Every 12 hours	1	%Drift ± 20%

Calibration Summary for SW-846 Methods

	Initial Calibration			Continuing Calibration Verification		
Instrument	Frequency	# Std Conc	Acceptance Criteria	Frequency	# Std Conc	Acceptance Criteria
GC VOA	After C-cal fails	At least 5	% RSD ≤20% for individual compounds. Alternatively, if the average of the %RSDs of all compounds in the calibration standard is ≤20% then the average RF can be used for all compounds.	Every 10 samples	1	%Drift ± 15% for individual compounds or average % drift for all compounds in the standard ± 15%
GC Pesticides (8081A)	After C-cal fails	5	20% RSD of RFs of initial calibration to use avg. RF, otherwise use curve fit. Degradation for DDT, endrin 15% Alternatively, if the average of the %RSDs of all compounds in the calibration standard is ≤20%, then the AVG RF can be used for all compounds.	Every 20 samples or 12 hours	1	≤15% drift from initial response for quantitation C-cal - A CCV is also compliant if the average % difference is ≤15% for all compounds in the CCV standard. DDT/Endrin breakdown check 15% every 12 hours or 20 injections
GC Pesticides (8081B)	After C-cal fails	5	20% RSD of RFs of initial calibration to use avg. RF, otherwise use curve fit. Degradation for DDT, endrin 15%	Every 20 samples or 12 hours ,	1	≤20% drift from initial response for quantitation DDT/Endrin breakdown check 15% every 12 hours or 20 injections
GC PCBs (8082)	After C-cal fails	5	20% RSD of RFs of initial calibration to use avg. RF, otherwise use curve fit. Alternatively, if the average of the %RSDs of all compounds in the calibration standard is ≤20%, then the AVG RF can be used for all compounds.	Every 20 samples or 12 hours	1	≤15% drift from initial response for quantitation C-cal - A CCV is also compliant if the average % difference is ≤15% for all compounds in the CCV standard.
GC PCBs (8082A)	After C-cal fails	5	20% RSD of RFs of initial calibration to use avg. RF, otherwise use curve fit.	Every 20 samples or 12 hours	1	≤20% drift from initial response for quantitation
GC Herbicides (8151A)	After C-cal fails	5	20% RSD of RFs of initial calibration to use avg. RF, otherwise use curve fit. Alternatively, if the average of the %RSDs of all compounds in the calibration standard is ≤20%, then the AVG RF can be used for all compounds.	Every 10 samples	1	≤15% drift from initial response for quantitation C-cal - A CCV is also compliant if the average % difference is ≤15% for all compounds in the CCV standard.

Calibration Summary for SW-846 Methods

	Initial Calibration			Continuing Calibration Verification		
Instrument	Frequency	# Std Conc	Acceptance Criteria	Frequency	# Std Conc	Acceptance Criteria
Explosives by HPLC (8330)	Each new run or after C-cal fails	5	20% RSD of RFs of initial calibration to use average RF, otherwise use curve fit Alternatively, if the average of the %RSDs of all compounds in the calibration standard is ≤20%, then the AVG RF can be used for all compounds.	Every 10 samples	1	≤15% drift from initial response for quantitation C-cal - A CCV is also compliant if the average % difference is ≤15% for all compounds in the CCV standard.
Explosives by HPLC (8330A/B)	Each new run or after C-cal fails	5	20% RSD of RFs of initial calibration to use average RF, otherwise use curve fit	Every 10 samples	1	≤20% drift from initial response for quantitation
Congeners by HRGC/HRMS	After C-cal fails	6	If %RSD for native compounds <20% and for labeled compounds <35%, otherwise a calibration curve is used	Every 12 hours	1	<15% valley peak resolution for 2378-TCDD All native and labeled compounds meet method defined recovery limits RTs within ±15 secs of RT in ICAL
Dioxins by HRGC/HRMS	After C-cal fails	6	If %RSD for native compounds <20% and for labeled compounds <35%, otherwise a calibration curve is used	Every 12 hours	1	<25% valley peak resolution for 2378-TCDD All native and labeled compounds meet method defined recovery limits RTs within ±15 secs of RT in ICAL
GC TPH-GRO	After C-cal fails	At least 5	% RSD of <20% to use the average CF, otherwise use calibration curve	Every 12 hours	1	%Drift ±15%
GC TPH-DRO (8015B)	After C-cal fails	5	20% RSD of RFs of initial calibration to use average RF, otherwise use curve fit.	Every 12 hours	1	% Drift ±15%
GC TPH-DRO (8015C/D)	After C-cal fails	5	20% RSD of RFs of initial calibration to use average RF, otherwise use curve fit.	Every 12 hours	1	% Drift ±20%
ICP/MS	Each new run	1	Independent calibration verification (ICV) within ±10%	Every 10 samples	1	±10% of true value
ICP	Each new run	1	Independent calibration verification within ±10%, standards <5%RSD	Every 10 samples	1	Same as initial
CVAA	Each new run	5	Independent calibration verification within ±10% Correlation coefficient >0.995	Every 10 samples	1	±20% of true value

Calibration Summary for SW-846 Methods						
	Initial Calibration			Continuing Calibration Verification		
Instrument	Frequency	# Std Conc	Acceptance Criteria	Frequency	# Std Conc	Acceptance Criteria
Autoanalyzer	Daily	6	Correlation coefficient >0.995	Every 10 samples	1	±10% of true value
TOC Analyzer	Monthly	Water – 6 Soil – 4	Corr. Coeff. > 0.995	Every 10 samples	1	±10% of true value
Balance	Daily	bracket range of use	Top-loading: ± 2% or ± 0.02g of true value of weight, whichever is greater. Analytical: ± 0.1% or ± 0.5mg of true value of weight, whichever is greater.	N/A	N/A	N/A

*All compounds with %RSD >15 must use first or second order regression fit of the six calibration points. Alternatively, if average of the %RSD of all compounds in calibration standard is ≤15%, the AVG RF can be used for all compounds.

Abbreviations
Std Conc - The number of standard concentrations used
%RSD - Percent Relative Standard Deviation   CF – Calibration Factor
SPCCs - System Performance Check Compounds
CCCs - Calibration Check Compounds   C-cal - Continuing Calibration
RF - Response factor
CVAA - Cold Vapor Atomic Absorption
ICP/MS - Inductively Coupled Plasma – Mass Spectrometry
ICP - Inductively Coupled Plasma spectrophotometer; ICP run also includes inter-element correction check standard (at beginning and end of run)

GC/MS Tuning Criteria		
BFB Key Ions and Ion Abundance Criteria:		
Mass	**Method 8260B**	**Method 524.2**
50	15% to 40% of mass 95	15% to 40% of mass 95
75	30% to 60% of mass 95	30% to 80% of mass 95
95	Base peak = 100%	Base peak = 100%
96	5% to 9% of mass 95	5% to 9% of mass 95
173	<2% of mass 174	<2% of mass 174
174	>50% of mass 95	>50% of mass 95
175	5% to 9% of mass 174	5% to 9% of mass 174
176	>95% but <101% of mass 174	>95% but <101% of mass 174
177	5% to 9% of mass 176	5% to 9% of mass 176

DFTPP Key Ions and Ion Abundance Criteria:			
Mass	**Method 8270D**	**Method 8270C**	**Method 525.2**
51	30 % to 80 % of mass 198	30 % to 60 % of mass 198	10 % to 80 % of base peak
68	<2% of mass 69	<2% of mass 69	<2% of mass 69
69	mass 69 relative	mass 69 relative abundance	mass 69 relative abundance

	abundance		
70	<2% of mass 69	<2% of mass 69	<2% of mass 69
127	25 % to 75 % of mass 198	40% to 60 % of mass 198	10% to 80 % of base peak
197	<1% of mass 198	<1% of mass 198	<2% of mass 198
198	Base Peak = 100%	Base Peak = 100%	Base peak or >50 % of mass 442
199	5% to 9% of mass 198	5% to 9% of mass 198	5% to 9% of mass 198
275	10% to 30% of mass 198	10% to 30% of mass 198	10% to 60% of base peak
365	>0.75% of mass 198	>1% of mass 198	>1% of base peak
441	Present but < 24% mass 442	Present but < mass 443	Present but < mass 443
442	>50% of mass 198	>40% of mass 198	Base peak or >50% of mass 198
443	15% to 24% of mass 442	17% to 23% of mass 442	15% to 24% of mass 442

Calibration Summary for Drinking Water Methods

	Initial Calibration			Continuing Calibration Verification		
Instrument	Frequency	# Std Conc	Acceptance Criteria	Frequency	# Std Conc	Acceptance Criteria
GC/MS 525.2	After C-cal fails	6	The RSD for each analyte mean RF must be ≤30%. Or a linear regression calibration curve may be used.	Every 12 hours	1	%D for RF must be ≤30%. If curve used, the point must fall on curve from I-cal.
GC 504.1	Every new run	5	% RSD <20% to use Average RF, otherwise use calibration curve.	Every 10 samples or each batch if <10 samples	1	70% to 130% of expected value
GC/MS 524.2	After C-cal fails	4	% RSD <20% otherwise use calibration curve	Every 12 hours	1	%D for RF must be ≤30%. If curved used, the % recovery based on the concentration spiked must be 70% to 130% of expected value.
GC 507 515.1	Each new run, or after C-cal fails	3	≤20% RSD of RFs of Initial Calibration to use avg. RF, otherwise use curve fit. (Degradation for DDT, Endrin ≤20% initially - Method 508.)	Every 10 samples	1	≤20% drift from initial response for both quantitation and confirmation.
HPLC 531.1	Each new run, or after C-cal fails	3	≤20% RSD of RFs of initial calibration to use avg. RF, otherwise use curve fit	Every 10 samples and/or blanks	1	≤20% drift from initial response.
Mercury auto-analyzer	Each new run	5	Initial calibration verification with ±5%	Every 10 samples	1	±10% of true value
Auto-analyzer	Daily	6	Correlation coefficient >0.995	Every 10 samples	1	±10% of true value
Balance	Daily	bracket range of use	Top-loading: ± 2% or ± 0.02g of true value of weight, whichever is greater. Analytical: ± 0.1% or ± 0.5mg of true value of weight, whichever is greater.	N/A	N/A	N/A

Calibration Summary for Drinking Water Methods						
	Initial Calibration			Continuing Calibration Verification		
Instrument	Frequency	# Std Conc	Acceptance Criteria	Frequency	# Std Conc	Acceptance Criteria
ICP	Each new run	1	Initial calibration verification ±5%	Every 10 samples	1	±10% of true value
ICP-MS	Each new run	1	Independent calibration verification within ±10%	Every 10 samples	1	±15% of true value
pH meter	Daily	3	See SOP	Every 10 samples	1	Statistical limits
IC	Monthly	5	Correlation coefficient >0.995	Every 10 samples	1	±10% of true value
ISE	Every 3 months	5	Correlation coefficient >0.995	Every 10 samples	1	±10% of true value

Abbreviations

Std Conc - The number of standard concentrations used
SPCCs - System Performance Check Compounds
CCCs - Calibration Check Compounds
RF - Response Factor
%RSD - Percent Relative Standard Deviation
%D - Percent Difference
C-cal - Continuing Calibration
CVAF – Cold Vapor Atomic Fluorescence
HPLC - High Performance Liquid Chromatography
GC - Gas Chromatograph
GC/MS - Gas Chromatography/Mass Spectrometry
ICP - Inductively Coupled Plasma spectrophotometer
ICP/MS - Inductively Coupled Plasma – Mass Spectrometry
IC - Ion Chromatograph
ISE - Ion Specific Electrode

Method 507

Laboratory Performance Check Solution (analyzed prior to system calibration)

Test	Analyte	Conc. µg/mL	Requirements
Sensitivity	Vernolate	0.05	Detection of analyte; S/N > 3
Chromatographic performance	Bromacil	5.0	$0.80 < \mathrm{PGF}^{a} < 1.20$
Column performance	Prometon Atrazine	0.30 0.15	Resolution[b] > 0.7

[a] PGF - Peak Gaussian factor. Calculated using the equation:

$$PGF = \frac{1.83 \times W(1/2)}{W(1/10)}$$

Where W(1/2) is the peak width at half height and W(1/10) is the peak width at 10% peak height.

[b] Resolution between the two peaks as defined by the equation:

$$R = \frac{t}{W}$$

Where t is the difference in elution times between the two peaks and W is the average peak width, at the baseline, of the two peaks.

Method 531.1

Laboratory Performance Check Solution (analyzed prior to system calibration)

Test	*Analyte*	Conc. µg/mL	Requirements
Sensitivity	3-Hydroxycarbofuran	2	Detection of analyte; S/N > 3
Chromatographic performance	Aldicarb Sulfoxide	100	0.90 < PGF < 1.1[a]
Column performance	Methiocarb4-Bromo-3,5-Dimethylphenyl N-Methylcarbamate (IS)	20 10	Resolution > 1.0[b]

[a] PGF - Peak Gaussian factor. Calculated using the equation:

$$PGF = \frac{1.83 \times W(1/2)}{W(1/10)}$$

Where: W(1/2) is the peak width at half height in seconds
W(1/10) is the peak width in seconds at 10% peak height.

[b] Resolution between the two peaks as defined by the equation:

$$R = \frac{t}{W}$$

Where: t is the difference in elution times between the two peaks
W is the average peak width, at the baseline, of the two peaks.

Method 515

Laboratory Performance Check Solution
(analyzed prior to system calibration)

Test	Analyte	Conc. µg/mL	Requirements
Sensitivity	Dinoseb	0.004	Detection of analyte; S/N >3
Chromatographic performance	4-Nitrophenol	1.6	$0.70 < PGF^{a} < 1.05$
Column performance	3,5-Dichlorobenzoic acid 4-Nitrophenol	0.6 1.6	Resolution[b] >0.40

[a] PGF - Peak Gaussian factor. Calculated using the equation:

$$PGF = \frac{1.83 \times W(1/2)}{W(1/10)}$$

Where W(1/2) is the peak width at half height and W(1/10) is the peak width at tenth height.

[b] Resolution between the two peaks as defined by the equation:

$$R = \frac{t}{W}$$

Where t is the difference in elution times between the two peaks and W is the average peak width, at the baseline, of the two peaks.

Calibration Summary for EPA 100, 200, 300, 600 & 1600 Series Methods

	Initial Calibration			Continuing Calibration Verification		
Instrument	Frequency	# Std Conc	Acceptance Criteria	Frequency	# Std Conc	Acceptance Criteria
GC/MS Volatiles*	After C-cal fails	5	RSD ≤35% for all compounds*, or a linear regression may be used	Every 24 hours	1	All compounds must meet the QC acceptance criteria as stated in the method. Compounds not stated must meet a 65% -135% recovery criteria.
GC/MS Semivolatiles**	After C-cal fails	5	RSD ≤35% for all compounds**, or a linear regression may be used Tailing factors: Benzidine < 3 Pentachlorophenol < 5	Every 24 hours	1	All compounds calibrating for <20
GC Pesticides & PCBs (Method 608)	After C-cal fails	5	10% RSD of RFs of initial calibration to use avg. RF, otherwise use curve fit. Degradation for DDT, Endrin 15%	Every 10 samples	1	≤15% drift from initial response for quantitation
GC VOA Halocarbons and/or Aromatics	After C-cal fails	At least 5	%RSD of ≤10% for individual compounds to use average RFs. If %RSD >10%, a quadratic fit type is used if correlation coefficient is >0.995.	Every 12 hours, or every 10 samples	1	Method defined limits
Dioxins by HRGC/HRMS	After C-cal fails	6	If %RSD for native compounds <20% and for labeled compounds <20%, otherwise a calibration curve is used	Every 12 hours	1	<25% valley peak resolution for 2378-TCDD All native and labeled compounds meet method defined recovery limits RTs within ±15 secs of RT in ICAL
ICP/MS	Each new run	1	Independent calibration verification (ICV) within ±10%	Every 10 samples	1	±15% of true value
ICP	Each new run	1	Independent calibration verification within ±5%, standards <3%RSD	Every 10 samples	1	±10% of true value
CVAA	Each new run	5	Independent calibration verification within ±5% Correlation coefficient >0.995	Every 10 samples	1	±10% of true value

Calibration Summary for EPA 100, 200, 300, 600 & 1600 Series Methods

	Initial Calibration			Continuing Calibration Verification		
Instrument	Frequency	# Std Conc	Acceptance Criteria	Frequency	# Std Conc	Acceptance Criteria
CVAF	Each new run	5	The RSD ≤ 15%, and the low standard recovers ±23% of the true value	After the calibration and at the end of the analytical batch	1	±23% of the true value
Auto-analyzer	Daily	6	Correlation coefficient >0.995	Every 10 samples	1	±10% of true value
TOC	Monthly	6	Corr. Coeff. > 0.995	Every 10 samples	1	±10% of true value
Balance	Daily	4	Top-loading ±0.5%, Analytical ± 0.1% for weights >0.1 g 50 mg ± 0.5%, 20 mg ± 1.0% 10 mg and 5 mg ± 2.0%	N/A	N/A	N/A

*All compounds with %RSD >35 must use first or second order regression fit of the five calibration points. The first order regression may only be used if the correlation coefficient r ≥0.990. The second order regression may only be used if the coefficient of determination $r^2 \geq 0.990$.

* * All compounds with % RSD >35 must use first order regression fit of the five calibration points. The first order regression may only be used if the correlation coefficient r ≥0.990.

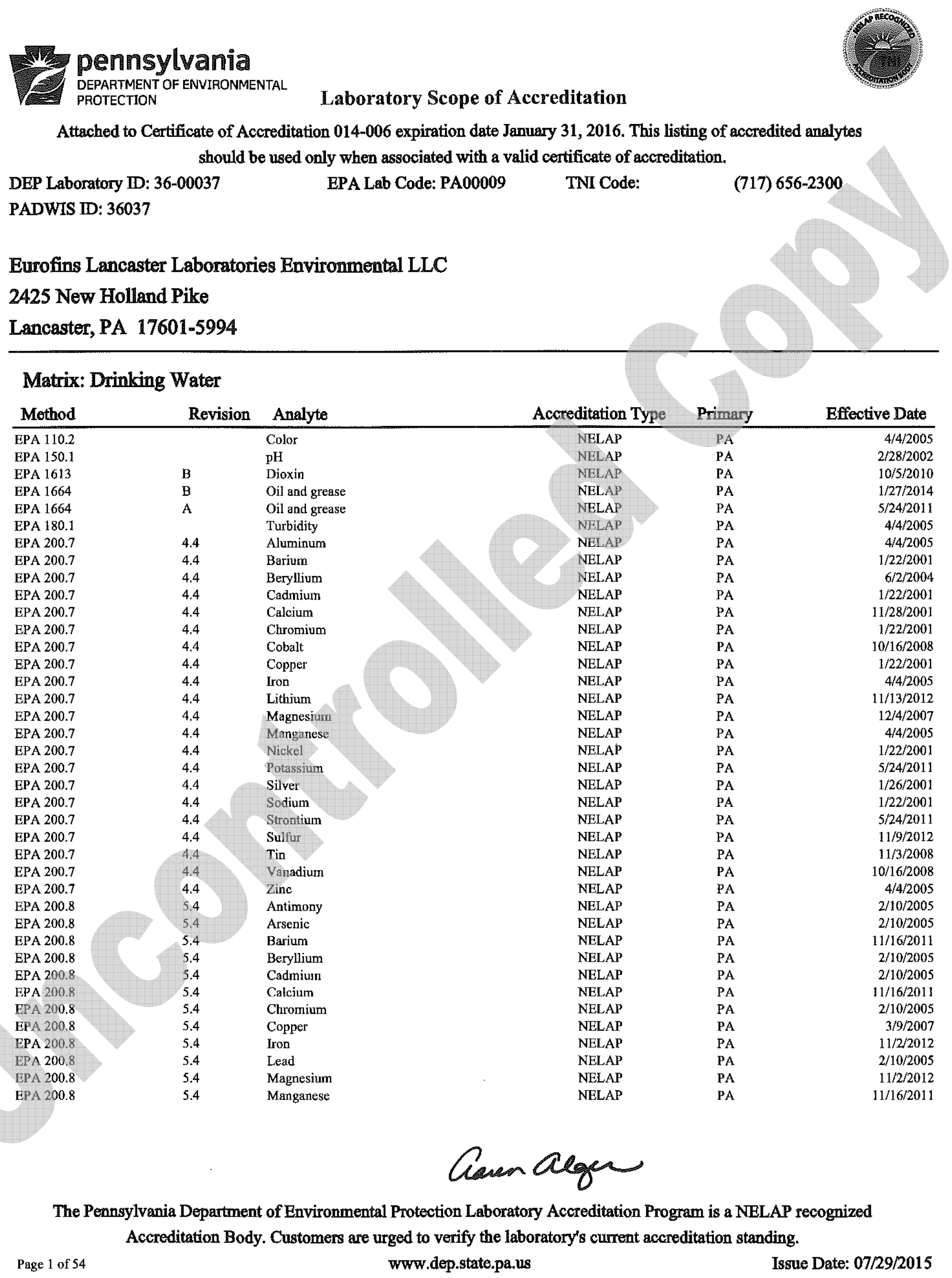
Abbreviations
Std Conc - The number of standard concentrations used
SPCCs - System Performance Check Compounds
CCCs - Calibration Check Compounds
RF - Response Factor
%RSD - Percent Relative Standard Deviation
C-cal - Continuing Calibration
CVAA - Cold Vapor Atomic Absorption spectrophotometer
CVAF - Cold Vapor Fluorescence spectrophotometer
HPLC - High Performance Liquid Chromatography
ICP - Inductively Coupled Plasma spectrophotometer; ICP run also includes inter-element correction check standard (beginning and end of run)
ICP/MS - Inductively Coupled Plasma - Mass Spectrometry

Calibration Summary for EPA TO Series Methods						
	Initial Calibration			Continuing Calibration Verification		
Instrument	Frequency	# Std Conc	Acceptance Criteria	Frequency	# Std Conc	Acceptance Criteria
GC/MS Volatiles TO-15	After C-cal fails	Minimum of 5	RSD ≤30% for all compounds, 2 allowed to be >30% as long as <40%.	Every 24 hours	1	All compounds ≤30 difference.
GC/MS Volatiles TO-14A	After C-cal fails	Minimum of 5	RSD ≤30% for all compounds, 2 allowed to be >30% as long as <40%.	Every 24 hours	1	All compounds ≤30 difference.

Eurofins Document Reference	1-P-QM-GDL-9015386	**Revision**	4
Effective Date	Dec 31, 2015	**Status**	Effective
Historical/Local Document Number	DOD - Environmental Quality Policy Manual Appendix I		
Local Document Level	Level 1		
Local Document Type	POL - Policy		
Local Document Category	ES - Environmental Sciences		

Prepared by	Barbara Reedy
Reviewed and Approved by	Duane Luckenbill;Review;Sunday, December 13, 2015 10:27:16 PM EST Dorothy Love;Approval;Thursday, December 17, 2015 3:58:32 PM EST

NOTE: Current certificates are maintained by the QA Department and are available on our website at http://env.lancasterlabs.com/resources/certifications



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DEPARTMENT OF ENVIRONMENTAL PROTECTION

Laboratory Scope of Accreditation

Attached to Certificate of Accreditation 014-006 expiration date January 31, 2016. This listing of accredited analytes should be used only when associated with a valid certificate of accreditation.

DEP Laboratory ID: 36-00037 **EPA Lab Code: PA00009** **TNI Code:** **(717) 656-2300**
PADWIS ID: 36037

Eurofins Lancaster Laboratories Environmental LLC
2425 New Holland Pike
Lancaster, PA 17601-5994

Matrix: Drinking Water

Method	Revision	Analyte	Accreditation Type	Primary	Effective Date
EPA 110.2		Color	NELAP	PA	4/4/2005
EPA 150.1		pH	NELAP	PA	2/28/2002
EPA 1613	B	Dioxin	NELAP	PA	10/5/2010
EPA 1664	B	Oil and grease	NELAP	PA	1/27/2014
EPA 1664	A	Oil and grease	NELAP	PA	5/24/2011
EPA 180.1		Turbidity	NELAP	PA	4/4/2005
EPA 200.7	4.4	Aluminum	NELAP	PA	4/4/2005
EPA 200.7	4.4	Barium	NELAP	PA	1/22/2001
EPA 200.7	4.4	Beryllium	NELAP	PA	6/2/2004
EPA 200.7	4.4	Cadmium	NELAP	PA	1/22/2001
EPA 200.7	4.4	Calcium	NELAP	PA	11/28/2001
EPA 200.7	4.4	Chromium	NELAP	PA	1/22/2001
EPA 200.7	4.4	Cobalt	NELAP	PA	10/16/2008
EPA 200.7	4.4	Copper	NELAP	PA	1/22/2001
EPA 200.7	4.4	Iron	NELAP	PA	4/4/2005
EPA 200.7	4.4	Lithium	NELAP	PA	11/13/2012
EPA 200.7	4.4	Magnesium	NELAP	PA	12/4/2007
EPA 200.7	4.4	Manganese	NELAP	PA	4/4/2005
EPA 200.7	4.4	Nickel	NELAP	PA	1/22/2001
EPA 200.7	4.4	Potassium	NELAP	PA	5/24/2011
EPA 200.7	4.4	Silver	NELAP	PA	1/26/2001
EPA 200.7	4.4	Sodium	NELAP	PA	1/22/2001
EPA 200.7	4.4	Strontium	NELAP	PA	5/24/2011
EPA 200.7	4.4	Sulfur	NELAP	PA	11/9/2012
EPA 200.7	4.4	Tin	NELAP	PA	11/3/2008
EPA 200.7	4.4	Vanadium	NELAP	PA	10/16/2008
EPA 200.7	4.4	Zinc	NELAP	PA	4/4/2005
EPA 200.8	5.4	Antimony	NELAP	PA	2/10/2005
EPA 200.8	5.4	Arsenic	NELAP	PA	2/10/2005
EPA 200.8	5.4	Barium	NELAP	PA	11/16/2011
EPA 200.8	5.4	Beryllium	NELAP	PA	2/10/2005
EPA 200.8	5.4	Cadmium	NELAP	PA	2/10/2005
EPA 200.8	5.4	Calcium	NELAP	PA	11/16/2011
EPA 200.8	5.4	Chromium	NELAP	PA	2/10/2005
EPA 200.8	5.4	Copper	NELAP	PA	3/9/2007
EPA 200.8	5.4	Iron	NELAP	PA	11/2/2012
EPA 200.8	5.4	Lead	NELAP	PA	2/10/2005
EPA 200.8	5.4	Magnesium	NELAP	PA	11/2/2012
EPA 200.8	5.4	Manganese	NELAP	PA	11/16/2011

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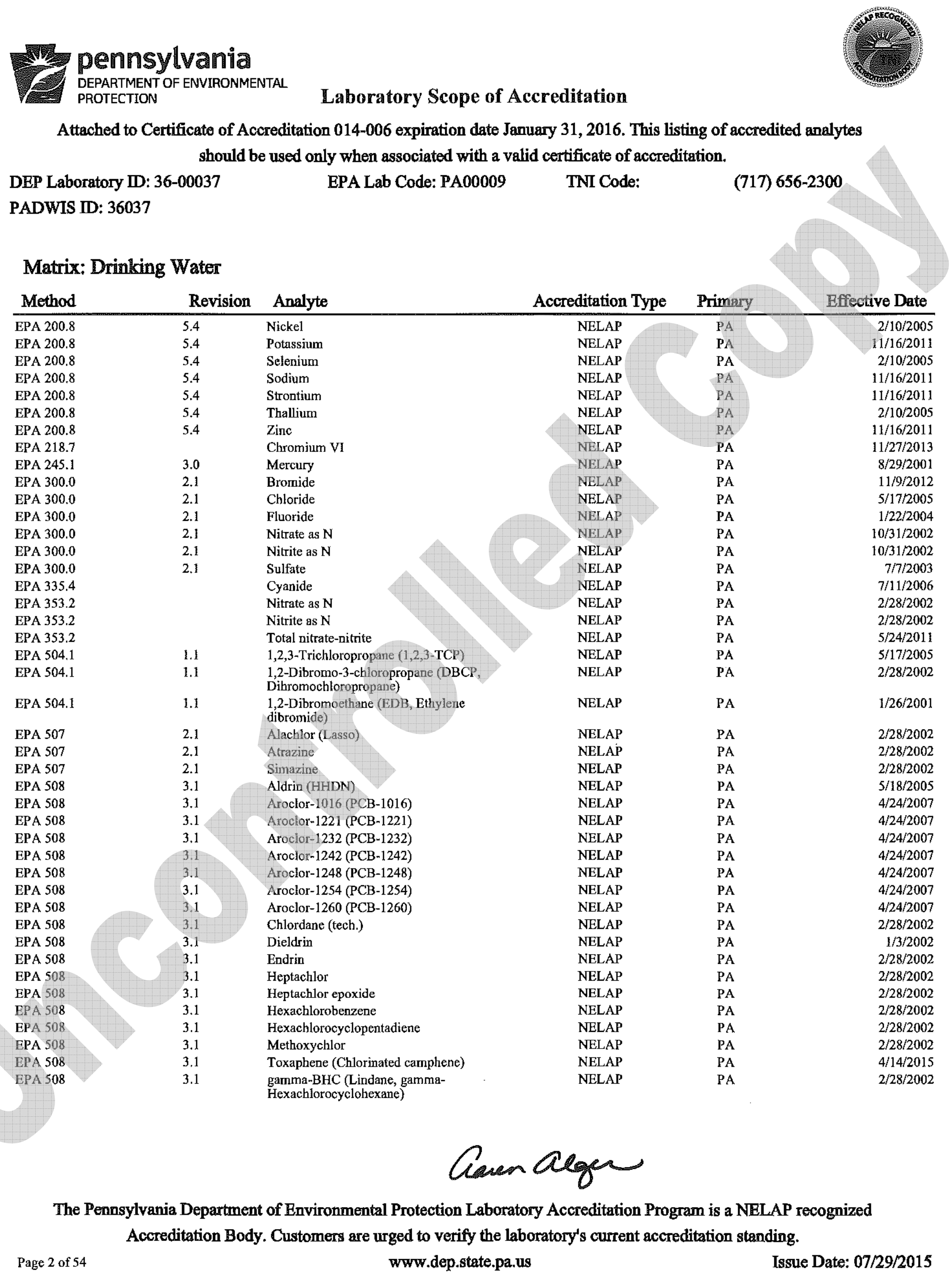

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DEPARTMENT OF ENVIRONMENTAL PROTECTION

Laboratory Scope of Accreditation

Attached to Certificate of Accreditation 014-006 expiration date January 31, 2016. This listing of accredited analytes should be used only when associated with a valid certificate of accreditation.

DEP Laboratory ID: 36-00037 **EPA Lab Code: PA00009** **TNI Code:** **(717) 656-2300**
PADWIS ID: 36037

Matrix: Drinking Water

Method	Revision	Analyte	Accreditation Type	Primary	Effective Date
EPA 200.8	5.4	Nickel	NELAP	PA	2/10/2005
EPA 200.8	5.4	Potassium	NELAP	PA	11/16/2011
EPA 200.8	5.4	Selenium	NELAP	PA	2/10/2005
EPA 200.8	5.4	Sodium	NELAP	PA	11/16/2011
EPA 200.8	5.4	Strontium	NELAP	PA	11/16/2011
EPA 200.8	5.4	Thallium	NELAP	PA	2/10/2005
EPA 200.8	5.4	Zinc	NELAP	PA	11/16/2011
EPA 218.7		Chromium VI	NELAP	PA	11/27/2013
EPA 245.1	3.0	Mercury	NELAP	PA	8/29/2001
EPA 300.0	2.1	Bromide	NELAP	PA	11/9/2012
EPA 300.0	2.1	Chloride	NELAP	PA	5/17/2005
EPA 300.0	2.1	Fluoride	NELAP	PA	1/22/2004
EPA 300.0	2.1	Nitrate as N	NELAP	PA	10/31/2002
EPA 300.0	2.1	Nitrite as N	NELAP	PA	10/31/2002
EPA 300.0	2.1	Sulfate	NELAP	PA	7/7/2003
EPA 335.4		Cyanide	NELAP	PA	7/11/2006
EPA 353.2		Nitrate as N	NELAP	PA	2/28/2002
EPA 353.2		Nitrite as N	NELAP	PA	2/28/2002
EPA 353.2		Total nitrate-nitrite	NELAP	PA	5/24/2011
EPA 504.1	1.1	1,2,3-Trichloropropane (1,2,3-TCP)	NELAP	PA	5/17/2005
EPA 504.1	1.1	1,2-Dibromo-3-chloropropane (DBCP, Dibromochloropropane)	NELAP	PA	2/28/2002
EPA 504.1	1.1	1,2-Dibromoethane (EDB, Ethylene dibromide)	NELAP	PA	1/26/2001
EPA 507	2.1	Alachlor (Lasso)	NELAP	PA	2/28/2002
EPA 507	2.1	Atrazine	NELAP	PA	2/28/2002
EPA 507	2.1	Simazine	NELAP	PA	2/28/2002
EPA 508	3.1	Aldrin (HHDN)	NELAP	PA	5/18/2005
EPA 508	3.1	Aroclor-1016 (PCB-1016)	NELAP	PA	4/24/2007
EPA 508	3.1	Aroclor-1221 (PCB-1221)	NELAP	PA	4/24/2007
EPA 508	3.1	Aroclor-1232 (PCB-1232)	NELAP	PA	4/24/2007
EPA 508	3.1	Aroclor-1242 (PCB-1242)	NELAP	PA	4/24/2007
EPA 508	3.1	Aroclor-1248 (PCB-1248)	NELAP	PA	4/24/2007
EPA 508	3.1	Aroclor-1254 (PCB-1254)	NELAP	PA	4/24/2007
EPA 508	3.1	Aroclor-1260 (PCB-1260)	NELAP	PA	4/24/2007
EPA 508	3.1	Chlordane (tech.)	NELAP	PA	2/28/2002
EPA 508	3.1	Dieldrin	NELAP	PA	1/3/2002
EPA 508	3.1	Endrin	NELAP	PA	2/28/2002
EPA 508	3.1	Heptachlor	NELAP	PA	2/28/2002
EPA 508	3.1	Heptachlor epoxide	NELAP	PA	2/28/2002
EPA 508	3.1	Hexachlorobenzene	NELAP	PA	2/28/2002
EPA 508	3.1	Hexachlorocyclopentadiene	NELAP	PA	2/28/2002
EPA 508	3.1	Methoxychlor	NELAP	PA	2/28/2002
EPA 508	3.1	Toxaphene (Chlorinated camphene)	NELAP	PA	4/14/2015
EPA 508	3.1	gamma-BHC (Lindane, gamma-Hexachlorocyclohexane)	NELAP	PA	2/28/2002

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DEPARTMENT OF ENVIRONMENTAL PROTECTION

Laboratory Scope of Accreditation

Attached to Certificate of Accreditation 014-006 expiration date January 31, 2016. This listing of accredited analytes should be used only when associated with a valid certificate of accreditation.

DEP Laboratory ID: 36-00037 **EPA Lab Code: PA00009** **TNI Code:** **(717) 656-2300**
PADWIS ID: 36037

Matrix: Drinking Water

Method	Revision	Analyte	Accreditation Type	Primary	Effective Date
EPA 515.1	4.0	2,4,5-TP (Silvex)	NELAP	PA	1/24/2001
EPA 515.1	4.0	2,4-D	NELAP	PA	1/24/2001
EPA 515.1	4.0	Dalapon (2,2-Dichloropropionic acid)	NELAP	PA	1/24/2001
EPA 515.1	4.0	Dicamba	NELAP	PA	1/24/2001
EPA 515.1	4.0	Dinoseb (2-sec-Butyl-4,6-dinitrophenol, DNBP)	NELAP	PA	1/24/2001
EPA 515.1	4.0	Pentachlorophenol (PCP)	NELAP	PA	1/24/2001
EPA 515.1	4.0	Picloram (4-Amino-3,5,6-trichloro-2-pyridinecarboxylic acid)	NELAP	PA	1/24/2001
EPA 524.2	4.1	1,1,1,2-Tetrachloroethane	NELAP	PA	10/31/2002
EPA 524.2	4.1	1,1,1-Trichloroethane	NELAP	PA	10/31/2002
EPA 524.2	4.1	1,1,2,2-Tetrachloroethane	NELAP	PA	10/31/2002
EPA 524.2	4.1	1,1,2-Trichloroethane	NELAP	PA	10/31/2002
EPA 524.2	4.1	1,1-Dichloro-2-propanone (1,1-Dichloropropanone)	NELAP	PA	5/17/2005
EPA 524.2	4.1	1,1-Dichloroethane	NELAP	PA	10/31/2002
EPA 524.2	4.1	1,1-Dichloroethene (1,1-Dichloroethylene)	NELAP	PA	10/31/2002
EPA 524.2	4.1	1,1-Dichloropropene	NELAP	PA	10/31/2002
EPA 524.2	4.1	1,2,3-Trichlorobenzene	NELAP	PA	4/4/2005
EPA 524.2	4.1	1,2,3-Trichloropropane (1,2,3-TCP)	NELAP	PA	10/31/2002
EPA 524.2	4.1	1,2,4-Trichlorobenzene	NELAP	PA	10/31/2002
EPA 524.2	4.1	1,2,4-Trimethylbenzene	NELAP	PA	4/4/2005
EPA 524.2	4.1	1,2-Dichlorobenzene (o-Dichlorobenzene)	NELAP	PA	10/31/2002
EPA 524.2	4.1	1,2-Dichloroethane	NELAP	PA	10/31/2002
EPA 524.2	4.1	1,2-Dichloropropane	NELAP	PA	10/31/2002
EPA 524.2	4.1	1,3,5-Trimethylbenzene	NELAP	PA	5/17/2005
EPA 524.2	4.1	1,3-Dichlorobenzene (m-Dichlorobenzene)	NELAP	PA	10/31/2002
EPA 524.2	4.1	1,3-Dichloropropane	NELAP	PA	10/31/2002
EPA 524.2	4.1	1,4-Dichlorobenzene (p-Dichlorobenzene)	NELAP	PA	10/31/2002
EPA 524.2	4.1	1-Chlorobutane	NELAP	PA	5/24/2007
EPA 524.2	4.1	2,2-Dichloropropane	NELAP	PA	10/31/2002
EPA 524.2	4.1	2-Butanone (Methyl ethyl ketone, MEK)	NELAP	PA	5/24/2007
EPA 524.2	4.1	2-Chlorotoluene	NELAP	PA	10/31/2002
EPA 524.2	4.1	2-Hexanone	NELAP	PA	5/24/2007
EPA 524.2	4.1	2-Nitropropane	NELAP	PA	5/24/2007
EPA 524.2	4.1	4-Chlorotoluene	NELAP	PA	10/31/2002
EPA 524.2	4.1	4-Methyl-2-pentanone (MIBK)	NELAP	PA	5/24/2007
EPA 524.2	4.1	Acetone	NELAP	PA	5/24/2007
EPA 524.2	4.1	Acrylonitrile	NELAP	PA	5/24/2007
EPA 524.2	4.1	Allyl chloride (3-Chloropropene)	NELAP	PA	7/3/2007
EPA 524.2	4.1	Benzene	NELAP	PA	10/31/2002
EPA 524.2	4.1	Bromobenzene	NELAP	PA	10/31/2002
EPA 524.2	4.1	Bromochloromethane	NELAP	PA	4/4/2005
EPA 524.2	4.1	Bromodichloromethane	NELAP	PA	10/31/2002
EPA 524.2	4.1	Bromoform	NELAP	PA	10/31/2002
EPA 524.2	4.1	Carbon disulfide	NELAP	PA	5/24/2007

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DEPARTMENT OF ENVIRONMENTAL PROTECTION

Laboratory Scope of Accreditation

Attached to Certificate of Accreditation 014-006 expiration date January 31, 2016. This listing of accredited analytes should be used only when associated with a valid certificate of accreditation.

DEP Laboratory ID: 36-00037 **EPA Lab Code: PA00009** **TNI Code:** **(717) 656-2300**
PADWIS ID: 36037

Matrix: Drinking Water

Method	Revision	Analyte	Accreditation Type	Primary	Effective Date
EPA 524.2	4.1	Carbon tetrachloride	NELAP	PA	10/31/2002
EPA 524.2	4.1	Chloroacetonitrile	NELAP	PA	5/24/2007
EPA 524.2	4.1	Chlorobenzene	NELAP	PA	10/31/2002
EPA 524.2	4.1	Chloroethane	NELAP	PA	10/31/2002
EPA 524.2	4.1	Chloroform	NELAP	PA	10/31/2002
EPA 524.2	4.1	Dibromochloromethane	NELAP	PA	10/31/2002
EPA 524.2	4.1	Dibromomethane	NELAP	PA	10/31/2002
EPA 524.2	4.1	Dichlorodifluoromethane (Freon 12)	NELAP	PA	4/4/2005
EPA 524.2	4.1	Diethyl ether (Ethyl ether)	NELAP	PA	5/24/2007
EPA 524.2	4.1	Diisopropyl ether (DIPE)	NELAP	PA	1/7/2010
EPA 524.2	4.1	Ethyl methacrylate	NELAP	PA	5/24/2007
EPA 524.2	4.1	Ethyl tert-butyl ether (ETBE)	NELAP	PA	1/24/2007
EPA 524.2	4.1	Ethylbenzene	NELAP	PA	10/31/2002
EPA 524.2	4.1	Hexachlorobutadiene (1,3-Hexachlorobutadiene)	NELAP	PA	4/4/2005
EPA 524.2	4.1	Hexachloroethane	NELAP	PA	5/24/2007
EPA 524.2	4.1	Isopropylbenzene (Cumene)	NELAP	PA	4/4/2005
EPA 524.2	4.1	Methacrylonitrile	NELAP	PA	5/24/2007
EPA 524.2	4.1	Methyl bromide (Bromomethane)	NELAP	PA	10/31/2002
EPA 524.2	4.1	Methyl chloride (Chloromethane)	NELAP	PA	10/31/2002
EPA 524.2	4.1	Methyl iodide (Iodomethane)	NELAP	PA	5/24/2007
EPA 524.2	4.1	Methyl tert-butyl ether (MTBE)	NELAP	PA	4/4/2005
EPA 524.2	4.1	Methylacrylate	NELAP	PA	5/24/2007
EPA 524.2	4.1	Methylene chloride (Dichloromethane)	NELAP	PA	10/31/2002
EPA 524.2	4.1	Methylmethacrylate	NELAP	PA	5/24/2007
EPA 524.2	4.1	Naphthalene	NELAP	PA	5/17/2005
EPA 524.2	4.1	Nitrobenzene	NELAP	PA	5/17/2005
EPA 524.2	4.1	Pentachloroethane	NELAP	PA	5/24/2007
EPA 524.2	4.1	Propionitrile (Ethyl cyanide)	NELAP	PA	5/24/2007
EPA 524.2	4.1	Styrene	NELAP	PA	10/31/2002
EPA 524.2	4.1	Tetrachloroethene (PCE, Perchloroethylene)	NELAP	PA	10/31/2002
EPA 524.2	4.1	Tetrahydrofuran (THF)	NELAP	PA	5/24/2007
EPA 524.2	4.1	Toluene	NELAP	PA	10/31/2002
EPA 524.2	4.1	Total trihalomethanes (TTHMs)	NELAP	PA	10/31/2002
EPA 524.2	4.1	Trichloroethene (TCE, Trichloroethylene)	NELAP	PA	10/31/2002
EPA 524.2	4.1	Trichlorofluoromethane (Freon 11)	NELAP	PA	4/4/2005
EPA 524.2	4.1	Vinyl chloride (Chloroethene)	NELAP	PA	10/31/2002
EPA 524.2	4.1	Xylenes, total	NELAP	PA	10/31/2002
EPA 524.2	4.1	cis-1,2-Dichloroethene	NELAP	PA	10/31/2002
EPA 524.2	4.1	cis-1,3-Dichloropropene	NELAP	PA	10/31/2002
EPA 524.2	4.1	m+p-Xylene	NELAP	PA	12/8/2014
EPA 524.2	4.1	n-Butylbenzene	NELAP	PA	4/4/2005
EPA 524.2	4.1	n-Propylbenzene	NELAP	PA	5/17/2005
EPA 524.2	4.1	o-Xylene	NELAP	PA	12/8/2014
EPA 524.2	4.1	p-Isopropyltoluene (4-Isopropyltoluene)	NELAP	PA	5/17/2005
EPA 524.2	4.1	sec-Butylbenzene	NELAP	PA	4/4/2005

Aaren Alger

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DEPARTMENT OF ENVIRONMENTAL PROTECTION

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DEP Laboratory ID: 36-00037 **EPA Lab Code: PA00009** **TNI Code:** **(717) 656-2300**
PADWIS ID: 36037

Matrix: Drinking Water

Method	Revision	Analyte	Accreditation Type	Primary	Effective Date
EPA 524.2	4.1	tert-Amyl methyl ether (TAME)	NELAP	PA	1/24/2007
EPA 524.2	4.1	tert-Butyl alcohol (2-Methyl-2-propanol)	NELAP	PA	5/24/2007
EPA 524.2	4.1	tert-Butylbenzene	NELAP	PA	4/4/2005
EPA 524.2	4.1	trans-1,2-Dichloroethene	NELAP	PA	10/31/2002
EPA 524.2	4.1	trans-1,3-Dichloropropene	NELAP	PA	10/31/2002
EPA 524.2	4.1	trans-1,4-Dichloro-2-butene	NELAP	PA	5/24/2007
EPA 525.2	2.0	2,3-Dichlorobiphenyl (BZ 5)	NELAP	PA	5/17/2005
EPA 525.2	2.0	Acenaphthene	NELAP	PA	5/25/2007
EPA 525.2	2.0	Acenaphthylene	NELAP	PA	4/28/2010
EPA 525.2	2.0	Alachlor (Lasso)	NELAP	PA	2/28/2002
EPA 525.2	2.0	Aldrin (HHDN)	NELAP	PA	10/9/2013
EPA 525.2	2.0	Anthracene	NELAP	PA	5/25/2007
EPA 525.2	2.0	Atrazine	NELAP	PA	1/3/2002
EPA 525.2	2.0	Benzo[a]anthracene	NELAP	PA	5/25/2007
EPA 525.2	2.0	Benzo[a]pyrene	NELAP	PA	1/24/2001
EPA 525.2	2.0	Benzo[b]fluoranthene	NELAP	PA	6/4/2007
EPA 525.2	2.0	Benzo[ghi]perylene	NELAP	PA	7/3/2007
EPA 525.2	2.0	Benzo[k]fluoranthene	NELAP	PA	6/4/2007
EPA 525.2	2.0	Benzyl butyl phthalate (Butyl benzyl phthalate)	NELAP	PA	5/25/2007
EPA 525.2	2.0	Butachlor	NELAP	PA	12/19/2002
EPA 525.2	2.0	Chrysene (Benzo[a]phenanthrene)	NELAP	PA	5/25/2007
EPA 525.2	2.0	Di-n-butyl phthalate	NELAP	PA	5/25/2007
EPA 525.2	2.0	Dibenzo[a,h]anthracene	NELAP	PA	5/25/2007
EPA 525.2	2.0	Dieldrin	NELAP	PA	5/17/2005
EPA 525.2	2.0	Diethyl phthalate	NELAP	PA	5/25/2007
EPA 525.2	2.0	Dimethyl phthalate	NELAP	PA	5/25/2007
EPA 525.2	2.0	Endrin	NELAP	PA	5/17/2005
EPA 525.2	2.0	Fluoranthene	NELAP	PA	3/7/2012
EPA 525.2	2.0	Fluorene	NELAP	PA	2/7/2012
EPA 525.2	2.0	Heptachlor	NELAP	PA	5/17/2005
EPA 525.2	2.0	Heptachlor epoxide	NELAP	PA	5/17/2005
EPA 525.2	2.0	Hexachlorobenzene	NELAP	PA	2/11/2005
EPA 525.2	2.0	Hexachlorocyclopentadiene	NELAP	PA	1/24/2001
EPA 525.2	2.0	Indeno(1,2,3-cd)pyrene	NELAP	PA	2/7/2012
EPA 525.2	2.0	Methoxychlor	NELAP	PA	1/24/2001
EPA 525.2	2.0	Metolachlor	NELAP	PA	12/19/2002
EPA 525.2	2.0	Metribuzin	NELAP	PA	12/19/2002
EPA 525.2	2.0	Phenanthrene	NELAP	PA	5/25/2007
EPA 525.2	2.0	Propachlor (Ramrod)	NELAP	PA	1/24/2001
EPA 525.2	2.0	Pyrene	NELAP	PA	5/25/2007
EPA 525.2	2.0	Simazine	NELAP	PA	1/3/2002
EPA 525.2	2.0	bis(2-Ethylhexyl) adipate (di(2-Ethylhexyl) adipate)	NELAP	PA	1/24/2001
EPA 525.2	2.0	bis(2-Ethylhexyl) phthalate (DEHP)	NELAP	PA	1/24/2001

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Laboratory Scope of Accreditation

Attached to Certificate of Accreditation 014-006 expiration date January 31, 2016. This listing of accredited analytes should be used only when associated with a valid certificate of accreditation.

DEP Laboratory ID: 36-00037 **EPA Lab Code: PA00009** **TNI Code:** **(717) 656-2300**
PADWIS ID: 36037

Matrix: Drinking Water

Method	Revision	Analyte	Accreditation Type	Primary	Effective Date
EPA 525.2	2.0	gamma-BHC (Lindane, gamma-Hexachlorocyclohexane)	NELAP	PA	1/24/2001
EPA 531.1	3.1	3-Hydroxycarbofuran	NELAP	PA	11/7/2006
EPA 531.1	3.1	Aldicarb (Temik)	NELAP	PA	4/14/2015
EPA 531.1	3.1	Aldicarb sulfone	NELAP	PA	1/24/2001
EPA 531.1	3.1	Aldicarb sulfoxide	NELAP	PA	1/24/2001
EPA 531.1	3.1	Carbaryl (Sevin)	NELAP	PA	10/9/2002
EPA 531.1	3.1	Carbofuran (Furaden)	NELAP	PA	1/24/2001
EPA 531.1	3.1	Methomyl (Lannate)	NELAP	PA	1/24/2001
EPA 531.1	3.1	Oxamyl (Vydate)	NELAP	PA	1/24/2001
EPA 8015		Ethane	NELAP	PA	5/24/2011
EPA 8015		Methane	NELAP	PA	5/24/2011
EPA 8015		Propane	NELAP	PA	11/9/2012
SM 2120 B		Color	NELAP	PA	5/25/2005
SM 2130 B		Turbidity	NELAP	PA	5/17/2005
SM 2320 B		Alkalinity as CaCO3	NELAP	PA	1/24/2001
SM 2340 C		Total hardness as CaCO3	NELAP	PA	5/24/2011
SM 2510 B		Conductivity	NELAP	PA	5/17/2005
SM 2540 C		Total dissolved solids (TDS)	NELAP	PA	6/2/2004
SM 2540 D		Residue, nonfilterable (TSS)	NELAP	PA	5/24/2011
SM 2550 B		Temperature, deg. C	NELAP	PA	4/4/2005
SM 4500-Cl F		Total residual chlorine	NELAP	PA	5/24/2011
SM 4500-F- C		Fluoride	NELAP	PA	10/15/2003
SM 4500-H+ B		pH	NELAP	PA	5/16/2007
SM 4500-P E		Orthophosphate as P	NELAP	PA	6/12/2007
SM 4500-SiO2 C	20-22	Silica, dissolved	NELAP	PA	5/24/2007
SM 5310 C		Total organic carbon (TOC)	NELAP	PA	4/18/2013
SM 5540 C		Surfactants as MBAS	NELAP	PA	5/24/2007
SM 9215 B		Heterotrophic bacteria (Enumeration)	NELAP	PA	2/5/2003
SM 9223 Colilert		Total coliform & E. coli (P/A)	NELAP	PA	1/26/2001

Matrix: Non-Potable Water

Method	Revision	Analyte	Accreditation Type	Primary	Effective Date
AK-101		Gasoline-range organics (GRO)	NELAP	PA	12/12/2005
AK-102		Diesel-range organics (DRO)	NELAP	PA	12/12/2005
ASTM D7511-09		Total cyanide	NELAP	PA	2/15/2013
EPA 1010		Ignitability	NELAP	PA	12/12/2005
EPA 130.2		Hardness	NELAP	PA	1/19/2005
EPA 1311		Toxicity characteristic leaching procedure (TCLP)	NELAP	PA	12/12/2005
EPA 1312		Synthetic precipitation leaching procedure (SPLP)	NELAP	PA	12/12/2005
EPA 160.1		Residue, filterable (TDS)	NELAP	PA	1/19/2005
EPA 160.4		Residue, volatile	NELAP	PA	1/19/2005

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DEP Laboratory ID: 36-00037 **EPA Lab Code: PA00009** **TNI Code:** **(717) 656-2300**
PADWIS ID: 36037

Matrix: Non-Potable Water

Method	Revision	Analyte	Accreditation Type	Primary	Effective Date
EPA 1613	B	1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	NELAP	PA	6/30/2010
EPA 1613	B	1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	NELAP	PA	6/30/2010
EPA 1613	B	1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (1,2,3,4,6,7,8-hpcdd)	NELAP	PA	6/30/2010
EPA 1613	B	1,2,3,4,6,7,8-Heptachlorodibenzofuran (1,2,3,4,6,7,8-hpcdf)	NELAP	PA	6/30/2010
EPA 1613	B	1,2,3,4,7,8,9-Heptachlorodibenzofuran (1,2,3,4,7,8,9-hpcdf)	NELAP	PA	6/30/2010
EPA 1613	B	1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	NELAP	PA	6/30/2010
EPA 1613	B	1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF)	NELAP	PA	6/30/2010
EPA 1613	B	1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	NELAP	PA	6/30/2010
EPA 1613	B	1,2,3,6,7,8-Hexachlorodibenzofuran (HxCDF)	NELAP	PA	6/30/2010
EPA 1613	B	1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (HxCDD)	NELAP	PA	6/30/2010
EPA 1613	B	1,2,3,7,8,9-Hexachlorodibenzofuran (HxCDF)	NELAP	PA	6/30/2010
EPA 1613	B	1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD)	NELAP	PA	6/30/2010
EPA 1613	B	1,2,3,7,8-Pentachlorodibenzofuran (PeCDF)	NELAP	PA	6/30/2010
EPA 1613	B	2,3,4,6,7,8-Hexachlorodibenzofuran (HxCDF)	NELAP	PA	6/30/2010
EPA 1613	B	2,3,4,7,8-Pentachlorodibenzofuran (PeCDF)	NELAP	PA	6/30/2010
EPA 1613	B	2,3,7,8-Tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD)(Dioxin)	NELAP	PA	6/30/2010
EPA 1613	B	2,3,7,8-Tetrachlorodibenzofuran (TCDF)	NELAP	PA	6/30/2010
EPA 1613	B	Total heptachlorodibenzo-p-dioxin (HpCDD)	NELAP	PA	8/6/2010
EPA 1613	B	Total heptachlorodibenzofuran (HpCDF)	NELAP	PA	8/6/2010
EPA 1613	B	Total hexachlorodibenzo-p-dioxin (HxCDD)	NELAP	PA	8/6/2010
EPA 1613	B	Total hexachlorodibenzofuran (HxCDF)	NELAP	PA	8/6/2010
EPA 1613	B	Total pentachlorodibenzo-p-dioxin (PeCDD)	NELAP	PA	8/6/2010
EPA 1613	B	Total pentachlorodibenzofuran (PeCDF)	NELAP	PA	8/6/2010
EPA 1613	B	Total tetrachlorodibenzo-p-dioxin (TCDD)	NELAP	PA	8/6/2010
EPA 1613	B	Total tetrachlorodibenzofuran (TCDF)	NELAP	PA	8/6/2010
EPA 1625	C	N-Nitrosodimethylamine	NELAP	PA	11/23/2010
EPA 1631	E	Mercury	NELAP	PA	10/16/2014
EPA 1664	A	Non-polar material	NELAP	PA	11/17/2006
EPA 1664	A	Oil and grease	NELAP	PA	1/19/2005
EPA 1664	B	Oil and grease	NELAP	PA	1/27/2014
EPA 1666	A	4-Methyl-2-pentanone (MIBK)	NELAP	PA	12/12/2005
EPA 1666	A	Diisopropyl ether (DIPE)	NELAP	PA	1/19/2005
EPA 1666	A	Ethyl acetate	NELAP	PA	1/19/2005

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Laboratory Scope of Accreditation

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DEP Laboratory ID: 36-00037 **EPA Lab Code: PA00009** **TNI Code:** **(717) 656-2300**
PADWIS ID: 36037

Matrix: Non-Potable Water

Method	Revision	Analyte	Accreditation Type	Primary	Effective Date
EPA 1666	A	Isobutyraldehyde	NELAP	PA	1/19/2005
EPA 1666	A	Isopropyl acetate	NELAP	PA	1/19/2005
EPA 1666	A	Isopropyl alcohol (2-Propanol)	NELAP	PA	12/2/2009
EPA 1666	A	Methyl formate	NELAP	PA	1/19/2005
EPA 1666	A	Tetrahydrofuran (THF)	NELAP	PA	1/19/2005
EPA 1666	A	Xylenes, total	NELAP	PA	1/19/2005
EPA 1666	A	n-Amyl acetate (n-Pentyl acetate)	NELAP	PA	4/4/2005
EPA 1666	A	n-Amyl alcohol (1-Pentanol)	NELAP	PA	4/4/2005
EPA 1666	A	n-Butyl acetate	NELAP	PA	4/4/2005
EPA 1666	A	n-Heptane	NELAP	PA	1/19/2005
EPA 1666	A	n-Hexane	NELAP	PA	1/19/2005
EPA 1666	A	tert-Butyl alcohol (2-Methyl-2-propanol)	NELAP	PA	4/4/2005
EPA 1668		2,2',3,3',4,4',5,5',6-Nonachlorobiphenyl (BZ 206)	NELAP	PA	2/1/2013
EPA 1668		2,2',3,3',4,4',5,5'-Octachlorobiphenyl (BZ 194)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,3',4,4',5,6'-Octachlorobiphenyl (BZ 196)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,3',4,4',5,6,6'-Nonachlorobiphenyl (BZ 207)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,3',4,4',5,6-Octachlorobiphenyl (BZ 195)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,3',4,4',5-Heptachlorobiphenyl (BZ 170)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,3',4,4',6,6'-Octachlorobiphenyl (BZ 197)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,3',4,4',6-Heptachlorobiphenyl (BZ 171)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,3',4,4'-Hexachlorobiphenyl (BZ 128)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,3',4,5',6'-Heptachlorobiphenyl (BZ 177)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,3',4,5',6,6'-Octachlorobiphenyl (BZ 201)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,3',4,5',6-Heptachlorobiphenyl (BZ 175)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,3',4,5'-Hexachlorobiphenyl (BZ 130)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,3',4,5,5',6'-Octachlorobiphenyl (BZ 199)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,3',4,5,5',6,6'-Nonachlorobiphenyl (BZ 208)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,3',4,5,5',6-Octachlorobiphenyl (BZ 198)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,3',4,5,5'-Heptachlorobiphenyl (BZ 172)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,3',4,5,6'-Heptachlorobiphenyl (BZ 174)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,3',4,5,6,6'-Octachlorobiphenyl (BZ 200)	NELAP	PA	12/17/2012

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DEP Laboratory ID: 36-00037 **EPA Lab Code: PA00009** **TNI Code:** **(717) 656-2300**
PADWIS ID: 36037

Matrix: Non-Potable Water

Method	Revision	Analyte	Accreditation Type	Primary	Effective Date
EPA 1668		2,2',3,3',4,5,6-Heptachlorobiphenyl (BZ 173)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,3',4,5-Hexachlorobiphenyl (BZ 129)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,3',4,6'-Hexachlorobiphenyl (BZ 132)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,3',4,6,6'-Heptachlorobiphenyl (BZ 176)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,3',4,6-Hexachlorobiphenyl (BZ 131)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,3',4-Pentachlorobiphenyl (BZ 82)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,3',5,5',6,6'-Octachlorobiphenyl (BZ 202)	NELAP	PA	2/1/2013
EPA 1668		2,2',3,3',5,5',6-Heptachlorobiphenyl (BZ 178)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,3',5,5'-Hexachlorobiphenyl (BZ 133)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,3',5,6'-Hexachlorobiphenyl (BZ 135)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,3',5,6,6'-Heptachlorobiphenyl (BZ 179)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,3',5,6-Hexachlorobiphenyl (BZ 134)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,3',5-Pentachlorobiphenyl (BZ 83)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,3',6,6'-Hexachlorobiphenyl (BZ 136)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,3',6-Pentachlorobiphenyl (BZ 84)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,3'-Tetrachlorobiphenyl (BZ 40)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,4',5',6-Hexachlorobiphenyl (BZ 149)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,4',5'-Pentachlorobiphenyl (BZ 97)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,4',5,5',6-Heptachlorobiphenyl (BZ 187)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,4',5,5'-Hexachlorobiphenyl (BZ 146)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,4',5,6'-Hexachlorobiphenyl (BZ 148)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,4',5,6,6'-Heptachlorobiphenyl (BZ 188)	NELAP	PA	2/1/2013
EPA 1668		2,2',3,4',5,6-Hexachlorobiphenyl (BZ 147)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,4',5-Pentachlorobiphenyl (BZ 90)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,4',6'-Pentachlorobiphenyl (BZ 98)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,4',6,6'-Hexachlorobiphenyl (BZ 150)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,4',6-Pentachlorobiphenyl (BZ 91)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,4'-Tetrachlorobiphenyl (BZ 42)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,4,4',5',6-Heptachlorobiphenyl (BZ 183)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,4,4',5'-Hexachlorobiphenyl (BZ 138)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,4,4',5,5',6-Octachlorobiphenyl (BZ 203)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,4,4',5,5'-Heptachlorobiphenyl (BZ 180)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,4,4',5,6'-Heptachlorobiphenyl (BZ 182)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,4,4',5,6,6'-Octachlorobiphenyl (BZ 204)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,4,4',5,6-Heptachlorobiphenyl (BZ 181)	NELAP	PA	12/17/2012

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DEP Laboratory ID: 36-00037 **EPA Lab Code: PA00009** **TNI Code:** **(717) 656-2300**
PADWIS ID: 36037

Matrix: Non-Potable Water

Method	Revision	Analyte	Accreditation Type	Primary	Effective Date
EPA 1668		2,2',3,4,4',5-Hexachlorobiphenyl (BZ 137)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,4,4',6'-Hexachlorobiphenyl (BZ 140)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,4,4',6,6'-Heptachlorobiphenyl (BZ 184)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,4,4',6-Hexachlorobiphenyl (BZ 139)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,4,4'-Pentachlorobiphenyl (BZ 85)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,4,5',6-Hexachlorobiphenyl (BZ 144)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,4,5'-Pentachlorobiphenyl (BZ 87)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,4,5,5',6-Heptachlorobiphenyl (BZ 185)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,4,5,5'-Hexachlorobiphenyl (BZ 141)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,4,5,6'-Hexachlorobiphenyl (BZ 143)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,4,5,6,6'-Heptachlorobiphenyl (BZ 186)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,4,5,6-Hexachlorobiphenyl (BZ 142)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,4,5-Pentachlorobiphenyl (BZ 86)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,4,6'-Pentachlorobiphenyl (BZ 89)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,4,6,6'-Hexachlorobiphenyl (BZ 145)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,4,6-Pentachlorobiphenyl (BZ 88)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,4-Tetrachlorobiphenyl (BZ 41)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,5',6-Pentachlorobiphenyl (BZ 95)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,5'-Tetrachlorobiphenyl (BZ 44)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,5,5',6-Hexachlorobiphenyl (BZ 151)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,5,5'-Pentachlorobiphenyl (BZ 92)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,5,6'-Pentachlorobiphenyl (BZ 94)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,5,6,6'-Hexachlorobiphenyl (BZ 152)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,5,6-Pentachlorobiphenyl (BZ 93)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,5-Tetrachlorobiphenyl (BZ 43)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,6'-Tetrachlorobiphenyl (BZ 46)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,6,6'-Pentachlorobiphenyl (BZ 96)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,6-Tetrachlorobiphenyl (BZ 45)	NELAP	PA	12/17/2012
EPA 1668		2,2',3-Trichlorobiphenyl (BZ 16)	NELAP	PA	12/17/2012
EPA 1668		2,2',4,4',5,5'-Hexachlorobiphenyl (BZ 153)	NELAP	PA	12/17/2012
EPA 1668		2,2',4,4',5,6'-Hexachlorobiphenyl (BZ 154)	NELAP	PA	12/17/2012
EPA 1668		2,2',4,4',5-Pentachlorobiphenyl (BZ 99)	NELAP	PA	12/17/2012
EPA 1668		2,2',4,4',6,6'-Hexachlorobiphenyl (BZ 155)	NELAP	PA	12/17/2012
EPA 1668		2,2',4,4',6-Pentachlorobiphenyl (BZ 100)	NELAP	PA	12/17/2012
EPA 1668		2,2',4,4'-Tetrachlorobiphenyl (BZ 47)	NELAP	PA	12/17/2012
EPA 1668		2,2',4,5',6-Pentachlorobiphenyl (BZ 103)	NELAP	PA	12/17/2012
EPA 1668		2,2',4,5'-Tetrachlorobiphenyl (BZ 49)	NELAP	PA	12/17/2012
EPA 1668		2,2',4,5,5'-Pentachlorobiphenyl (BZ 101)	NELAP	PA	12/17/2012
EPA 1668		2,2',4,5,6'-Pentachlorobiphenyl (BZ 102)	NELAP	PA	12/17/2012
EPA 1668		2,2',4,5-Tetrachlorobiphenyl (BZ 48)	NELAP	PA	12/17/2012
EPA 1668		2,2',4,6'-Tetrachlorobiphenyl (BZ 51)	NELAP	PA	12/17/2012
EPA 1668		2,2',4,6,6'-Pentachlorobiphenyl (BZ 104)	NELAP	PA	2/1/2013
EPA 1668		2,2',4,6-Tetrachlorobiphenyl (BZ 50)	NELAP	PA	12/17/2012

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DEPARTMENT OF ENVIRONMENTAL PROTECTION

Laboratory Scope of Accreditation

Attached to Certificate of Accreditation 014-006 expiration date January 31, 2016. This listing of accredited analytes should be used only when associated with a valid certificate of accreditation.

DEP Laboratory ID: 36-00037 **EPA Lab Code: PA00009** **TNI Code:** **(717) 656-2300**
PADWIS ID: 36037

Matrix: Non-Potable Water

Method	Revision	Analyte	Accreditation Type	Primary	Effective Date
EPA 1668		2,2',4-Trichlorobiphenyl (BZ 17)	NELAP	PA	12/17/2012
EPA 1668		2,2',5,5'-Tetrachlorobiphenyl (BZ 52)	NELAP	PA	12/17/2012
EPA 1668		2,2',5,6'-Tetrachlorobiphenyl (BZ 53)	NELAP	PA	12/17/2012
EPA 1668		2,2',5-Trichlorobiphenyl (BZ 18)	NELAP	PA	12/17/2012
EPA 1668		2,2',6,6'-Tetrachlorobiphenyl (BZ 54)	NELAP	PA	12/17/2012
EPA 1668		2,2',6-Trichlorobiphenyl (BZ 19)	NELAP	PA	12/17/2012
EPA 1668		2,2'-Dichlorobiphenyl (BZ 4)	NELAP	PA	12/17/2012
EPA 1668		2,3',4',5',6-Pentachlorobiphenyl (BZ 125)	NELAP	PA	12/17/2012
EPA 1668		2,3',4',5'-Tetrachlorobiphenyl (BZ 76)	NELAP	PA	12/17/2012
EPA 1668		2,3',4',5,5'-Pentachlorobiphenyl (BZ 124)	NELAP	PA	12/17/2012
EPA 1668		2,3',4',5-Tetrachlorobiphenyl (BZ 70)	NELAP	PA	12/17/2012
EPA 1668		2,3',4',6-Tetrachlorobiphenyl (BZ 71)	NELAP	PA	12/17/2012
EPA 1668		2,3',4'-Trichlorobiphenyl (BZ 33)	NELAP	PA	12/17/2012
EPA 1668		2,3',4,4',5',6-Hexachlorobiphenyl (BZ 168)	NELAP	PA	12/17/2012
EPA 1668		2,3',4,4',5'-Pentachlorobiphenyl (BZ 123)	NELAP	PA	12/17/2012
EPA 1668		2,3',4,4',5,5'-Hexachlorobiphenyl (BZ 167)	NELAP	PA	12/17/2012
EPA 1668		2,3',4,4',5-Pentachlorobiphenyl (BZ 118)	NELAP	PA	12/17/2012
EPA 1668		2,3',4,4',6-Pentachlorobiphenyl (BZ 119)	NELAP	PA	12/17/2012
EPA 1668		2,3',4,4'-Tetrachlorobiphenyl (BZ 66)	NELAP	PA	12/17/2012
EPA 1668		2,3',4,5',6-Pentachlorobiphenyl (BZ 121)	NELAP	PA	12/17/2012
EPA 1668		2,3',4,5'-Tetrachlorobiphenyl (BZ 68)	NELAP	PA	12/17/2012
EPA 1668		2,3',4,5,5'-Pentachlorobiphenyl (BZ 120)	NELAP	PA	12/17/2012
EPA 1668		2,3',4,5-Tetrachlorobiphenyl (BZ 67)	NELAP	PA	12/17/2012
EPA 1668		2,3',4,6-Tetrachlorobiphenyl (BZ 69)	NELAP	PA	12/17/2012
EPA 1668		2,3',4-Trichlorobiphenyl (BZ 25)	NELAP	PA	12/17/2012
EPA 1668		2,3',5',6-Tetrachlorobiphenyl (BZ 73)	NELAP	PA	12/17/2012
EPA 1668		2,3',5'-Trichlorobiphenyl (BZ 34)	NELAP	PA	12/17/2012
EPA 1668		2,3',5,5'-Tetrachlorobiphenyl (BZ 72)	NELAP	PA	12/17/2012
EPA 1668		2,3',5-Trichlorobiphenyl (BZ 26)	NELAP	PA	12/17/2012
EPA 1668		2,3',6-Trichlorobiphenyl (BZ 27)	NELAP	PA	12/17/2012
EPA 1668		2,3'-Dichlorobiphenyl (BZ 6)	NELAP	PA	12/17/2012
EPA 1668		2,3,3',4',5',6-Hexachlorobiphenyl (BZ 164)	NELAP	PA	12/17/2012
EPA 1668		2,3,3',4',5'-Pentachlorobiphenyl (BZ 122)	NELAP	PA	12/17/2012
EPA 1668		2,3,3',4',5,5',6-Heptachlorobiphenyl (BZ 193)	NELAP	PA	12/17/2012
EPA 1668		2,3,3',4',5,5'-Hexachlorobiphenyl (BZ 162)	NELAP	PA	12/17/2012
EPA 1668		2,3,3',4',5,6-Hexachlorobiphenyl (BZ 163)	NELAP	PA	12/17/2012
EPA 1668		2,3,3',4',5-Pentachlorobiphenyl (BZ 107)	NELAP	PA	12/17/2012
EPA 1668		2,3,3',4',6-Pentachlorobiphenyl (BZ 110)	NELAP	PA	12/17/2012
EPA 1668		2,3,3',4'-Tetrachlorobiphenyl (BZ 56)	NELAP	PA	12/17/2012
EPA 1668		2,3,3',4,4',5',6-Heptachlorobiphenyl (BZ 191)	NELAP	PA	12/17/2012
EPA 1668		2,3,3',4,4',5'-Hexachlorobiphenyl (BZ 157)	NELAP	PA	12/17/2012
EPA 1668		2,3,3',4,4',5,5',6-Octachlorobiphenyl (BZ 205)	NELAP	PA	2/1/2013

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Laboratory Scope of Accreditation

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DEP Laboratory ID: 36-00037 **EPA Lab Code: PA00009** **TNI Code:** **(717) 656-2300**
PADWIS ID: 36037

Matrix: Non-Potable Water

Method	Revision	Analyte	Accreditation Type	Primary	Effective Date
EPA 1668		2,3,3',4,4',5,5'-Heptachlorobiphenyl (BZ 189)	NELAP	PA	12/17/2012
EPA 1668		2,3,3',4,4',5,6-Heptachlorobiphenyl (BZ 190)	NELAP	PA	12/17/2012
EPA 1668		2,3,3',4,4',5-Hexachlorobiphenyl (BZ 156)	NELAP	PA	12/17/2012
EPA 1668		2,3,3',4,4',6-Hexachlorobiphenyl (BZ 158)	NELAP	PA	12/17/2012
EPA 1668		2,3,3',4,4'-Pentachlorobiphenyl (BZ 105)	NELAP	PA	12/17/2012
EPA 1668		2,3,3',4,5',6-Hexachlorobiphenyl (BZ 161)	NELAP	PA	12/17/2012
EPA 1668		2,3,3',4,5'-Pentachlorobiphenyl (BZ 108)	NELAP	PA	12/17/2012
EPA 1668		2,3,3',4,5,5',6-Heptachlorobiphenyl (BZ 192)	NELAP	PA	12/17/2012
EPA 1668		2,3,3',4,5,5'-Hexachlorobiphenyl (BZ 159)	NELAP	PA	12/17/2012
EPA 1668		2,3,3',4,5,6-Hexachlorobiphenyl (BZ 160)	NELAP	PA	12/17/2012
EPA 1668		2,3,3',4,5-Pentachlorobiphenyl (BZ 106)	NELAP	PA	12/17/2012
EPA 1668		2,3,3',4,6-Pentachlorobiphenyl (BZ 109)	NELAP	PA	12/17/2012
EPA 1668		2,3,3',4-Tetrachlorobiphenyl (BZ 55)	NELAP	PA	12/17/2012
EPA 1668		2,3,3',5',6-Pentachlorobiphenyl (BZ 113)	NELAP	PA	12/17/2012
EPA 1668		2,3,3',5'-Tetrachlorobiphenyl (BZ 58)	NELAP	PA	12/17/2012
EPA 1668		2,3,3',5,5',6-Hexachlorobiphenyl (BZ 165)	NELAP	PA	12/17/2012
EPA 1668		2,3,3',5,5'-Pentachlorobiphenyl (BZ 111)	NELAP	PA	12/17/2012
EPA 1668		2,3,3',5,6-Pentachlorobiphenyl (BZ 112)	NELAP	PA	12/17/2012
EPA 1668		2,3,3',5-Tetrachlorobiphenyl (BZ 57)	NELAP	PA	12/17/2012
EPA 1668		2,3,3',6-Tetrachlorobiphenyl (BZ 59)	NELAP	PA	12/17/2012
EPA 1668		2,3,3'-Trichlorobiphenyl (BZ 20)	NELAP	PA	12/17/2012
EPA 1668		2,3,4',5,6-Pentachlorobiphenyl (BZ 117)	NELAP	PA	12/17/2012
EPA 1668		2,3,4',5-Tetrachlorobiphenyl (BZ 63)	NELAP	PA	12/17/2012
EPA 1668		2,3,4',6-Tetrachlorobiphenyl (BZ 64)	NELAP	PA	12/17/2012
EPA 1668		2,3,4'-Trichlorobiphenyl (BZ 22)	NELAP	PA	12/17/2012
EPA 1668		2,3,4,4',5,6-Hexachlorobiphenyl (BZ 166)	NELAP	PA	12/17/2012
EPA 1668		2,3,4,4',5-Pentachlorobiphenyl (BZ 114)	NELAP	PA	12/17/2012
EPA 1668		2,3,4,4',6-Pentachlorobiphenyl (BZ 115)	NELAP	PA	12/17/2012
EPA 1668		2,3,4,4'-Tetrachlorobiphenyl (BZ 60)	NELAP	PA	12/17/2012
EPA 1668		2,3,4,5,6-Pentachlorobiphenyl (BZ 116)	NELAP	PA	12/17/2012
EPA 1668		2,3,4,5-Tetrachlorobiphenyl (BZ 61)	NELAP	PA	12/17/2012
EPA 1668		2,3,4,6-Tetrachlorobiphenyl (BZ 62)	NELAP	PA	12/17/2012
EPA 1668		2,3,4-Trichlorobiphenyl (BZ 21)	NELAP	PA	12/17/2012
EPA 1668		2,3,5,6-Tetrachlorobiphenyl (BZ 65)	NELAP	PA	12/17/2012
EPA 1668		2,3,5-Trichlorobiphenyl (BZ 23)	NELAP	PA	12/17/2012
EPA 1668		2,3,6-Trichlorobiphenyl (BZ 24)	NELAP	PA	12/17/2012
EPA 1668		2,3-Dichlorobiphenyl (BZ 5)	NELAP	PA	12/17/2012
EPA 1668		2,4',5-Trichlorobiphenyl (BZ 31)	NELAP	PA	12/17/2012
EPA 1668		2,4',6-Trichlorobiphenyl (BZ 32)	NELAP	PA	12/17/2012
EPA 1668		2,4'-Dichlorobiphenyl (BZ 8)	NELAP	PA	12/17/2012
EPA 1668		2,4,4',5-Tetrachlorobiphenyl (BZ 74)	NELAP	PA	12/17/2012
EPA 1668		2,4,4',6-Tetrachlorobiphenyl (BZ 75)	NELAP	PA	12/17/2012
EPA 1668		2,4,4'-Trichlorobiphenyl (BZ 28)	NELAP	PA	12/17/2012

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www.dep.state.pa.us **Issue Date: 07/29/2015**

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DEPARTMENT OF ENVIRONMENTAL PROTECTION

Laboratory Scope of Accreditation

Attached to Certificate of Accreditation 014-006 expiration date January 31, 2016. This listing of accredited analytes should be used only when associated with a valid certificate of accreditation.

DEP Laboratory ID: 36-00037 **EPA Lab Code: PA00009** **TNI Code:** **(717) 656-2300**
PADWIS ID: 36037

Matrix: Non-Potable Water

Method	Revision	Analyte	Accreditation Type	Primary	Effective Date
EPA 1668		2,4,5-Trichlorobiphenyl (BZ 29)	NELAP	PA	12/17/2012
EPA 1668		2,4,6-Trichlorobiphenyl (BZ 30)	NELAP	PA	12/17/2012
EPA 1668		2,4-Dichlorobiphenyl (BZ 7)	NELAP	PA	12/17/2012
EPA 1668		2,5-Dichlorobiphenyl (BZ 9)	NELAP	PA	12/17/2012
EPA 1668		2,6-Dichlorobiphenyl (BZ 10)	NELAP	PA	12/17/2012
EPA 1668		2-Chlorobiphenyl (BZ 1)	NELAP	PA	12/17/2012
EPA 1668		3,3',4,4',5,5'-Hexachlorobiphenyl (BZ 169)	NELAP	PA	12/17/2012
EPA 1668		3,3',4,4',5-Pentachlorobipbenyl (BZ 126)	NELAP	PA	12/17/2012
EPA 1668		3,3',4,4'-Tetrachlorobiphenyl (BZ 77)	NELAP	PA	12/17/2012
EPA 1668		3,3',4,5'-Tetrachlorobiphenyl (BZ 79)	NELAP	PA	12/17/2012
EPA 1668		3,3',4,5,5'-Pentachlorobiphenyl (BZ 127)	NELAP	PA	12/17/2012
EPA 1668		3,3',4,5-Tetrachlorobiphenyl (BZ 78)	NELAP	PA	12/17/2012
EPA 1668		3,3',4-Trichlorobiphenyl (BZ 35)	NELAP	PA	12/17/2012
EPA 1668		3,3',5,5'-Tetrachlorobiphenyl (BZ 80)	NELAP	PA	12/17/2012
EPA 1668		3,3',5-Trichlorobiphenyl (BZ 36)	NELAP	PA	12/17/2012
EPA 1668		3,3'-Dichlorobiphenyl (BZ 11)	NELAP	PA	12/17/2012
EPA 1668		3,4',5-Tricblorobiphenyl (BZ 39)	NELAP	PA	12/17/2012
EPA 1668		3,4'-Dichlorobiphenyl (BZ 13)	NELAP	PA	12/17/2012
EPA 1668		3,4,4',5-Tetrachlorobiphenyl (BZ 81)	NELAP	PA	12/17/2012
EPA 1668		3,4,4'-Trichlorobiphenyl (BZ 37)	NELAP	PA	12/17/2012
EPA 1668		3,4,5-Trichlorobipbenyl (BZ 38)	NELAP	PA	12/17/2012
EPA 1668		3,4-Dichlorobiphenyl (BZ 12)	NELAP	PA	12/17/2012
EPA 1668		3,5-Dichlorobiphenyl (BZ 14)	NELAP	PA	12/17/2012
EPA 1668		3-Chlorobiphenyl (BZ 2)	NELAP	PA	12/17/2012
EPA 1668		4,4'-Dichlorobiphenyl (BZ 15)	NELAP	PA	12/17/2012
EPA 1668		4-Chlorobiphenyl (BZ 3)	NELAP	PA	12/17/2012
EPA 1668		Decachlorobiphenyl	NELAP	PA	2/1/2013
EPA 1668	A	PCBs as congeners by HRGC/HRMS	NELAP	PA	3/4/2015
EPA 1668	C	PCBs as congeners by HRGC/HRMS	NELAP	PA	3/4/2015
EPA 1671	A	Acetonitrile	NELAP	PA	1/19/2005
EPA 1671	A	Diethylamine	NELAP	PA	1/19/2005
EPA 1671	A	Dimethyl sulfoxide	NELAP	PA	1/19/2005
EPA 1671	A	Ethanol	NELAP	PA	1/19/2005
EPA 1671	A	Methanol	NELAP	PA	1/19/2005
EPA 1671	A	Methyl cellosolve (2-Metboxyetbanol)	NELAP	PA	1/19/2005
EPA 1671	A	Triethylamine	NELAP	PA	1/19/2005
EPA 1671	A	n-Propanol (1-Propanol)	NELAP	PA	1/19/2005
EPA 170.1		Temperature, deg. C	NELAP	PA	4/4/2005
EPA 180.1		Turbidity	NELAP	PA	1/19/2005
EPA 200.2		Metals sample preparation	NELAP	PA	1/24/2007
EPA 200.7	4.4	Aluminum	NELAP	PA	1/19/2005
EPA 200.7	4.4	Antimony	NELAP	PA	1/19/2005
EPA 200.7	4.4	Arsenic	NELAP	PA	1/19/2005
EPA 200.7	4.4	Barium	NELAP	PA	1/19/2005
EPA 200.7	4.4	Beryllium	NELAP	PA	1/19/2005

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Laboratory Scope of Accreditation

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DEP Laboratory ID: 36-00037 **EPA Lab Code: PA00009** **TNI Code:** **(717) 656-2300**
PADWIS ID: 36037

Matrix: Non-Potable Water

Method	Revision	Analyte	Accreditation Type	Primary	Effective Date
EPA 200.7	4.4	Boron	NELAP	PA	1/19/2005
EPA 200.7	4.4	Cadmium	NELAP	PA	1/19/2005
EPA 200.7	4.4	Calcium	NELAP	PA	1/19/2005
EPA 200.7	4.4	Chromium	NELAP	PA	1/19/2005
EPA 200.7	4.4	Cobalt	NELAP	PA	1/19/2005
EPA 200.7	4.4	Copper	NELAP	PA	1/19/2005
EPA 200.7	4.4	Iron	NELAP	PA	1/19/2005
EPA 200.7	4.4	Lead	NELAP	PA	1/19/2005
EPA 200.7	4.4	Lithium	NELAP	PA	2/7/2012
EPA 200.7	4.4	Magnesium	NELAP	PA	1/19/2005
EPA 200.7	4.4	Manganese	NELAP	PA	1/19/2005
EPA 200.7	4.4	Molybdenum	NELAP	PA	1/19/2005
EPA 200.7	4.4	Nickel	NELAP	PA	1/19/2005
EPA 200.7	4.4	Potassium	NELAP	PA	1/19/2005
EPA 200.7	4.4	Selenium	NELAP	PA	1/19/2005
EPA 200.7	4.4	Silver	NELAP	PA	4/4/2005
EPA 200.7	4.4	Sodium	NELAP	PA	1/19/2005
EPA 200.7	4.4	Strontium	NELAP	PA	5/24/2011
EPA 200.7	4.4	Thallium	NELAP	PA	1/19/2005
EPA 200.7	4.4	Tin	NELAP	PA	1/19/2005
EPA 200.7	4.4	Titanium	NELAP	PA	1/19/2005
EPA 200.7	4.4	Vanadium	NELAP	PA	1/19/2005
EPA 200.7	4.4	Zinc	NELAP	PA	1/19/2005
EPA 200.7	4.4	Zirconium	NELAP	PA	7/29/2015
EPA 200.8	5.4	Aluminum	NELAP	PA	1/7/2010
EPA 200.8	5.4	Antimony	NELAP	PA	4/4/2005
EPA 200.8	5.4	Arsenic	NELAP	PA	4/4/2005
EPA 200.8	5.4	Barium	NELAP	PA	4/4/2005
EPA 200.8	5.4	Beryllium	NELAP	PA	4/4/2005
EPA 200.8	5.4	Boron	NELAP	PA	1/11/2012
EPA 200.8	5.4	Cadmium	NELAP	PA	4/4/2005
EPA 200.8	5.4	Calcium	NELAP	PA	1/7/2010
EPA 200.8	5.4	Chromium	NELAP	PA	4/4/2005
EPA 200.8	5.4	Cobalt	NELAP	PA	11/23/2010
EPA 200.8	5.4	Copper	NELAP	PA	4/4/2005
EPA 200.8	5.4	Iron	NELAP	PA	11/23/2010
EPA 200.8	5.4	Lead	NELAP	PA	4/4/2005
EPA 200.8	5.4	Magnesium	NELAP	PA	1/7/2010
EPA 200.8	5.4	Manganese	NELAP	PA	11/23/2010
EPA 200.8	5.4	Molybdenum	NELAP	PA	1/7/2010
EPA 200.8	5.4	Nickel	NELAP	PA	4/4/2005
EPA 200.8	5.4	Potassium	NELAP	PA	1/7/2010
EPA 200.8	5.4	Selenium	NELAP	PA	12/12/2005
EPA 200.8	5.4	Silver	NELAP	PA	1/2/2007
EPA 200.8	5.4	Sodium	NELAP	PA	1/7/2010

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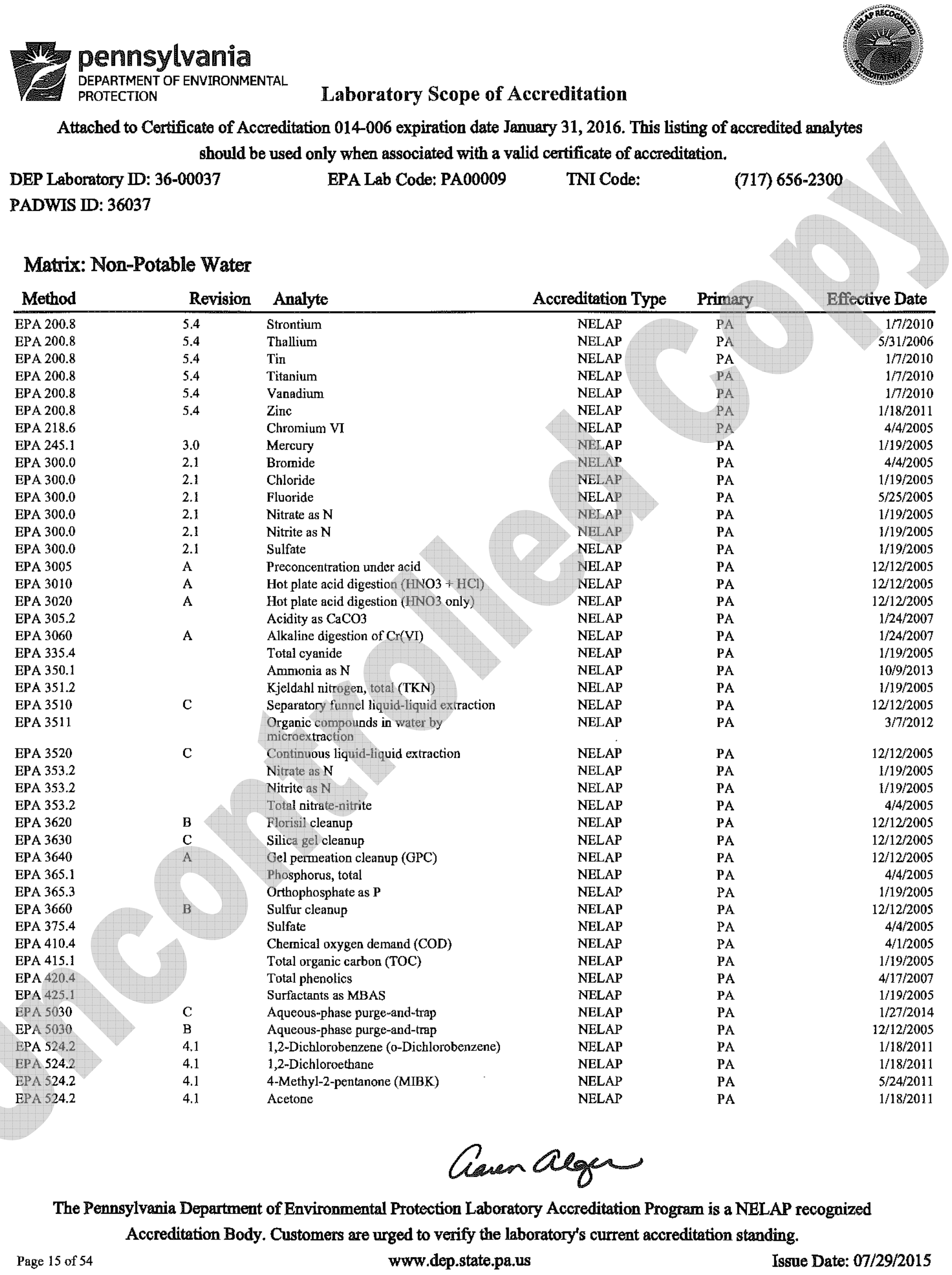

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DEPARTMENT OF ENVIRONMENTAL PROTECTION

Laboratory Scope of Accreditation

Attached to Certificate of Accreditation 014-006 expiration date January 31, 2016. This listing of accredited analytes should be used only when associated with a valid certificate of accreditation.

DEP Laboratory ID: 36-00037 **EPA Lab Code: PA00009** **TNI Code:** **(717) 656-2300**
PADWIS ID: 36037

Matrix: Non-Potable Water

Method	Revision	Analyte	Accreditation Type	Primary	Effective Date
EPA 200.8	5.4	Strontium	NELAP	PA	1/7/2010
EPA 200.8	5.4	Thallium	NELAP	PA	5/31/2006
EPA 200.8	5.4	Tin	NELAP	PA	1/7/2010
EPA 200.8	5.4	Titanium	NELAP	PA	1/7/2010
EPA 200.8	5.4	Vanadium	NELAP	PA	1/7/2010
EPA 200.8	5.4	Zinc	NELAP	PA	1/18/2011
EPA 218.6		Chromium VI	NELAP	PA	4/4/2005
EPA 245.1	3.0	Mercury	NELAP	PA	1/19/2005
EPA 300.0	2.1	Bromide	NELAP	PA	4/4/2005
EPA 300.0	2.1	Chloride	NELAP	PA	1/19/2005
EPA 300.0	2.1	Fluoride	NELAP	PA	5/25/2005
EPA 300.0	2.1	Nitrate as N	NELAP	PA	1/19/2005
EPA 300.0	2.1	Nitrite as N	NELAP	PA	1/19/2005
EPA 300.0	2.1	Sulfate	NELAP	PA	1/19/2005
EPA 3005	A	Preconcentration under acid	NELAP	PA	12/12/2005
EPA 3010	A	Hot plate acid digestion (HNO3 + HCl)	NELAP	PA	12/12/2005
EPA 3020	A	Hot plate acid digestion (HNO3 only)	NELAP	PA	12/12/2005
EPA 305.2		Acidity as CaCO3	NELAP	PA	1/24/2007
EPA 3060	A	Alkaline digestion of Cr(VI)	NELAP	PA	1/24/2007
EPA 335.4		Total cyanide	NELAP	PA	1/19/2005
EPA 350.1		Ammonia as N	NELAP	PA	10/9/2013
EPA 351.2		Kjeldahl nitrogen, total (TKN)	NELAP	PA	1/19/2005
EPA 3510	C	Separatory funnel liquid-liquid extraction	NELAP	PA	12/12/2005
EPA 3511		Organic compounds in water by microextraction	NELAP	PA	3/7/2012
EPA 3520	C	Continuous liquid-liquid extraction	NELAP	PA	12/12/2005
EPA 353.2		Nitrate as N	NELAP	PA	1/19/2005
EPA 353.2		Nitrite as N	NELAP	PA	1/19/2005
EPA 353.2		Total nitrate-nitrite	NELAP	PA	4/4/2005
EPA 3620	B	Florisil cleanup	NELAP	PA	12/12/2005
EPA 3630	C	Silica gel cleanup	NELAP	PA	12/12/2005
EPA 3640	A	Gel permeation cleanup (GPC)	NELAP	PA	12/12/2005
EPA 365.1		Phosphorus, total	NELAP	PA	4/4/2005
EPA 365.3		Orthophosphate as P	NELAP	PA	1/19/2005
EPA 3660	B	Sulfur cleanup	NELAP	PA	12/12/2005
EPA 375.4		Sulfate	NELAP	PA	4/4/2005
EPA 410.4		Chemical oxygen demand (COD)	NELAP	PA	4/1/2005
EPA 415.1		Total organic carbon (TOC)	NELAP	PA	1/19/2005
EPA 420.4		Total phenolics	NELAP	PA	4/17/2007
EPA 425.1		Surfactants as MBAS	NELAP	PA	1/19/2005
EPA 5030	C	Aqueous-phase purge-and-trap	NELAP	PA	1/27/2014
EPA 5030	B	Aqueous-phase purge-and-trap	NELAP	PA	12/12/2005
EPA 524.2	4.1	1,2-Dichlorobenzene (o-Dichlorobenzene)	NELAP	PA	1/18/2011
EPA 524.2	4.1	1,2-Dichloroethane	NELAP	PA	1/18/2011
EPA 524.2	4.1	4-Methyl-2-pentanone (MIBK)	NELAP	PA	5/24/2011
EPA 524.2	4.1	Acetone	NELAP	PA	1/18/2011

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DEPARTMENT OF ENVIRONMENTAL PROTECTION

Laboratory Scope of Accreditation

Attached to Certificate of Accreditation 014-006 expiration date January 31, 2016. This listing of accredited analytes should be used only when associated with a valid certificate of accreditation.

DEP Laboratory ID: 36-00037 **EPA Lab Code: PA00009** **TNI Code:** **(717) 656-2300**
PADWIS ID: 36037

Matrix: Non-Potable Water

Method	Revision	Analyte	Accreditation Type	Primary	Effective Date
EPA 524.2	4.1	Benzene	NELAP	PA	1/18/2011
EPA 524.2	4.1	Chlorobenzene	NELAP	PA	1/18/2011
EPA 524.2	4.1	Chloroform	NELAP	PA	1/18/2011
EPA 524.2	4.1	Methylene chloride (Dichloromethane)	NELAP	PA	5/24/2011
EPA 524.2	4.1	Tetrahydrofuran (THF)	NELAP	PA	5/24/2011
EPA 524.2	4.1	Toluene	NELAP	PA	1/18/2011
EPA 524.2	4.1	m+p-Xylene	NELAP	PA	7/25/2011
EPA 524.2	4.1	o-Xylene	NELAP	PA	5/24/2011
EPA 6010		Aluminum	NELAP	PA	12/12/2005
EPA 6010		Antimony	NELAP	PA	12/12/2005
EPA 6010		Arsenic	NELAP	PA	12/12/2005
EPA 6010		Barium	NELAP	PA	12/12/2005
EPA 6010		Beryllium	NELAP	PA	12/12/2005
EPA 6010		Boron	NELAP	PA	12/12/2005
EPA 6010		Cadmium	NELAP	PA	12/12/2005
EPA 6010		Calcium	NELAP	PA	12/12/2005
EPA 6010		Chromium	NELAP	PA	12/12/2005
EPA 6010		Cobalt	NELAP	PA	12/12/2005
EPA 6010		Copper	NELAP	PA	12/12/2005
EPA 6010		Iron	NELAP	PA	12/12/2005
EPA 6010		Lead	NELAP	PA	12/12/2005
EPA 6010		Lithium	NELAP	PA	1/18/2011
EPA 6010		Magnesium	NELAP	PA	12/12/2005
EPA 6010		Manganese	NELAP	PA	12/12/2005
EPA 6010	C	Metals by ICP/AES	NELAP	PA	3/26/2012
EPA 6010	B	Metals by ICP/AES	NELAP	PA	3/26/2012
EPA 6010		Molybdenum	NELAP	PA	12/12/2005
EPA 6010		Nickel	NELAP	PA	12/12/2005
EPA 6010		Potassium	NELAP	PA	12/12/2005
EPA 6010		Selenium	NELAP	PA	12/12/2005
EPA 6010		Silver	NELAP	PA	12/12/2005
EPA 6010		Sodium	NELAP	PA	12/12/2005
EPA 6010		Strontium	NELAP	PA	12/12/2005
EPA 6010		Sulfur	NELAP	PA	12/19/2011
EPA 6010		Thallium	NELAP	PA	12/12/2005
EPA 6010		Tin	NELAP	PA	12/12/2005
EPA 6010		Titanium	NELAP	PA	12/12/2005
EPA 6010		Vanadium	NELAP	PA	12/12/2005
EPA 6010		Zinc	NELAP	PA	12/12/2005
EPA 6010		Zirconium	NELAP	PA	7/29/2015
EPA 602		Benzene	NELAP	PA	1/19/2005
EPA 602		Ethylbenzene	NELAP	PA	1/19/2005
EPA 602		Methyl tert-butyl ether (MTBE)	NELAP	PA	1/19/2005
EPA 602		Naphthalene	NELAP	PA	1/18/2011
EPA 602		Styrene	NELAP	PA	6/24/2008

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PADWIS ID: 36037

Matrix: Non-Potable Water

Method	Revision	Analyte	Accreditation Type	Primary	Effective Date
EPA 602		Toluene	NELAP	PA	1/19/2005
EPA 602		Xylenes, total	NELAP	PA	1/19/2005
EPA 602		m+p-Xylene	NELAP	PA	1/18/2011
EPA 602		o-Xylene	NELAP	PA	1/18/2011
EPA 6020		Aluminum	NELAP	PA	1/7/2010
EPA 6020		Antimony	NELAP	PA	12/12/2005
EPA 6020		Arsenic	NELAP	PA	12/12/2005
EPA 6020		Barium	NELAP	PA	12/12/2005
EPA 6020		Beryllium	NELAP	PA	12/12/2005
EPA 6020		Boron	NELAP	PA	1/11/2012
EPA 6020		Cadmium	NELAP	PA	12/12/2005
EPA 6020		Calcium	NELAP	PA	1/7/2010
EPA 6020		Chromium	NELAP	PA	12/12/2005
EPA 6020		Cobalt	NELAP	PA	11/23/2010
EPA 6020		Copper	NELAP	PA	12/12/2005
EPA 6020		Iron	NELAP	PA	11/23/2010
EPA 6020		Lead	NELAP	PA	12/12/2005
EPA 6020		Magnesium	NELAP	PA	1/7/2010
EPA 6020		Manganese	NELAP	PA	11/23/2010
EPA 6020	A	Metals by ICP/MS	NELAP	PA	3/26/2012
EPA 6020		Molybdenum	NELAP	PA	1/7/2010
EPA 6020		Nickel	NELAP	PA	7/23/2008
EPA 6020		Potassium	NELAP	PA	1/7/2010
EPA 6020		Selenium	NELAP	PA	12/12/2005
EPA 6020		Silver	NELAP	PA	1/12/2007
EPA 6020		Sodium	NELAP	PA	1/7/2010
EPA 6020		Strontium	NELAP	PA	1/7/2010
EPA 6020		Thallium	NELAP	PA	12/12/2005
EPA 6020		Tin	NELAP	PA	1/7/2010
EPA 6020		Titanium	NELAP	PA	1/7/2010
EPA 6020		Vanadium	NELAP	PA	1/7/2010
EPA 6020		Zinc	NELAP	PA	1/18/2011
EPA 608		4,4'-DDD	NELAP	PA	1/19/2005
EPA 608		4,4'-DDE	NELAP	PA	1/19/2005
EPA 608		4,4'-DDT	NELAP	PA	1/19/2005
EPA 608		Aldrin (HHDN)	NELAP	PA	1/19/2005
EPA 608		Aroclor-1016 (PCB-1016)	NELAP	PA	12/11/2006
EPA 608		Aroclor-1221 (PCB-1221)	NELAP	PA	12/11/2006
EPA 608		Aroclor-1232 (PCB-1232)	NELAP	PA	12/11/2006
EPA 608		Aroclor-1242 (PCB-1242)	NELAP	PA	12/11/2006
EPA 608		Aroclor-1248 (PCB-1248)	NELAP	PA	12/11/2006
EPA 608		Aroclor-1254 (PCB-1254)	NELAP	PA	12/11/2006
EPA 608		Aroclor-1260 (PCB-1260)	NELAP	PA	12/11/2006
EPA 608		Aroclor-1268 (PCB-1268)	NELAP	PA	11/13/2012
EPA 608		Chlordane (tech.)	NELAP	PA	1/19/2005

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PADWIS ID: 36037

Matrix: Non-Potable Water

Method	Revision	Analyte	Accreditation Type	Primary	Effective Date
EPA 608		Dieldrin	NELAP	PA	1/19/2005
EPA 608		Endosulfan I	NELAP	PA	1/19/2005
EPA 608		Endosulfan II	NELAP	PA	1/19/2005
EPA 608		Endosulfan sulfate	NELAP	PA	1/19/2005
EPA 608		Endrin	NELAP	PA	1/19/2005
EPA 608		Endrin aldehyde	NELAP	PA	1/19/2005
EPA 608		Heptachlor	NELAP	PA	1/19/2005
EPA 608		Heptachlor epoxide	NELAP	PA	1/19/2005
EPA 608		Methoxychlor	NELAP	PA	5/2/2006
EPA 608		Mirex	NELAP	PA	11/13/2012
EPA 608		Toxaphene (Chlorinated camphene)	NELAP	PA	1/19/2005
EPA 608		alpha-BHC (alpha-Hexachlorocyclohexane)	NELAP	PA	1/19/2005
EPA 608		beta-BHC (beta-Hexachlorocyclohexane)	NELAP	PA	1/19/2005
EPA 608		delta-BHC (delta-Hexachlorocyclohexane)	NELAP	PA	1/19/2005
EPA 608		gamma-BHC (Lindane, gamma-Hexachlorocyclohexane)	NELAP	PA	1/19/2005
EPA 622		Azinphos-methyl (Guthion)	NELAP	PA	6/15/2009
EPA 622		Bolstar (Sulprofos)	NELAP	PA	6/15/2009
EPA 622		Carbophenothion (Trithion)	NELAP	PA	4/28/2010
EPA 622		Chlorpyrifos	NELAP	PA	6/15/2009
EPA 622		Coumaphos	NELAP	PA	6/15/2009
EPA 622		Demeton-O	NELAP	PA	6/15/2009
EPA 622		Demeton-S	NELAP	PA	6/15/2009
EPA 622		Diazinon (Spectracide)	NELAP	PA	6/15/2009
EPA 622		Dichlorovos (DDVP, Dichlorvos)	NELAP	PA	6/15/2009
EPA 622		Disulfoton	NELAP	PA	6/15/2009
EPA 622		EPN (Santox)	NELAP	PA	6/15/2009
EPA 622		Ethion	NELAP	PA	6/15/2009
EPA 622		Ethoprop (Prophos)	NELAP	PA	6/15/2009
EPA 622		Famphur	NELAP	PA	6/15/2009
EPA 622		Fensulfothion	NELAP	PA	6/15/2009
EPA 622		Fenthion	NELAP	PA	6/15/2009
EPA 622		Malathion	NELAP	PA	6/15/2009
EPA 622		Merphos	NELAP	PA	6/15/2009
EPA 622		Methyl parathion (Parathion, methyl)	NELAP	PA	6/15/2009
EPA 622		Mevinphos	NELAP	PA	6/15/2009
EPA 622		Naled	NELAP	PA	6/15/2009
EPA 622		Parathion, ethyl (Ethyl parathion, Parathion)	NELAP	PA	6/15/2009
EPA 622		Phorate (Thimet)	NELAP	PA	6/15/2009
EPA 622		Ronnel	NELAP	PA	6/15/2009
EPA 622		Stirophos (Tetrachlorovinphos)	NELAP	PA	6/15/2009
EPA 622		Tokuthion (Prothiophos)	NELAP	PA	6/15/2009
EPA 622		Trichloronate	NELAP	PA	6/15/2009
EPA 624		1,1,1,2-Tetrachloroethane	NELAP	PA	1/19/2005
EPA 624		1,1,1-Trichloroethane	NELAP	PA	1/19/2005
EPA 624		1,1,2,2-Tetrachloroethane	NELAP	PA	1/19/2005

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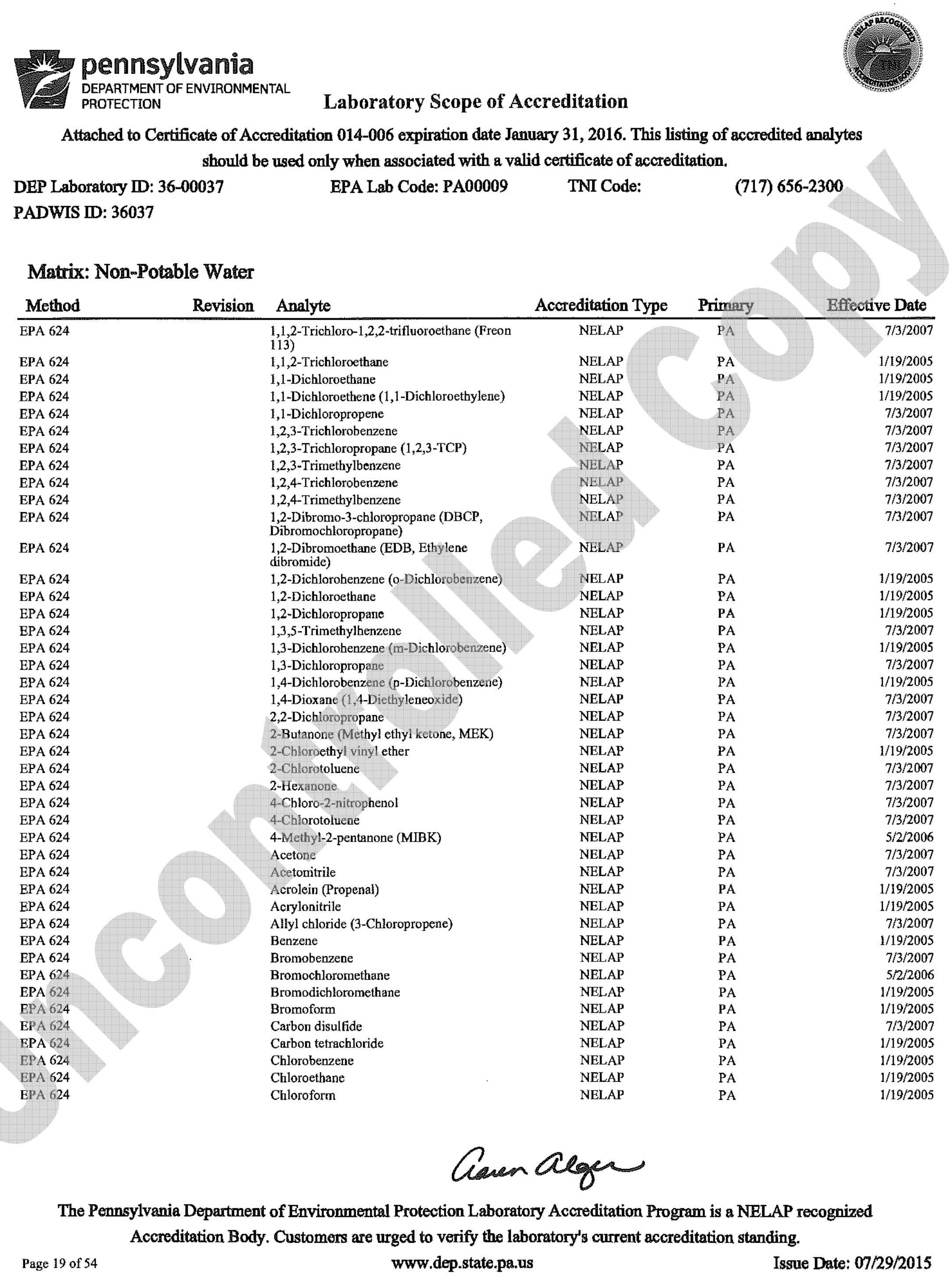

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DEPARTMENT OF ENVIRONMENTAL PROTECTION

Laboratory Scope of Accreditation

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DEP Laboratory ID: 36-00037 **EPA Lab Code: PA00009** **TNI Code:** **(717) 656-2300**
PADWIS ID: 36037

Matrix: Non-Potable Water

Method	Revision	Analyte	Accreditation Type	Primary	Effective Date
EPA 624		1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)	NELAP	PA	7/3/2007
EPA 624		1,1,2-Trichloroethane	NELAP	PA	1/19/2005
EPA 624		1,1-Dichloroethane	NELAP	PA	1/19/2005
EPA 624		1,1-Dichloroethene (1,1-Dichloroethylene)	NELAP	PA	1/19/2005
EPA 624		1,1-Dichloropropene	NELAP	PA	7/3/2007
EPA 624		1,2,3-Trichlorobenzene	NELAP	PA	7/3/2007
EPA 624		1,2,3-Trichloropropane (1,2,3-TCP)	NELAP	PA	7/3/2007
EPA 624		1,2,3-Trimethylbenzene	NELAP	PA	7/3/2007
EPA 624		1,2,4-Trichlorobenzene	NELAP	PA	7/3/2007
EPA 624		1,2,4-Trimethylbenzene	NELAP	PA	7/3/2007
EPA 624		1,2-Dibromo-3-chloropropane (DBCP, Dibromochloropropane)	NELAP	PA	7/3/2007
EPA 624		1,2-Dibromoethane (EDB, Ethylene dibromide)	NELAP	PA	7/3/2007
EPA 624		1,2-Dichlorobenzene (o-Dichlorobenzene)	NELAP	PA	1/19/2005
EPA 624		1,2-Dichloroethane	NELAP	PA	1/19/2005
EPA 624		1,2-Dichloropropane	NELAP	PA	1/19/2005
EPA 624		1,3,5-Trimethylbenzene	NELAP	PA	7/3/2007
EPA 624		1,3-Dichlorobenzene (m-Dichlorobenzene)	NELAP	PA	1/19/2005
EPA 624		1,3-Dichloropropane	NELAP	PA	7/3/2007
EPA 624		1,4-Dichlorobenzene (p-Dichlorobenzene)	NELAP	PA	1/19/2005
EPA 624		1,4-Dioxane (1,4-Diethyleneoxide)	NELAP	PA	7/3/2007
EPA 624		2,2-Dichloropropane	NELAP	PA	7/3/2007
EPA 624		2-Butanone (Methyl ethyl ketone, MEK)	NELAP	PA	7/3/2007
EPA 624		2-Chloroethyl vinyl ether	NELAP	PA	1/19/2005
EPA 624		2-Chlorotoluene	NELAP	PA	7/3/2007
EPA 624		2-Hexanone	NELAP	PA	7/3/2007
EPA 624		4-Chloro-2-nitrophenol	NELAP	PA	7/3/2007
EPA 624		4-Chlorotoluene	NELAP	PA	7/3/2007
EPA 624		4-Methyl-2-pentanone (MIBK)	NELAP	PA	5/2/2006
EPA 624		Acetone	NELAP	PA	7/3/2007
EPA 624		Acetonitrile	NELAP	PA	7/3/2007
EPA 624		Acrolein (Propenal)	NELAP	PA	1/19/2005
EPA 624		Acrylonitrile	NELAP	PA	1/19/2005
EPA 624		Allyl chloride (3-Chloropropene)	NELAP	PA	7/3/2007
EPA 624		Benzene	NELAP	PA	1/19/2005
EPA 624		Bromobenzene	NELAP	PA	7/3/2007
EPA 624		Bromochloromethane	NELAP	PA	5/2/2006
EPA 624		Bromodichloromethane	NELAP	PA	1/19/2005
EPA 624		Bromoform	NELAP	PA	1/19/2005
EPA 624		Carbon disulfide	NELAP	PA	7/3/2007
EPA 624		Carbon tetrachloride	NELAP	PA	1/19/2005
EPA 624		Chlorobenzene	NELAP	PA	1/19/2005
EPA 624		Chloroethane	NELAP	PA	1/19/2005
EPA 624		Chloroform	NELAP	PA	1/19/2005

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PADWIS ID: 36037

Matrix: Non-Potable Water

Method	Revision	Analyte	Accreditation Type	Primary	Effective Date
EPA 624		Chloroprene (2-Chloro-1,3-butadiene)	NELAP	PA	6/12/2009
EPA 624		Cyclohexane	NELAP	PA	7/3/2007
EPA 624		Dibromochloromethane	NELAP	PA	4/4/2005
EPA 624		Dibromomethane	NELAP	PA	7/3/2007
EPA 624		Dichlorodifluoromethane (Freon 12)	NELAP	PA	7/3/2007
EPA 624		Diisopropyl ether (DIPE)	NELAP	PA	5/2/2006
EPA 624		Ethyl acetate	NELAP	PA	1/20/2012
EPA 624		Ethyl methacrylate	NELAP	PA	7/3/2007
EPA 624		Ethylbenzene	NELAP	PA	1/19/2005
EPA 624		Freon 113 (1,1,2-Trichloro-1,2,2-trifluoroethane)	NELAP	PA	2/1/2011
EPA 624		Freon-123A	NELAP	PA	2/1/2011
EPA 624		Isobutyl alcohol (2-Methyl-1-propanol)	NELAP	PA	7/3/2007
EPA 624		Isopropylbenzene (Cumene)	NELAP	PA	5/2/2006
EPA 624		Methacrylonitrile	NELAP	PA	7/3/2007
EPA 624		Methyl bromide (Bromomethane)	NELAP	PA	1/19/2005
EPA 624		Methyl chloride (Chloromethane)	NELAP	PA	1/19/2005
EPA 624		Methyl iodide (Iodomethane)	NELAP	PA	7/3/2007
EPA 624		Methyl tert-butyl ether (MTBE)	NELAP	PA	12/12/2005
EPA 624		Methylene chloride (Dichloromethane)	NELAP	PA	1/19/2005
EPA 624		Methylmethacrylate	NELAP	PA	7/3/2007
EPA 624		Naphthalene	NELAP	PA	7/3/2007
EPA 624		Pentachloroethane	NELAP	PA	7/3/2007
EPA 624		Propionitrile (Ethyl cyanide)	NELAP	PA	7/3/2007
EPA 624		Styrene	NELAP	PA	5/2/2006
EPA 624		Tetrachloroethene (PCE, Perchloroethylene)	NELAP	PA	1/19/2005
EPA 624		Tetrahydrofuran (THF)	NELAP	PA	7/3/2007
EPA 624		Toluene	NELAP	PA	1/19/2005
EPA 624		Trichloroethene (TCE, Trichloroethylene)	NELAP	PA	1/19/2005
EPA 624		Trichlorofluoromethane (Freon 11)	NELAP	PA	1/19/2005
EPA 624		Vinyl acetate	NELAP	PA	7/3/2007
EPA 624		Vinyl chloride (Chloroethene)	NELAP	PA	1/19/2005
EPA 624		Xylenes, total	NELAP	PA	1/19/2005
EPA 624		cis-1,2-Dichloroethene	NELAP	PA	6/12/2009
EPA 624		cis-1,3-Dichloropropene	NELAP	PA	1/19/2005
EPA 624		n-Butylbenzene	NELAP	PA	7/3/2007
EPA 624		n-Heptane	NELAP	PA	7/3/2007
EPA 624		n-Hexane	NELAP	PA	7/3/2007
EPA 624		n-Propylbenzene	NELAP	PA	7/3/2007
EPA 624		p-Isopropyltoluene (4-Isopropyltoluene)	NELAP	PA	7/3/2007
EPA 624		sec-Butylbenzene	NELAP	PA	7/3/2007
EPA 624		tert-Amyl methyl ether (TAME)	NELAP	PA	5/2/2006
EPA 624		tert-Butyl alcohol (2-Methyl-2-propanol)	NELAP	PA	5/2/2006
EPA 624		tert-Butyl ethyl ether	NELAP	PA	5/2/2006
EPA 624		tert-Butylbenzene	NELAP	PA	7/3/2007
EPA 624		trans-1,2-Dichloroethene	NELAP	PA	1/19/2005

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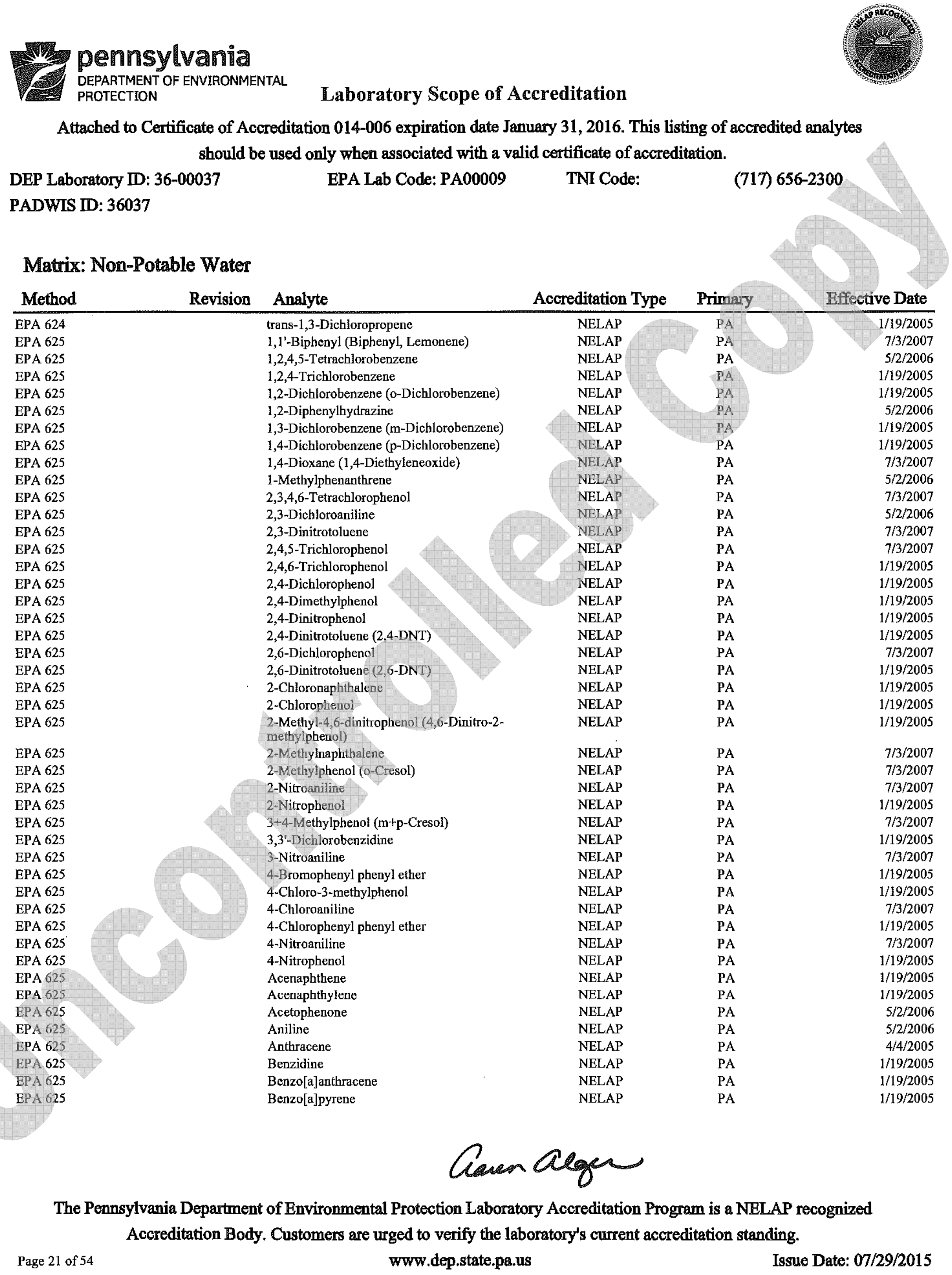

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Laboratory Scope of Accreditation

Attached to Certificate of Accreditation 014-006 expiration date January 31, 2016. This listing of accredited analytes should be used only when associated with a valid certificate of accreditation.

DEP Laboratory ID: 36-00037 **EPA Lab Code: PA00009** **TNI Code:** **(717) 656-2300**

PADWIS ID: 36037

Matrix: Non-Potable Water

Method	Revision	Analyte	Accreditation Type	Primary	Effective Date
EPA 624		trans-1,3-Dichloropropene	NELAP	PA	1/19/2005
EPA 625		1,1'-Biphenyl (Biphenyl, Lemonene)	NELAP	PA	7/3/2007
EPA 625		1,2,4,5-Tetrachlorobenzene	NELAP	PA	5/2/2006
EPA 625		1,2,4-Trichlorobenzene	NELAP	PA	1/19/2005
EPA 625		1,2-Dichlorobenzene (o-Dichlorobenzene)	NELAP	PA	1/19/2005
EPA 625		1,2-Diphenylhydrazine	NELAP	PA	5/2/2006
EPA 625		1,3-Dichlorobenzene (m-Dichlorobenzene)	NELAP	PA	1/19/2005
EPA 625		1,4-Dichlorobenzene (p-Dichlorobenzene)	NELAP	PA	1/19/2005
EPA 625		1,4-Dioxane (1,4-Diethyleneoxide)	NELAP	PA	7/3/2007
EPA 625		1-Methylphenanthrene	NELAP	PA	5/2/2006
EPA 625		2,3,4,6-Tetrachlorophenol	NELAP	PA	7/3/2007
EPA 625		2,3-Dichloroaniline	NELAP	PA	5/2/2006
EPA 625		2,3-Dinitrotoluene	NELAP	PA	7/3/2007
EPA 625		2,4,5-Trichlorophenol	NELAP	PA	7/3/2007
EPA 625		2,4,6-Trichlorophenol	NELAP	PA	1/19/2005
EPA 625		2,4-Dichlorophenol	NELAP	PA	1/19/2005
EPA 625		2,4-Dimethylphenol	NELAP	PA	1/19/2005
EPA 625		2,4-Dinitrophenol	NELAP	PA	1/19/2005
EPA 625		2,4-Dinitrotoluene (2,4-DNT)	NELAP	PA	1/19/2005
EPA 625		2,6-Dichlorophenol	NELAP	PA	7/3/2007
EPA 625		2,6-Dinitrotoluene (2,6-DNT)	NELAP	PA	1/19/2005
EPA 625		2-Chloronaphthalene	NELAP	PA	1/19/2005
EPA 625		2-Chlorophenol	NELAP	PA	1/19/2005
EPA 625		2-Methyl-4,6-dinitrophenol (4,6-Dinitro-2-methylphenol)	NELAP	PA	1/19/2005
EPA 625		2-Methylnaphthalene	NELAP	PA	7/3/2007
EPA 625		2-Methylphenol (o-Cresol)	NELAP	PA	7/3/2007
EPA 625		2-Nitroaniline	NELAP	PA	7/3/2007
EPA 625		2-Nitrophenol	NELAP	PA	1/19/2005
EPA 625		3+4-Methylphenol (m+p-Cresol)	NELAP	PA	7/3/2007
EPA 625		3,3'-Dichlorobenzidine	NELAP	PA	1/19/2005
EPA 625		3-Nitroaniline	NELAP	PA	7/3/2007
EPA 625		4-Bromophenyl phenyl ether	NELAP	PA	1/19/2005
EPA 625		4-Chloro-3-methylphenol	NELAP	PA	1/19/2005
EPA 625		4-Chloroaniline	NELAP	PA	7/3/2007
EPA 625		4-Chlorophenyl phenyl ether	NELAP	PA	1/19/2005
EPA 625		4-Nitroaniline	NELAP	PA	7/3/2007
EPA 625		4-Nitrophenol	NELAP	PA	1/19/2005
EPA 625		Acenaphthene	NELAP	PA	1/19/2005
EPA 625		Acenaphthylene	NELAP	PA	1/19/2005
EPA 625		Acetophenone	NELAP	PA	5/2/2006
EPA 625		Aniline	NELAP	PA	5/2/2006
EPA 625		Anthracene	NELAP	PA	4/4/2005
EPA 625		Benzidine	NELAP	PA	1/19/2005
EPA 625		Benzo[a]anthracene	NELAP	PA	1/19/2005
EPA 625		Benzo[a]pyrene	NELAP	PA	1/19/2005

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DEPARTMENT OF ENVIRONMENTAL PROTECTION

Laboratory Scope of Accreditation

Attached to Certificate of Accreditation 014-006 expiration date January 31, 2016. This listing of accredited analytes should be used only when associated with a valid certificate of accreditation.

DEP Laboratory ID: 36-00037 **EPA Lab Code: PA00009** **TNI Code:** **(717) 656-2300**

PADWIS ID: 36037

Matrix: Non-Potable Water

Method	Revision	Analyte	Accreditation Type	Primary	Effective Date
EPA 625		Benzo[b]fluoranthene	NELAP	PA	1/19/2005
EPA 625		Benzo[ghi]perylene	NELAP	PA	1/19/2005
EPA 625		Benzo[k]fluoranthene	NELAP	PA	1/19/2005
EPA 625		Benzoic acid	NELAP	PA	5/2/2006
EPA 625		Benzyl alcohol	NELAP	PA	7/3/2007
EPA 625		Butyl benzyl phthalate (Benzyl butyl phthalate)	NELAP	PA	1/19/2005
EPA 625		Carbazole	NELAP	PA	5/2/2006
EPA 625		Chrysene (Benzo[a]phenanthrene)	NELAP	PA	1/19/2005
EPA 625		Di-n-butyl phthalate	NELAP	PA	1/19/2005
EPA 625		Di-n-octyl phthalate	NELAP	PA	1/19/2005
EPA 625		Dibenzo[a,h]anthracene	NELAP	PA	1/19/2005
EPA 625		Dibenzofuran	NELAP	PA	7/3/2007
EPA 625		Diethyl phthalate	NELAP	PA	1/19/2005
EPA 625		Dimethyl phthalate	NELAP	PA	1/19/2005
EPA 625		Diphenyl ether	NELAP	PA	7/3/2007
EPA 625		Fluoranthene	NELAP	PA	1/19/2005
EPA 625		Fluorene	NELAP	PA	1/19/2005
EPA 625		Hexachlorobenzene	NELAP	PA	1/19/2005
EPA 625		Hexachlorobutadiene (1,3-Hexachlorobutadiene)	NELAP	PA	1/19/2005
EPA 625		Hexachlorocyclopentadiene	NELAP	PA	1/19/2005
EPA 625		Hexachloroethane	NELAP	PA	1/19/2005
EPA 625		Indeno(1,2,3-cd)pyrene	NELAP	PA	1/19/2005
EPA 625		Isophorone	NELAP	PA	1/19/2005
EPA 625		N-Nitrosodi-n-butylamine	NELAP	PA	5/2/2006
EPA 625		N-Nitrosodi-n-propylamine	NELAP	PA	1/19/2005
EPA 625		N-Nitrosodiethylamine	NELAP	PA	5/2/2006
EPA 625		N-Nitrosodimethylamine	NELAP	PA	1/19/2005
EPA 625		N-Nitrosodiphenylamine	NELAP	PA	1/19/2005
EPA 625		N-Nitrosopyrrolidine	NELAP	PA	5/2/2006
EPA 625		Naphthalene	NELAP	PA	1/19/2005
EPA 625		Nitrobenzene	NELAP	PA	1/19/2005
EPA 625		Pentachlorobenzene	NELAP	PA	7/3/2007
EPA 625		Pentachlorophenol (PCP)	NELAP	PA	1/19/2005
EPA 625		Phenanthrene	NELAP	PA	1/19/2005
EPA 625		Phenol	NELAP	PA	1/19/2005
EPA 625		Pyrene	NELAP	PA	1/19/2005
EPA 625		Pyridine	NELAP	PA	5/2/2006
EPA 625		alpha-Terpineol	NELAP	PA	5/2/2006
EPA 625		bis(2-Chloroethoxy)methane	NELAP	PA	1/19/2005
EPA 625		bis(2-Chloroethyl) ether	NELAP	PA	1/19/2005
EPA 625		bis(2-Chloroisopropyl) ether	NELAP	PA	1/19/2005
EPA 625		bis(2-Ethylhexyl) phthalate (DEHP)	NELAP	PA	1/19/2005
EPA 625		n-Decane	NELAP	PA	5/2/2006
EPA 625		n-Docosane	NELAP	PA	5/2/2006

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DEPARTMENT OF ENVIRONMENTAL PROTECTION

Laboratory Scope of Accreditation

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DEP Laboratory ID: 36-00037 **EPA Lab Code: PA00009** **TNI Code:** **(717) 656-2300**
PADWIS ID: 36037

Matrix: Non-Potable Water

Method	Revision	Analyte	Accreditation Type	Primary	Effective Date
EPA 625		n-Dodecane	NELAP	PA	5/2/2006
EPA 625		n-Eicosane	NELAP	PA	5/2/2006
EPA 625		n-Hexadecane	NELAP	PA	5/2/2006
EPA 625		n-Octadecane	NELAP	PA	5/2/2006
EPA 625		n-Tetradecane	NELAP	PA	5/2/2006
EPA 625		o-Toluidine (2-Toluidine, 2-Methylaniline)	NELAP	PA	7/3/2007
EPA 6850		Perchlorate	NELAP	PA	1/19/2011
EPA 7196	A	Chromium VI	NELAP	PA	4/6/2006
EPA 7199		Chromium VI	NELAP	PA	1/4/2006
EPA 7470		Mercury	NELAP	PA	11/21/2005
EPA 8011		1,2-Dibromo-3-chloropropane (DBCP, Dibromochloropropane)	NELAP	PA	5/2/2006
EPA 8011		1,2-Dibromoethane (EDB, Ethylene dibromide)	NELAP	PA	12/12/2005
EPA 8015		Diesel-range organics (DRO)	NELAP	PA	12/12/2005
EPA 8015		Diethylene glycol	NELAP	PA	1/20/2012
EPA 8015		Ethane	NELAP	PA	12/4/2007
EPA 8015		Ethanol	NELAP	PA	12/4/2007
EPA 8015		Ethene	NELAP	PA	12/4/2007
EPA 8015		Ethylene glycol	NELAP	PA	12/4/2007
EPA 8015		Gasoline-range organics (GRO)	NELAP	PA	12/12/2005
EPA 8015		Isobutyl alcohol (2-Methyl-1-propanol)	NELAP	PA	2/7/2012
EPA 8015		Isopropyl alcohol (2-Propanol)	NELAP	PA	12/4/2007
EPA 8015		Methane	NELAP	PA	12/4/2007
EPA 8015		Methanol	NELAP	PA	12/4/2007
EPA 8015	C	Nonhalogenated organics by GC/FID	NELAP	PA	3/26/2012
EPA 8015	B	Nonhalogenated organics by GC/FID	NELAP	PA	3/26/2012
EPA 8015	D	Nonhalogenated organics by GC/FID	NELAP	PA	7/29/2015
EPA 8015		Propane	NELAP	PA	12/4/2007
EPA 8015		Propylene glycol	NELAP	PA	1/20/2012
EPA 8015		Tetraethylene glycol	NELAP	PA	1/20/2012
EPA 8015		Total petroleum hydrocarbons (TPH)	NELAP	PA	1/24/2007
EPA 8015		Triethylene glycol	NELAP	PA	1/20/2012
EPA 8015		n-Butyl alcohol (n-Butanol, 1-Butanol)	NELAP	PA	2/7/2012
EPA 8015		n-Propanol (1-Propanol)	NELAP	PA	2/7/2012
EPA 8021		Benzene	NELAP	PA	12/12/2005
EPA 8021		Ethylbenzene	NELAP	PA	12/12/2005
EPA 8021		Isopropylbenzene (Cumene)	NELAP	PA	12/12/2005
EPA 8021		Methyl tert-butyl ether (MTBE)	NELAP	PA	2/11/2011
EPA 8021		Napbthalene	NELAP	PA	6/24/2008
EPA 8021		Toluene	NELAP	PA	12/12/2005
EPA 8021	B	VOCs by GC/PID/ELCD	NELAP	PA	3/26/2012
EPA 8021		Xylenes, total	NELAP	PA	12/12/2005
EPA 8021		m-Xylene	NELAP	PA	11/23/2009
EPA 8021		o-Xylene	NELAP	PA	11/23/2009
EPA 8021		p-Xylene	NELAP	PA	11/23/2009

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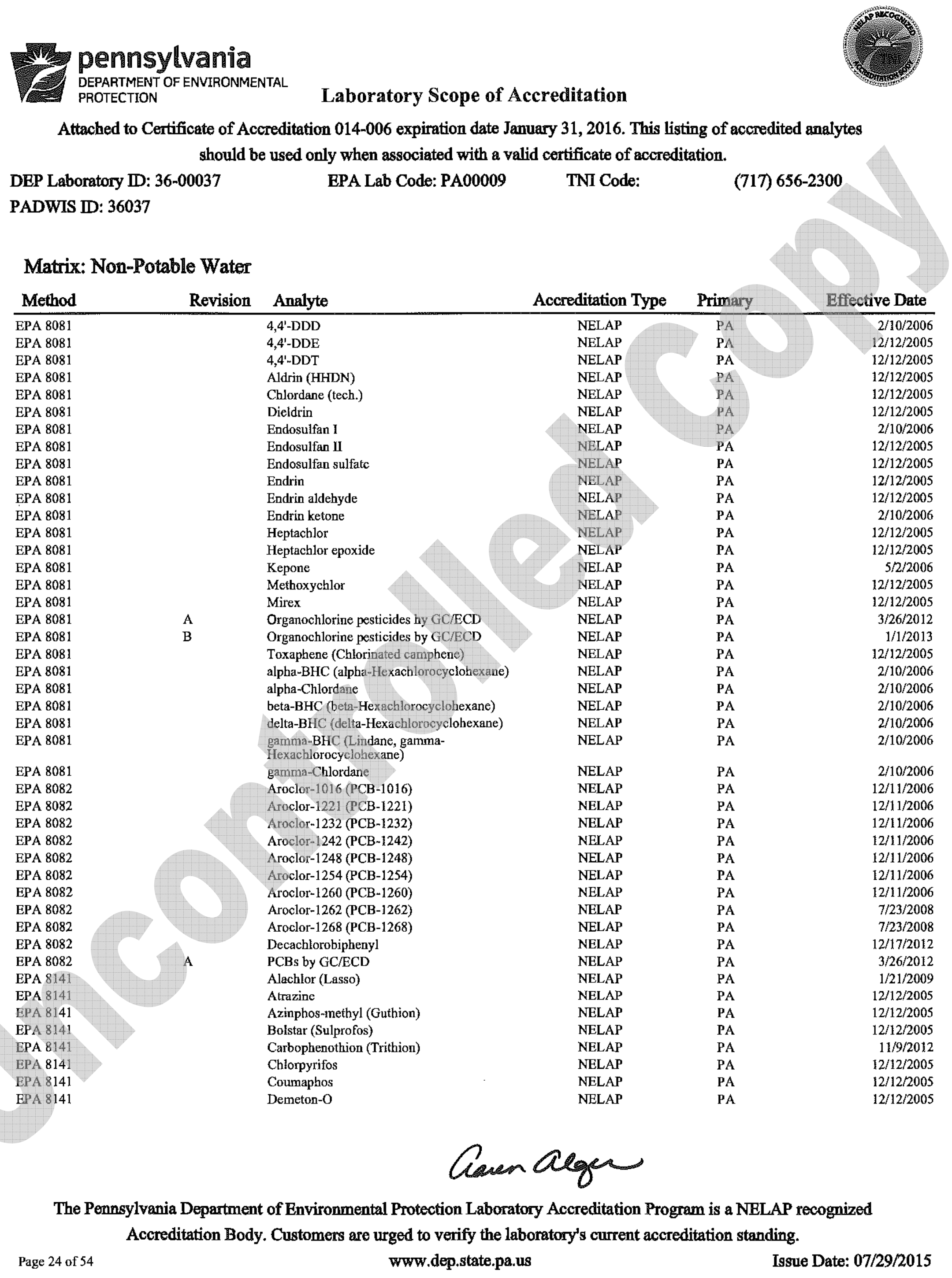

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DEPARTMENT OF ENVIRONMENTAL PROTECTION

Laboratory Scope of Accreditation

Attached to Certificate of Accreditation 014-006 expiration date January 31, 2016. This listing of accredited analytes should be used only when associated with a valid certificate of accreditation.

DEP Laboratory ID: 36-00037 **EPA Lab Code: PA00009** **TNI Code:** **(717) 656-2300**
PADWIS ID: 36037

Matrix: Non-Potable Water

Method	Revision	Analyte	Accreditation Type	Primary	Effective Date
EPA 8081		4,4'-DDD	NELAP	PA	2/10/2006
EPA 8081		4,4'-DDE	NELAP	PA	12/12/2005
EPA 8081		4,4'-DDT	NELAP	PA	12/12/2005
EPA 8081		Aldrin (HHDN)	NELAP	PA	12/12/2005
EPA 8081		Chlordane (tech.)	NELAP	PA	12/12/2005
EPA 8081		Dieldrin	NELAP	PA	12/12/2005
EPA 8081		Endosulfan I	NELAP	PA	2/10/2006
EPA 8081		Endosulfan II	NELAP	PA	12/12/2005
EPA 8081		Endosulfan sulfate	NELAP	PA	12/12/2005
EPA 8081		Endrin	NELAP	PA	12/12/2005
EPA 8081		Endrin aldehyde	NELAP	PA	12/12/2005
EPA 8081		Endrin ketone	NELAP	PA	2/10/2006
EPA 8081		Heptachlor	NELAP	PA	12/12/2005
EPA 8081		Heptachlor epoxide	NELAP	PA	12/12/2005
EPA 8081		Kepone	NELAP	PA	5/2/2006
EPA 8081		Methoxychlor	NELAP	PA	12/12/2005
EPA 8081		Mirex	NELAP	PA	12/12/2005
EPA 8081	A	Organochlorine pesticides by GC/ECD	NELAP	PA	3/26/2012
EPA 8081	B	Organochlorine pesticides by GC/ECD	NELAP	PA	1/1/2013
EPA 8081		Toxaphene (Chlorinated camphene)	NELAP	PA	12/12/2005
EPA 8081		alpha-BHC (alpha-Hexachlorocyclohexane)	NELAP	PA	2/10/2006
EPA 8081		alpha-Chlordane	NELAP	PA	2/10/2006
EPA 8081		beta-BHC (beta-Hexachlorocyclohexane)	NELAP	PA	2/10/2006
EPA 8081		delta-BHC (delta-Hexachlorocyclohexane)	NELAP	PA	2/10/2006
EPA 8081		gamma-BHC (Lindane, gamma-Hexachlorocyclohexane)	NELAP	PA	2/10/2006
EPA 8081		gamma-Chlordane	NELAP	PA	2/10/2006
EPA 8082		Aroclor-1016 (PCB-1016)	NELAP	PA	12/11/2006
EPA 8082		Aroclor-1221 (PCB-1221)	NELAP	PA	12/11/2006
EPA 8082		Aroclor-1232 (PCB-1232)	NELAP	PA	12/11/2006
EPA 8082		Aroclor-1242 (PCB-1242)	NELAP	PA	12/11/2006
EPA 8082		Aroclor-1248 (PCB-1248)	NELAP	PA	12/11/2006
EPA 8082		Aroclor-1254 (PCB-1254)	NELAP	PA	12/11/2006
EPA 8082		Aroclor-1260 (PCB-1260)	NELAP	PA	12/11/2006
EPA 8082		Aroclor-1262 (PCB-1262)	NELAP	PA	7/23/2008
EPA 8082		Aroclor-1268 (PCB-1268)	NELAP	PA	7/23/2008
EPA 8082		Decachlorobiphenyl	NELAP	PA	12/17/2012
EPA 8082	A	PCBs by GC/ECD	NELAP	PA	3/26/2012
EPA 8141		Alachlor (Lasso)	NELAP	PA	1/21/2009
EPA 8141		Atrazine	NELAP	PA	12/12/2005
EPA 8141		Azinphos-methyl (Guthion)	NELAP	PA	12/12/2005
EPA 8141		Bolstar (Sulprofos)	NELAP	PA	12/12/2005
EPA 8141		Carbophenothion (Trithion)	NELAP	PA	11/9/2012
EPA 8141		Chlorpyrifos	NELAP	PA	12/12/2005
EPA 8141		Coumaphos	NELAP	PA	12/12/2005
EPA 8141		Demeton-O	NELAP	PA	12/12/2005

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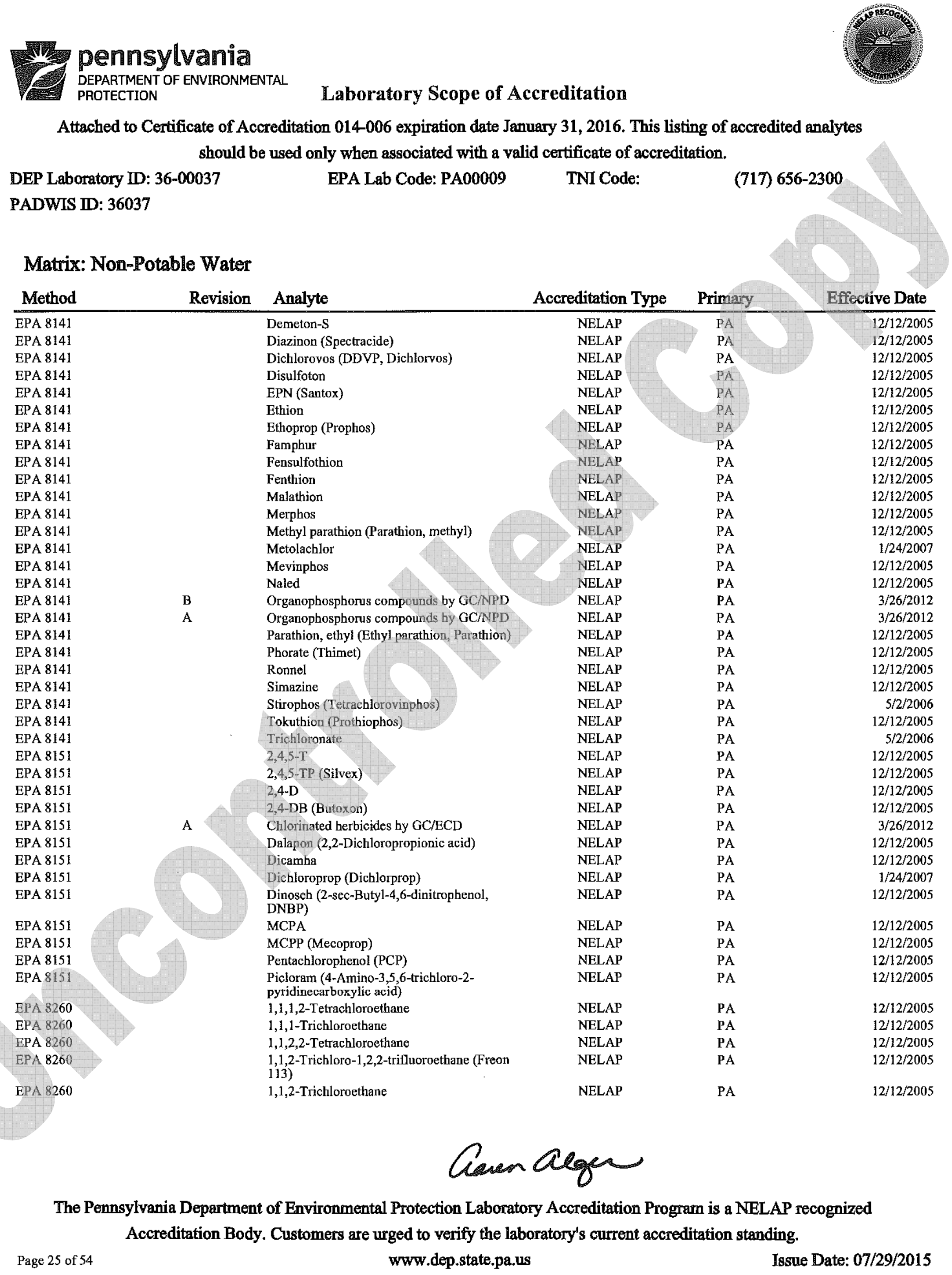

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DEPARTMENT OF ENVIRONMENTAL PROTECTION

Laboratory Scope of Accreditation

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DEP Laboratory ID: 36-00037 **EPA Lab Code: PA00009** **TNI Code:** **(717) 656-2300**
PADWIS ID: 36037

Matrix: Non-Potable Water

Method	Revision	Analyte	Accreditation Type	Primary	Effective Date
EPA 8141		Demeton-S	NELAP	PA	12/12/2005
EPA 8141		Diazinon (Spectracide)	NELAP	PA	12/12/2005
EPA 8141		Dichlorovos (DDVP, Dichlorvos)	NELAP	PA	12/12/2005
EPA 8141		Disulfoton	NELAP	PA	12/12/2005
EPA 8141		EPN (Santox)	NELAP	PA	12/12/2005
EPA 8141		Ethion	NELAP	PA	12/12/2005
EPA 8141		Ethoprop (Prophos)	NELAP	PA	12/12/2005
EPA 8141		Famphur	NELAP	PA	12/12/2005
EPA 8141		Fensulfothion	NELAP	PA	12/12/2005
EPA 8141		Fenthion	NELAP	PA	12/12/2005
EPA 8141		Malathion	NELAP	PA	12/12/2005
EPA 8141		Merphos	NELAP	PA	12/12/2005
EPA 8141		Methyl parathion (Parathion, methyl)	NELAP	PA	12/12/2005
EPA 8141		Metolachlor	NELAP	PA	1/24/2007
EPA 8141		Mevinphos	NELAP	PA	12/12/2005
EPA 8141		Naled	NELAP	PA	12/12/2005
EPA 8141	B	Organophosphorus compounds by GC/NPD	NELAP	PA	3/26/2012
EPA 8141	A	Organophosphorus compounds by GC/NPD	NELAP	PA	3/26/2012
EPA 8141		Parathion, ethyl (Ethyl parathion, Parathion)	NELAP	PA	12/12/2005
EPA 8141		Phorate (Thimet)	NELAP	PA	12/12/2005
EPA 8141		Ronnel	NELAP	PA	12/12/2005
EPA 8141		Simazine	NELAP	PA	12/12/2005
EPA 8141		Stirophos (Tetrachlorovinphos)	NELAP	PA	5/2/2006
EPA 8141		Tokuthion (Prothiophos)	NELAP	PA	12/12/2005
EPA 8141		Trichloronate	NELAP	PA	5/2/2006
EPA 8151		2,4,5-T	NELAP	PA	12/12/2005
EPA 8151		2,4,5-TP (Silvex)	NELAP	PA	12/12/2005
EPA 8151		2,4-D	NELAP	PA	12/12/2005
EPA 8151		2,4-DB (Butoxon)	NELAP	PA	12/12/2005
EPA 8151	A	Chlorinated herbicides by GC/ECD	NELAP	PA	3/26/2012
EPA 8151		Dalapon (2,2-Dichloropropionic acid)	NELAP	PA	12/12/2005
EPA 8151		Dicamba	NELAP	PA	12/12/2005
EPA 8151		Dichloroprop (Dichlorprop)	NELAP	PA	1/24/2007
EPA 8151		Dinoseb (2-sec-Butyl-4,6-dinitrophenol, DNBP)	NELAP	PA	12/12/2005
EPA 8151		MCPA	NELAP	PA	12/12/2005
EPA 8151		MCPP (Mecoprop)	NELAP	PA	12/12/2005
EPA 8151		Pentachlorophenol (PCP)	NELAP	PA	12/12/2005
EPA 8151		Picloram (4-Amino-3,5,6-trichloro-2-pyridinecarboxylic acid)	NELAP	PA	12/12/2005
EPA 8260		1,1,1,2-Tetrachloroethane	NELAP	PA	12/12/2005
EPA 8260		1,1,1-Trichloroethane	NELAP	PA	12/12/2005
EPA 8260		1,1,2,2-Tetrachloroethane	NELAP	PA	12/12/2005
EPA 8260		1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)	NELAP	PA	12/12/2005
EPA 8260		1,1,2-Trichloroethane	NELAP	PA	12/12/2005

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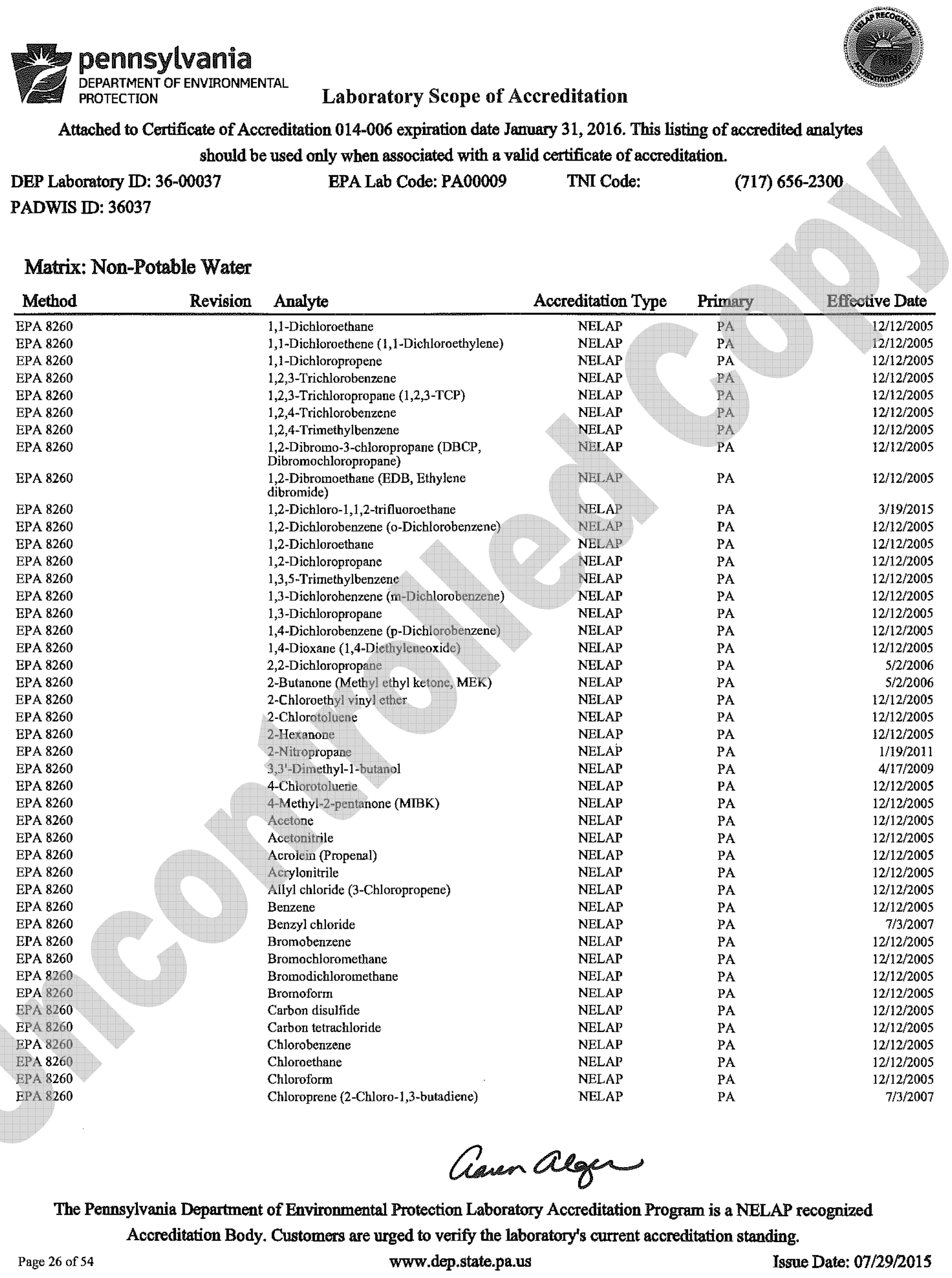

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DEPARTMENT OF ENVIRONMENTAL PROTECTION

Laboratory Scope of Accreditation

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DEP Laboratory ID: 36-00037 **EPA Lab Code: PA00009** **TNI Code:** **(717) 656-2300**
PADWIS ID: 36037

Matrix: Non-Potable Water

Method	Revision	Analyte	Accreditation Type	Primary	Effective Date
EPA 8260		1,1-Dichloroethane	NELAP	PA	12/12/2005
EPA 8260		1,1-Dichloroethene (1,1-Dichloroethylene)	NELAP	PA	12/12/2005
EPA 8260		1,1-Dichloropropene	NELAP	PA	12/12/2005
EPA 8260		1,2,3-Trichlorobenzene	NELAP	PA	12/12/2005
EPA 8260		1,2,3-Trichloropropane (1,2,3-TCP)	NELAP	PA	12/12/2005
EPA 8260		1,2,4-Trichlorobenzene	NELAP	PA	12/12/2005
EPA 8260		1,2,4-Trimethylbenzene	NELAP	PA	12/12/2005
EPA 8260		1,2-Dibromo-3-chloropropane (DBCP, Dibromochloropropane)	NELAP	PA	12/12/2005
EPA 8260		1,2-Dibromoethane (EDB, Ethylene dibromide)	NELAP	PA	12/12/2005
EPA 8260		1,2-Dichloro-1,1,2-trifluoroethane	NELAP	PA	3/19/2015
EPA 8260		1,2-Dichlorobenzene (o-Dichlorobenzene)	NELAP	PA	12/12/2005
EPA 8260		1,2-Dichloroethane	NELAP	PA	12/12/2005
EPA 8260		1,2-Dichloropropane	NELAP	PA	12/12/2005
EPA 8260		1,3,5-Trimethylbenzene	NELAP	PA	12/12/2005
EPA 8260		1,3-Dichlorobenzene (m-Dichlorobenzene)	NELAP	PA	12/12/2005
EPA 8260		1,3-Dichloropropane	NELAP	PA	12/12/2005
EPA 8260		1,4-Dichlorobenzene (p-Dichlorobenzene)	NELAP	PA	12/12/2005
EPA 8260		1,4-Dioxane (1,4-Diethyleneoxide)	NELAP	PA	12/12/2005
EPA 8260		2,2-Dichloropropane	NELAP	PA	5/2/2006
EPA 8260		2-Butanone (Methyl ethyl ketone, MEK)	NELAP	PA	5/2/2006
EPA 8260		2-Chloroethyl vinyl ether	NELAP	PA	12/12/2005
EPA 8260		2-Chlorotoluene	NELAP	PA	12/12/2005
EPA 8260		2-Hexanone	NELAP	PA	12/12/2005
EPA 8260		2-Nitropropane	NELAP	PA	1/19/2011
EPA 8260		3,3'-Dimethyl-1-butanol	NELAP	PA	4/17/2009
EPA 8260		4-Chlorotoluene	NELAP	PA	12/12/2005
EPA 8260		4-Methyl-2-pentanone (MIBK)	NELAP	PA	12/12/2005
EPA 8260		Acetone	NELAP	PA	12/12/2005
EPA 8260		Acetonitrile	NELAP	PA	12/12/2005
EPA 8260		Acrolein (Propenal)	NELAP	PA	12/12/2005
EPA 8260		Acrylonitrile	NELAP	PA	12/12/2005
EPA 8260		Allyl chloride (3-Chloropropene)	NELAP	PA	12/12/2005
EPA 8260		Benzene	NELAP	PA	12/12/2005
EPA 8260		Benzyl chloride	NELAP	PA	7/3/2007
EPA 8260		Bromobenzene	NELAP	PA	12/12/2005
EPA 8260		Bromochloromethane	NELAP	PA	12/12/2005
EPA 8260		Bromodichloromethane	NELAP	PA	12/12/2005
EPA 8260		Bromoform	NELAP	PA	12/12/2005
EPA 8260		Carbon disulfide	NELAP	PA	12/12/2005
EPA 8260		Carbon tetrachloride	NELAP	PA	12/12/2005
EPA 8260		Chlorobenzene	NELAP	PA	12/12/2005
EPA 8260		Chloroethane	NELAP	PA	12/12/2005
EPA 8260		Chloroform	NELAP	PA	12/12/2005
EPA 8260		Chloroprene (2-Chloro-1,3-butadiene)	NELAP	PA	7/3/2007

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Laboratory Scope of Accreditation

Attached to Certificate of Accreditation 014-006 expiration date January 31, 2016. This listing of accredited analytes should be used only when associated with a valid certificate of accreditation.

DEP Laboratory ID: 36-00037 **EPA Lab Code: PA00009** **TNI Code:** **(717) 656-2300**
PADWIS ID: 36037

Matrix: Non-Potable Water

Method	Revision	Analyte	Accreditation Type	Primary	Effective Date
EPA 8260		Crotonaldehyde	NELAP	PA	10/30/2014
EPA 8260		Cyclohexane	NELAP	PA	7/3/2007
EPA 8260		Cyclohexanone	NELAP	PA	6/7/2012
EPA 8260		Dibromochloromethane	NELAP	PA	12/12/2005
EPA 8260		Dibromomethane	NELAP	PA	5/2/2006
EPA 8260		Dichlorodifluoromethane (Freon 12)	NELAP	PA	12/12/2005
EPA 8260		Diethyl ether (Ethyl ether)	NELAP	PA	2/1/2011
EPA 8260		Diisopropyl ether (DIPE)	NELAP	PA	7/3/2007
EPA 8260		Dimethyl ether	NELAP	PA	6/7/2012
EPA 8260		Epichlorohydrin (1-Chloro-2,3-epoxypropane)	NELAP	PA	4/17/2009
EPA 8260		Ethanol	NELAP	PA	1/24/2007
EPA 8260		Ethyl acetate	NELAP	PA	1/24/2007
EPA 8260		Ethyl methacrylate	NELAP	PA	1/24/2007
EPA 8260		Ethyl tert-butyl ether (ETBE)	NELAP	PA	1/24/2007
EPA 8260		Ethylbenzene	NELAP	PA	12/12/2005
EPA 8260		Ethylene oxide	NELAP	PA	10/30/2014
EPA 8260		Freon 113 (1,1,2-Trichloro-1,2,2-trifluoroethane)	NELAP	PA	3/4/2015
EPA 8260		Gasoline-range organics (GRO)	NELAP	PA	6/8/2006
EPA 8260		Heptane	NELAP	PA	1/20/2012
EPA 8260		Hexachlorobutadiene (1,3-Hexachlorobutadiene)	NELAP	PA	12/12/2005
EPA 8260		Hexachloroethane	NELAP	PA	5/23/2012
EPA 8260		Isobutyl alcohol (2-Methyl-1-propanol)	NELAP	PA	7/3/2007
EPA 8260		Isopropyl alcohol (2-Propanol)	NELAP	PA	1/18/2011
EPA 8260		Isopropylbenzene (Cumene)	NELAP	PA	5/2/2006
EPA 8260		Methacrylonitrile	NELAP	PA	7/3/2007
EPA 8260		Methyl acetate	NELAP	PA	1/24/2007
EPA 8260		Methyl bromide (Bromomethane)	NELAP	PA	12/12/2005
EPA 8260		Methyl chloride (Chloromethane)	NELAP	PA	12/12/2005
EPA 8260		Methyl iodide (Iodomethane)	NELAP	PA	5/25/2007
EPA 8260		Methyl tert-butyl ether (MTBE)	NELAP	PA	12/12/2005
EPA 8260		Methylcyclohexane	NELAP	PA	1/21/2009
EPA 8260		Methylene chloride (Dichloromethane)	NELAP	PA	12/12/2005
EPA 8260		Methylmethacrylate	NELAP	PA	5/25/2007
EPA 8260		Naphthalene	NELAP	PA	12/12/2005
EPA 8260		Pentachloroethane	NELAP	PA	1/24/2007
EPA 8260		Propionitrile (Ethyl cyanide)	NELAP	PA	12/12/2005
EPA 8260		Styrene	NELAP	PA	12/12/2005
EPA 8260		Tetrachloroethene (PCE, Perchloroethylene)	NELAP	PA	12/12/2005
EPA 8260		Tetrahydrofuran (THF)	NELAP	PA	1/18/2011
EPA 8260		Toluene	NELAP	PA	12/12/2005
EPA 8260		Trichloroethene (TCE, Trichloroethylene)	NELAP	PA	12/12/2005
EPA 8260		Trichlorofluoromethane (Freon 11)	NELAP	PA	12/12/2005
EPA 8260	B	VOCs by GC/MS	NELAP	PA	3/26/2012

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Laboratory Scope of Accreditation

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DEP Laboratory ID: 36-00037 **EPA Lab Code: PA00009** **TNI Code:** **(717) 656-2300**
PADWIS ID: 36037

Matrix: Non-Potable Water

Method	Revision	Analyte	Accreditation Type	Primary	Effective Date
EPA 8260	C	VOCs by GC/MS	NELAP	PA	3/26/2012
EPA 8260		Vinyl acetate	NELAP	PA	12/12/2005
EPA 8260		Vinyl chloride (Chloroethene)	NELAP	PA	12/12/2005
EPA 8260		Xylenes, total	NELAP	PA	12/12/2005
EPA 8260		cis-1,2-Dichloroethene	NELAP	PA	12/12/2005
EPA 8260		cis-1,3-Dichloropropene	NELAP	PA	12/12/2005
EPA 8260		m+p-Xylene	NELAP	PA	4/17/2009
EPA 8260		n-Butyl alcohol (n-Butanol, 1-Butanol)	NELAP	PA	4/17/2009
EPA 8260		n-Butylbenzene	NELAP	PA	12/12/2005
EPA 8260		n-Hexane	NELAP	PA	1/20/2012
EPA 8260		n-Propylamine	NELAP	PA	12/12/2005
EPA 8260		n-Propylbenzene	NELAP	PA	1/24/2007
EPA 8260		o-Xylene	NELAP	PA	4/17/2009
EPA 8260		p-Isopropyltoluene (4-Isopropyltoluene)	NELAP	PA	1/24/2007
EPA 8260		sec-Butylbenzene	NELAP	PA	12/12/2005
EPA 8260		tert-Amyl alcohol (2-Methyl-2-butanol)	NELAP	PA	4/17/2009
EPA 8260		tert-Amyl methyl ether (TAME)	NELAP	PA	1/24/2007
EPA 8260		tert-Butyl alcohol (2-Methyl-2-propanol)	NELAP	PA	12/12/2005
EPA 8260		tert-Butyl formate	NELAP	PA	4/17/2009
EPA 8260		tert-Butylbenzene	NELAP	PA	12/12/2005
EPA 8260		trans-1,2-Dichloroethene	NELAP	PA	12/12/2005
EPA 8260		trans-1,3-Dichloropropene	NELAP	PA	12/12/2005
EPA 8260		trans-1,4-Dichloro-2-butene	NELAP	PA	7/3/2007
EPA 8260 SIM		1,4-Dioxane (1,4-Diethyleneoxide)	NELAP	PA	12/4/2007
EPA 8270		1,1'-Biphenyl (Biphenyl, Lemonene)	NELAP	PA	4/17/2009
EPA 8270		1,2,3,4-Tetrachlorobenzene	NELAP	PA	7/3/2007
EPA 8270		1,2,3,4-Tetrahydronaphthalene	NELAP	PA	4/17/2009
EPA 8270		1,2,3,5-Tetrachlorobenzene	NELAP	PA	7/3/2007
EPA 8270		1,2,4,5-Tetrachlorobenzene	NELAP	PA	12/12/2005
EPA 8270		1,2,4-Trichlorobenzene	NELAP	PA	12/12/2005
EPA 8270		1,2-Dichlorobenzene (o-Dichlorobenzene)	NELAP	PA	12/12/2005
EPA 8270		1,2-Diphenylhydrazine	NELAP	PA	12/12/2005
EPA 8270		1,3,5-Trinitrobenzene (1,3,5-TNB)	NELAP	PA	12/12/2005
EPA 8270		1,3-Dichlorobenzene (m-Dichlorobenzene)	NELAP	PA	12/12/2005
EPA 8270		1,3-Dinitrobenzene (1,3-DNB)	NELAP	PA	12/12/2005
EPA 8270		1,4-Dichlorobenzene (p-Dichlorobenzene)	NELAP	PA	12/12/2005
EPA 8270		1,4-Dinitrobenzene (1,4-DNB)	NELAP	PA	4/17/2009
EPA 8270		1,4-Dioxane (1,4-Diethyleneoxide)	NELAP	PA	4/17/2009
EPA 8270		1,4-Naphthoquinone	NELAP	PA	12/12/2005
EPA 8270		1,4-Phenylenediamine	NELAP	PA	12/12/2005
EPA 8270		1-Chloronaphthalene	NELAP	PA	12/12/2005
EPA 8270		1-Methylnaphthalene	NELAP	PA	4/17/2009
EPA 8270		1-Naphthylamine (alpha-Naphthylamine)	NELAP	PA	12/12/2005
EPA 8270		2,2'-Oxybis(1-chloropropane) (bis(2-Chloro-1-methylethyl) ether)	NELAP	PA	1/19/2011
EPA 8270		2,3,4,6-Tetrachlorophenol	NELAP	PA	12/12/2005

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Laboratory Scope of Accreditation

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DEP Laboratory ID: 36-00037 **EPA Lab Code: PA00009** **TNI Code:** **(717) 656-2300**
PADWIS ID: 36037

Matrix: Non-Potable Water

Method	Revision	Analyte	Accreditation Type	Primary	Effective Date
EPA 8270		2,4,5-Trichlorophenol	NELAP	PA	12/12/2005
EPA 8270		2,4,6-Trichlorophenol	NELAP	PA	12/12/2005
EPA 8270		2,4-Dichlorophenol	NELAP	PA	12/12/2005
EPA 8270		2,4-Dimethylphenol	NELAP	PA	12/12/2005
EPA 8270		2,4-Dinitrophenol	NELAP	PA	12/12/2005
EPA 8270		2,4-Dinitrotoluene (2,4-DNT)	NELAP	PA	12/12/2005
EPA 8270		2,6-Dichlorophenol	NELAP	PA	12/12/2005
EPA 8270		2,6-Dinitrotoluene (2,6-DNT)	NELAP	PA	12/12/2005
EPA 8270		2-Acetylaminofluorene	NELAP	PA	12/12/2005
EPA 8270		2-Butoxyethanol	NELAP	PA	2/7/2012
EPA 8270		2-Chloronaphthalene	NELAP	PA	12/12/2005
EPA 8270		2-Chlorophenol	NELAP	PA	12/12/2005
EPA 8270		2-Methyl-4,6-dinitrophenol (4,6-Dinitro-2-methylphenol)	NELAP	PA	12/12/2005
EPA 8270		2-Methylnaphthalene	NELAP	PA	12/12/2005
EPA 8270		2-Methylphenol (o-Cresol)	NELAP	PA	12/12/2005
EPA 8270		2-Naphthylamine (beta-Naphthylamine)	NELAP	PA	12/12/2005
EPA 8270		2-Nitroaniline	NELAP	PA	12/12/2005
EPA 8270		2-Nitrophenol	NELAP	PA	12/12/2005
EPA 8270		2-Picoline (2-Methylpyridine)	NELAP	PA	5/2/2006
EPA 8270		3+4-Methylphenol (m+p-Cresol)	NELAP	PA	12/12/2005
EPA 8270		3,3'-Dichlorobenzidine	NELAP	PA	12/12/2005
EPA 8270		3,3'-Dimethylbenzidine	NELAP	PA	7/3/2007
EPA 8270		3-Methylcholanthrene	NELAP	PA	12/12/2005
EPA 8270		3-Nitroaniline	NELAP	PA	12/12/2005
EPA 8270		4,4'-Methylenebis(2-chloroaniline)	NELAP	PA	12/12/2005
EPA 8270		4-Aminobiphenyl	NELAP	PA	12/12/2005
EPA 8270		4-Bromophenyl phenyl ether	NELAP	PA	12/12/2005
EPA 8270		4-Chloro-3-methylphenol	NELAP	PA	12/12/2005
EPA 8270		4-Chloroaniline	NELAP	PA	12/12/2005
EPA 8270		4-Chlorophenyl phenyl ether	NELAP	PA	12/12/2005
EPA 8270		4-Nitroaniline	NELAP	PA	12/12/2005
EPA 8270		4-Nitrophenol	NELAP	PA	12/12/2005
EPA 8270		4-Nitroquinoline-1-oxide	NELAP	PA	7/3/2007
EPA 8270		5-Nitro-o-toluidine	NELAP	PA	12/12/2005
EPA 8270		6-Methylchrysene	NELAP	PA	1/19/2011
EPA 8270		7,12-Dimethylbenz(a)anthracene	NELAP	PA	12/12/2005
EPA 8270		Acenaphthene	NELAP	PA	12/12/2005
EPA 8270		Acenaphthylene	NELAP	PA	12/12/2005
EPA 8270		Acetophenone	NELAP	PA	12/12/2005
EPA 8270		Aniline	NELAP	PA	12/12/2005
EPA 8270		Anthracene	NELAP	PA	12/12/2005
EPA 8270		Aramite	NELAP	PA	12/12/2005
EPA 8270		Atrazine	NELAP	PA	1/22/2007
EPA 8270		Benzaldehyde	NELAP	PA	4/17/2009
EPA 8270		Benzenethiol	NELAP	PA	4/17/2009

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Laboratory Scope of Accreditation

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DEP Laboratory ID: 36-00037 **EPA Lab Code: PA00009** **TNI Code:** **(717) 656-2300**
PADWIS ID: 36037

Matrix: Non-Potable Water

Method	Revision	Analyte	Accreditation Type	Primary	Effective Date
EPA 8270		Benzidine	NELAP	PA	12/12/2005
EPA 8270		Benzo[a]anthracene	NELAP	PA	12/12/2005
EPA 8270		Benzo[a]pyrene	NELAP	PA	12/12/2005
EPA 8270		Benzo[b]fluoranthene	NELAP	PA	12/12/2005
EPA 8270		Benzo[ghi]perylene	NELAP	PA	12/12/2005
EPA 8270		Benzo[k]fluoranthene	NELAP	PA	12/12/2005
EPA 8270		Benzoic acid	NELAP	PA	12/12/2005
EPA 8270		Benzyl alcohol	NELAP	PA	12/12/2005
EPA 8270		Butyl benzyl phthalate (Benzyl butyl phthalate)	NELAP	PA	12/12/2005
EPA 8270		Caprolactam	NELAP	PA	4/17/2009
EPA 8270		Carbazole	NELAP	PA	12/12/2005
EPA 8270		Chlorobenzilate	NELAP	PA	12/12/2005
EPA 8270		Chrysene (Benzo[a]phenanthrene)	NELAP	PA	12/12/2005
EPA 8270		Di-n-butyl phthalate	NELAP	PA	12/12/2005
EPA 8270		Di-n-octyl phthalate	NELAP	PA	12/12/2005
EPA 8270		Diallate (cis or trans)	NELAP	PA	12/12/2005
EPA 8270		Dibenz[a,h]acridine	NELAP	PA	4/17/2009
EPA 8270		Dibenz[a,j]acridine	NELAP	PA	12/12/2005
EPA 8270		Dibenzo[a,h]anthracene	NELAP	PA	12/12/2005
EPA 8270		Dibenzofuran	NELAP	PA	12/12/2005
EPA 8270		Diethyl phthalate	NELAP	PA	12/12/2005
EPA 8270		Dimethoate	NELAP	PA	12/12/2005
EPA 8270		Dimethyl phthalate	NELAP	PA	12/12/2005
EPA 8270		Dimethylaminoazobenzene (4-Dimethylaminoazobenzene)	NELAP	PA	5/2/2006
EPA 8270		Dinoseb (2-sec-Butyl-4,6-dinitrophenol, DNBP)	NELAP	PA	12/12/2005
EPA 8270		Diphenylamine	NELAP	PA	12/12/2005
EPA 8270		Disulfoton	NELAP	PA	12/12/2005
EPA 8270		Ethyl methanesulfonate	NELAP	PA	12/12/2005
EPA 8270		Famphur	NELAP	PA	12/12/2005
EPA 8270		Fluoranthene	NELAP	PA	12/12/2005
EPA 8270		Fluorene	NELAP	PA	12/12/2005
EPA 8270		Hexachlorobenzene	NELAP	PA	12/12/2005
EPA 8270		Hexachlorobutadiene (1,3-Hexachlorobutadiene)	NELAP	PA	12/12/2005
EPA 8270		Hexachlorocyclopentadiene	NELAP	PA	12/12/2005
EPA 8270		Hexachloroethane	NELAP	PA	12/12/2005
EPA 8270		Hexachloropropene	NELAP	PA	12/12/2005
EPA 8270		Indene	NELAP	PA	4/17/2009
EPA 8270		Indeno(1,2,3-cd)pyrene	NELAP	PA	12/12/2005
EPA 8270		Isodrin	NELAP	PA	12/12/2005
EPA 8270		Isophorone	NELAP	PA	12/12/2005
EPA 8270		Isosafrole	NELAP	PA	12/12/2005
EPA 8270		Kepone	NELAP	PA	12/12/2005

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DEP Laboratory ID: 36-00037 **EPA Lab Code: PA00009** **TNI Code:** **(717) 656-2300**
PADWIS ID: 36037

Matrix: Non-Potable Water

Method	Revision	Analyte	Accreditation Type	Primary	Effective Date
EPA 8270		Methapyrilene	NELAP	PA	12/12/2005
EPA 8270		Methyl methanesulfonate	NELAP	PA	12/12/2005
EPA 8270		Methyl parathion (Parathion, methyl)	NELAP	PA	5/25/2007
EPA 8270		N,N-Dimethylacetamide	NELAP	PA	4/17/2009
EPA 8270		N,N-Dimethylformamide	NELAP	PA	4/17/2009
EPA 8270		N-Nitrosodi-n-butylamine	NELAP	PA	12/12/2005
EPA 8270		N-Nitrosodi-n-propylamine	NELAP	PA	12/12/2005
EPA 8270		N-Nitrosodiethylamine	NELAP	PA	12/12/2005
EPA 8270		N-Nitrosodimethylamine	NELAP	PA	12/12/2005
EPA 8270		N-Nitrosodiphenylamine	NELAP	PA	12/12/2005
EPA 8270		N-Nitrosomethylethylamine	NELAP	PA	12/12/2005
EPA 8270		N-Nitrosomorpholine	NELAP	PA	12/12/2005
EPA 8270		N-Nitrosopiperidine	NELAP	PA	12/12/2005
EPA 8270		N-Nitrosopyrrolidine	NELAP	PA	12/12/2005
EPA 8270		Naphthalene	NELAP	PA	12/12/2005
EPA 8270		Nitrobenzene	NELAP	PA	12/12/2005
EPA 8270		O,O,O-Triethyl phosphorothioate	NELAP	PA	12/12/2005
EPA 8270		Parathion, ethyl (Ethyl parathion, Parathion)	NELAP	PA	5/25/2007
EPA 8270		Pentachlorobenzene	NELAP	PA	12/12/2005
EPA 8270		Pentachloronitrobenzene (PCNB)	NELAP	PA	12/12/2005
EPA 8270		Pentachlorophenol (PCP)	NELAP	PA	12/12/2005
EPA 8270		Phenacetin	NELAP	PA	12/12/2005
EPA 8270		Phenanthrene	NELAP	PA	12/12/2005
EPA 8270		Phenol	NELAP	PA	12/12/2005
EPA 8270		Phorate (Thimet)	NELAP	PA	12/12/2005
EPA 8270		Phthalic anhydride	NELAP	PA	1/21/2009
EPA 8270		Pronamide (Kerb)	NELAP	PA	12/12/2005
EPA 8270		Pyrene	NELAP	PA	12/12/2005
EPA 8270		Pyridine	NELAP	PA	12/12/2005
EPA 8270		Quinoline	NELAP	PA	4/17/2009
EPA 8270	C	SOCs by GC/MS	NELAP	PA	3/26/2012
EPA 8270	D	SOCs by GC/MS	NELAP	PA	3/26/2012
EPA 8270		Safrole	NELAP	PA	12/12/2005
EPA 8270		Sulfotepp (Tetraethyl dithiopyrophosphate)	NELAP	PA	4/17/2009
EPA 8270		Tetraethyl lead	NELAP	PA	3/7/2012
EPA 8270		Thionazine (Thionazin, Zinophos)	NELAP	PA	12/12/2005
EPA 8270		a,a-Dimethylphenethylamine (Phentermine)	NELAP	PA	12/12/2005
EPA 8270		a-Methylstyrene	NELAP	PA	4/17/2009
EPA 8270		bis(2-Chloroethoxy)methane	NELAP	PA	12/12/2005
EPA 8270		bis(2-Chloroethyl) ether	NELAP	PA	12/12/2005
EPA 8270		bis(2-Chloroisopropyl) ether	NELAP	PA	12/12/2005
EPA 8270		bis(2-Chloromethyl) ether	NELAP	PA	1/21/2009
EPA 8270		bis(2-Ethylhexyl) phthalate (DEHP)	NELAP	PA	12/12/2005
EPA 8270		o-Toluidine (2-Toluidine, 2-Methylaniline)	NELAP	PA	12/12/2005
EPA 8270		p-(Dimethylamino)azobenzene	NELAP	PA	4/17/2009

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DEPARTMENT OF ENVIRONMENTAL PROTECTION

Laboratory Scope of Accreditation

Attached to Certificate of Accreditation 014-006 expiration date January 31, 2016. This listing of accredited analytes should be used only when associated with a valid certificate of accreditation.

DEP Laboratory ID: 36-00037 **EPA Lab Code: PA00009** **TNI Code:** **(717) 656-2300**
PADWIS ID: 36037

Matrix: Non-Potable Water

Method	Revision	Analyte	Accreditation Type	Primary	Effective Date
EPA 8270		tris-(2,3-Dibromopropyl) phosphate (tris-BP)	NELAP	PA	4/17/2009
EPA 8270 SIM		1-Methylnaphthalene	NELAP	PA	7/25/2011
EPA 8270 SIM		2-Methylnaphthalene	NELAP	PA	5/23/2012
EPA 8270 SIM		Acenaphthene	NELAP	PA	12/4/2007
EPA 8270 SIM		Acenaphthylene	NELAP	PA	12/4/2007
EPA 8270 SIM		Anthracene	NELAP	PA	12/4/2007
EPA 8270 SIM		Benzo[a]anthracene	NELAP	PA	12/4/2007
EPA 8270 SIM		Benzo[a]pyrene	NELAP	PA	12/4/2007
EPA 8270 SIM		Benzo[b]fluoranthene	NELAP	PA	12/4/2007
EPA 8270 SIM		Benzo[ghi]perylene	NELAP	PA	12/4/2007
EPA 8270 SIM		Benzo[k]fluoranthene	NELAP	PA	12/4/2007
EPA 8270 SIM		Chrysene (Benzo[a]phenanthrene)	NELAP	PA	12/4/2007
EPA 8270 SIM		Dibenzo[a,h]anthracene	NELAP	PA	12/4/2007
EPA 8270 SIM		Fluoranthene	NELAP	PA	12/4/2007
EPA 8270 SIM		Fluorene	NELAP	PA	12/4/2007
EPA 8270 SIM		Indeno(1,2,3-cd)pyrene	NELAP	PA	12/4/2007
EPA 8270 SIM		Naphthalene	NELAP	PA	12/4/2007
EPA 8270 SIM		Phenanthrene	NELAP	PA	12/4/2007
EPA 8270 SIM		Pyrene	NELAP	PA	12/4/2007
EPA 8290		1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	NELAP	PA	6/30/2010
EPA 8290		1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	NELAP	PA	6/30/2010
EPA 8290		1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (1,2,3,4,6,7,8-hpcdd)	NELAP	PA	6/30/2010
EPA 8290		1,2,3,4,6,7,8-Heptachlorodibenzofuran (1,2,3,4,6,7,8-hpcdf)	NELAP	PA	6/30/2010
EPA 8290		1,2,3,4,7,8,9-Heptachlorodibenzofuran (1,2,3,4,7,8,9-hpcdf)	NELAP	PA	6/30/2010
EPA 8290		1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	NELAP	PA	6/30/2010
EPA 8290		1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF)	NELAP	PA	8/6/2010
EPA 8290		1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	NELAP	PA	6/30/2010
EPA 8290		1,2,3,6,7,8-Hexachlorodibenzofuran (HxCDF)	NELAP	PA	6/30/2010
EPA 8290		1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (HxCDD)	NELAP	PA	6/30/2010
EPA 8290		1,2,3,7,8,9-Hexachlorodibenzofuran (HxCDF)	NELAP	PA	6/30/2010
EPA 8290		1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD)	NELAP	PA	6/30/2010
EPA 8290		1,2,3,7,8-Pentachlorodibenzofuran (PeCDF)	NELAP	PA	6/30/2010
EPA 8290		2,3,4,6,7,8-Hexachlorodibenzofuran (HxCDF)	NELAP	PA	6/30/2010
EPA 8290		2,3,4,7,8-Pentachlorodibenzofuran (PeCDF)	NELAP	PA	8/6/2010

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Laboratory Scope of Accreditation

Attached to Certificate of Accreditation 014-006 expiration date January 31, 2016. This listing of accredited analytes should be used only when associated with a valid certificate of accreditation.

DEP Laboratory ID: 36-00037 **EPA Lab Code: PA00009** **TNI Code:** **(717) 656-2300**
PADWIS ID: 36037

Matrix: Non-Potable Water

Method	Revision	Analyte	Accreditation Type	Primary	Effective Date
EPA 8290		2,3,7,8-Tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD)(Dioxin)	NELAP	PA	6/30/2010
EPA 8290		2,3,7,8-Tetrachlorodibenzofuran (TCDF)	NELAP	PA	6/30/2010
EPA 8290	A	PCDDs and PCDFs by HRGC-HRMS	NELAP	PA	3/4/2015
EPA 8290		PCDDs and PCDFs by HRGC-HRMS	NELAP	PA	3/26/2012
EPA 8290		Total TCDD	NELAP	PA	6/30/2010
EPA 8290		Total TCDF	NELAP	PA	6/30/2010
EPA 8290		Total heptachlorodibenzo-p-dioxin (HpCDD)	NELAP	PA	6/30/2010
EPA 8290		Total heptachlorodibenzofuran (HpCDF)	NELAP	PA	6/30/2010
EPA 8290		Total hexachlorodibenzo-p-dioxin (HxCDD)	NELAP	PA	6/30/2010
EPA 8290		Total hexachlorodibenzofuran (HxCDF)	NELAP	PA	6/30/2010
EPA 8290		Total pentachlorodibenzo-p-dioxin (PeCDD)	NELAP	PA	6/30/2010
EPA 8290		Total pentachlorodibenzofuran (PeCDF)	NELAP	PA	6/30/2010
EPA 8315		2,5-Dimethylbenzaldehyde	NELAP	PA	12/12/2005
EPA 8315		Acetaldehyde	NELAP	PA	12/12/2005
EPA 8315		Benzaldehyde	NELAP	PA	12/12/2005
EPA 8315		Butanal (Butyraldehyde)	NELAP	PA	5/2/2006
EPA 8315	A	Carbonyl compounds by HPLC	NELAP	PA	3/26/2012
EPA 8315		Crotonaldehyde	NELAP	PA	12/12/2005
EPA 8315		Formaldehyde	NELAP	PA	12/12/2005
EPA 8315		Hexanal (Hexaldehyde)	NELAP	PA	1/21/2009
EPA 8315		Isovaleraldehyde	NELAP	PA	12/12/2005
EPA 8315		Pentanal (Valeraldehyde)	NELAP	PA	12/12/2005
EPA 8315		Propanal (Propionaldehyde)	NELAP	PA	1/21/2009
EPA 8315		m-Tolualdehyde (1,3-Tolualdehyde)	NELAP	PA	5/2/2006
EPA 8315		o-Tolualdehyde (1,2-Tolualdehyde)	NELAP	PA	1/24/2007
EPA 8315		p-Tolualdehyde (1,4-Tolualdehyde)	NELAP	PA	1/24/2007
EPA 8330		1,3,5-Trinitrobenzene (1,3,5-TNB)	NELAP	PA	12/12/2005
EPA 8330		1,3-Dinitrobenzene (1,3-DNB)	NELAP	PA	12/12/2005
EPA 8330		2,4,6-Trinitrotoluene (2,4,6-TNT)	NELAP	PA	12/12/2005
EPA 8330		2,4-Diamino-6-nitrotoluene	NELAP	PA	7/29/2015
EPA 8330		2,4-Dinitrotoluene (2,4-DNT)	NELAP	PA	6/11/2007
EPA 8330		2,6-Diamino-4-nitrotoluene	NELAP	PA	7/29/2015
EPA 8330		2,6-Dinitrotoluene (2,6-DNT)	NELAP	PA	6/11/2007
EPA 8330		2-Amino-4,6-dinitrotoluene (2-Am-DNT)	NELAP	PA	12/12/2005
EPA 8330		2-Nitrotoluene	NELAP	PA	12/12/2005
EPA 8330		3,5-Dinitroaniline	NELAP	PA	7/29/2015
EPA 8330		3-Nitrotoluene	NELAP	PA	12/12/2005
EPA 8330		4-Amino-2,6-dinitrotoluene (4-Am-DNT)	NELAP	PA	12/12/2005
EPA 8330		4-Nitrotoluene	NELAP	PA	12/12/2005
EPA 8330		Methyl-2,4,6-trinitrophenylnitramine (Tetryl)	NELAP	PA	12/12/2005
EPA 8330		Nitroaromatics and nitramines by HPLC/UV	NELAP	PA	3/26/2012
EPA 8330	B	Nitroaromatics and nitramines by HPLC/UV	NELAP	PA	7/29/2015
EPA 8330	A	Nitroaromatics and nitramines by HPLC/UV	NELAP	PA	3/26/2012

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DEPARTMENT OF ENVIRONMENTAL PROTECTION

Laboratory Scope of Accreditation

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DEP Laboratory ID: 36-00037 **EPA Lab Code: PA00009** **TNI Code:** **(717) 656-2300**
PADWIS ID: 36037

Matrix: Non-Potable Water

Method	Revision	Analyte	Accreditation Type	Primary	Effective Date
EPA 8330		Nitrobenzene	NELAP	PA	6/11/2007
EPA 8330		Nitroglycerin	NELAP	PA	1/24/2007
EPA 8330		Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)	NELAP	PA	12/12/2005
EPA 8330		Pentaerythritol tetranitrate (PETN)	NELAP	PA	5/2/2006
EPA 8330		RDX (Hexahydro-1,3,5-trinitro-1,3,5-triazine)	NELAP	PA	12/12/2005
EPA 9012		Total cyanide	NELAP	PA	12/12/2005
EPA 9040		pH	NELAP	PA	12/12/2005
EPA 9050	A	Conductivity	NELAP	PA	1/27/2014
EPA 9050		Conductivity	NELAP	PA	12/12/2005
EPA 9056	A	Anions by IC	NELAP	PA	3/19/2015
EPA 9056		Bromide	NELAP	PA	12/12/2005
EPA 9056		Chloride	NELAP	PA	12/12/2005
EPA 9056		Fluoride	NELAP	PA	12/12/2005
EPA 9056		Nitrate as N	NELAP	PA	12/12/2005
EPA 9056		Nitrite as N	NELAP	PA	1/19/2005
EPA 9056		Sulfate	NELAP	PA	12/12/2005
EPA 9060		Total organic carbon (TOC)	NELAP	PA	12/12/2005
EPA 9066		Total phenolics	NELAP	PA	12/12/2005
FL-PRO		Total petroleum hydrocarbons (TPH)	NELAP	PA	12/12/2005
MA DEP EPH	1.1	C11-C22 Aromatics	NELAP	PA	7/15/2013
MA DEP EPH	1.1	C19-C36 Aliphatics	NELAP	PA	7/15/2013
MA DEP EPH	1.1	C9-C18 Aliphatics	NELAP	PA	7/15/2013
MA DEP VPH	1.1	C5-C8 Aliphatics	NELAP	PA	7/15/2013
MA DEP VPH	1.1	C9-C10 Aromatics	NELAP	PA	7/29/2015
MA DEP VPH	1.1	C9-C12 Aliphatics	NELAP	PA	7/15/2013
NWTPH-Dx		Diesel-range organics (DRO)	NELAP	PA	12/12/2005
NWTPH-Gx		Gasoline-range organics (GRO)	NELAP	PA	12/12/2005
OIA 1677		Available cyanide	NELAP	PA	10/9/2013
OIA 1677		Free cyanide	NELAP	PA	10/9/2013
RSK-175		Acetylene (Ethyne)	NELAP	PA	1/20/2012
RSK-175		Ethane	NELAP	PA	6/29/2010
RSK-175		Ethene	NELAP	PA	6/29/2010
RSK-175		Methane	NELAP	PA	6/29/2010
RSK-175		Propane	NELAP	PA	6/29/2010
RSK-175		n-Butane	NELAP	PA	12/22/2011
SM 2120 B		Color	NELAP	PA	4/17/2007
SM 2310 B		Acidity as CaCO3	NELAP	PA	4/17/2007
SM 2320 B		Alkalinity as CaCO3	NELAP	PA	1/19/2005
SM 2340 C		Total hardness as CaCO3	NELAP	PA	4/17/2007
SM 2510 B		Conductivity	NELAP	PA	12/12/2005
SM 2540 B		Residue, total	NELAP	PA	4/17/2007
SM 2540 C		Residue, filterable (TDS)	NELAP	PA	4/17/2007
SM 2540 D		Residue, nonfilterable (TSS)	NELAP	PA	4/17/2007
SM 2540 F		Residue, settleable	NELAP	PA	4/17/2007

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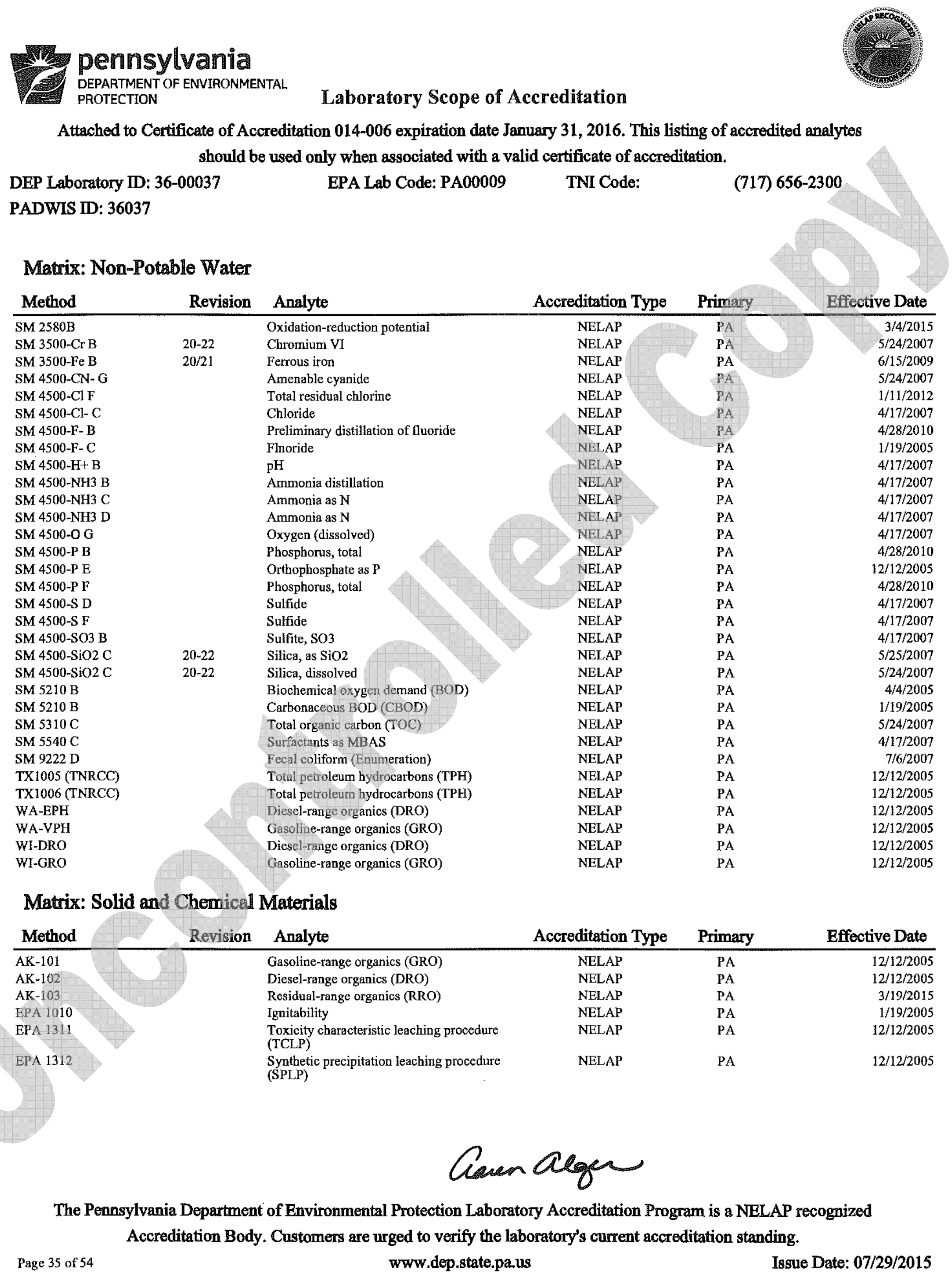

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DEPARTMENT OF ENVIRONMENTAL PROTECTION

Laboratory Scope of Accreditation

Attached to Certificate of Accreditation 014-006 expiration date January 31, 2016. This listing of accredited analytes should be used only when associated with a valid certificate of accreditation.

DEP Laboratory ID: 36-00037 **EPA Lab Code: PA00009** **TNI Code:** **(717) 656-2300**
PADWIS ID: 36037

Matrix: Non-Potable Water

Method	Revision	Analyte	Accreditation Type	Primary	Effective Date
SM 2580B		Oxidation-reduction potential	NELAP	PA	3/4/2015
SM 3500-Cr B	20-22	Chromium VI	NELAP	PA	5/24/2007
SM 3500-Fe B	20/21	Ferrous iron	NELAP	PA	6/15/2009
SM 4500-CN- G		Amenable cyanide	NELAP	PA	5/24/2007
SM 4500-Cl F		Total residual chlorine	NELAP	PA	1/11/2012
SM 4500-Cl- C		Chloride	NELAP	PA	4/17/2007
SM 4500-F- B		Preliminary distillation of fluoride	NELAP	PA	4/28/2010
SM 4500-F- C		Fluoride	NELAP	PA	1/19/2005
SM 4500-H+ B		pH	NELAP	PA	4/17/2007
SM 4500-NH3 B		Ammonia distillation	NELAP	PA	4/17/2007
SM 4500-NH3 C		Ammonia as N	NELAP	PA	4/17/2007
SM 4500-NH3 D		Ammonia as N	NELAP	PA	4/17/2007
SM 4500-O G		Oxygen (dissolved)	NELAP	PA	4/17/2007
SM 4500-P B		Phosphorus, total	NELAP	PA	4/28/2010
SM 4500-P E		Orthophosphate as P	NELAP	PA	12/12/2005
SM 4500-P F		Phosphorus, total	NELAP	PA	4/28/2010
SM 4500-S D		Sulfide	NELAP	PA	4/17/2007
SM 4500-S F		Sulfide	NELAP	PA	4/17/2007
SM 4500-SO3 B		Sulfite, SO3	NELAP	PA	4/17/2007
SM 4500-SiO2 C	20-22	Silica, as SiO2	NELAP	PA	5/25/2007
SM 4500-SiO2 C	20-22	Silica, dissolved	NELAP	PA	5/24/2007
SM 5210 B		Biochemical oxygen demand (BOD)	NELAP	PA	4/4/2005
SM 5210 B		Carbonaceous BOD (CBOD)	NELAP	PA	1/19/2005
SM 5310 C		Total organic carbon (TOC)	NELAP	PA	5/24/2007
SM 5540 C		Surfactants as MBAS	NELAP	PA	4/17/2007
SM 9222 D		Fecal coliform (Enumeration)	NELAP	PA	7/6/2007
TX1005 (TNRCC)		Total petroleum hydrocarbons (TPH)	NELAP	PA	12/12/2005
TX1006 (TNRCC)		Total petroleum hydrocarbons (TPH)	NELAP	PA	12/12/2005
WA-EPH		Diesel-range organics (DRO)	NELAP	PA	12/12/2005
WA-VPH		Gasoline-range organics (GRO)	NELAP	PA	12/12/2005
WI-DRO		Diesel-range organics (DRO)	NELAP	PA	12/12/2005
WI-GRO		Gasoline-range organics (GRO)	NELAP	PA	12/12/2005

Matrix: Solid and Chemical Materials

Method	Revision	Analyte	Accreditation Type	Primary	Effective Date
AK-101		Gasoline-range organics (GRO)	NELAP	PA	12/12/2005
AK-102		Diesel-range organics (DRO)	NELAP	PA	12/12/2005
AK-103		Residual-range organics (RRO)	NELAP	PA	3/19/2015
EPA 1010		Ignitability	NELAP	PA	1/19/2005
EPA 1311		Toxicity characteristic leaching procedure (TCLP)	NELAP	PA	12/12/2005
EPA 1312		Synthetic precipitation leaching procedure (SPLP)	NELAP	PA	12/12/2005

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Laboratory Scope of Accreditation

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DEP Laboratory ID: 36-00037 **EPA Lab Code: PA00009** **TNI Code:** **(717) 656-2300**
PADWIS ID: 36037

Matrix: Solid and Chemical Materials

Method	Revision	Analyte	Accreditation Type	Primary	Effective Date
EPA 1668		2,2',3,3',4,4',5,5',6-Nonachlorobiphenyl (BZ 206)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,3',4,4',5,5'-Octachlorobiphenyl (BZ 194)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,3',4,4',5,6'-Octachlorobiphenyl (BZ 196)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,3',4,4',5,6,6'-Nonachlorobiphenyl (BZ 207)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,3',4,4',5,6-Octachlorobiphenyl (BZ 195)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,3',4,4',5-Heptachlorobiphenyl (BZ 170)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,3',4,4',6,6'-Octachlorobiphenyl (BZ 197)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,3',4,4',6-Heptachlorobiphenyl (BZ 171)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,3',4,4'-Hexachlorobiphenyl (BZ 128)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,3',4,5',6'-Heptachlorobiphenyl (BZ 177)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,3',4,5',6,6'-Octachlorobiphenyl (BZ 201)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,3',4,5',6-Heptachlorobiphenyl (BZ 175)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,3',4,5'-Hexachlorobiphenyl (BZ 130)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,3',4,5,5',6'-Octachlorobiphenyl (BZ 199)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,3',4,5,5',6,6'-Nonachlorobiphenyl (BZ 208)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,3',4,5,5',6-Octachlorobiphenyl (BZ 198)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,3',4,5,5'-Heptachlorobiphenyl (BZ 172)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,3',4,5,6'-Heptachlorobiphenyl (BZ 174)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,3',4,5,6,6'-Octachlorobiphenyl (BZ 200)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,3',4,5,6-Heptachlorobiphenyl (BZ 173)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,3',4,5-Hexachlorobiphenyl (BZ 129)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,3',4,6'-Hexachlorobiphenyl (BZ 132)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,3',4,6,6'-Heptachlorobiphenyl (BZ 176)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,3',4,6-Hexachlorobiphenyl (BZ 131)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,3',4-Pentachlorobiphenyl (BZ 82)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,3',5,5',6,6'-Octachlorobiphenyl (BZ 202)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,3',5,5',6-Heptachlorobiphenyl (BZ 178)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,3',5,5'-Hexachlorobiphenyl (BZ 133)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,3',5,6'-Hexachlorobiphenyl (BZ 135)	NELAP	PA	12/17/2012

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Laboratory Scope of Accreditation

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DEP Laboratory ID: 36-00037 **EPA Lab Code: PA00009** **TNI Code:** **(717) 656-2300**
PADWIS ID: 36037

Matrix: Solid and Chemical Materials

Method	Revision	Analyte	Accreditation Type	Primary	Effective Date
EPA 1668		2,2',3,3',5,6,6'-Heptachlorobiphenyl (BZ 179)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,3',5,6-Hexachlorobiphenyl (BZ 134)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,3',5-Pentachlorobiphenyl (BZ 83)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,3',6,6'-Hexachlorobiphenyl (BZ 136)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,3',6-Pentachlorobiphenyl (BZ 84)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,3'-Tetrachlorobiphenyl (BZ 40)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,4',5',6-Hexachlorobiphenyl (BZ 149)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,4',5'-Pentachlorobiphenyl (BZ 97)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,4',5,5',6-Heptachlorobiphenyl (BZ 187)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,4',5,5'-Hexachlorobiphenyl (BZ 146)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,4',5,6'-Hexachlorobiphenyl (BZ 148)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,4',5,6,6'-Heptachlorobiphenyl (BZ 188)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,4',5,6-Hexachlorobiphenyl (BZ 147)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,4',5-Pentachlorobiphenyl (BZ 90)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,4',6'-Pentachlorobiphenyl (BZ 98)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,4',6,6'-Hexachlorobiphenyl (BZ 150)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,4',6-Pentachlorobiphenyl (BZ 91)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,4'-Tetrachlorobiphenyl (BZ 42)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,4,4',5',6-Heptachlorobiphenyl (BZ 183)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,4,4',5'-Hexachlorobiphenyl (BZ 138)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,4,4',5,5',6-Octachlorobiphenyl (BZ 203)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,4,4',5,5'-Heptachlorobiphenyl (BZ 180)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,4,4',5,6'-Heptachlorobiphenyl (BZ 182)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,4,4',5,6,6'-Octachlorobiphenyl (BZ 204)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,4,4',5,6-Heptachlorobiphenyl (BZ 181)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,4,4',5-Hexachlorobiphenyl (BZ 137)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,4,4',6'-Hexachlorobiphenyl (BZ 140)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,4,4',6,6'-Heptachlorobiphenyl (BZ 184)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,4,4',6-Hexachlorobiphenyl (BZ 139)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,4,4'-Pentachlorobiphenyl (BZ 85)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,4,5',6-Hexachlorobiphenyl (BZ 144)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,4,5'-Pentachlorobiphenyl (BZ 87)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,4,5,5',6-Heptachlorobiphenyl (BZ 185)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,4,5,5'-Hexachlorobiphenyl (BZ 141)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,4,5,6'-Hexachlorobiphenyl (BZ 143)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,4,5,6,6'-Heptachlorobiphenyl (BZ 186)	NELAP	PA	12/17/2012

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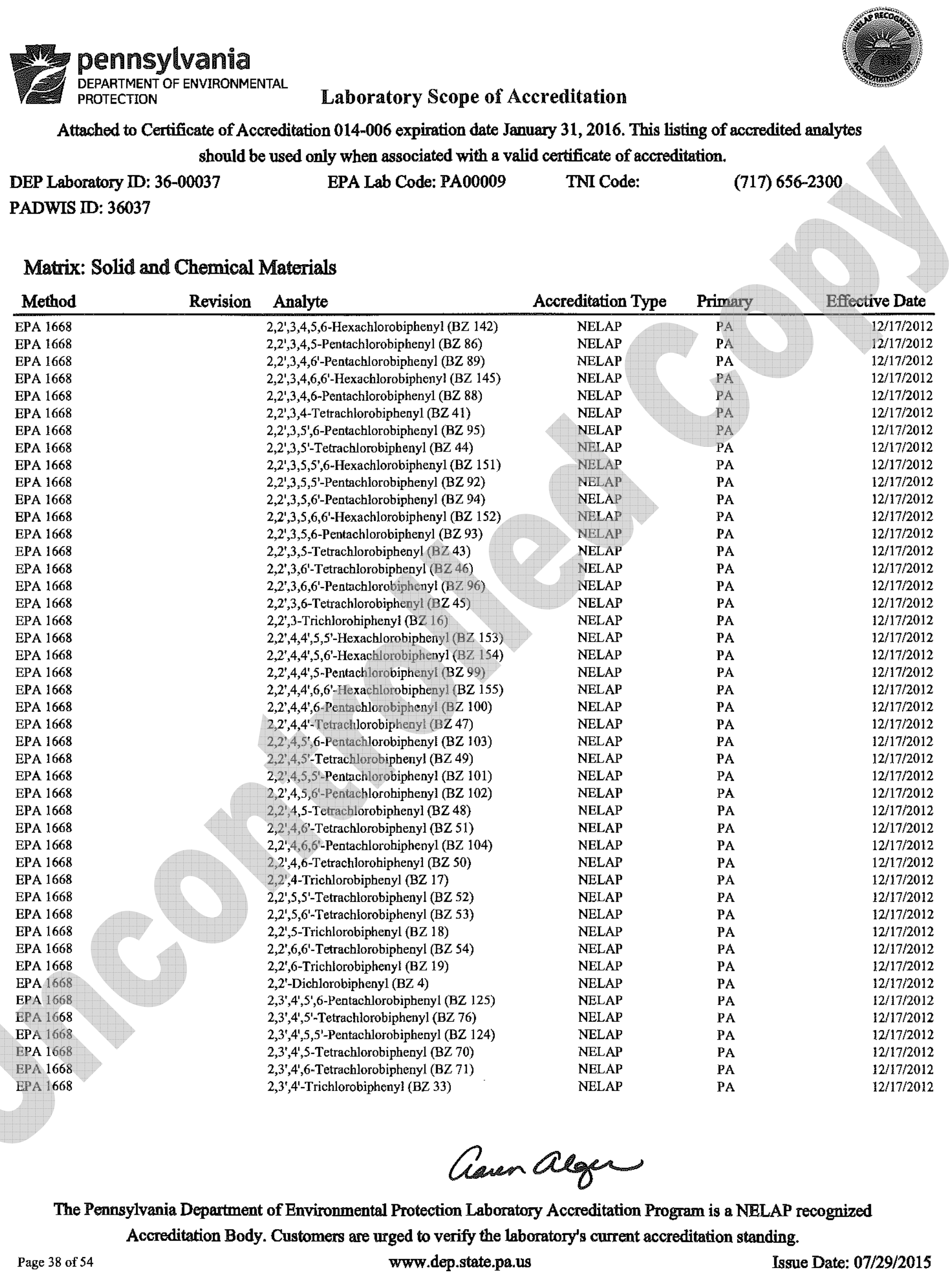

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DEPARTMENT OF ENVIRONMENTAL PROTECTION

Laboratory Scope of Accreditation

Attached to Certificate of Accreditation 014-006 expiration date January 31, 2016. This listing of accredited analytes should be used only when associated with a valid certificate of accreditation.

DEP Laboratory ID: 36-00037 **EPA Lab Code: PA00009** **TNI Code:** **(717) 656-2300**
PADWIS ID: 36037

Matrix: Solid and Chemical Materials

Method	Revision	Analyte	Accreditation Type	Primary	Effective Date
EPA 1668		2,2',3,4,5,6-Hexachlorobiphenyl (BZ 142)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,4,5-Pentachlorobiphenyl (BZ 86)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,4,6'-Pentachlorobiphenyl (BZ 89)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,4,6,6'-Hexachlorobiphenyl (BZ 145)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,4,6-Pentachlorobiphenyl (BZ 88)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,4-Tetrachlorobiphenyl (BZ 41)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,5',6-Pentachlorobiphenyl (BZ 95)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,5'-Tetrachlorobiphenyl (BZ 44)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,5,5',6-Hexachlorobiphenyl (BZ 151)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,5,5'-Pentachlorobiphenyl (BZ 92)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,5,6'-Pentachlorobiphenyl (BZ 94)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,5,6,6'-Hexachlorobiphenyl (BZ 152)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,5,6-Pentachlorobiphenyl (BZ 93)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,5-Tetrachlorobiphenyl (BZ 43)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,6'-Tetrachlorobiphenyl (BZ 46)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,6,6'-Pentachlorobiphenyl (BZ 96)	NELAP	PA	12/17/2012
EPA 1668		2,2',3,6-Tetrachlorobiphenyl (BZ 45)	NELAP	PA	12/17/2012
EPA 1668		2,2',3-Trichlorobiphenyl (BZ 16)	NELAP	PA	12/17/2012
EPA 1668		2,2',4,4',5,5'-Hexachlorobiphenyl (BZ 153)	NELAP	PA	12/17/2012
EPA 1668		2,2',4,4',5,6'-Hexachlorobiphenyl (BZ 154)	NELAP	PA	12/17/2012
EPA 1668		2,2',4,4',5-Pentachlorobiphenyl (BZ 99)	NELAP	PA	12/17/2012
EPA 1668		2,2',4,4',6,6'-Hexachlorobiphenyl (BZ 155)	NELAP	PA	12/17/2012
EPA 1668		2,2',4,4',6-Pentachlorobiphenyl (BZ 100)	NELAP	PA	12/17/2012
EPA 1668		2,2',4,4'-Tetrachlorobiphenyl (BZ 47)	NELAP	PA	12/17/2012
EPA 1668		2,2',4,5',6-Pentachlorobiphenyl (BZ 103)	NELAP	PA	12/17/2012
EPA 1668		2,2',4,5'-Tetrachlorobiphenyl (BZ 49)	NELAP	PA	12/17/2012
EPA 1668		2,2',4,5,5'-Pentachlorobiphenyl (BZ 101)	NELAP	PA	12/17/2012
EPA 1668		2,2',4,5,6'-Pentachlorobiphenyl (BZ 102)	NELAP	PA	12/17/2012
EPA 1668		2,2',4,5-Tetrachlorobiphenyl (BZ 48)	NELAP	PA	12/17/2012
EPA 1668		2,2',4,6'-Tetrachlorobiphenyl (BZ 51)	NELAP	PA	12/17/2012
EPA 1668		2,2',4,6,6'-Pentachlorobiphenyl (BZ 104)	NELAP	PA	12/17/2012
EPA 1668		2,2',4,6-Tetrachlorobiphenyl (BZ 50)	NELAP	PA	12/17/2012
EPA 1668		2,2',4-Trichlorobiphenyl (BZ 17)	NELAP	PA	12/17/2012
EPA 1668		2,2',5,5'-Tetrachlorobiphenyl (BZ 52)	NELAP	PA	12/17/2012
EPA 1668		2,2',5,6'-Tetrachlorobiphenyl (BZ 53)	NELAP	PA	12/17/2012
EPA 1668		2,2',5-Trichlorobiphenyl (BZ 18)	NELAP	PA	12/17/2012
EPA 1668		2,2',6,6'-Tetrachlorobiphenyl (BZ 54)	NELAP	PA	12/17/2012
EPA 1668		2,2',6-Trichlorobiphenyl (BZ 19)	NELAP	PA	12/17/2012
EPA 1668		2,2'-Dichlorobiphenyl (BZ 4)	NELAP	PA	12/17/2012
EPA 1668		2,3',4',5',6-Pentachlorobiphenyl (BZ 125)	NELAP	PA	12/17/2012
EPA 1668		2,3',4',5'-Tetrachlorobiphenyl (BZ 76)	NELAP	PA	12/17/2012
EPA 1668		2,3',4',5,5'-Pentachlorobiphenyl (BZ 124)	NELAP	PA	12/17/2012
EPA 1668		2,3',4',5-Tetrachlorobiphenyl (BZ 70)	NELAP	PA	12/17/2012
EPA 1668		2,3',4',6-Tetrachlorobiphenyl (BZ 71)	NELAP	PA	12/17/2012
EPA 1668		2,3',4'-Trichlorobiphenyl (BZ 33)	NELAP	PA	12/17/2012

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DEPARTMENT OF ENVIRONMENTAL PROTECTION

Laboratory Scope of Accreditation

Attached to Certificate of Accreditation 014-006 expiration date January 31, 2016. This listing of accredited analytes should be used only when associated with a valid certificate of accreditation.

DEP Laboratory ID: 36-00037 **EPA Lab Code: PA00009** **TNI Code:** **(717) 656-2300**
PADWIS ID: 36037

Matrix: Solid and Chemical Materials

Method	Revision	Analyte	Accreditation Type	Primary	Effective Date
EPA 1668		2,3',4,4',5',6-Hexachlorobiphenyl (BZ 168)	NELAP	PA	12/17/2012
EPA 1668		2,3',4,4',5'-Pentachlorobiphenyl (BZ 123)	NELAP	PA	12/17/2012
EPA 1668		2,3',4,4',5,5'-Hexachlorobiphenyl (BZ 167)	NELAP	PA	12/17/2012
EPA 1668		2,3',4,4',5-Pentachlorobiphenyl (BZ 118)	NELAP	PA	12/17/2012
EPA 1668		2,3',4,4',6-Pentachlorobiphenyl (BZ 119)	NELAP	PA	12/17/2012
EPA 1668		2,3',4,4'-Tetrachlorobiphenyl (BZ 66)	NELAP	PA	12/17/2012
EPA 1668		2,3',4,5',6-Pentachlorobiphenyl (BZ 121)	NELAP	PA	12/17/2012
EPA 1668		2,3',4,5'-Tetrachlorobiphenyl (BZ 68)	NELAP	PA	12/17/2012
EPA 1668		2,3',4,5,5'-Pentachlorobiphenyl (BZ 120)	NELAP	PA	12/17/2012
EPA 1668		2,3',4,5-Tetrachlorobiphenyl (BZ 67)	NELAP	PA	12/17/2012
EPA 1668		2,3',4,6-Tetrachlorobiphenyl (BZ 69)	NELAP	PA	12/17/2012
EPA 1668		2,3',4-Trichlorobiphenyl (BZ 25)	NELAP	PA	12/17/2012
EPA 1668		2,3',5',6-Tetrachlorobiphenyl (BZ 73)	NELAP	PA	12/17/2012
EPA 1668		2,3',5'-Trichlorobiphenyl (BZ 34)	NELAP	PA	12/17/2012
EPA 1668		2,3',5,5'-Tetrachlorobiphenyl (BZ 72)	NELAP	PA	12/17/2012
EPA 1668		2,3',5-Trichlorobiphenyl (BZ 26)	NELAP	PA	12/17/2012
EPA 1668		2,3',6-Trichlorobiphenyl (BZ 27)	NELAP	PA	12/17/2012
EPA 1668		2,3'-Dichlorobiphenyl (BZ 6)	NELAP	PA	12/17/2012
EPA 1668		2,3,3',4',5',6-Hexachlorobiphenyl (BZ 164)	NELAP	PA	12/17/2012
EPA 1668		2,3,3',4',5'-Pentachlorobiphenyl (BZ 122)	NELAP	PA	12/17/2012
EPA 1668		2,3,3',4',5,5',6-Heptachlorobiphenyl (BZ 193)	NELAP	PA	12/17/2012
EPA 1668		2,3,3',4',5,5'-Hexachlorobiphenyl (BZ 162)	NELAP	PA	12/17/2012
EPA 1668		2,3,3',4',5,6-Hexachlorobiphenyl (BZ 163)	NELAP	PA	12/17/2012
EPA 1668		2,3,3',4',5-Pentachlorobiphenyl (BZ 107)	NELAP	PA	12/17/2012
EPA 1668		2,3,3',4',6-Pentachlorobiphenyl (BZ 110)	NELAP	PA	12/17/2012
EPA 1668		2,3,3',4'-Tetrachlorobiphenyl (BZ 56)	NELAP	PA	12/17/2012
EPA 1668		2,3,3',4,4',5',6-Heptachlorobiphenyl (BZ 191)	NELAP	PA	12/17/2012
EPA 1668		2,3,3',4,4',5'-Hexachlorobiphenyl (BZ 157)	NELAP	PA	12/17/2012
EPA 1668		2,3,3',4,4',5,5',6-Octachlorobiphenyl (BZ 205)	NELAP	PA	12/17/2012
EPA 1668		2,3,3',4,4',5,5'-Heptachlorobiphenyl (BZ 189)	NELAP	PA	12/17/2012
EPA 1668		2,3,3',4,4',5,6-Heptachlorobiphenyl (BZ 190)	NELAP	PA	12/17/2012
EPA 1668		2,3,3',4,4',5-Hexachlorobiphenyl (BZ 156)	NELAP	PA	12/17/2012
EPA 1668		2,3,3',4,4',6-Hexachlorobiphenyl (BZ 158)	NELAP	PA	12/17/2012
EPA 1668		2,3,3',4,4'-Pentachlorobiphenyl (BZ 105)	NELAP	PA	12/17/2012
EPA 1668		2,3,3',4,5',6-Hexachlorobiphenyl (BZ 161)	NELAP	PA	12/17/2012
EPA 1668		2,3,3',4,5'-Pentachlorobiphenyl (BZ 108)	NELAP	PA	12/17/2012
EPA 1668		2,3,3',4,5,5',6-Heptachlorobiphenyl (BZ 192)	NELAP	PA	12/17/2012
EPA 1668		2,3,3',4,5,5'-Hexachlorobiphenyl (BZ 159)	NELAP	PA	12/17/2012
EPA 1668		2,3,3',4,5,6-Hexachlorobiphenyl (BZ 160)	NELAP	PA	12/17/2012
EPA 1668		2,3,3',4,5-Pentachlorobiphenyl (BZ 106)	NELAP	PA	12/17/2012
EPA 1668		2,3,3',4,6-Pentachlorobiphenyl (BZ 109)	NELAP	PA	12/17/2012

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DEPARTMENT OF ENVIRONMENTAL PROTECTION

Laboratory Scope of Accreditation

Attached to Certificate of Accreditation 014-006 expiration date January 31, 2016. This listing of accredited analytes should be used only when associated with a valid certificate of accreditation.

DEP Laboratory ID: 36-00037 **EPA Lab Code: PA00009** **TNI Code:** **(717) 656-2300**
PADWIS ID: 36037

Matrix: Solid and Chemical Materials

Method	Revision	Analyte	Accreditation Type	Primary	Effective Date
EPA 1668		2,3,3',4-Tetrachlorobiphenyl (BZ 55)	NELAP	PA	12/17/2012
EPA 1668		2,3,3',5',6-Pentachlorobiphenyl (BZ 113)	NELAP	PA	12/17/2012
EPA 1668		2,3,3',5'-Tetrachlorobiphenyl (BZ 58)	NELAP	PA	12/17/2012
EPA 1668		2,3,3',5,5',6-Hexachlorobiphenyl (BZ 165)	NELAP	PA	12/17/2012
EPA 1668		2,3,3',5,5'-Pentachlorobiphenyl (BZ 111)	NELAP	PA	12/17/2012
EPA 1668		2,3,3',5,6-Pentachlorobiphenyl (BZ 112)	NELAP	PA	12/17/2012
EPA 1668		2,3,3',5-Tetrachlorobiphenyl (BZ 57)	NELAP	PA	12/17/2012
EPA 1668		2,3,3',6-Tetrachlorobiphenyl (BZ 59)	NELAP	PA	12/17/2012
EPA 1668		2,3,3'-Trichlorobiphenyl (BZ 20)	NELAP	PA	12/17/2012
EPA 1668		2,3,4',5,6-Pentachlorobiphenyl (BZ 117)	NELAP	PA	12/17/2012
EPA 1668		2,3,4',5-Tetrachlorobiphenyl (BZ 63)	NELAP	PA	12/17/2012
EPA 1668		2,3,4',6-Tetrachlorobiphenyl (BZ 64)	NELAP	PA	12/17/2012
EPA 1668		2,3,4'-Trichlorobiphenyl (BZ 22)	NELAP	PA	12/17/2012
EPA 1668		2,3,4,4',5,6-Hexachlorobiphenyl (BZ 166)	NELAP	PA	12/17/2012
EPA 1668		2,3,4,4',5-Pentachlorobiphenyl (BZ 114)	NELAP	PA	12/17/2012
EPA 1668		2,3,4,4',6-Pentachlorobiphenyl (BZ 115)	NELAP	PA	12/17/2012
EPA 1668		2,3,4,4'-Tetrachlorobiphenyl (BZ 60)	NELAP	PA	12/17/2012
EPA 1668		2,3,4,5,6-Pentachlorobiphenyl (BZ 116)	NELAP	PA	12/17/2012
EPA 1668		2,3,4,5-Tetrachlorobiphenyl (BZ 61)	NELAP	PA	12/17/2012
EPA 1668		2,3,4,6-Tetrachlorobiphenyl (BZ 62)	NELAP	PA	12/17/2012
EPA 1668		2,3,4-Trichlorobiphenyl (BZ 21)	NELAP	PA	12/17/2012
EPA 1668		2,3,5,6-Tetrachlorobiphenyl (BZ 65)	NELAP	PA	12/17/2012
EPA 1668		2,3,5-Trichlorobiphenyl (BZ 23)	NELAP	PA	12/17/2012
EPA 1668		2,3,6-Trichlorobiphenyl (BZ 24)	NELAP	PA	12/17/2012
EPA 1668		2,3-Dichlorobiphenyl (BZ 5)	NELAP	PA	12/17/2012
EPA 1668		2,4',5-Trichlorobiphenyl (BZ 31)	NELAP	PA	12/17/2012
EPA 1668		2,4',6-Trichlorobiphenyl (BZ 32)	NELAP	PA	12/17/2012
EPA 1668		2,4'-Dichlorobiphenyl (BZ 8)	NELAP	PA	12/17/2012
EPA 1668		2,4,4',5-Tetrachlorobiphenyl (BZ 74)	NELAP	PA	12/17/2012
EPA 1668		2,4,4',6-Tetrachlorobiphenyl (BZ 75)	NELAP	PA	12/17/2012
EPA 1668		2,4,4'-Trichlorobiphenyl (BZ 28)	NELAP	PA	12/17/2012
EPA 1668		2,4,5-Trichlorobiphenyl (BZ 29)	NELAP	PA	12/17/2012
EPA 1668		2,4,6-Trichlorobiphenyl (BZ 30)	NELAP	PA	12/17/2012
EPA 1668		2,4-Dichlorobiphenyl (BZ 7)	NELAP	PA	12/17/2012
EPA 1668		2,5-Dichlorobiphenyl (BZ 9)	NELAP	PA	12/17/2012
EPA 1668		2,6-Dichlorobiphenyl (BZ 10)	NELAP	PA	12/17/2012
EPA 1668		2-Chlorobiphenyl (BZ 1)	NELAP	PA	12/17/2012
EPA 1668		3,3',4,4',5,5'-Hexachlorobiphenyl (BZ 169)	NELAP	PA	12/17/2012
EPA 1668		3,3',4,4',5-Pentachlorobiphenyl (BZ 126)	NELAP	PA	12/17/2012
EPA 1668		3,3',4,4'-Tetrachlorobiphenyl (BZ 77)	NELAP	PA	12/17/2012
EPA 1668		3,3',4,5'-Tetrachlorobiphenyl (BZ 79)	NELAP	PA	12/17/2012
EPA 1668		3,3',4,5,5'-Pentachlorobiphenyl (BZ 127)	NELAP	PA	12/17/2012
EPA 1668		3,3',4,5-Tetrachlorobiphenyl (BZ 78)	NELAP	PA	12/17/2012
EPA 1668		3,3',4-Trichlorobiphenyl (BZ 35)	NELAP	PA	12/17/2012
EPA 1668		3,3',5,5'-Tetrachlorobiphenyl (BZ 80)	NELAP	PA	12/17/2012

Aaron Alger

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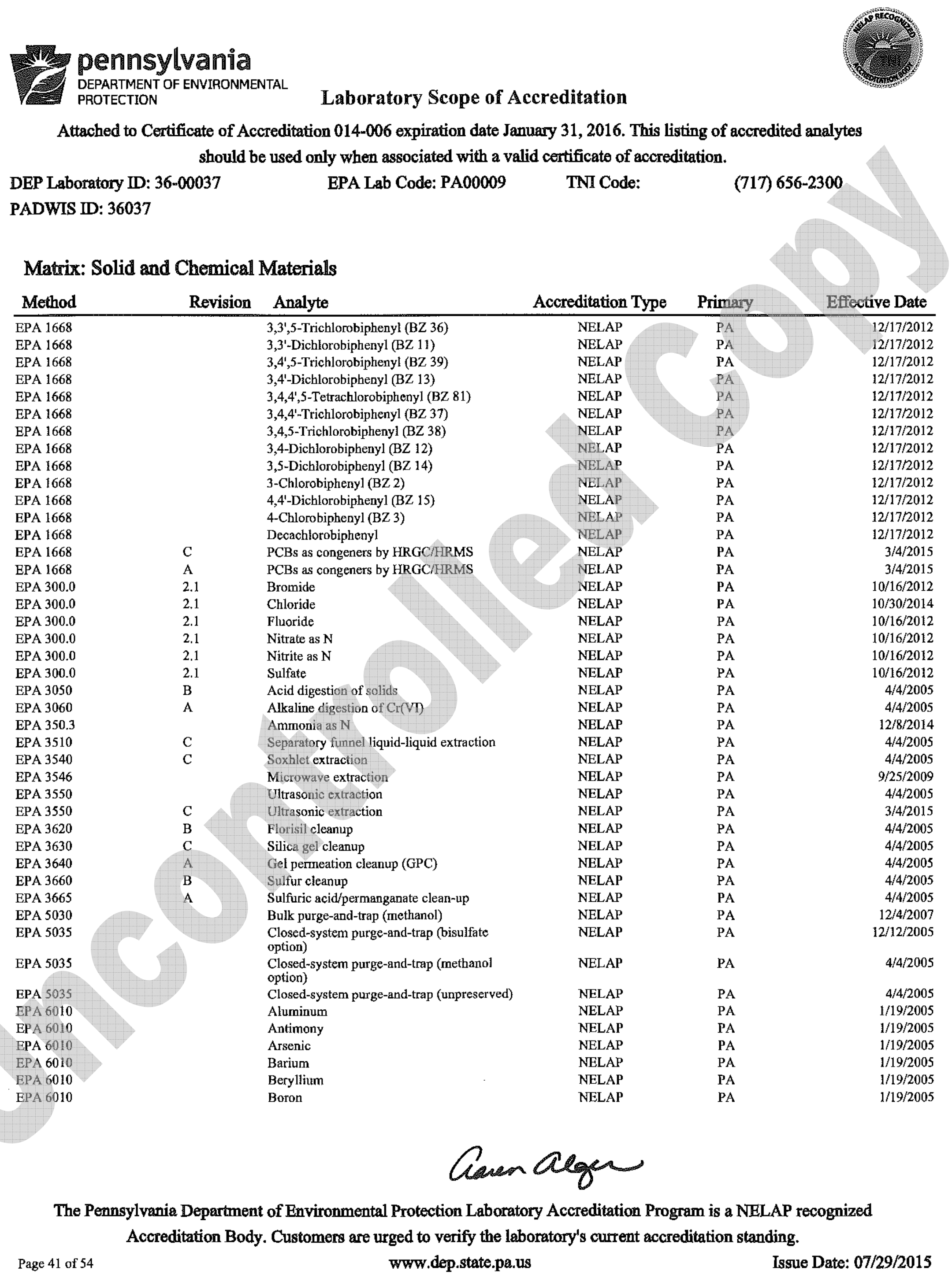

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DEPARTMENT OF ENVIRONMENTAL PROTECTION

Laboratory Scope of Accreditation

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DEP Laboratory ID: 36-00037 **EPA Lab Code: PA00009** **TNI Code:** **(717) 656-2300**
PADWIS ID: 36037

Matrix: Solid and Chemical Materials

Method	Revision	Analyte	Accreditation Type	Primary	Effective Date
EPA 1668		3,3',5-Trichlorobiphenyl (BZ 36)	NELAP	PA	12/17/2012
EPA 1668		3,3'-Dichlorobiphenyl (BZ 11)	NELAP	PA	12/17/2012
EPA 1668		3,4',5-Trichlorobiphenyl (BZ 39)	NELAP	PA	12/17/2012
EPA 1668		3,4'-Dichlorobiphenyl (BZ 13)	NELAP	PA	12/17/2012
EPA 1668		3,4,4',5-Tetrachlorobiphenyl (BZ 81)	NELAP	PA	12/17/2012
EPA 1668		3,4,4'-Trichlorobiphenyl (BZ 37)	NELAP	PA	12/17/2012
EPA 1668		3,4,5-Trichlorobiphenyl (BZ 38)	NELAP	PA	12/17/2012
EPA 1668		3,4-Dichlorobiphenyl (BZ 12)	NELAP	PA	12/17/2012
EPA 1668		3,5-Dichlorobiphenyl (BZ 14)	NELAP	PA	12/17/2012
EPA 1668		3-Chlorobiphenyl (BZ 2)	NELAP	PA	12/17/2012
EPA 1668		4,4'-Dichlorobiphenyl (BZ 15)	NELAP	PA	12/17/2012
EPA 1668		4-Chlorobiphenyl (BZ 3)	NELAP	PA	12/17/2012
EPA 1668		Decachlorobiphenyl	NELAP	PA	12/17/2012
EPA 1668	C	PCBs as congeners by HRGC/HRMS	NELAP	PA	3/4/2015
EPA 1668	A	PCBs as congeners by HRGC/HRMS	NELAP	PA	3/4/2015
EPA 300.0	2.1	Bromide	NELAP	PA	10/16/2012
EPA 300.0	2.1	Chloride	NELAP	PA	10/30/2014
EPA 300.0	2.1	Fluoride	NELAP	PA	10/16/2012
EPA 300.0	2.1	Nitrate as N	NELAP	PA	10/16/2012
EPA 300.0	2.1	Nitrite as N	NELAP	PA	10/16/2012
EPA 300.0	2.1	Sulfate	NELAP	PA	10/16/2012
EPA 3050	B	Acid digestion of solids	NELAP	PA	4/4/2005
EPA 3060	A	Alkaline digestion of Cr(VI)	NELAP	PA	4/4/2005
EPA 350.3		Ammonia as N	NELAP	PA	12/8/2014
EPA 3510	C	Separatory funnel liquid-liquid extraction	NELAP	PA	4/4/2005
EPA 3540	C	Soxhlet extraction	NELAP	PA	4/4/2005
EPA 3546		Microwave extraction	NELAP	PA	9/25/2009
EPA 3550		Ultrasonic extraction	NELAP	PA	4/4/2005
EPA 3550	C	Ultrasonic extraction	NELAP	PA	3/4/2015
EPA 3620	B	Florisil cleanup	NELAP	PA	4/4/2005
EPA 3630	C	Silica gel cleanup	NELAP	PA	4/4/2005
EPA 3640	A	Gel permeation cleanup (GPC)	NELAP	PA	4/4/2005
EPA 3660	B	Sulfur cleanup	NELAP	PA	4/4/2005
EPA 3665	A	Sulfuric acid/permanganate clean-up	NELAP	PA	4/4/2005
EPA 5030		Bulk purge-and-trap (methanol)	NELAP	PA	12/4/2007
EPA 5035		Closed-system purge-and-trap (bisulfate option)	NELAP	PA	12/12/2005
EPA 5035		Closed-system purge-and-trap (methanol option)	NELAP	PA	4/4/2005
EPA 5035		Closed-system purge-and-trap (unpreserved)	NELAP	PA	4/4/2005
EPA 6010		Aluminum	NELAP	PA	1/19/2005
EPA 6010		Antimony	NELAP	PA	1/19/2005
EPA 6010		Arsenic	NELAP	PA	1/19/2005
EPA 6010		Barium	NELAP	PA	1/19/2005
EPA 6010		Beryllium	NELAP	PA	1/19/2005
EPA 6010		Boron	NELAP	PA	1/19/2005

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Laboratory Scope of Accreditation

Attached to Certificate of Accreditation 014-006 expiration date January 31, 2016. This listing of accredited analytes should be used only when associated with a valid certificate of accreditation.

DEP Laboratory ID: 36-00037 **EPA Lab Code: PA00009** **TNI Code:** **(717) 656-2300**
PADWIS ID: 36037

Matrix: Solid and Chemical Materials

Method	Revision	Analyte	Accreditation Type	Primary	Effective Date
EPA 6010		Cadmium	NELAP	PA	1/19/2005
EPA 6010		Calcium	NELAP	PA	1/19/2005
EPA 6010		Chromium	NELAP	PA	1/19/2005
EPA 6010		Cobalt	NELAP	PA	1/19/2005
EPA 6010		Copper	NELAP	PA	1/19/2005
EPA 6010		Iron	NELAP	PA	1/19/2005
EPA 6010		Lead	NELAP	PA	1/19/2005
EPA 6010		Lithium	NELAP	PA	1/20/2012
EPA 6010		Magnesium	NELAP	PA	1/19/2005
EPA 6010		Manganese	NELAP	PA	1/19/2005
EPA 6010	C	Metals by ICP/AES	NELAP	PA	3/26/2012
EPA 6010	B	Metals by ICP/AES	NELAP	PA	3/26/2012
EPA 6010		Molybdenum	NELAP	PA	1/19/2005
EPA 6010		Nickel	NELAP	PA	1/19/2005
EPA 6010		Potassium	NELAP	PA	1/19/2005
EPA 6010		Selenium	NELAP	PA	1/19/2005
EPA 6010		Silica, as SiO2	NELAP	PA	1/20/2012
EPA 6010		Silver	NELAP	PA	1/19/2005
EPA 6010		Sodium	NELAP	PA	1/19/2005
EPA 6010		Strontium	NELAP	PA	1/19/2005
EPA 6010		Sulfur	NELAP	PA	12/19/2011
EPA 6010		Thallium	NELAP	PA	1/19/2005
EPA 6010		Tin	NELAP	PA	1/19/2005
EPA 6010		Titanium	NELAP	PA	1/19/2005
EPA 6010		Vanadium	NELAP	PA	1/19/2005
EPA 6010		Zinc	NELAP	PA	1/19/2005
EPA 6010		Zirconium	NELAP	PA	7/29/2015
EPA 6020		Aluminum	NELAP	PA	4/29/2010
EPA 6020		Antimony	NELAP	PA	1/19/2005
EPA 6020		Arsenic	NELAP	PA	1/19/2005
EPA 6020		Barium	NELAP	PA	1/20/2012
EPA 6020		Beryllium	NELAP	PA	1/19/2005
EPA 6020		Boron	NELAP	PA	4/29/2010
EPA 6020		Cadmium	NELAP	PA	1/19/2005
EPA 6020		Calcium	NELAP	PA	4/29/2010
EPA 6020		Chromium	NELAP	PA	1/19/2005
EPA 6020		Cobalt	NELAP	PA	4/29/2010
EPA 6020		Copper	NELAP	PA	1/19/2005
EPA 6020		Iron	NELAP	PA	4/29/2010
EPA 6020		Lead	NELAP	PA	1/19/2005
EPA 6020		Magnesium	NELAP	PA	4/29/2010
EPA 6020		Manganese	NELAP	PA	4/29/2010
EPA 6020	A	Metals by ICP/MS	NELAP	PA	3/26/2012
EPA 6020		Molybdenum	NELAP	PA	7/25/2011
EPA 6020		Nickel	NELAP	PA	4/4/2005

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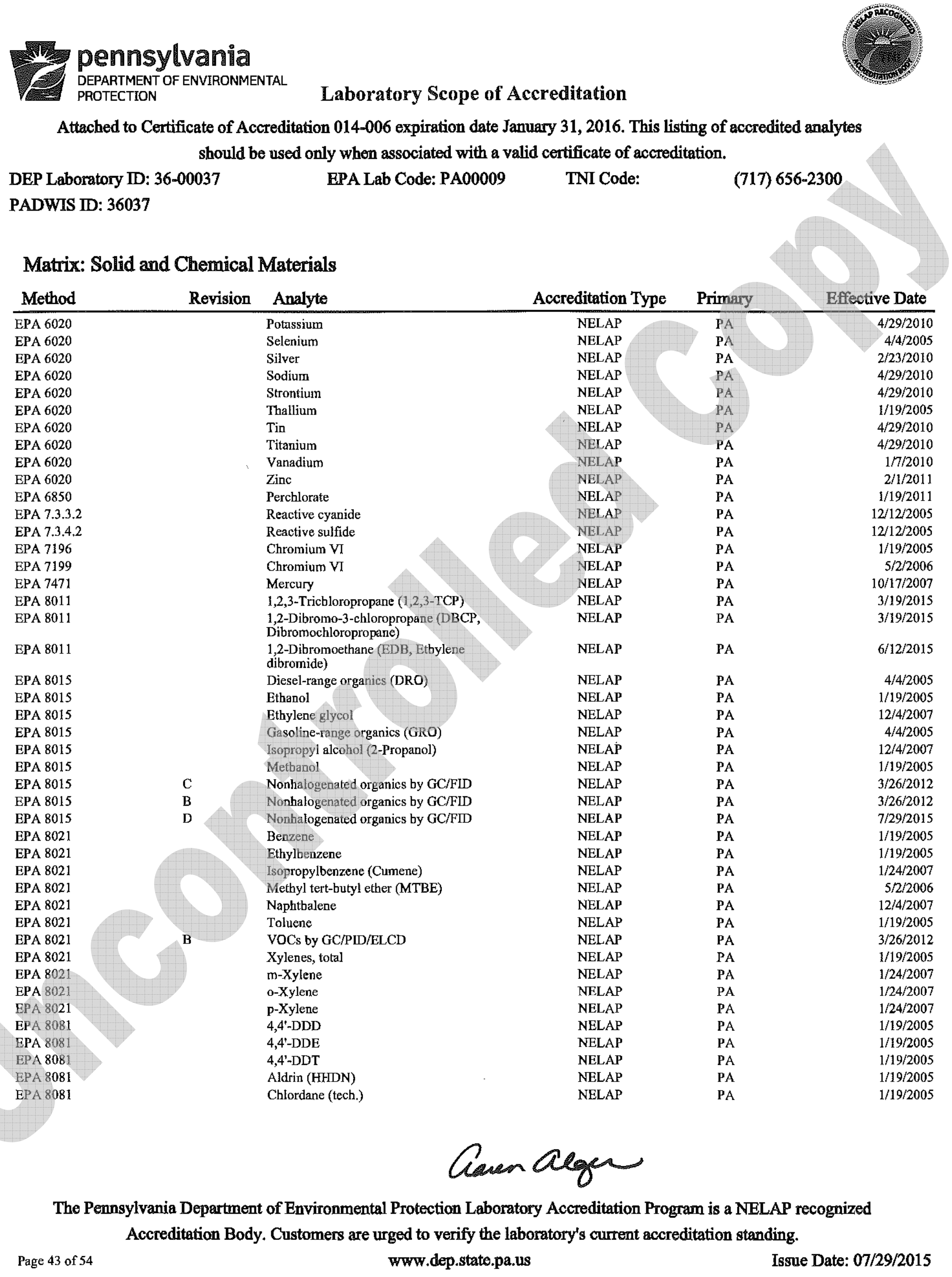

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DEP Laboratory ID: 36-00037 **EPA Lab Code: PA00009** **TNI Code:** **(717) 656-2300**
PADWIS ID: 36037

Matrix: Solid and Chemical Materials

Method	Revision	Analyte	Accreditation Type	Primary	Effective Date
EPA 6020		Potassium	NELAP	PA	4/29/2010
EPA 6020		Selenium	NELAP	PA	4/4/2005
EPA 6020		Silver	NELAP	PA	2/23/2010
EPA 6020		Sodium	NELAP	PA	4/29/2010
EPA 6020		Strontium	NELAP	PA	4/29/2010
EPA 6020		Thallium	NELAP	PA	1/19/2005
EPA 6020		Tin	NELAP	PA	4/29/2010
EPA 6020		Titanium	NELAP	PA	4/29/2010
EPA 6020		Vanadium	NELAP	PA	1/7/2010
EPA 6020		Zinc	NELAP	PA	2/1/2011
EPA 6850		Perchlorate	NELAP	PA	1/19/2011
EPA 7.3.3.2		Reactive cyanide	NELAP	PA	12/12/2005
EPA 7.3.4.2		Reactive sulfide	NELAP	PA	12/12/2005
EPA 7196		Chromium VI	NELAP	PA	1/19/2005
EPA 7199		Chromium VI	NELAP	PA	5/2/2006
EPA 7471		Mercury	NELAP	PA	10/17/2007
EPA 8011		1,2,3-Trichloropropane (1,2,3-TCP)	NELAP	PA	3/19/2015
EPA 8011		1,2-Dibromo-3-chloropropane (DBCP, Dibromochloropropane)	NELAP	PA	3/19/2015
EPA 8011		1,2-Dibromoethane (EDB, Ethylene dibromide)	NELAP	PA	6/12/2015
EPA 8015		Diesel-range organics (DRO)	NELAP	PA	4/4/2005
EPA 8015		Ethanol	NELAP	PA	1/19/2005
EPA 8015		Ethylene glycol	NELAP	PA	12/4/2007
EPA 8015		Gasoline-range organics (GRO)	NELAP	PA	4/4/2005
EPA 8015		Isopropyl alcohol (2-Propanol)	NELAP	PA	12/4/2007
EPA 8015		Methanol	NELAP	PA	1/19/2005
EPA 8015	C	Nonhalogenated organics by GC/FID	NELAP	PA	3/26/2012
EPA 8015	B	Nonhalogenated organics by GC/FID	NELAP	PA	3/26/2012
EPA 8015	D	Nonhalogenated organics by GC/FID	NELAP	PA	7/29/2015
EPA 8021		Benzene	NELAP	PA	1/19/2005
EPA 8021		Ethylbenzene	NELAP	PA	1/19/2005
EPA 8021		Isopropylbenzene (Cumene)	NELAP	PA	1/24/2007
EPA 8021		Methyl tert-butyl ether (MTBE)	NELAP	PA	5/2/2006
EPA 8021		Naphthalene	NELAP	PA	12/4/2007
EPA 8021		Toluene	NELAP	PA	1/19/2005
EPA 8021	B	VOCs by GC/PID/ELCD	NELAP	PA	3/26/2012
EPA 8021		Xylenes, total	NELAP	PA	1/19/2005
EPA 8021		m-Xylene	NELAP	PA	1/24/2007
EPA 8021		o-Xylene	NELAP	PA	1/24/2007
EPA 8021		p-Xylene	NELAP	PA	1/24/2007
EPA 8081		4,4'-DDD	NELAP	PA	1/19/2005
EPA 8081		4,4'-DDE	NELAP	PA	1/19/2005
EPA 8081		4,4'-DDT	NELAP	PA	1/19/2005
EPA 8081		Aldrin (HHDN)	NELAP	PA	1/19/2005
EPA 8081		Chlordane (tech.)	NELAP	PA	1/19/2005

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Laboratory Scope of Accreditation

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DEP Laboratory ID: 36-00037 **EPA Lab Code: PA00009** **TNI Code:** **(717) 656-2300**
PADWIS ID: 36037

Matrix: Solid and Chemical Materials

Method	Revision	Analyte	Accreditation Type	Primary	Effective Date
EPA 8081		Dieldrin	NELAP	PA	1/19/2005
EPA 8081		Endosulfan I	NELAP	PA	1/19/2005
EPA 8081		Endosulfan II	NELAP	PA	1/19/2005
EPA 8081		Endosulfan sulfate	NELAP	PA	1/19/2005
EPA 8081		Endrin	NELAP	PA	1/19/2005
EPA 8081		Endrin aldehyde	NELAP	PA	1/19/2005
EPA 8081		Endrin ketone	NELAP	PA	1/19/2005
EPA 8081		Heptachlor	NELAP	PA	1/19/2005
EPA 8081		Heptachlor epoxide	NELAP	PA	1/19/2005
EPA 8081		Kepone	NELAP	PA	1/19/2005
EPA 8081		Methoxychlor	NELAP	PA	1/19/2005
EPA 8081		Mirex	NELAP	PA	1/19/2005
EPA 8081	A	Organochlorine pesticides by GC/ECD	NELAP	PA	3/26/2012
EPA 8081	B	Organochlorine pesticides by GC/ECD	NELAP	PA	1/1/2013
EPA 8081		Toxaphene (Chlorinated camphene)	NELAP	PA	1/19/2005
EPA 8081		alpha-BHC (alpha-Hexachlorocyclohexane)	NELAP	PA	1/19/2005
EPA 8081		alpha-Chlordane	NELAP	PA	4/4/2005
EPA 8081		beta-BHC (beta-Hexachlorocyclohexane)	NELAP	PA	1/19/2005
EPA 8081		delta-BHC (delta-Hexachlorocyclohexane)	NELAP	PA	1/19/2005
EPA 8081		gamma-BHC (Lindane, gamma-Hexachlorocyclohexane)	NELAP	PA	1/19/2005
EPA 8081		gamma-Chlordane	NELAP	PA	4/4/2005
EPA 8082		Aroclor-1016 (PCB-1016)	NELAP	PA	1/2/2007
EPA 8082		Aroclor-1016 (in oil)	NELAP	PA	5/24/2011
EPA 8082		Aroclor-1221 (PCB-1221)	NELAP	PA	1/2/2007
EPA 8082		Aroclor-1221 (in oil)	NELAP	PA	5/24/2011
EPA 8082		Aroclor-1232 (PCB-1232)	NELAP	PA	1/2/2007
EPA 8082		Aroclor-1232 (in oil)	NELAP	PA	5/24/2011
EPA 8082		Aroclor-1242 (PCB-1242)	NELAP	PA	1/2/2007
EPA 8082		Aroclor-1242 (in oil)	NELAP	PA	5/24/2011
EPA 8082		Aroclor-1248 (PCB-1248)	NELAP	PA	1/2/2007
EPA 8082		Aroclor-1248 (in oil)	NELAP	PA	5/24/2011
EPA 8082		Aroclor-1254 (PCB-1254)	NELAP	PA	1/2/2007
EPA 8082		Aroclor-1254 (in oil)	NELAP	PA	5/24/2011
EPA 8082		Aroclor-1260 (PCB-1260)	NELAP	PA	1/2/2007
EPA 8082		Aroclor-1260 (in oil)	NELAP	PA	5/24/2011
EPA 8082		Aroclor-1262 (PCB-1262)	NELAP	PA	7/23/2008
EPA 8082		Aroclor-1268 (PCB-1268)	NELAP	PA	7/23/2008
EPA 8082		Decachlorobiphenyl	NELAP	PA	12/17/2012
EPA 8082	A	PCBs by GC/ECD	NELAP	PA	3/26/2012
EPA 8141		Alachlor (Lasso)	NELAP	PA	1/21/2009
EPA 8141		Atrazine	NELAP	PA	1/19/2005
EPA 8141		Azinphos-methyl (Guthion)	NELAP	PA	4/4/2005
EPA 8141		Bolstar (Sulprofos)	NELAP	PA	1/19/2005
EPA 8141		Carbophenothion (Trithion)	NELAP	PA	11/9/2012
EPA 8141		Chlorpyrifos	NELAP	PA	4/4/2005

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Laboratory Scope of Accreditation

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DEP Laboratory ID: 36-00037 **EPA Lab Code: PA00009** **TNI Code:** **(717) 656-2300**
PADWIS ID: 36037

Matrix: Solid and Chemical Materials

Method	Revision	Analyte	Accreditation Type	Primary	Effective Date
EPA 8141		Coumaphos	NELAP	PA	1/19/2005
EPA 8141		Demeton-O	NELAP	PA	1/19/2005
EPA 8141		Demeton-S	NELAP	PA	1/19/2005
EPA 8141		Diazinon (Spectracide)	NELAP	PA	1/19/2005
EPA 8141		Dichlorovos (DDVP, Dichlorvos)	NELAP	PA	1/19/2005
EPA 8141		Disulfoton	NELAP	PA	1/19/2005
EPA 8141		EPN (Santox)	NELAP	PA	1/19/2005
EPA 8141		Ethion	NELAP	PA	1/19/2005
EPA 8141		Ethoprop (Prophos)	NELAP	PA	1/19/2005
EPA 8141		Famphur	NELAP	PA	1/19/2005
EPA 8141		Fensulfothion	NELAP	PA	1/19/2005
EPA 8141		Fenthion	NELAP	PA	4/4/2005
EPA 8141		Malathion	NELAP	PA	1/19/2005
EPA 8141		Merphos	NELAP	PA	1/19/2005
EPA 8141		Methyl parathion (Parathion, methyl)	NELAP	PA	5/25/2005
EPA 8141		Mevinphos	NELAP	PA	1/19/2005
EPA 8141		Naled	NELAP	PA	1/19/2005
EPA 8141	A	Organophosphorus compounds by GC/NPD	NELAP	PA	3/26/2012
EPA 8141	B	Organophosphorus compounds by GC/NPD	NELAP	PA	3/26/2012
EPA 8141		Parathion, ethyl (Ethyl parathion, Parathion)	NELAP	PA	1/19/2005
EPA 8141		Phorate (Thimet)	NELAP	PA	1/19/2005
EPA 8141		Ronnel	NELAP	PA	1/19/2005
EPA 8141		Simazine	NELAP	PA	1/4/2006
EPA 8141		Stirophos (Tetrachlorovinphos)	NELAP	PA	1/19/2005
EPA 8141		Tokuthion (Prothiophos)	NELAP	PA	1/19/2005
EPA 8141		Trichloronate	NELAP	PA	1/19/2005
EPA 8151		2,4,5-T	NELAP	PA	1/19/2005
EPA 8151		2,4,5-TP (Silvex)	NELAP	PA	1/19/2005
EPA 8151		2,4-D	NELAP	PA	1/19/2005
EPA 8151		2,4-DB (Butoxon)	NELAP	PA	4/4/2005
EPA 8151	A	Chlorinated herbicides by GC/ECD	NELAP	PA	3/26/2012
EPA 8151		Dalapon (2,2-Dichloropropionic acid)	NELAP	PA	1/19/2005
EPA 8151		Dicamba	NELAP	PA	1/19/2005
EPA 8151		Dichloroprop (Dichlorprop)	NELAP	PA	1/19/2005
EPA 8151		Dinoseb (2-sec-Butyl-4,6-dinitrophenol, DNBP)	NELAP	PA	1/19/2005
EPA 8151		MCPA	NELAP	PA	1/19/2005
EPA 8151		MCPP (Mecoprop)	NELAP	PA	5/2/2006
EPA 8151		Pentachlorophenol (PCP)	NELAP	PA	1/19/2005
EPA 8151		Picloram (4-Amino-3,5,6-trichloro-2-pyridinecarboxylic acid)	NELAP	PA	1/19/2005
EPA 8260		1,1,1,2-Tetrachloroethane	NELAP	PA	1/19/2005
EPA 8260		1,1,1-Trichloroethane	NELAP	PA	1/19/2005
EPA 8260		1,1,2,2-Tetrachloroethane	NELAP	PA	1/19/2005
EPA 8260		1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)	NELAP	PA	5/2/2006

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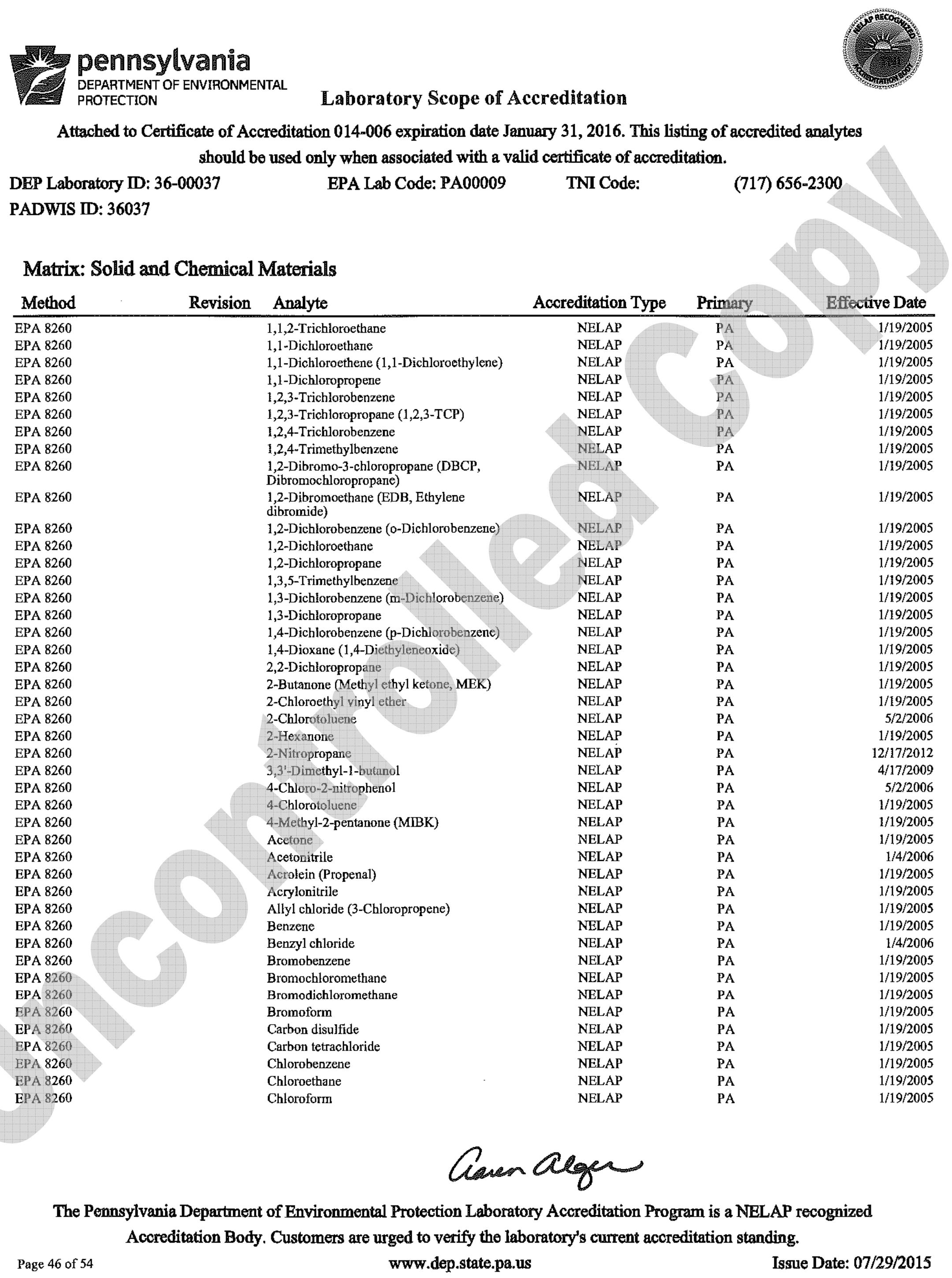

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DEP Laboratory ID: 36-00037 **EPA Lab Code: PA00009** **TNI Code:** **(717) 656-2300**
PADWIS ID: 36037

Matrix: Solid and Chemical Materials

Method	Revision	Analyte	Accreditation Type	Primary	Effective Date
EPA 8260		1,1,2-Trichloroethane	NELAP	PA	1/19/2005
EPA 8260		1,1-Dichloroethane	NELAP	PA	1/19/2005
EPA 8260		1,1-Dichloroethene (1,1-Dichloroethylene)	NELAP	PA	1/19/2005
EPA 8260		1,1-Dichloropropene	NELAP	PA	1/19/2005
EPA 8260		1,2,3-Trichlorobenzene	NELAP	PA	1/19/2005
EPA 8260		1,2,3-Trichloropropane (1,2,3-TCP)	NELAP	PA	1/19/2005
EPA 8260		1,2,4-Trichlorobenzene	NELAP	PA	1/19/2005
EPA 8260		1,2,4-Trimethylbenzene	NELAP	PA	1/19/2005
EPA 8260		1,2-Dibromo-3-chloropropane (DBCP, Dibromochloropropane)	NELAP	PA	1/19/2005
EPA 8260		1,2-Dibromoethane (EDB, Ethylene dibromide)	NELAP	PA	1/19/2005
EPA 8260		1,2-Dichlorobenzene (o-Dichlorobenzene)	NELAP	PA	1/19/2005
EPA 8260		1,2-Dichloroethane	NELAP	PA	1/19/2005
EPA 8260		1,2-Dichloropropane	NELAP	PA	1/19/2005
EPA 8260		1,3,5-Trimethylbenzene	NELAP	PA	1/19/2005
EPA 8260		1,3-Dichlorobenzene (m-Dichlorobenzene)	NELAP	PA	1/19/2005
EPA 8260		1,3-Dichloropropane	NELAP	PA	1/19/2005
EPA 8260		1,4-Dichlorobenzene (p-Dichlorobenzene)	NELAP	PA	1/19/2005
EPA 8260		1,4-Dioxane (1,4-Diethyleneoxide)	NELAP	PA	1/19/2005
EPA 8260		2,2-Dichloropropane	NELAP	PA	1/19/2005
EPA 8260		2-Butanone (Methyl ethyl ketone, MEK)	NELAP	PA	1/19/2005
EPA 8260		2-Chloroethyl vinyl ether	NELAP	PA	1/19/2005
EPA 8260		2-Chlorotoluene	NELAP	PA	5/2/2006
EPA 8260		2-Hexanone	NELAP	PA	1/19/2005
EPA 8260		2-Nitropropane	NELAP	PA	12/17/2012
EPA 8260		3,3'-Dimethyl-1-butanol	NELAP	PA	4/17/2009
EPA 8260		4-Chloro-2-nitrophenol	NELAP	PA	5/2/2006
EPA 8260		4-Chlorotoluene	NELAP	PA	1/19/2005
EPA 8260		4-Methyl-2-pentanone (MIBK)	NELAP	PA	1/19/2005
EPA 8260		Acetone	NELAP	PA	1/19/2005
EPA 8260		Acetonitrile	NELAP	PA	1/4/2006
EPA 8260		Acrolein (Propenal)	NELAP	PA	1/19/2005
EPA 8260		Acrylonitrile	NELAP	PA	1/19/2005
EPA 8260		Allyl chloride (3-Chloropropene)	NELAP	PA	1/19/2005
EPA 8260		Benzene	NELAP	PA	1/19/2005
EPA 8260		Benzyl chloride	NELAP	PA	1/4/2006
EPA 8260		Bromobenzene	NELAP	PA	1/19/2005
EPA 8260		Bromochloromethane	NELAP	PA	1/19/2005
EPA 8260		Bromodichloromethane	NELAP	PA	1/19/2005
EPA 8260		Bromoform	NELAP	PA	1/19/2005
EPA 8260		Carbon disulfide	NELAP	PA	1/19/2005
EPA 8260		Carbon tetrachloride	NELAP	PA	1/19/2005
EPA 8260		Chlorobenzene	NELAP	PA	1/19/2005
EPA 8260		Chloroethane	NELAP	PA	1/19/2005
EPA 8260		Chloroform	NELAP	PA	1/19/2005

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Laboratory Scope of Accreditation

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DEP Laboratory ID: 36-00037 **EPA Lab Code: PA00009** **TNI Code:** **(717) 656-2300**
PADWIS ID: 36037

Matrix: Solid and Chemical Materials

Method	Revision	Analyte	Accreditation Type	Primary	Effective Date
EPA 8260		Chloroprene (2-Chloro-1,3-butadiene)	NELAP	PA	4/17/2009
EPA 8260		Crotonaldehyde	NELAP	PA	10/30/2014
EPA 8260		Cyclohexane	NELAP	PA	6/29/2010
EPA 8260		Cyclohexanone	NELAP	PA	7/3/2007
EPA 8260		Dibromochloromethane	NELAP	PA	1/19/2005
EPA 8260		Dibromomethane	NELAP	PA	1/19/2005
EPA 8260		Dichlorodifluoromethane (Freon 12)	NELAP	PA	1/19/2005
EPA 8260		Diisopropyl ether (DIPE)	NELAP	PA	7/3/2007
EPA 8260		Epichlorohydrin (1-Chloro-2,3-epoxypropane)	NELAP	PA	1/4/2006
EPA 8260		Ethanol	NELAP	PA	1/4/2006
EPA 8260		Ethyl acetate	NELAP	PA	1/4/2006
EPA 8260		Ethyl methacrylate	NELAP	PA	1/4/2006
EPA 8260		Ethyl tert-butyl ether (ETBE)	NELAP	PA	7/3/2007
EPA 8260		Ethylbenzene	NELAP	PA	1/19/2005
EPA 8260		Ethylene oxide	NELAP	PA	10/30/2014
EPA 8260		Gasoline-range organics (GRO)	NELAP	PA	6/8/2006
EPA 8260		Hexachlorobutadiene (1,3-Hexachlorobutadiene)	NELAP	PA	1/19/2005
EPA 8260		Isobutyl alcohol (2-Methyl-1-propanol)	NELAP	PA	7/3/2007
EPA 8260		Isopropyl alcohol (2-Propanol)	NELAP	PA	1/19/2005
EPA 8260		Isopropylbenzene (Cumene)	NELAP	PA	8/7/2005
EPA 8260		Methacrylonitrile	NELAP	PA	1/24/2007
EPA 8260		Methyl acetate	NELAP	PA	6/29/2010
EPA 8260		Methyl bromide (Bromomethane)	NELAP	PA	1/19/2005
EPA 8260		Methyl chloride (Chloromethane)	NELAP	PA	1/19/2005
EPA 8260		Methyl iodide (Iodomethane)	NELAP	PA	5/2/2006
EPA 8260		Methyl tert-butyl ether (MTBE)	NELAP	PA	1/19/2005
EPA 8260		Methylcyclohexane	NELAP	PA	1/21/2009
EPA 8260		Methylene chloride (Dichloromethane)	NELAP	PA	1/19/2005
EPA 8260		Methylmethacrylate	NELAP	PA	5/2/2006
EPA 8260		Naphthalene	NELAP	PA	1/19/2005
EPA 8260		Pentachloroethane	NELAP	PA	1/24/2007
EPA 8260		Propionitrile (Ethyl cyanide)	NELAP	PA	1/24/2007
EPA 8260		Styrene	NELAP	PA	1/19/2005
EPA 8260		Tetrachloroethene (PCE, Perchloroethylene)	NELAP	PA	1/19/2005
EPA 8260		Tetrahydrofuran (THF)	NELAP	PA	6/7/2012
EPA 8260		Toluene	NELAP	PA	1/19/2005
EPA 8260		Trichloroethene (TCE, Trichloroethylene)	NELAP	PA	1/19/2005
EPA 8260		Trichlorofluoromethane (Freon 11)	NELAP	PA	1/19/2005
EPA 8260	B	VOCs by GC/MS	NELAP	PA	3/26/2012
EPA 8260	C	VOCs by GC/MS	NELAP	PA	3/26/2012
EPA 8260		Vinyl acetate	NELAP	PA	1/19/2005
EPA 8260		Vinyl chloride (Chloroethene)	NELAP	PA	1/19/2005
EPA 8260		Xylenes, total	NELAP	PA	1/19/2005
EPA 8260		cis-1,2-Dichloroethene	NELAP	PA	1/19/2005

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Laboratory Scope of Accreditation

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DEP Laboratory ID: 36-00037 **EPA Lab Code: PA00009** **TNI Code:** **(717) 656-2300**
PADWIS ID: 36037

Matrix: Solid and Chemical Materials

Method	Revision	Analyte	Accreditation Type	Primary	Effective Date
EPA 8260		cis-1,3-Dichloropropene	NELAP	PA	1/19/2005
EPA 8260		m+p-Xylene	NELAP	PA	1/24/2007
EPA 8260		n-Butyl alcohol (n-Butanol, 1-Butanol)	NELAP	PA	1/19/2005
EPA 8260		n-Butylbenzene	NELAP	PA	1/19/2005
EPA 8260		n-Propylbenzene	NELAP	PA	1/4/2006
EPA 8260		o-Xylene	NELAP	PA	1/24/2007
EPA 8260		p-Isopropyltoluene (4-Isopropyltoluene)	NELAP	PA	1/24/2007
EPA 8260		sec-Butylbenzene	NELAP	PA	1/19/2005
EPA 8260		tert-Amyl alcohol (2-Methyl-2-butanol)	NELAP	PA	4/17/2009
EPA 8260		tert-Amyl methyl ether (TAME)	NELAP	PA	7/3/2007
EPA 8260		tert-Butyl alcohol (2-Methyl-2-propanol)	NELAP	PA	1/19/2005
EPA 8260		tert-Butyl ethyl ether	NELAP	PA	5/25/2007
EPA 8260		tert-Butyl formate	NELAP	PA	4/17/2009
EPA 8260		tert-Butylbenzene	NELAP	PA	1/19/2005
EPA 8260		trans-1,2-Dichloroethene	NELAP	PA	1/19/2005
EPA 8260		trans-1,3-Dichloropropene	NELAP	PA	1/19/2005
EPA 8260		trans-1,4-Dichloro-2-butene	NELAP	PA	7/3/2007
EPA 8260 SIM		1,4-Dioxane (1,4-Diethyleneoxide)	NELAP	PA	4/17/2009
EPA 8270		1,1'-Biphenyl (Biphenyl, Lemonene)	NELAP	PA	12/4/2007
EPA 8270		1,2,3,4-Tetrachlorobenzene	NELAP	PA	7/3/2007
EPA 8270		1,2,3,4-Tetrahydronaphthalene	NELAP	PA	12/4/2007
EPA 8270		1,2,3,5-Tetrachlorobenzene	NELAP	PA	7/3/2007
EPA 8270		1,2,4,5-Tetrachlorobenzene	NELAP	PA	4/4/2005
EPA 8270		1,2,4-Trichlorobenzene	NELAP	PA	1/19/2005
EPA 8270		1,2-Dichlorobenzene (o-Dichlorobenzene)	NELAP	PA	1/19/2005
EPA 8270		1,2-Dinitrobenzene (1,2-DNB)	NELAP	PA	1/19/2005
EPA 8270		1,2-Diphenylhydrazine	NELAP	PA	5/2/2006
EPA 8270		1,3,5-Trinitrobenzene (1,3,5-TNB)	NELAP	PA	1/4/2006
EPA 8270		1,3-Dichlorobenzene (m-Dichlorobenzene)	NELAP	PA	1/19/2005
EPA 8270		1,3-Dinitrobenzene (1,3-DNB)	NELAP	PA	1/19/2005
EPA 8270		1,4-Dichlorobenzene (p-Dichlorobenzene)	NELAP	PA	1/19/2005
EPA 8270		1,4-Dinitrobenzene (1,4-DNB)	NELAP	PA	5/2/2006
EPA 8270		1,4-Dioxane (1,4-Diethyleneoxide)	NELAP	PA	12/4/2007
EPA 8270		1,4-Naphthoquinone	NELAP	PA	1/19/2005
EPA 8270		1,4-Phenylenediamine	NELAP	PA	1/19/2005
EPA 8270		1-Chloronaphthalene	NELAP	PA	1/4/2006
EPA 8270		1-Methylnaphthalene	NELAP	PA	12/4/2007
EPA 8270		1-Naphthylamine (alpha-Naphthylamine)	NELAP	PA	4/4/2005
EPA 8270		2,2'-Oxybis(1-chloropropane) (bis(2-Chloro-1-methylethyl) ether)	NELAP	PA	10/30/2014
EPA 8270		2,3,4,6-Tetrachlorophenol	NELAP	PA	1/19/2005
EPA 8270		2,4,5-Trichlorophenol	NELAP	PA	1/19/2005
EPA 8270		2,4,6-Trichlorophenol	NELAP	PA	1/19/2005
EPA 8270		2,4-Dichlorophenol	NELAP	PA	1/19/2005
EPA 8270		2,4-Dimethylphenol	NELAP	PA	1/19/2005
EPA 8270		2,4-Dinitrophenol	NELAP	PA	1/19/2005

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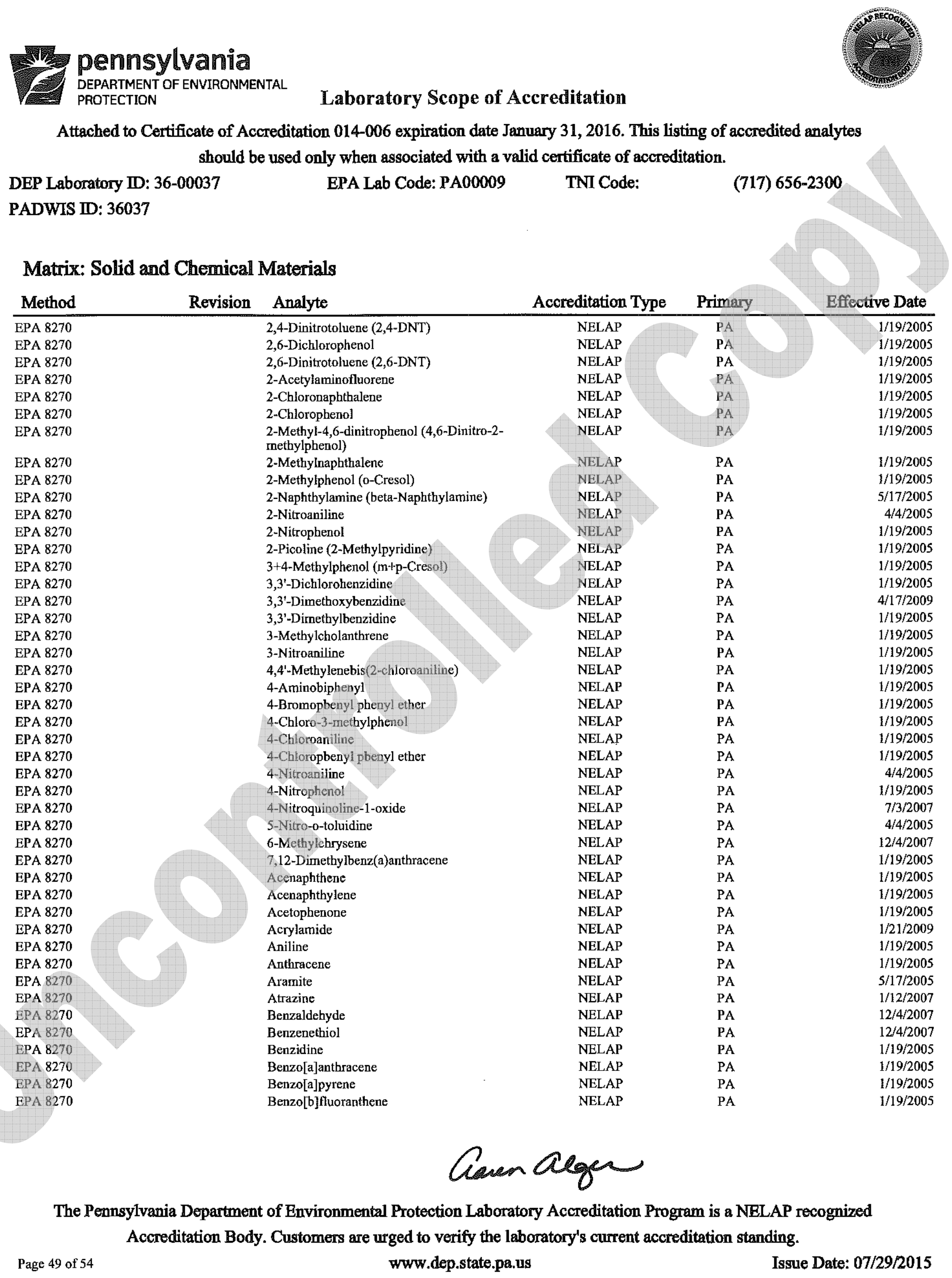

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Laboratory Scope of Accreditation

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DEP Laboratory ID: 36-00037 **EPA Lab Code: PA00009** **TNI Code:** **(717) 656-2300**
PADWIS ID: 36037

Matrix: Solid and Chemical Materials

Method	Revision	Analyte	Accreditation Type	Primary	Effective Date
EPA 8270		2,4-Dinitrotoluene (2,4-DNT)	NELAP	PA	1/19/2005
EPA 8270		2,6-Dichlorophenol	NELAP	PA	1/19/2005
EPA 8270		2,6-Dinitrotoluene (2,6-DNT)	NELAP	PA	1/19/2005
EPA 8270		2-Acetylaminofluorene	NELAP	PA	1/19/2005
EPA 8270		2-Chloronaphthalene	NELAP	PA	1/19/2005
EPA 8270		2-Chlorophenol	NELAP	PA	1/19/2005
EPA 8270		2-Methyl-4,6-dinitrophenol (4,6-Dinitro-2-methylphenol)	NELAP	PA	1/19/2005
EPA 8270		2-Methylnaphthalene	NELAP	PA	1/19/2005
EPA 8270		2-Methylphenol (o-Cresol)	NELAP	PA	1/19/2005
EPA 8270		2-Naphthylamine (beta-Naphthylamine)	NELAP	PA	5/17/2005
EPA 8270		2-Nitroaniline	NELAP	PA	4/4/2005
EPA 8270		2-Nitrophenol	NELAP	PA	1/19/2005
EPA 8270		2-Picoline (2-Methylpyridine)	NELAP	PA	1/19/2005
EPA 8270		3+4-Methylphenol (m+p-Cresol)	NELAP	PA	1/19/2005
EPA 8270		3,3'-Dichlorobenzidine	NELAP	PA	1/19/2005
EPA 8270		3,3'-Dimethoxybenzidine	NELAP	PA	4/17/2009
EPA 8270		3,3'-Dimethylbenzidine	NELAP	PA	1/19/2005
EPA 8270		3-Methylcholanthrene	NELAP	PA	1/19/2005
EPA 8270		3-Nitroaniline	NELAP	PA	1/19/2005
EPA 8270		4,4'-Methylenebis(2-chloroaniline)	NELAP	PA	1/19/2005
EPA 8270		4-Aminobiphenyl	NELAP	PA	1/19/2005
EPA 8270		4-Bromophenyl phenyl ether	NELAP	PA	1/19/2005
EPA 8270		4-Chloro-3-methylphenol	NELAP	PA	1/19/2005
EPA 8270		4-Chloroaniline	NELAP	PA	1/19/2005
EPA 8270		4-Chlorophenyl phenyl ether	NELAP	PA	1/19/2005
EPA 8270		4-Nitroaniline	NELAP	PA	4/4/2005
EPA 8270		4-Nitrophenol	NELAP	PA	1/19/2005
EPA 8270		4-Nitroquinoline-1-oxide	NELAP	PA	7/3/2007
EPA 8270		5-Nitro-o-toluidine	NELAP	PA	4/4/2005
EPA 8270		6-Methylchrysene	NELAP	PA	12/4/2007
EPA 8270		7,12-Dimethylbenz(a)anthracene	NELAP	PA	1/19/2005
EPA 8270		Acenaphthene	NELAP	PA	1/19/2005
EPA 8270		Acenaphthylene	NELAP	PA	1/19/2005
EPA 8270		Acetophenone	NELAP	PA	1/19/2005
EPA 8270		Acrylamide	NELAP	PA	1/21/2009
EPA 8270		Aniline	NELAP	PA	1/19/2005
EPA 8270		Anthracene	NELAP	PA	1/19/2005
EPA 8270		Aramite	NELAP	PA	5/17/2005
EPA 8270		Atrazine	NELAP	PA	1/12/2007
EPA 8270		Benzaldehyde	NELAP	PA	12/4/2007
EPA 8270		Benzenethiol	NELAP	PA	12/4/2007
EPA 8270		Benzidine	NELAP	PA	1/19/2005
EPA 8270		Benzo[a]anthracene	NELAP	PA	1/19/2005
EPA 8270		Benzo[a]pyrene	NELAP	PA	1/19/2005
EPA 8270		Benzo[b]fluoranthene	NELAP	PA	1/19/2005

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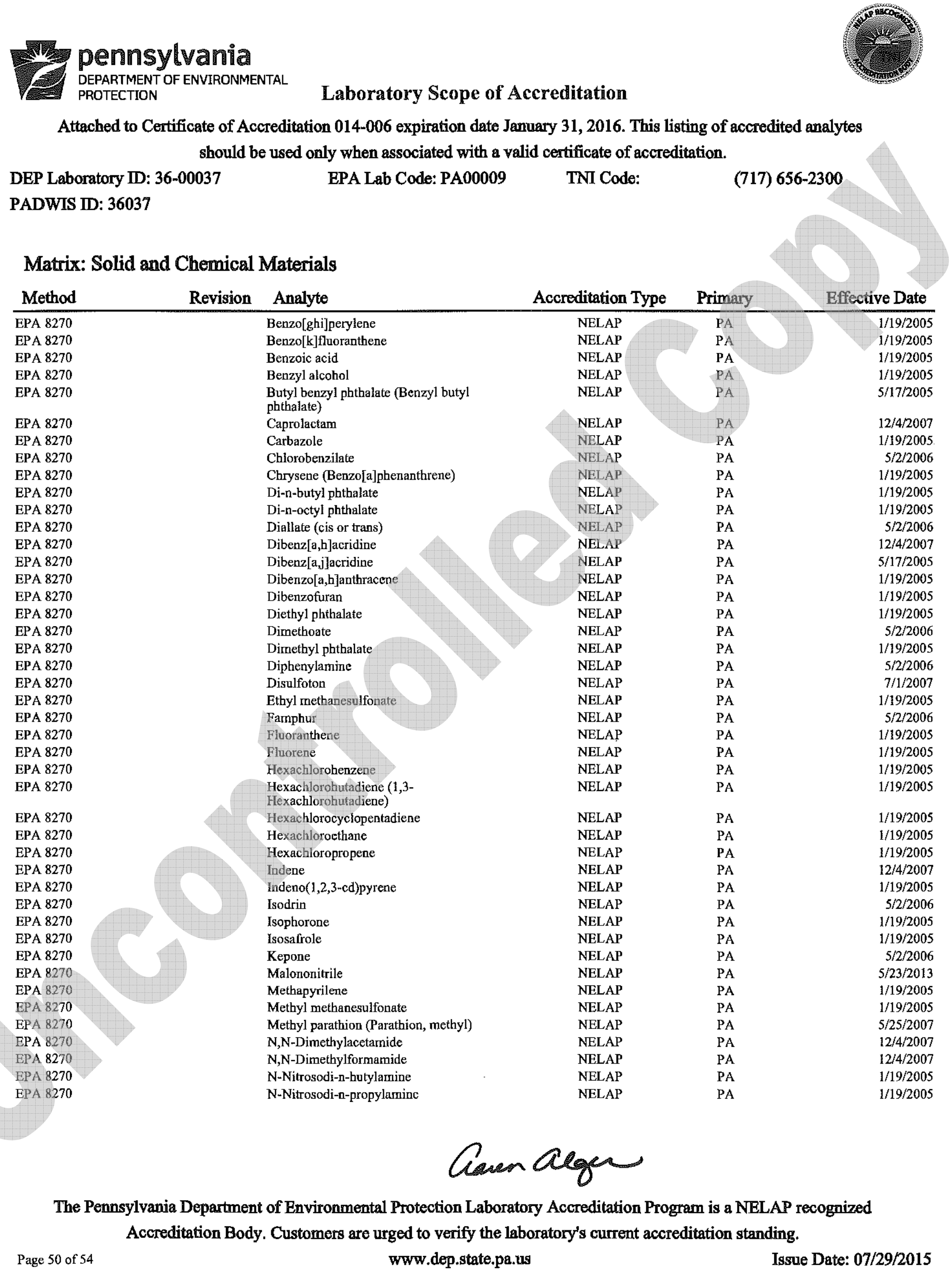
www.dep.state.pa.us **Issue Date: 07/29/2015**



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DEPARTMENT OF ENVIRONMENTAL PROTECTION

Laboratory Scope of Accreditation

Attached to Certificate of Accreditation 014-006 expiration date January 31, 2016. This listing of accredited analytes should be used only when associated with a valid certificate of accreditation.

DEP Laboratory ID: 36-00037 **EPA Lab Code: PA00009** **TNI Code:** **(717) 656-2300**
PADWIS ID: 36037

Matrix: Solid and Chemical Materials

Method	Revision	Analyte	Accreditation Type	Primary	Effective Date
EPA 8270		Benzo[ghi]perylene	NELAP	PA	1/19/2005
EPA 8270		Benzo[k]fluoranthene	NELAP	PA	1/19/2005
EPA 8270		Benzoic acid	NELAP	PA	1/19/2005
EPA 8270		Benzyl alcohol	NELAP	PA	1/19/2005
EPA 8270		Butyl benzyl phthalate (Benzyl butyl phthalate)	NELAP	PA	5/17/2005
EPA 8270		Caprolactam	NELAP	PA	12/4/2007
EPA 8270		Carbazole	NELAP	PA	1/19/2005
EPA 8270		Chlorobenzilate	NELAP	PA	5/2/2006
EPA 8270		Chrysene (Benzo[a]phenanthrene)	NELAP	PA	1/19/2005
EPA 8270		Di-n-butyl phthalate	NELAP	PA	1/19/2005
EPA 8270		Di-n-octyl phthalate	NELAP	PA	1/19/2005
EPA 8270		Diallate (cis or trans)	NELAP	PA	5/2/2006
EPA 8270		Dibenz[a,h]acridine	NELAP	PA	12/4/2007
EPA 8270		Dibenz[a,j]acridine	NELAP	PA	5/17/2005
EPA 8270		Dibenzo[a,h]anthracene	NELAP	PA	1/19/2005
EPA 8270		Dibenzofuran	NELAP	PA	1/19/2005
EPA 8270		Diethyl phthalate	NELAP	PA	1/19/2005
EPA 8270		Dimethoate	NELAP	PA	5/2/2006
EPA 8270		Dimethyl phthalate	NELAP	PA	1/19/2005
EPA 8270		Diphenylamine	NELAP	PA	5/2/2006
EPA 8270		Disulfoton	NELAP	PA	7/1/2007
EPA 8270		Ethyl methanesulfonate	NELAP	PA	1/19/2005
EPA 8270		Famphur	NELAP	PA	5/2/2006
EPA 8270		Fluoranthene	NELAP	PA	1/19/2005
EPA 8270		Fluorene	NELAP	PA	1/19/2005
EPA 8270		Hexachlorobenzene	NELAP	PA	1/19/2005
EPA 8270		Hexachlorobutadiene (1,3-Hexachlorobutadiene)	NELAP	PA	1/19/2005
EPA 8270		Hexachlorocyclopentadiene	NELAP	PA	1/19/2005
EPA 8270		Hexachloroethane	NELAP	PA	1/19/2005
EPA 8270		Hexachloropropene	NELAP	PA	1/19/2005
EPA 8270		Indene	NELAP	PA	12/4/2007
EPA 8270		Indeno(1,2,3-cd)pyrene	NELAP	PA	1/19/2005
EPA 8270		Isodrin	NELAP	PA	5/2/2006
EPA 8270		Isophorone	NELAP	PA	1/19/2005
EPA 8270		Isosafrole	NELAP	PA	1/19/2005
EPA 8270		Kepone	NELAP	PA	5/2/2006
EPA 8270		Malononitrile	NELAP	PA	5/23/2013
EPA 8270		Methapyrilene	NELAP	PA	1/19/2005
EPA 8270		Methyl methanesulfonate	NELAP	PA	1/19/2005
EPA 8270		Methyl parathion (Parathion, methyl)	NELAP	PA	5/25/2007
EPA 8270		N,N-Dimethylacetamide	NELAP	PA	12/4/2007
EPA 8270		N,N-Dimethylformamide	NELAP	PA	12/4/2007
EPA 8270		N-Nitrosodi-n-butylamine	NELAP	PA	1/19/2005
EPA 8270		N-Nitrosodi-n-propylamine	NELAP	PA	1/19/2005

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DEPARTMENT OF ENVIRONMENTAL PROTECTION

Laboratory Scope of Accreditation

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DEP Laboratory ID: 36-00037 **EPA Lab Code: PA00009** **TNI Code:** **(717) 656-2300**
PADWIS ID: 36037

Matrix: Solid and Chemical Materials

Method	Revision	Analyte	Accreditation Type	Primary	Effective Date
EPA 8270		N-Nitrosodiethylamine	NELAP	PA	1/19/2005
EPA 8270		N-Nitrosodimethylamine	NELAP	PA	1/19/2005
EPA 8270		N-Nitrosodiphenylamine	NELAP	PA	1/19/2005
EPA 8270		N-Nitrosomethylethylamine	NELAP	PA	1/19/2005
EPA 8270		N-Nitrosomorpholine	NELAP	PA	1/19/2005
EPA 8270		N-Nitrosopiperidine	NELAP	PA	1/19/2005
EPA 8270		N-Nitrosopyrrolidine	NELAP	PA	1/19/2005
EPA 8270		Naphthalene	NELAP	PA	1/19/2005
EPA 8270		Nitrobenzene	NELAP	PA	1/4/2006
EPA 8270		O,O,O-Triethyl phosphorothioate	NELAP	PA	5/2/2006
EPA 8270		Parathion, ethyl (Ethyl parathion, Parathion)	NELAP	PA	5/25/2007
EPA 8270		Pentachlorobenzene	NELAP	PA	1/19/2005
EPA 8270		Pentachloronitrobenzene (PCNB)	NELAP	PA	1/19/2005
EPA 8270		Pentachlorophenol (PCP)	NELAP	PA	1/19/2005
EPA 8270		Phenacetin	NELAP	PA	1/19/2005
EPA 8270		Phenanthrene	NELAP	PA	1/19/2005
EPA 8270		Phenol	NELAP	PA	1/19/2005
EPA 8270		Phorate (Thimet)	NELAP	PA	5/2/2006
EPA 8270		Phthalic anhydride	NELAP	PA	1/21/2009
EPA 8270		Pronamide (Kerb)	NELAP	PA	1/19/2005
EPA 8270		Pyrene	NELAP	PA	1/19/2005
EPA 8270		Pyridine	NELAP	PA	4/4/2005
EPA 8270		Quinoline	NELAP	PA	12/4/2007
EPA 8270	C	SOCs by GC/MS	NELAP	PA	3/26/2012
EPA 8270	D	SOCs by GC/MS	NELAP	PA	3/26/2012
EPA 8270		Safrole	NELAP	PA	1/19/2005
EPA 8270		Sulfotepp (Tetraethyl dithiopyrophosphate)	NELAP	PA	12/4/2007
EPA 8270		Tetraethyl lead	NELAP	PA	3/7/2012
EPA 8270		Thionazine (Thionazin, Zinophos)	NELAP	PA	5/2/2006
EPA 8270		a,a-Dimethylphenethylamine (Phentermine)	NELAP	PA	5/2/2006
EPA 8270		bis(2-Chloroethoxy)methane	NELAP	PA	1/19/2005
EPA 8270		bis(2-Chloroethyl) ether	NELAP	PA	1/19/2005
EPA 8270		bis(2-Chloroisopropyl) ether	NELAP	PA	1/4/2006
EPA 8270		bis(2-Chloromethyl) ether	NELAP	PA	1/21/2009
EPA 8270		bis(2-Ethylhexyl) adipate (di(2-Ethylhexyl) adipate)	NELAP	PA	1/21/2009
EPA 8270		bis(2-Ethylhexyl) phthalate (DEHP)	NELAP	PA	1/19/2005
EPA 8270		o-Toluidine (2-Toluidine, 2-Methylaniline)	NELAP	PA	1/19/2005
EPA 8270		p-(Dimethylamino)azobenzene	NELAP	PA	5/2/2006
EPA 8270		p-Chloronitrobenzene	NELAP	PA	1/21/2009
EPA 8270		tris-(2,3-Dibromopropyl) phosphate (tris-BP)	NELAP	PA	12/4/2007
EPA 8270 SIM		1-Methylnaphthalene	NELAP	PA	7/25/2011
EPA 8270 SIM		2-Methylnaphthalene	NELAP	PA	5/23/2012
EPA 8270 SIM		Acenaphthene	NELAP	PA	12/4/2007
EPA 8270 SIM		Acenaphthylene	NELAP	PA	12/4/2007

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DEPARTMENT OF ENVIRONMENTAL PROTECTION

Laboratory Scope of Accreditation

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DEP Laboratory ID: 36-00037 | **EPA Lab Code: PA00009** | **TNI Code:** | **(717) 656-2300**
PADWIS ID: 36037

Matrix: Solid and Chemical Materials

Method	Revision	Analyte	Accreditation Type	Primary	Effective Date
EPA 8270 SIM		Anthracene	NELAP	PA	12/4/2007
EPA 8270 SIM		Benzo[a]anthracene	NELAP	PA	12/4/2007
EPA 8270 SIM		Benzo[a]pyrene	NELAP	PA	12/4/2007
EPA 8270 SIM		Benzo[b]fluoranthene	NELAP	PA	12/4/2007
EPA 8270 SIM		Benzo[ghi]perylene	NELAP	PA	12/4/2007
EPA 8270 SIM		Benzo[k]fluoranthene	NELAP	PA	12/4/2007
EPA 8270 SIM		Chrysene (Benzo[a]phenanthrene)	NELAP	PA	12/4/2007
EPA 8270 SIM		Dibenzo[a,h]anthracene	NELAP	PA	12/4/2007
EPA 8270 SIM		Fluoranthene	NELAP	PA	12/4/2007
EPA 8270 SIM		Fluorene	NELAP	PA	12/4/2007
EPA 8270 SIM		Indeno(1,2,3-cd)pyrene	NELAP	PA	12/4/2007
EPA 8270 SIM		Naphthalene	NELAP	PA	12/4/2007
EPA 8270 SIM		Phenanthrene	NELAP	PA	12/4/2007
EPA 8270 SIM		Pyrene	NELAP	PA	12/4/2007
EPA 8290		1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	NELAP	PA	6/30/2010
EPA 8290		1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	NELAP	PA	6/30/2010
EPA 8290		1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (1,2,3,4,6,7,8-hpcdd)	NELAP	PA	6/30/2010
EPA 8290		1,2,3,4,6,7,8-Heptachlorodibenzofuran (1,2,3,4,6,7,8-hpcdf)	NELAP	PA	6/30/2010
EPA 8290		1,2,3,4,7,8,9-Heptachlorodibenzofuran (1,2,3,4,7,8,9-hpcdf)	NELAP	PA	6/30/2010
EPA 8290		1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	NELAP	PA	6/30/2010
EPA 8290		1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF)	NELAP	PA	8/6/2010
EPA 8290		1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	NELAP	PA	6/30/2010
EPA 8290		1,2,3,6,7,8-Hexachlorodibenzofuran (HxCDF)	NELAP	PA	6/30/2010
EPA 8290		1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (HxCDD)	NELAP	PA	6/30/2010
EPA 8290		1,2,3,7,8,9-Hexachlorodibenzofuran (HxCDF)	NELAP	PA	6/30/2010
EPA 8290		1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD)	NELAP	PA	6/30/2010
EPA 8290		1,2,3,7,8-Pentachlorodibenzofuran (PeCDF)	NELAP	PA	6/30/2010
EPA 8290		2,3,4,6,7,8-Hexachlorodibenzofuran (HxCDF)	NELAP	PA	6/30/2010
EPA 8290		2,3,4,7,8-Pentachlorodibenzofuran (PeCDF)	NELAP	PA	8/6/2010
EPA 8290		2,3,7,8-Tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD)(Dioxin)	NELAP	PA	6/30/2010
EPA 8290		2,3,7,8-Tetrachlorodibenzofuran (TCDF)	NELAP	PA	6/30/2010
EPA 8290		PCDDs and PCDFs by HRGC-HRMS	NELAP	PA	3/26/2012
EPA 8290	A	PCDDs and PCDFs by HRGC-HRMS	NELAP	PA	3/4/2015
EPA 8290		Total TCDD	NELAP	PA	6/30/2010

Aaron Alger

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pennsylvania
DEPARTMENT OF ENVIRONMENTAL PROTECTION

Laboratory Scope of Accreditation

Attached to Certificate of Accreditation 014-006 expiration date January 31, 2016. This listing of accredited analytes should be used only when associated with a valid certificate of accreditation.

DEP Laboratory ID: 36-00037 **EPA Lab Code: PA00009** **TNI Code:** **(717) 656-2300**
PADWIS ID: 36037

Matrix: Solid and Chemical Materials

Method	Revision	Analyte	Accreditation Type	Primary	Effective Date
EPA 8290		Total TCDF	NELAP	PA	6/30/2010
EPA 8290		Total heptachlorodibenzo-p-dioxin (HpCDD)	NELAP	PA	6/30/2010
EPA 8290		Total heptachlorodibenzofuran (HpCDF)	NELAP	PA	6/30/2010
EPA 8290		Total hexachlorodibenzo-p-dioxin (HxCDD)	NELAP	PA	6/30/2010
EPA 8290		Total hexachlorodibenzofuran (HxCDF)	NELAP	PA	6/30/2010
EPA 8290		Total pentachlorodibenzo-p-dioxin (PeCDD)	NELAP	PA	6/30/2010
EPA 8290		Total pentachlorodibenzofuran (PeCDF)	NELAP	PA	6/30/2010
EPA 8315		2,5-Dimethylbenzaldehyde	NELAP	PA	1/21/2009
EPA 8315		Acetaldehyde	NELAP	PA	1/21/2009
EPA 8315		Benzaldehyde	NELAP	PA	1/21/2009
EPA 8315		Butanal (Butyraldehyde)	NELAP	PA	1/21/2009
EPA 8315	A	Carbonyl compounds by HPLC	NELAP	PA	3/26/2012
EPA 8315		Crotonaldehyde	NELAP	PA	1/21/2009
EPA 8315		Formaldehyde	NELAP	PA	1/19/2005
EPA 8315		Hexanal (Hexaldehyde)	NELAP	PA	1/21/2009
EPA 8315		Isovaleraldehyde	NELAP	PA	1/21/2009
EPA 8315		Pentanal (Valeraldehyde)	NELAP	PA	1/21/2009
EPA 8315		Propanal (Propionaldehyde)	NELAP	PA	1/21/2009
EPA 8315		m-Tolualdehyde (1,3-Tolualdehyde)	NELAP	PA	1/21/2009
EPA 8315		o-Tolualdehyde (1,2-Tolualdehyde)	NELAP	PA	1/21/2009
EPA 8315		p-Tolualdehyde (1,4-Tolualdehyde)	NELAP	PA	1/21/2009
EPA 8318		3-Hydroxycarbofuran	NELAP	PA	4/4/2005
EPA 8318		Aldicarb (Temik)	NELAP	PA	4/4/2005
EPA 8318		Aldicarb sulfone	NELAP	PA	4/4/2005
EPA 8318		Aldicarb sulfoxide	NELAP	PA	12/12/2005
EPA 8318		Carbaryl (Sevin)	NELAP	PA	4/4/2005
EPA 8318		Carbofuran (Furaden)	NELAP	PA	4/4/2005
EPA 8318		Methiocarb (Mesurol)	NELAP	PA	4/4/2005
EPA 8318		Methomyl (Lannate)	NELAP	PA	4/4/2005
EPA 8318	A	N-Methylcarbamates by HPLC	NELAP	PA	10/15/2012
EPA 8318		Oxamyl (Vydate)	NELAP	PA	12/12/2005
EPA 8318		Propoxur (Baygon)	NELAP	PA	4/4/2005
EPA 8330		1,3,5-Trinitrobenzene (1,3,5-TNB)	NELAP	PA	1/19/2005
EPA 8330		1,3-Dinitrobenzene (1,3-DNB)	NELAP	PA	1/19/2005
EPA 8330		2,4,6-Trinitrotoluene (2,4,6-TNT)	NELAP	PA	1/19/2005
EPA 8330		2,4-Diamino-6-nitrotoluene	NELAP	PA	7/29/2015
EPA 8330		2,4-Dinitrotoluene (2,4-DNT)	NELAP	PA	1/19/2005
EPA 8330		2,6-Diamino-4-nitrotoluene	NELAP	PA	7/29/2015
EPA 8330		2,6-Dinitrotoluene (2,6-DNT)	NELAP	PA	1/19/2005
EPA 8330		2-Amino-4,6-dinitrotoluene (2-Am-DNT)	NELAP	PA	1/19/2005
EPA 8330		2-Nitrotoluene	NELAP	PA	1/19/2005
EPA 8330		3,5-Dinitroaniline	NELAP	PA	7/29/2015
EPA 8330		3-Nitrotoluene	NELAP	PA	1/19/2005
EPA 8330		4-Amino-2,6-dinitrotoluene (4-Am-DNT)	NELAP	PA	1/19/2005
EPA 8330		4-Nitrotoluene	NELAP	PA	1/19/2005

Aaron Alger

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www.dep.state.pa.us **Issue Date: 07/29/2015**

pennsylvania
DEPARTMENT OF ENVIRONMENTAL PROTECTION

Laboratory Scope of Accreditation

Attached to Certificate of Accreditation 014-006 expiration date January 31, 2016. This listing of accredited analytes should be used only when associated with a valid certificate of accreditation.

DEP Laboratory ID: 36-00037 **EPA Lab Code: PA00009** **TNI Code:** **(717) 656-2300**
PADWIS ID: 36037

Matrix: Solid and Chemical Materials

Method	Revision	Analyte	Accreditation Type	Primary	Effective Date
EPA 8330		Methyl-2,4,6-trinitrophenylnitramine (Tetryl)	NELAP	PA	1/19/2005
EPA 8330		Nitroaromatics and nitramines by HPLC/UV	NELAP	PA	3/26/2012
EPA 8330	A	Nitroaromatics and nitramines by HPLC/UV	NELAP	PA	3/26/2012
EPA 8330	B	Nitroaromatics and nitramines by HPLC/UV	NELAP	PA	7/29/2015
EPA 8330		Nitrobenzene	NELAP	PA	1/19/2005
EPA 8330		Nitroglycerin	NELAP	PA	10/9/2013
EPA 8330		Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)	NELAP	PA	1/24/2006
EPA 8330		Pentaerythritol tetranitrate (PETN)	NELAP	PA	11/21/2005
EPA 8330		RDX (Hexahydro-1,3,5-trinitro-1,3,5-triazine)	NELAP	PA	1/19/2005
EPA 9012		Total cyanide	NELAP	PA	4/18/2013
EPA 9045		pH	NELAP	PA	11/19/2008
EPA 9050	A	Conductivity	NELAP	PA	1/27/2014
EPA 9050		Conductivity	NELAP	PA	5/17/2005
EPA 9060		Total organic carbon (TOC)	NELAP	PA	1/19/2005
EPA 9066		Total phenolics	NELAP	PA	4/4/2005
EPA 9071	B	Oil and grease	NELAP	PA	1/19/2005
EPA 9081		Cation exchange capacity of soils (Ammonium acetate)	NELAP	PA	5/25/2005
EPA 9095	A	Paint filter liquids test	NELAP	PA	1/24/2007
EPA Lloyd Kahn Method		Total organic carbon (TOC)	NELAP	PA	10/9/2013
FL-PRO		Total petroleum hydrocarbons (TPH)	NELAP	PA	12/12/2005
MA DEP EPH	1.1	C11-C22 Aromatics	NELAP	PA	7/15/2013
MA DEP EPH	1.1	C19-C36 Aliphatics	NELAP	PA	7/15/2013
MA DEP EPH	1.1	C9-C18 Aliphatics	NELAP	PA	7/15/2013
MA DEP VPH	1.1	C5-C8 Aliphatics	NELAP	PA	7/15/2013
MA DEP VPH	1.1	C9-C10 Aromatics	NELAP	PA	7/15/2013
MA DEP VPH	1.1	C9-C12 Aliphatics	NELAP	PA	7/15/2013
NWTPH-Dx		Diesel-range organics (DRO)	NELAP	PA	12/12/2005
NWTPH-Gx		Gasoline-range organics (GRO)	NELAP	PA	12/12/2005
SM 2540 G		Residue, total	NELAP	PA	2/25/2014
SM 2540 G		Total, fixed, and volatile residue	NELAP	PA	3/19/2015
SM 5310 B		Total organic carbon (TOC)	NELAP	PA	10/9/2013
TX1005 (TNRCC)		Total petroleum hydrocarbons (TPH)	NELAP	PA	12/12/2005
TX1006 (TNRCC)		Total petroleum hydrocarbons (TPH)	NELAP	PA	12/12/2005
WA-EPH		Diesel-range organics (DRO)	NELAP	PA	12/12/2005
WA-VPH		Gasoline-range organics (GRO)	NELAP	PA	12/12/2005
WI-DRO		Diesel-range organics (DRO)	NELAP	PA	12/12/2005
WI-GRO		Gasoline-range organics (GRO)	NELAP	PA	12/12/2005

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STATE OF LOUISIANA
DEPARTMENT OF ENVIRONMENTAL QUALITY
Issue Date: July 1, 2015

Eurofins Lancaster Laboratories Inc
AI Number: 30729
Expiration Date: June 30, 2016

2425 New Holland Pike, Lancaster, Pennsylvania 17601-5994

Certificate Number: 02055

Air Emissions

Analyte	Method Name	Method Code	Type	AB
4385 - Bromobenzene	EPA TO-15 (extended)	2368	NELAP	LA
4577 - Chlorodifluoromethane (Freon-22)	EPA TO-15 (extended)	2368	NELAP	LA
4627 - Dichlorofluoromethane (Freon 21)	EPA TO-15 (extended)	2368	NELAP	LA
4645 - cis-1,2-Dichloroethylene	EPA TO-15 (extended)	2368	NELAP	LA
5027 - n-Octane	EPA TO-15 (extended)	2368	NELAP	LA
5028 - n-Pentane	EPA TO-15 (extended)	2368	NELAP	LA
100170 - Gaseous Organic Compound Emissions	EPA 18	10246636	NELAP	LA
100077 - Gaseous Nonmethane Organic Emissions	EPA Method 25	10246738	NELAP	LA
5105 - 1,1,1,2-Tetrachloroethane	EPA TO-15	10248803	NELAP	LA
5160 - 1,1,1-Trichloroethane	EPA TO-15	10248803	NELAP	LA
5110 - 1,1,2,2-Tetrachloroethane	EPA TO-15	10248803	NELAP	LA
5195 - 1,1,2-Trichloro-1,2,2-trifluoroethane	EPA TO-15	10248803	NELAP	LA
5165 - 1,1,2-Trichloroethane	EPA TO-15	10248803	NELAP	LA
4630 - 1,1-Dichloroethane	EPA TO-15	10248803	NELAP	LA
4640 - 1,1-Dichloroethylene	EPA TO-15	10248803	NELAP	LA
5155 - 1,2,4-Trichlorobenzene	EPA TO-15	10248803	NELAP	LA
5210 - 1,2,4-Trimethylbenzene	EPA TO-15	10248803	NELAP	LA
4570 - 1,2-Dibromo-3-chloropropane (DBCP)	EPA TO-15	10248803	NELAP	LA
4585 - 1,2-Dibromoethane (EDB, Ethylene dibromide)	EPA TO-15	10248803	NELAP	LA
4695 - 1,2-Dichloro-1,1,2,2-tetrafluoroethane (Freon-114)	EPA TO-15	10248803	NELAP	LA
4610 - 1,2-Dichlorobenzene	EPA TO-15	10248803	NELAP	LA
4635 - 1,2-Dichloroethane (Ethylene dichloride)	EPA TO-15	10248803	NELAP	LA
4655 - 1,2-Dichloropropane	EPA TO-15	10248803	NELAP	LA
5215 - 1,3,5-Trimethylbenzene	EPA TO-15	10248803	NELAP	LA
9318 - 1,3-Butadiene	EPA TO-15	10248803	NELAP	LA
4615 - 1,3-Dichlorobenzene	EPA TO-15	10248803	NELAP	LA
4620 - 1,4-Dichlorobenzene	EPA TO-15	10248803	NELAP	LA
4735 - 1,4-Dioxane (1,4- Diethyleneoxide)	EPA TO-15	10248803	NELAP	LA
5220 - 2,2,4-Trimethylpentane (Isooctane)	EPA TO-15	10248803	NELAP	LA
4410 - 2-Butanone (Methyl ethyl ketone, MEK)	EPA TO-15	10248803	NELAP	LA
4535 - 2-Chlorotoluene	EPA TO-15	10248803	NELAP	LA
4860 - 2-Hexanone	EPA TO-15	10248803	NELAP	LA
4542 - 4-Ethyltoluene	EPA TO-15	10248803	NELAP	LA
4995 - 4-Methyl-2-pentanone (MIBK)	EPA TO-15	10248803	NELAP	LA
4315 - Acetone	EPA TO-15	10248803	NELAP	LA
4320 - Acetonitrile	EPA TO-15	10248803	NELAP	LA
4325 - Acrolein (Propenal)	EPA TO-15	10248803	NELAP	LA
4340 - Acrylonitrile	EPA TO-15	10248803	NELAP	LA
4355 - Allyl chloride (3-Chloropropene)	EPA TO-15	10248803	NELAP	LA
4375 - Benzene	EPA TO-15	10248803	NELAP	LA
5635 - Benzyl chloride	EPA TO-15	10248803	NELAP	LA
4395 - Bromodichloromethane	EPA TO-15	10248803	NELAP	LA
4400 - Bromoform	EPA TO-15	10248803	NELAP	LA

Clients and Customers are urged to verify the laboratory's current certification status with the Louisiana Environmental Laboratory Accreditation Program.

Air Emissions

Analyte	Method Name	Method Code	Type	AB
4450 - Carbon disulfide	EPA TO-15	10248803	NELAP	LA
4455 - Carbon tetrachloride	EPA TO-15	10248803	NELAP	LA
4475 - Chlorobenzene	EPA TO-15	10248803	NELAP	LA
4575 - Chlorodibromomethane	EPA TO-15	10248803	NELAP	LA
4485 - Chloroethane (Ethyl chloride)	EPA TO-15	10248803	NELAP	LA
4505 - Chloroform	EPA TO-15	10248803	NELAP	LA
4555 - Cyclohexane	EPA TO-15	10248803	NELAP	LA
9375 - Di-isopropylether (DIPE) (Isopropyl ether)	EPA TO-15	10248803	NELAP	LA
4595 - Dibromomethane (Methylene bromide)	EPA TO-15	10248803	NELAP	LA
4625 - Dichlorodifluoromethane (Freon-12)	EPA TO-15	10248803	NELAP	LA
4750 - Ethanol	EPA TO-15	10248803	NELAP	LA
4755 - Ethyl acetate	EPA TO-15	10248803	NELAP	LA
4760 - Ethyl acrylate	EPA TO-15	10248803	NELAP	LA
4810 - Ethyl methacrylate	EPA TO-15	10248803	NELAP	LA
4770 - Ethyl-t-butyl ether (ETBE) (2-Ethoxy-2-methylpropane)	EPA TO-15	10248803	NELAP	LA
4765 - Ethylbenzene	EPA TO-15	10248803	NELAP	LA
4835 - Hexachlorobutadiene	EPA TO-15	10248803	NELAP	LA
4840 - Hexachloroethane	EPA TO-15	10248803	NELAP	LA
4870 - Iodomethane (Methyl iodide)	EPA TO-15	10248803	NELAP	LA
4900 - Isopropylbenzene	EPA TO-15	10248803	NELAP	LA
4945 - Methyl acrylate	EPA TO-15	10248803	NELAP	LA
4950 - Methyl bromide (Bromomethane)	EPA TO-15	10248803	NELAP	LA
4960 - Methyl chloride (Chloromethane)	EPA TO-15	10248803	NELAP	LA
100201 - Methyl isobutyl ketone (Hexanone)	EPA TO-15	10248803	NELAP	LA
4990 - Methyl methacrylate	EPA TO-15	10248803	NELAP	LA
5000 - Methyl tert-butyl ether (MTBE)	EPA TO-15	10248803	NELAP	LA
4975 - Methylene chloride (Dichloromethane)	EPA TO-15	10248803	NELAP	LA
5005 - Naphthalene	EPA TO-15	10248803	NELAP	LA
4836 - Propylene	EPA TO-15	10248803	NELAP	LA
5100 - Styrene	EPA TO-15	10248803	NELAP	LA
4370 - T-amylmethylether (TAME)	EPA TO-15	10248803	NELAP	LA
5115 - Tetrachloroethylene (Perchloroethylene)	EPA TO-15	10248803	NELAP	LA
5120 - Tetrahydrofuran (THF)	EPA TO-15	10248803	NELAP	LA
5140 - Toluene	EPA TO-15	10248803	NELAP	LA
5170 - Trichloroethene (Trichloroethylene)	EPA TO-15	10248803	NELAP	LA
5175 - Trichlorofluoromethane (Fluorotrichloromethane, Freon 11)	EPA TO-15	10248803	NELAP	LA
5225 - Vinyl acetate	EPA TO-15	10248803	NELAP	LA
5230 - Vinyl bromide (Bromoethane)	EPA TO-15	10248803	NELAP	LA
5235 - Vinyl chloride	EPA TO-15	10248803	NELAP	LA
5260 - Xylene (total)	EPA TO-15	10248803	NELAP	LA
4705 - cis & trans-1,2-Dichloroethene	EPA TO-15	10248803	NELAP	LA
4645 - cis-1,2-Dichloroethylene	EPA TO-15	10248803	NELAP	LA
4680 - cis-1,3-Dichloropropene	EPA TO-15	10248803	NELAP	LA
5240 - m+p-xylene	EPA TO-15	10248803	NELAP	LA
5245 - m-Xylene	EPA TO-15	10248803	NELAP	LA
4435 - n-Butylbenzene	EPA TO-15	10248803	NELAP	LA
4825 - n-Heptane	EPA TO-15	10248803	NELAP	LA
4855 - n-Hexane	EPA TO-15	10248803	NELAP	LA
5090 - n-Propylbenzene	EPA TO-15	10248803	NELAP	LA

Air Emissions

Analyte	Method Name	Method Code	Type	AB
5250 - o-Xylene	EPA TO-15	10248803	NELAP	LA
5255 - p-Xylene	EPA TO-15	10248803	NELAP	LA
4440 - sec-Butylbenzene	EPA TO-15	10248803	NELAP	LA
4420 - tert-Butyl alcohol	EPA TO-15	10248803	NELAP	LA
4445 - tert-Butylbenzene	EPA TO-15	10248803	NELAP	LA
4700 - trans-1,2-Dichloroethylene	EPA TO-15	10248803	NELAP	LA
4685 - trans-1,3-Dichloropropylene	EPA TO-15	10248803	NELAP	LA
5105 - 1,1,1,2-Tetrachloroethane	EPA TO-14A, Rev.2	10312002	NELAP	LA
5160 - 1,1,1-Trichloroethane	EPA TO-14A, Rev.2	10312002	NELAP	LA
5110 - 1,1,2,2-Tetrachloroethane	EPA TO-14A, Rev.2	10312002	NELAP	LA
5195 - 1,1,2-Trichloro-1,2,2-trifluoroethane	EPA TO-14A, Rev.2	10312002	NELAP	LA
5165 - 1,1,2-Trichloroethane	EPA TO-14A, Rev.2	10312002	NELAP	LA
4630 - 1,1-Dichloroethane	EPA TO-14A, Rev.2	10312002	NELAP	LA
4640 - 1,1-Dichloroethylene	EPA TO-14A, Rev.2	10312002	NELAP	LA
5180 - 1,2,3-Trichloropropane	EPA TO-14A, Rev.2	10312002	NELAP	LA
5155 - 1,2,4-Trichlorobenzene	EPA TO-14A, Rev.2	10312002	NELAP	LA
5210 - 1,2,4-Trimethylbenzene	EPA TO-14A, Rev.2	10312002	NELAP	LA
4585 - 1,2-Dibromoethane (EDB, Ethylene dibromide)	EPA TO-14A, Rev.2	10312002	NELAP	LA
4695 - 1,2-Dichloro-1,1,2,2-tetrafluoroethane (Freon-114)	EPA TO-14A, Rev.2	10312002	NELAP	LA
4610 - 1,2-Dichlorobenzene	EPA TO-14A, Rev.2	10312002	NELAP	LA
4635 - 1,2-Dichloroethane (Ethylene dichloride)	EPA TO-14A, Rev.2	10312002	NELAP	LA
4655 - 1,2-Dichloropropane	EPA TO-14A, Rev.2	10312002	NELAP	LA
5215 - 1,3,5-Trimethylbenzene	EPA TO-14A, Rev.2	10312002	NELAP	LA
4615 - 1,3-Dichlorobenzene	EPA TO-14A, Rev.2	10312002	NELAP	LA
4835 - 1,3-Hexachlorobutadiene	EPA TO-14A, Rev.2	10312002	NELAP	LA
4620 - 1,4-Dichlorobenzene	EPA TO-14A, Rev.2	10312002	NELAP	LA
4735 - 1,4-Dioxane (1,4- Diethyleneoxide)	EPA TO-14A, Rev.2	10312002	NELAP	LA
5220 - 2,2,4-Trimethylpentane (Isooctane)	EPA TO-14A, Rev.2	10312002	NELAP	LA
4410 - 2-Butanone (Methyl ethyl ketone, MEK)	EPA TO-14A, Rev.2	10312002	NELAP	LA
4860 - 2-Hexanone	EPA TO-14A, Rev.2	10312002	NELAP	LA
4542 - 4-Ethyltoluene	EPA TO-14A, Rev.2	10312002	NELAP	LA
4995 - 4-Methyl-2-pentanone (MIBK)	EPA TO-14A, Rev.2	10312002	NELAP	LA
4315 - Acetone	EPA TO-14A, Rev.2	10312002	NELAP	LA
4375 - Benzene	EPA TO-14A, Rev.2	10312002	NELAP	LA
5635 - Benzyl chloride	EPA TO-14A, Rev.2	10312002	NELAP	LA
4385 - Bromobenzene	EPA TO-14A, Rev.2	10312002	NELAP	LA
4395 - Bromodichloromethane	EPA TO-14A, Rev.2	10312002	NELAP	LA
4400 - Bromoform	EPA TO-14A, Rev.2	10312002	NELAP	LA
4450 - Carbon disulfide	EPA TO-14A, Rev.2	10312002	NELAP	LA
4455 - Carbon tetrachloride	EPA TO-14A, Rev.2	10312002	NELAP	LA
4475 - Chlorobenzene	EPA TO-14A, Rev.2	10312002	NELAP	LA
4485 - Chloroethane (Ethyl chloride)	EPA TO-14A, Rev.2	10312002	NELAP	LA
4505 - Chloroform	EPA TO-14A, Rev.2	10312002	NELAP	LA
4555 - Cyclohexane	EPA TO-14A, Rev.2	10312002	NELAP	LA
4625 - Dichlorodifluoromethane (Freon-12)	EPA TO-14A, Rev.2	10312002	NELAP	LA
4755 - Ethyl acetate	EPA TO-14A, Rev.2	10312002	NELAP	LA
4765 - Ethylbenzene	EPA TO-14A, Rev.2	10312002	NELAP	LA
4835 - Hexachlorobutadiene	EPA TO-14A, Rev.2	10312002	NELAP	LA
4950 - Methyl bromide (Bromomethane)	EPA TO-14A, Rev.2	10312002	NELAP	LA
4960 - Methyl chloride (Chloromethane)	EPA TO-14A, Rev.2	10312002	NELAP	LA
4990 - Methyl methacrylate	EPA TO-14A, Rev.2	10312002	NELAP	LA
5000 - Methyl tert-butyl ether (MTBE)	EPA TO-14A, Rev.2	10312002	NELAP	LA

Air Emissions

Analyte	Method Name	Method Code	Type	AB
4975 - Methylene chloride (Dichloromethane)	EPA TO-14A, Rev.2	10312002	NELAP	LA
5100 - Styrene	EPA TO-14A, Rev.2	10312002	NELAP	LA
5115 - Tetrachloroethylene (Perchloroethylene)	EPA TO-14A, Rev.2	10312002	NELAP	LA
5140 - Toluene	EPA TO-14A, Rev.2	10312002	NELAP	LA
5170 - Trichloroethene (Trichloroethylene)	EPA TO-14A, Rev.2	10312002	NELAP	LA
5175 - Trichlorofluoromethane (Fluorotrichloromethane, Freon 11)	EPA TO-14A, Rev.2	10312002	NELAP	LA
5225 - Vinyl acetate	EPA TO-14A, Rev.2	10312002	NELAP	LA
5235 - Vinyl chloride	EPA TO-14A, Rev.2	10312002	NELAP	LA
5260 - Xylene (total)	EPA TO-14A, Rev.2	10312002	NELAP	LA
4645 - cis-1,2-Dichloroethylene	EPA TO-14A, Rev.2	10312002	NELAP	LA
4680 - cis-1,3-Dichloropropene	EPA TO-14A, Rev.2	10312002	NELAP	LA
5240 - m+p-xylene	EPA TO-14A, Rev.2	10312002	NELAP	LA
5027 - n-Octane	EPA TO-14A, Rev.2	10312002	NELAP	LA
5028 - n-Pentane	EPA TO-14A, Rev.2	10312002	NELAP	LA
5090 - n-Propylbenzene	EPA TO-14A, Rev.2	10312002	NELAP	LA
5250 - o-Xylene	EPA TO-14A, Rev.2	10312002	NELAP	LA
4700 - trans-1,2-Dichloroethylene	EPA TO-14A, Rev.2	10312002	NELAP	LA
4685 - trans-1,3-Dichloropropylene	EPA TO-14A, Rev.2	10312002	NELAP	LA

Non Potable Water

Analyte	Method Name	Method Code	Type	AB
9369 - Diesel range organics (DRO)	Texas 1006	867	NELAP	PA
6211 - EPH Aliphatic >C10-C12	Texas 1006	867	NELAP	PA
6212 - EPH Aliphatic >C12-C16	Texas 1006	867	NELAP	PA
6214 - EPH Aliphatic >C16-C21	Texas 1006	867	NELAP	PA
6216 - EPH Aliphatic >C21-C34	Texas 1006	867	NELAP	PA
6224 - EPH Aromatic >C10-C12	Texas 1006	867	NELAP	PA
6226 - EPH Aromatic >C12-C16	Texas 1006	867	NELAP	PA
6228 - EPH Aromatic >C16-C21	Texas 1006	867	NELAP	PA
6231 - EPH Aromatic >C21-C34	Texas 1006	867	NELAP	PA
6236 - EPH Aromatic C8-C10	Texas 1006	867	NELAP	PA
100163 - 1,5-pentanediol	EPA 625 (extended)	2326	NELAP	PA
100164 - 1,6-hexanediol	EPA 625 (extended)	2326	NELAP	PA
5145 - 2-Methylaniline (o-Toluidine)	EPA 625 (extended)	2326	NELAP	PA
6205 - Diphenylamine	EPA 625 (extended)	2326	NELAP	PA
6298 - Hexanoic acid	EPA 625 (extended)	2326	NELAP	PA
6335 - Maleic anhydride	EPA 625 (extended)	2326	NELAP	PA
5035 - Pentachloroethane	EPA 625 (extended)	2326	NELAP	PA
9547 - Pentanoic Acid	EPA 625 (extended)	2326	NELAP	PA
100199 - Sulfolane	EPA 625 (extended)	2326	NELAP	PA
100253 - Toluene diamines (total)	EPA 625 (extended)	2326	NELAP	PA
8262 - Tributyl phosphate	EPA 625 (extended)	2326	NELAP	PA
100252 - p-Toluidine	EPA 625 (extended)	2326	NELAP	PA
4720 - Diethylene glycol	EPA 8015C (extended)	2331	NELAP	PA
6657 - Propylene Glycol	EPA 8015C (extended)	2331	NELAP	PA
9646 - Triethylene Glycol	EPA 8015C (extended)	2331	NELAP	PA
4670 - 1,1-Dichloropropene	EPA 624 (extended)	2337	NELAP	PA
5150 - 1,2,3-Trichlorobenzene	EPA 624 (extended)	2337	NELAP	PA
4660 - 1,3-Dichloropropane	EPA 624 (extended)	2337	NELAP	PA
4675 - 1,3-Dichloropropene	EPA 624 (extended)	2337	NELAP	PA
4665 - 2,2-Dichloropropane	EPA 624 (extended)	2337	NELAP	PA

Non Potable Water

Analyte	Method Name	Method Code	Type	AB
4535 - 2-Chlorotoluene	EPA 624 (extended)	2337	NELAP	PA
4540 - 4-Chlorotoluene	EPA 624 (extended)	2337	NELAP	PA
4910 - 4-Isopropyltoluene (p-Cymene)	EPA 624 (extended)	2337	NELAP	PA
4385 - Bromobenzene	EPA 624 (extended)	2337	NELAP	PA
4870 - Iodomethane (Methyl iodide)	EPA 624 (extended)	2337	NELAP	PA
4900 - Isopropylbenzene	EPA 624 (extended)	2337	NELAP	PA
4435 - n-Butylbenzene	EPA 624 (extended)	2337	NELAP	PA
5090 - n-Propylbenzene	EPA 624 (extended)	2337	NELAP	PA
4440 - sec-Butylbenzene	EPA 624 (extended)	2337	NELAP	PA
4445 - tert-Butylbenzene	EPA 624 (extended)	2337	NELAP	PA
1605 - Color	EPA 110.2	10005400	NELAP	PA
1755 - Total hardness as CaCO3	EPA 120.1	10006209	NELAP	PA
1610 - Conductivity	EPA 120.1	10006403	NELAP	PA
1750 - Hardness	EPA 130.2	10007202	NELAP	PA
1755 - Total hardness as CaCO3	EPA 130.2	10007202	NELAP	PA
1900 - pH	EPA 150.1	10008205	NELAP	PA
1955 - Residue-filterable (TDS)	EPA 160.1	10009004	NELAP	PA
1955 - Residue-filterable (TDS)	EPA 160.1	10009208	NELAP	PA
1960 - Residue-nonfilterable (TSS)	EPA 160.2	10009402	NELAP	PA
1950 - Residue-total	EPA 160.3	10009800	NELAP	PA
1970 - Residue-volatile	EPA 160.4	10010205	NELAP	PA
1970 - Residue-volatile	EPA 160.4	10010409	NELAP	PA
2030 - Temperature, deg. C	EPA 170.1	10011004	NELAP	PA
2055 - Turbidity	EPA 180.1	10011402	NELAP	PA
2055 - Turbidity	EPA 180.1, Rev.2	10011800	NELAP	PA
1015 - Barium	EPA 200.7	10013408	NELAP	PA
1080 - Lithium	EPA 200.7	10013408	NELAP	PA
1000 - Aluminum	EPA 200.7, Rev.4.4	10013806	NELAP	PA
1005 - Antimony	EPA 200.7, Rev.4.4	10013806	NELAP	PA
1010 - Arsenic	EPA 200.7, Rev.4.4	10013806	NELAP	PA
1015 - Barium	EPA 200.7, Rev.4.4	10013806	NELAP	PA
1020 - Beryllium	EPA 200.7, Rev.4.4	10013806	NELAP	PA
1025 - Boron	EPA 200.7, Rev.4.4	10013806	NELAP	PA
1030 - Cadmium	EPA 200.7, Rev.4.4	10013806	NELAP	PA
1035 - Calcium	EPA 200.7, Rev.4.4	10013806	NELAP	PA
1040 - Chromium	EPA 200.7, Rev.4.4	10013806	NELAP	PA
1050 - Cobalt	EPA 200.7, Rev.4.4	10013806	NELAP	PA
1055 - Copper	EPA 200.7, Rev.4.4	10013806	NELAP	PA
1070 - Iron	EPA 200.7, Rev.4.4	10013806	NELAP	PA
1075 - Lead	EPA 200.7, Rev.4.4	10013806	NELAP	PA
1085 - Magnesium	EPA 200.7, Rev.4.4	10013806	NELAP	PA
1090 - Manganese	EPA 200.7, Rev.4.4	10013806	NELAP	PA
1100 - Molybdenum	EPA 200.7, Rev.4.4	10013806	NELAP	PA
1105 - Nickel	EPA 200.7, Rev.4.4	10013806	NELAP	PA
1125 - Potassium	EPA 200.7, Rev.4.4	10013806	NELAP	PA
1140 - Selenium	EPA 200.7, Rev.4.4	10013806	NELAP	PA
1150 - Silver	EPA 200.7, Rev.4.4	10013806	NELAP	PA
1155 - Sodium	EPA 200.7, Rev.4.4	10013806	NELAP	PA
1160 - Strontium	EPA 200.7, Rev.4.4	10013806	NELAP	PA
1165 - Thallium	EPA 200.7, Rev.4.4	10013806	NELAP	PA
1175 - Tin	EPA 200.7, Rev.4.4	10013806	NELAP	PA
1180 - Titanium	EPA 200.7, Rev.4.4	10013806	NELAP	PA
1185 - Vanadium	EPA 200.7, Rev.4.4	10013806	NELAP	PA
1190 - Zinc	EPA 200.7, Rev.4.4	10013806	NELAP	PA
1000 - Aluminum	EPA 200.7	10014207	NELAP	PA
1005 - Antimony	EPA 200.7	10014207	NELAP	PA

Non Potable Water

Analyte	Method Name	Method Code	Type	AB
1010 - Arsenic	EPA 200.7	10014207	NELAP	PA
1015 - Barium	EPA 200.7	10014207	NELAP	PA
1020 - Beryllium	EPA 200.7	10014207	NELAP	PA
1025 - Boron	EPA 200.7	10014207	NELAP	PA
1030 - Cadmium	EPA 200.7	10014207	NELAP	PA
1035 - Calcium	EPA 200.7	10014207	NELAP	PA
1040 - Chromium	EPA 200.7	10014207	NELAP	PA
1050 - Cobalt	EPA 200.7	10014207	NELAP	PA
1055 - Copper	EPA 200.7	10014207	NELAP	PA
1070 - Iron	EPA 200.7	10014207	NELAP	PA
1075 - Lead	EPA 200.7	10014207	NELAP	PA
1085 - Magnesium	EPA 200.7	10014207	NELAP	PA
1090 - Manganese	EPA 200.7	10014207	NELAP	PA
1100 - Molybdenum	EPA 200.7	10014207	NELAP	PA
1105 - Nickel	EPA 200.7	10014207	NELAP	PA
1125 - Potassium	EPA 200.7	10014207	NELAP	PA
1140 - Selenium	EPA 200.7	10014207	NELAP	PA
1150 - Silver	EPA 200.7	10014207	NELAP	PA
1155 - Sodium	EPA 200.7	10014207	NELAP	PA
1165 - Thallium	EPA 200.7	10014207	NELAP	PA
1175 - Tin	EPA 200.7	10014207	NELAP	PA
1185 - Vanadium	EPA 200.7	10014207	NELAP	PA
1190 - Zinc	EPA 200.7	10014207	NELAP	PA
1000 - Aluminum	EPA 200.8, Rev.5.4	10014605	NELAP	PA
1005 - Antimony	EPA 200.8, Rev.5.4	10014605	NELAP	PA
1010 - Arsenic	EPA 200.8, Rev.5.4	10014605	NELAP	PA
1015 - Barium	EPA 200.8, Rev.5.4	10014605	NELAP	PA
1020 - Beryllium	EPA 200.8, Rev.5.4	10014605	NELAP	PA
1025 - Boron	EPA 200.8, Rev.5.4	10014605	NELAP	PA
1030 - Cadmium	EPA 200.8, Rev.5.4	10014605	NELAP	PA
1035 - Calcium	EPA 200.8, Rev.5.4	10014605	NELAP	PA
1040 - Chromium	EPA 200.8, Rev.5.4	10014605	NELAP	PA
1050 - Cobalt	EPA 200.8, Rev.5.4	10014605	NELAP	PA
1055 - Copper	EPA 200.8, Rev.5.4	10014605	NELAP	PA
1070 - Iron	EPA 200.8, Rev.5.4	10014605	NELAP	PA
1075 - Lead	EPA 200.8, Rev.5.4	10014605	NELAP	PA
1085 - Magnesium	EPA 200.8, Rev.5.4	10014605	NELAP	PA
1090 - Manganese	EPA 200.8, Rev.5.4	10014605	NELAP	PA
1100 - Molybdenum	EPA 200.8, Rev.5.4	10014605	NELAP	PA
1105 - Nickel	EPA 200.8, Rev.5.4	10014605	NELAP	PA
1125 - Potassium	EPA 200.8, Rev.5.4	10014605	NELAP	PA
1140 - Selenium	EPA 200.8, Rev.5.4	10014605	NELAP	PA
1150 - Silver	EPA 200.8, Rev.5.4	10014605	NELAP	PA
1155 - Sodium	EPA 200.8, Rev.5.4	10014605	NELAP	PA
1160 - Strontium	EPA 200.8, Rev.5.4	10014605	NELAP	PA
1165 - Thallium	EPA 200.8, Rev.5.4	10014605	NELAP	PA
1175 - Tin	EPA 200.8, Rev.5.4	10014605	NELAP	PA
1180 - Titanium	EPA 200.8, Rev.5.4	10014605	NELAP	PA
1185 - Vanadium	EPA 200.8, Rev.5.4	10014605	NELAP	PA
1190 - Zinc	EPA 200.8, Rev.5.4	10014605	NELAP	PA
1045 - Chromium VI	EPA 218.6	10027802	NELAP	PA
1045 - Chromium VI	EPA 218.6, Rev.3.3	10028009	NELAP	PA
1095 - Mercury	EPA 245.1, Rev.3	10036609	NELAP	PA
1540 - Bromide	EPA 300.0	10053006	NELAP	PA
1730 - Fluoride	EPA 300.0	10053006	NELAP	PA
1810 - Nitrate as N	EPA 300.0	10053006	NELAP	PA

Non Potable Water

Analyte	Method Name	Method Code	Type	AB
1540 - Bromide	EPA 300.0, Rev.2.1	10053200	NELAP	PA
1575 - Chloride	EPA 300.0, Rev.2.1	10053200	NELAP	PA
1730 - Fluoride	EPA 300.0, Rev.2.1	10053200	NELAP	PA
1810 - Nitrate as N	EPA 300.0, Rev.2.1	10053200	NELAP	PA
1835 - Nitrite	EPA 300.0, Rev.2.1	10053200	NELAP	PA
1840 - Nitrite as N	EPA 300.0, Rev.2.1	10053200	NELAP	PA
2000 - Sulfate	EPA 300.0, Rev.2.1	10053200	NELAP	PA
1505 - Alkalinity as CaCO3	EPA 310.1	10054601	NELAP	PA
1575 - Chloride	EPA 325.3	10057406	NELAP	PA
1645 - Total Cyanide	EPA 335.4	10061402	NELAP	PA
1515 - Ammonia as N	EPA 350.1, Rev.2	10063602	NELAP	PA
1515 - Ammonia as N	EPA 350.2	10063806	NELAP	PA
1515 - Ammonia as N	EPA 350.3	10064207	NELAP	PA
1795 - Kjeldahl nitrogen - total	EPA 351.2	10065006	NELAP	PA
1795 - Kjeldahl nitrogen - total	EPA 351.2, Rev.2	10065404	NELAP	PA
1810 - Nitrate as N	EPA 353.2	10067206	NELAP	PA
1840 - Nitrite as N	EPA 353.2	10067206	NELAP	PA
1825 - Total Nitrate+Nitrite	EPA 353.2	10067206	NELAP	PA
1810 - Nitrate as N	EPA 353.2, Rev.2	10067604	NELAP	PA
1820 - Nitrate-Nitrite	EPA 353.2, Rev.2	10067604	NELAP	PA
1840 - Nitrite as N	EPA 353.2, Rev.2	10067604	NELAP	PA
1880 - Oxygen, dissolved	EPA 360.1	10069008	NELAP	PA
1910 - Total Phosphorus	EPA 365.1, Rev.2	10070005	NELAP	PA
1870 - Orthophosphate as P	EPA 365.3	10070607	NELAP	PA
1870 - Orthophosphate as P	EPA 365.3	10070801	NELAP	PA
2000 - Sulfate	EPA 375.4	10073606	NELAP	PA
2005 - Sulfide	EPA 376.2	10074405	NELAP	PA
1555 - Carbonaceous BOD, CBOD	EPA 405.1	10075408	NELAP	PA
1565 - Chemical oxygen demand	EPA 410.1	10075806	NELAP	PA
1565 - Chemical oxygen demand	EPA 410.4	10077006	NELAP	PA
1565 - Chemical oxygen demand	EPA 410.4, Rev.2	10077404	NELAP	PA
2040 - Total Organic Carbon	EPA 415.1	10078203	NELAP	PA
2040 - Total Organic Carbon	EPA 415.1	10078407	NELAP	PA
1905 - Total Phenolics	EPA 420.4, Rev.1	10080203	NELAP	PA
2025 - Surfactants - MBAS	EPA 425.1	10080601	NELAP	PA
4375 - Benzene	EPA 602	10102202	NELAP	PA
4765 - Ethylbenzene	EPA 602	10102202	NELAP	PA
5000 - Methyl tert-butyl ether (MTBE)	EPA 602	10102202	NELAP	PA
5005 - Naphthalene	EPA 602	10102202	NELAP	PA
5100 - Styrene	EPA 602	10102202	NELAP	PA
5140 - Toluene	EPA 602	10102202	NELAP	PA
5260 - Xylene (total)	EPA 602	10102202	NELAP	PA
5250 - o-Xylene	EPA 602	10102202	NELAP	PA
5255 - p-Xylene	EPA 602	10102202	NELAP	PA
7355 - 4,4'-DDD	EPA 608	10103603	NELAP	PA
7360 - 4,4'-DDE	EPA 608	10103603	NELAP	PA
7365 - 4,4'-DDT	EPA 608	10103603	NELAP	PA
7025 - Aldrin	EPA 608	10103603	NELAP	PA
8880 - Aroclor-1016 (PCB-1016)	EPA 608	10103603	NELAP	PA
8885 - Aroclor-1221 (PCB-1221)	EPA 608	10103603	NELAP	PA
8890 - Aroclor-1232 (PCB-1232)	EPA 608	10103603	NELAP	PA
8895 - Aroclor-1242 (PCB-1242)	EPA 608	10103603	NELAP	PA
8900 - Aroclor-1248 (PCB-1248)	EPA 608	10103603	NELAP	PA
8905 - Aroclor-1254 (PCB-1254)	EPA 608	10103603	NELAP	PA
8910 - Aroclor-1260 (PCB-1260)	EPA 608	10103603	NELAP	PA
7250 - Chlordane (tech.)	EPA 608	10103603	NELAP	PA

Non Potable Water

Analyte	Method Name	Method Code	Type	AB
7470 - Dieldrin	EPA 608	10103603	NELAP	PA
7510 - Endosulfan I	EPA 608	10103603	NELAP	PA
7515 - Endosulfan II	EPA 608	10103603	NELAP	PA
7520 - Endosulfan sulfate	EPA 608	10103603	NELAP	PA
7540 - Endrin	EPA 608	10103603	NELAP	PA
7530 - Endrin aldehyde	EPA 608	10103603	NELAP	PA
7685 - Heptachlor	EPA 608	10103603	NELAP	PA
7690 - Heptachlor epoxide	EPA 608	10103603	NELAP	PA
8250 - Toxaphene (Chlorinated camphene)	EPA 608	10103603	NELAP	PA
7110 - alpha-BHC (alpha-Hexachlorocyclohexane)	EPA 608	10103603	NELAP	PA
7115 - beta-BHC (beta-Hexachlorocyclohexane)	EPA 608	10103603	NELAP	PA
7120 - gamma-BHC (Lindane, gamma-HexachlorocyclohexanE)	EPA 608	10103603	NELAP	PA
7075 - Azinphos-methyl (Guthion)	EPA 622	10106806	NELAP	PA
7125 - Bolstar (Sulprofos)	EPA 622	10106806	NELAP	PA
7220 - Carbophenothion	EPA 622	10106806	NELAP	PA
7300 - Chlorpyrifos	EPA 622	10106806	NELAP	PA
7315 - Coumaphos	EPA 622	10106806	NELAP	PA
7395 - Demeton-o	EPA 622	10106806	NELAP	PA
7385 - Demeton-s	EPA 622	10106806	NELAP	PA
7410 - Diazinon	EPA 622	10106806	NELAP	PA
8610 - Dichlorovos (DDVP, Dichlorvos)	EPA 622	10106806	NELAP	PA
7495 - Dioxathion	EPA 622	10106806	NELAP	PA
8625 - Disulfoton	EPA 622	10106806	NELAP	PA
7550 - EPN	EPA 622	10106806	NELAP	PA
7565 - Ethion	EPA 622	10106806	NELAP	PA
7570 - Ethoprop	EPA 622	10106806	NELAP	PA
7580 - Famphur	EPA 622	10106806	NELAP	PA
7600 - Fensulfothion	EPA 622	10106806	NELAP	PA
7605 - Fenthion	EPA 622	10106806	NELAP	PA
7640 - Fonophos (Fonofos)	EPA 622	10106806	NELAP	PA
7770 - Malathion	EPA 622	10106806	NELAP	PA
7785 - Merphos	EPA 622	10106806	NELAP	PA
7795 - Methamidophos	EPA 622	10106806	NELAP	PA
7825 - Methyl parathion (Parathion, methyl)	EPA 622	10106806	NELAP	PA
7850 - Mevinphos	EPA 622	10106806	NELAP	PA
7880 - Monocrotophos	EPA 622	10106806	NELAP	PA
7905 - Naled	EPA 622	10106806	NELAP	PA
7955 - Parathion, ethyl	EPA 622	10106806	NELAP	PA
7985 - Phorate	EPA 622	10106806	NELAP	PA
8000 - Phosmet (Imidan)	EPA 622	10106806	NELAP	PA
8110 - Ronnel	EPA 622	10106806	NELAP	PA
8140 - Stirophos	EPA 622	10106806	NELAP	PA
8185 - Terbufos	EPA 622	10106806	NELAP	PA
8245 - Tokuthion (Prothiophos)	EPA 622	10106806	NELAP	PA
8275 - Trichloronate	EPA 622	10106806	NELAP	PA
5160 - 1,1,1-Trichloroethane	EPA 624	10107207	NELAP	PA
5110 - 1,1,2,2-Tetrachloroethane	EPA 624	10107207	NELAP	PA
5165 - 1,1,2-Trichloroethane	EPA 624	10107207	NELAP	PA
4630 - 1,1-Dichloroethane	EPA 624	10107207	NELAP	PA
4640 - 1,1-Dichloroethylene	EPA 624	10107207	NELAP	PA
4670 - 1,1-Dichloropropene	EPA 624	10107207	NELAP	PA
5150 - 1,2,3-Trichlorobenzene	EPA 624	10107207	NELAP	PA
4610 - 1,2-Dichlorobenzene	EPA 624	10107207	NELAP	PA

Non Potable Water

Analyte	Method Name	Method Code	Type	AB
4635 - 1,2-Dichloroethane (Ethylene dichloride)	EPA 624	10107207	NELAP	PA
4655 - 1,2-Dichloropropane	EPA 624	10107207	NELAP	PA
4615 - 1,3-Dichlorobenzene	EPA 624	10107207	NELAP	PA
4660 - 1,3-Dichloropropane	EPA 624	10107207	NELAP	PA
4620 - 1,4-Dichlorobenzene	EPA 624	10107207	NELAP	PA
4480 - 1-Chlorobutane	EPA 624	10107207	NELAP	PA
4665 - 2,2-Dichloropropane	EPA 624	10107207	NELAP	PA
4500 - 2-Chloroethyl vinyl ether	EPA 624	10107207	NELAP	PA
4535 - 2-Chlorotoluene	EPA 624	10107207	NELAP	PA
6412 - 3+4 Methylphenol	EPA 624	10107207	NELAP	PA
100256 - 3,4-dichloro-1-butene	EPA 624	10107207	NELAP	PA
4540 - 4-Chlorotoluene	EPA 624	10107207	NELAP	PA
4910 - 4-Isopropyltoluene (p-Cymene)	EPA 624	10107207	NELAP	PA
4325 - Acrolein (Propenal)	EPA 624	10107207	NELAP	PA
4340 - Acrylonitrile	EPA 624	10107207	NELAP	PA
4355 - Allyl chloride (3-Chloropropene)	EPA 624	10107207	NELAP	PA
4375 - Benzene	EPA 624	10107207	NELAP	PA
4385 - Bromobenzene	EPA 624	10107207	NELAP	PA
4390 - Bromochloromethane	EPA 624	10107207	NELAP	PA
4395 - Bromodichloromethane	EPA 624	10107207	NELAP	PA
4397 - Bromoethane (Ethyl Bromide)	EPA 624	10107207	NELAP	PA
4398 - Bromoethene	EPA 624	10107207	NELAP	PA
4400 - Bromoform	EPA 624	10107207	NELAP	PA
4455 - Carbon tetrachloride	EPA 624	10107207	NELAP	PA
4475 - Chlorobenzene	EPA 624	10107207	NELAP	PA
4485 - Chloroethane (Ethyl chloride)	EPA 624	10107207	NELAP	PA
4505 - Chloroform	EPA 624	10107207	NELAP	PA
9375 - Di-isopropylether (DIPE) (Isopropyl ether)	EPA 624	10107207	NELAP	PA
4595 - Dibromomethane (Methylene bromide)	EPA 624	10107207	NELAP	PA
4725 - Diethyl ether	EPA 624	10107207	NELAP	PA
4737 - Divinylbenzene (vinylstyrene)	EPA 624	10107207	NELAP	PA
4755 - Ethyl acetate	EPA 624	10107207	NELAP	PA
4810 - Ethyl methacrylate	EPA 624	10107207	NELAP	PA
4765 - Ethylbenzene	EPA 624	10107207	NELAP	PA
4840 - Hexachloroethane	EPA 624	10107207	NELAP	PA
4870 - Iodomethane (Methyl iodide)	EPA 624	10107207	NELAP	PA
4900 - Isopropylbenzene	EPA 624	10107207	NELAP	PA
4925 - Methacrylonitrile	EPA 624	10107207	NELAP	PA
4950 - Methyl bromide (Bromomethane)	EPA 624	10107207	NELAP	PA
4960 - Methyl chloride (Chloromethane)	EPA 624	10107207	NELAP	PA
4975 - Methylene chloride (Dichloromethane)	EPA 624	10107207	NELAP	PA
5035 - Pentachloroethane	EPA 624	10107207	NELAP	PA
5080 - Propionitrile (Ethyl cyanide)	EPA 624	10107207	NELAP	PA
5115 - Tetrachloroethylene (Perchloroethylene)	EPA 624	10107207	NELAP	PA
5140 - Toluene	EPA 624	10107207	NELAP	PA
5170 - Trichloroethene (Trichloroethylene)	EPA 624	10107207	NELAP	PA
5175 - Trichlorofluoromethane (Fluorotrichloromethane, Freon 11)	EPA 624	10107207	NELAP	PA
5235 - Vinyl chloride	EPA 624	10107207	NELAP	PA
5260 - Xylene (total)	EPA 624	10107207	NELAP	PA
4705 - cis & trans-1,2-Dichloroethene	EPA 624	10107207	NELAP	PA

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Analyte	Method Name	Method Code	Type	AB
100290 - cis & trans-1,3-Dichloropropylene	EPA 624	10107207	NELAP	PA
4680 - cis-1,3-Dichloropropene	EPA 624	10107207	NELAP	PA
4435 - n-Butylbenzene	EPA 624	10107207	NELAP	PA
4855 - n-Hexane	EPA 624	10107207	NELAP	PA
5090 - n-Propylbenzene	EPA 624	10107207	NELAP	PA
4440 - sec-Butylbenzene	EPA 624	10107207	NELAP	PA
4445 - tert-Butylbenzene	EPA 624	10107207	NELAP	PA
100544 - total 1,3-dichloropropene	EPA 624	10107207	NELAP	PA
4700 - trans-1,2-Dichloroethylene	EPA 624	10107207	NELAP	PA
4685 - trans-1,3-Dichloropropylene	EPA 624	10107207	NELAP	PA
6715 - 1,2,4,5-Tetrachlorobenzene	EPA 625	10107401	NELAP	PA
5155 - 1,2,4-Trichlorobenzene	EPA 625	10107401	NELAP	PA
4610 - 1,2-Dichlorobenzene	EPA 625	10107401	NELAP	PA
6220 - 1,2-Diphenylhydrazine	EPA 625	10107401	NELAP	PA
6800 - 1,3,5-Trichlorobenzene	EPA 625	10107401	NELAP	PA
4615 - 1,3-Dichlorobenzene	EPA 625	10107401	NELAP	PA
6160 - 1,3-Dinitrobenzene (1,3-DNB)	EPA 625	10107401	NELAP	PA
4620 - 1,4-Dichlorobenzene	EPA 625	10107401	NELAP	PA
6165 - 1,4-Dinitrobenzene	EPA 625	10107401	NELAP	PA
5790 - 1-Chloronaphthalene	EPA 625	10107401	NELAP	PA
6380 - 1-Methylnaphthalene	EPA 625	10107401	NELAP	PA
9501 - 1-Methylphenanthrene	EPA 625	10107401	NELAP	PA
6735 - 2,3,4,6-Tetrachlorophenol	EPA 625	10107401	NELAP	PA
9363 - 2,3-Dichloroaniline	EPA 625	10107401	NELAP	PA
5983 - 2,3-Dichlorophenol	EPA 625	10107401	NELAP	PA
6835 - 2,4,5-Trichlorophenol	EPA 625	10107401	NELAP	PA
6840 - 2,4,6-Trichlorophenol	EPA 625	10107401	NELAP	PA
6000 - 2,4-Dichlorophenol	EPA 625	10107401	NELAP	PA
6130 - 2,4-Dimethylphenol	EPA 625	10107401	NELAP	PA
6175 - 2,4-Dinitrophenol	EPA 625	10107401	NELAP	PA
6185 - 2,4-Dinitrotoluene (2,4-DNT)	EPA 625	10107401	NELAP	PA
5992 - 2,5-Dichlorophenol	EPA 625	10107401	NELAP	PA
6005 - 2,6-Dichlorophenol	EPA 625	10107401	NELAP	PA
6190 - 2,6-Dinitrotoluene (2,6-DNT)	EPA 625	10107401	NELAP	PA
9322 - 2-Butoxyethanol	EPA 625	10107401	NELAP	PA
5795 - 2-Chloronaphthalene	EPA 625	10107401	NELAP	PA
5800 - 2-Chlorophenol	EPA 625	10107401	NELAP	PA
6360 - 2-Methyl-4,6-dinitrophenol (4,6-Dinitro-2-methylphenol)	EPA 625	10107401	NELAP	PA
6400 - 2-Methylphenol (o-Cresol)	EPA 625	10107401	NELAP	PA
6460 - 2-Nitroaniline	EPA 625	10107401	NELAP	PA
6490 - 2-Nitrophenol	EPA 625	10107401	NELAP	PA
6412 - 3+4 Methylphenol	EPA 625	10107401	NELAP	PA
5945 - 3,3'-Dichlorobenzidine	EPA 625	10107401	NELAP	PA
5997 - 3,4-Dichlorophenol	EPA 625	10107401	NELAP	PA
6397 - 3,5-Dichlorophenol	EPA 625	10107401	NELAP	PA
6405 - 3-Methylphenol (m-Cresol)	EPA 625	10107401	NELAP	PA
6465 - 3-Nitroaniline	EPA 625	10107401	NELAP	PA
6495 - 3-Nitrophenol	EPA 625	10107401	NELAP	PA
7355 - 4,4'-DDD	EPA 625	10107401	NELAP	PA
7360 - 4,4'-DDE	EPA 625	10107401	NELAP	PA
7365 - 4,4'-DDT	EPA 625	10107401	NELAP	PA
5660 - 4-Bromophenyl phenyl ether	EPA 625	10107401	NELAP	PA
5700 - 4-Chloro-3-methylphenol	EPA 625	10107401	NELAP	PA
5745 - 4-Chloroaniline	EPA 625	10107401	NELAP	PA
5825 - 4-Chlorophenyl phenylether	EPA 625	10107401	NELAP	PA

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Analyte	Method Name	Method Code	Type	AB
6410 - 4-Methylphenol (p-Cresol)	EPA 625	10107401	NELAP	PA
6470 - 4-Nitroaniline	EPA 625	10107401	NELAP	PA
6500 - 4-Nitrophenol	EPA 625	10107401	NELAP	PA
5500 - Acenaphthene	EPA 625	10107401	NELAP	PA
5505 - Acenaphthylene	EPA 625	10107401	NELAP	PA
5510 - Acetophenone	EPA 625	10107401	NELAP	PA
7025 - Aldrin	EPA 625	10107401	NELAP	PA
5545 - Aniline	EPA 625	10107401	NELAP	PA
5555 - Anthracene	EPA 625	10107401	NELAP	PA
8880 - Aroclor-1016 (PCB-1016)	EPA 625	10107401	NELAP	PA
8885 - Aroclor-1221 (PCB-1221)	EPA 625	10107401	NELAP	PA
8890 - Aroclor-1232 (PCB-1232)	EPA 625	10107401	NELAP	PA
8895 - Aroclor-1242 (PCB-1242)	EPA 625	10107401	NELAP	PA
8900 - Aroclor-1248 (PCB-1248)	EPA 625	10107401	NELAP	PA
8905 - Aroclor-1254 (PCB-1254)	EPA 625	10107401	NELAP	PA
8910 - Aroclor-1260 (PCB-1260)	EPA 625	10107401	NELAP	PA
7075 - Azinphos-methyl (Guthion)	EPA 625	10107401	NELAP	PA
5562 - Azobenzene	EPA 625	10107401	NELAP	PA
5595 - Benzidine	EPA 625	10107401	NELAP	PA
5575 - Benzo(a)anthracene	EPA 625	10107401	NELAP	PA
5580 - Benzo(a)pyrene	EPA 625	10107401	NELAP	PA
5585 - Benzo(b)fluoranthene	EPA 625	10107401	NELAP	PA
5590 - Benzo(g,h,i)perylene	EPA 625	10107401	NELAP	PA
5600 - Benzo(k)fluoranthene	EPA 625	10107401	NELAP	PA
5610 - Benzoic acid	EPA 625	10107401	NELAP	PA
5630 - Benzyl alcohol	EPA 625	10107401	NELAP	PA
5670 - Butyl benzyl phthalate	EPA 625	10107401	NELAP	PA
5680 - Carbazole	EPA 625	10107401	NELAP	PA
7220 - Carbophenothion	EPA 625	10107401	NELAP	PA
7250 - Chlordane (tech.)	EPA 625	10107401	NELAP	PA
7300 - Chlorpyrifos	EPA 625	10107401	NELAP	PA
5855 - Chrysene	EPA 625	10107401	NELAP	PA
6065 - Di(2-ethylhexyl) phthalate (bis(2-Ethylhexyl)phthalate, DEHP)	EPA 625	10107401	NELAP	LA
5925 - Di-n-butyl phthalate	EPA 625	10107401	NELAP	PA
6200 - Di-n-octyl phthalate	EPA 625	10107401	NELAP	PA
7410 - Diazinon	EPA 625	10107401	NELAP	PA
5895 - Dibenz(a,h) anthracene	EPA 625	10107401	NELAP	PA
5905 - Dibenzofuran	EPA 625	10107401	NELAP	PA
8610 - Dichlorovos (DDVP, Dichlorvos)	EPA 625	10107401	NELAP	PA
7470 - Dieldrin	EPA 625	10107401	NELAP	PA
6070 - Diethyl phthalate	EPA 625	10107401	NELAP	PA
6135 - Dimethyl phthalate	EPA 625	10107401	NELAP	PA
7495 - Dioxathion	EPA 625	10107401	NELAP	PA
6205 - Diphenylamine	EPA 625	10107401	NELAP	PA
8625 - Disulfoton	EPA 625	10107401	NELAP	PA
7550 - EPN	EPA 625	10107401	NELAP	PA
7510 - Endosulfan I	EPA 625	10107401	NELAP	PA
7515 - Endosulfan II	EPA 625	10107401	NELAP	PA
7520 - Endosulfan sulfate	EPA 625	10107401	NELAP	PA
7540 - Endrin	EPA 625	10107401	NELAP	PA
7530 - Endrin aldehyde	EPA 625	10107401	NELAP	PA
7535 - Endrin ketone	EPA 625	10107401	NELAP	PA
7565 - Ethion	EPA 625	10107401	NELAP	PA
7570 - Ethoprop	EPA 625	10107401	NELAP	PA
4769 - Ethylene glycol dimethacrylate	EPA 625	10107401	NELAP	PA

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Analyte	Method Name	Method Code	Type	AB
7580 - Famphur	EPA 625	10107401	NELAP	PA
6265 - Fluoranthene	EPA 625	10107401	NELAP	PA
6270 - Fluorene	EPA 625	10107401	NELAP	PA
7640 - Fonophos (Fonofos)	EPA 625	10107401	NELAP	PA
7685 - Heptachlor	EPA 625	10107401	NELAP	PA
7690 - Heptachlor epoxide	EPA 625	10107401	NELAP	PA
6275 - Hexachlorobenzene	EPA 625	10107401	NELAP	PA
4835 - Hexachlorobutadiene	EPA 625	10107401	NELAP	PA
6285 - Hexachlorocyclopentadiene	EPA 625	10107401	NELAP	PA
4840 - Hexachloroethane	EPA 625	10107401	NELAP	PA
6315 - Indeno(1,2,3-cd) pyrene	EPA 625	10107401	NELAP	PA
6320 - Isophorone	EPA 625	10107401	NELAP	PA
7770 - Malathion	EPA 625	10107401	NELAP	PA
7810 - Methoxychlor	EPA 625	10107401	NELAP	PA
7880 - Monocrotophos	EPA 625	10107401	NELAP	PA
5005 - Naphthalene	EPA 625	10107401	NELAP	PA
5015 - Nitrobenzene	EPA 625	10107401	NELAP	PA
6590 - Pentachlorobenzene	EPA 625	10107401	NELAP	PA
6605 - Pentachlorophenol	EPA 625	10107401	NELAP	PA
6615 - Phenanthrene	EPA 625	10107401	NELAP	PA
6625 - Phenol	EPA 625	10107401	NELAP	PA
7985 - Phorate	EPA 625	10107401	NELAP	PA
8000 - Phosmet (Imidan)	EPA 625	10107401	NELAP	PA
6665 - Pyrene	EPA 625	10107401	NELAP	PA
5095 - Pyridine	EPA 625	10107401	NELAP	PA
8185 - Terbufos	EPA 625	10107401	NELAP	PA
9662 - Total Tetrachlorobenzenes	EPA 625	10107401	NELAP	PA
1940 - Total residual chlorine	EPA 625	10107401	NELAP	PA
8250 - Toxaphene (Chlorinated camphene)	EPA 625	10107401	NELAP	PA
7110 - alpha-BHC (alpha-Hexachlorocyclohexane)	EPA 625	10107401	NELAP	PA
7240 - alpha-Chlordane	EPA 625	10107401	NELAP	PA
7115 - beta-BHC (beta-Hexachlorocyclohexane)	EPA 625	10107401	NELAP	PA
5760 - bis(2-Chloroethoxy)methane	EPA 625	10107401	NELAP	PA
5765 - bis(2-Chloroethyl) ether	EPA 625	10107401	NELAP	PA
5780 - bis(2-Chloroisopropyl) ether	EPA 625	10107401	NELAP	PA
6245 - bis(2-Ethoxyethyl) phthalate	EPA 625	10107401	NELAP	PA
6062 - bis(2-Ethylhexyl)adipate	EPA 625	10107401	NELAP	PA
6350 - bis(2-Methoxyethyl) phthalate	EPA 625	10107401	NELAP	PA
7105 - delta-BHC	EPA 625	10107401	NELAP	PA
7120 - gamma-BHC (Lindane, gamma-Hexachlorocyclohexane)	EPA 625	10107401	NELAP	PA
7245 - gamma-Chlordane	EPA 625	10107401	NELAP	PA
100149 - m+p chlorophenols	EPA 625	10107401	NELAP	PA
5875 - n-Decane	EPA 625	10107401	NELAP	PA
6545 - n-Nitrosodi-n-propylamine	EPA 625	10107401	NELAP	PA
6530 - n-Nitrosodimethylamine	EPA 625	10107401	NELAP	PA
6535 - n-Nitrosodiphenylamine	EPA 625	10107401	NELAP	PA
6565 - n-Nitrosopyrrolidine	EPA 625	10107401	NELAP	PA
6580 - n-Octadecane	EPA 625	10107401	NELAP	PA
9519 - 1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	EPA 1613B	10120602	NELAP	PA
9516 - 1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	EPA 1613B	10120602	NELAP	PA
9426 - 1,2,3,4,6,7,8-Heptachlorodibenzo-p-	EPA 1613B	10120602	NELAP	PA

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Analyte	Method Name	Method Code	Type	AB
dioxin (1,2,3,4,6,7,8-hpcdd)				
9420 - 1,2,3,4,6,7,8-Heptachlorodibenzofuran (1,2,3,4,6,7,8-hpcdf)	EPA 1613B	10120602	NELAP	PA
9423 - 1,2,3,4,7,8,9-Heptachlorodibenzofuran (1,2,3,4,7,8,9-hpcdf)	EPA 1613B	10120602	NELAP	PA
9453 - 1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (1,2,3,4,7,8-Hxcdd)	EPA 1613B	10120602	NELAP	PA
9471 - 1,2,3,4,7,8-Hexachlorodibenzofuran (1,2,3,4,7,8-Hxcdf)	EPA 1613B	10120602	NELAP	PA
9456 - 1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin(1,2,3,6,7,8-Hxcdd)	EPA 1613B	10120602	NELAP	PA
9474 - 1,2,3,6,7,8-Hexachlorodibenzofuran (1,2,3,6,7,8-Hxcdf)	EPA 1613B	10120602	NELAP	PA
9459 - 1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (1,2,3,7,8,9-Hxcdd)	EPA 1613B	10120602	NELAP	PA
9477 - 1,2,3,7,8,9-Hexachlorodibenzofuran (1,2,3,7,8,9-Hxcdf)	EPA 1613B	10120602	NELAP	PA
9540 - 1,2,3,7,8-Pentachlorodibenzo-p-dioxin (1,2,3,7,8-Pecdd)	EPA 1613B	10120602	NELAP	PA
9543 - 1,2,3,7,8-Pentachlorodibenzofuran (1,2,3,7,8-Pecdf)	EPA 1613B	10120602	NELAP	PA
9480 - 2,3,4,6,7,8-Hexachlorodibenzofuran	EPA 1613B	10120602	NELAP	PA
9549 - 2,3,4,7,8-Pentachlorodibenzofuran	EPA 1613B	10120602	NELAP	PA
9612 - 2,3,7,8-Tetrachlorodibenzofuran	EPA 1613B	10120602	NELAP	PA
9438 - Total Hpcdd	EPA 1613B	10120602	NELAP	PA
9444 - Total Hpcdf	EPA 1613B	10120602	NELAP	PA
9468 - Total Hxcdd	EPA 1613B	10120602	NELAP	PA
9483 - Total Hxcdf	EPA 1613B	10120602	NELAP	PA
9555 - Total Pecdd	EPA 1613B	10120602	NELAP	PA
9552 - Total Pecdf	EPA 1613B	10120602	NELAP	PA
9609 - Total TCDD	EPA 1613B	10120602	NELAP	PA
9615 - Total TCDF	EPA 1613B	10120602	NELAP	PA
1860 - Oil & Grease	EPA 1664A	10127409	NELAP	PA
1860 - Oil & Grease	EPA 1664A (HEM)	10127807	NELAP	PA
2050 - Total Petroleum Hydrocarbons (TPH)	EPA 1664A (HEM)	10127807	NELAP	PA
8954 - 2,2',3,3'+2,3',4',6-Tetrachlorobiphenyl (BZ-40+71)	EPA 1668	10129201	NELAP	PA
8919 - 2,2',3,3',4,4'+2,3,4,4',5,6-Hexachlorobiphenyl (BZ-128+166)	EPA 1668	10129201	NELAP	PA
9105 - 2,2',3,3',4,4',5,5',6,6'-Decachlorobiphenyl (BZ-209)	EPA 1668	10129201	NELAP	PA
9095 - 2,2',3,3',4,4',5,5',6-Nonachlorobiphenyl (BZ-206)	EPA 1668	10129201	NELAP	PA
9090 - 2,2',3,3',4,4',5,5'-Octachlorobiphenyl (BZ-194)	EPA 1668	10129201	NELAP	PA
9102 - 2,2',3,3',4,4',5,6'-Octachlorobiphenyl (BZ-196)	EPA 1668	10129201	NELAP	PA
9101 - 2,2',3,3',4,4',5,6,6'-Nonachlorobiphenyl (BZ-207)	EPA 1668	10129201	NELAP	PA
9103 - 2,2',3,3',4,4',5,6-Octachlorobiphenyl (BZ-195)	EPA 1668	10129201	NELAP	PA
9065 - 2,2',3,3',4,4',5-Heptachlorobiphenyl (BZ-170)	EPA 1668	10129201	NELAP	PA

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Analyte	Method Name	Method Code	Type	AB
8916 - 2,2',3,3',4,4',6+2,2',3,3',4,5,6-Heptachlorobiphenyl (BZ-171+173)	EPA 1668	10129201	NELAP	PA
9104 - 2,2',3,3',4,4',6,6'-Octachlorobiphenyl (BZ-197)	EPA 1668	10129201	NELAP	PA
9106 - 2,2',3,3',4,4',6-Heptachlorobiphenyl (BZ-171)	EPA 1668	10129201	NELAP	PA
9020 - 2,2',3,3',4,4'-Hexachlorobiphenyl (BZ-128)	EPA 1668	10129201	NELAP	PA
9114 - 2,2',3,3',4,5',6'-Heptachlorobiphenyl (BZ-177)	EPA 1668	10129201	NELAP	PA
9112 - 2,2',3,3',4,5',6,6'-Octachlorobiphenyl (BZ-201)	EPA 1668	10129201	NELAP	PA
9115 - 2,2',3,3',4,5',6-Heptachlorobiphenyl (BZ-175)	EPA 1668	10129201	NELAP	PA
9117 - 2,2',3,3',4,5'-Hexachlorobiphenyl (BZ-130)	EPA 1668	10129201	NELAP	PA
8922 - 2,2',3,3',4,5+2,2',3,4,4',5'+2,3,3',4',5,6-Hexachlorobiphenyl (BZ-129+138+163)	EPA 1668	10129201	NELAP	PA
9108 - 2,2',3,3',4,5,5',6'-Octachlorobiphenyl (BZ-199)	EPA 1668	10129201	NELAP	PA
8934 - 2,2',3,3',4,5,5',6+2,2',3,3',4,5,5',6'-Octachlorobiphenyl (BZ-198+199)	EPA 1668	10129201	NELAP	PA
9107 - 2,2',3,3',4,5,5',6,6'-Nonachlorobiphenyl (BZ-208)	EPA 1668	10129201	NELAP	PA
9110 - 2,2',3,3',4,5,5'-Heptachlorobiphenyl (BZ-172)	EPA 1668	10129201	NELAP	PA
9116 - 2,2',3,3',4,5,6'-Heptachlorobiphenyl (BZ-174)	EPA 1668	10129201	NELAP	PA
9111 - 2,2',3,3',4,5,6,6'-Octachlorobiphenyl (BZ-200)	EPA 1668	10129201	NELAP	PA
9113 - 2,2',3,3',4,5,6-Heptachlorobiphenyl (BZ-173)	EPA 1668	10129201	NELAP	PA
9118 - 2,2',3,3',4,5-Hexachlorobiphenyl (BZ-129)	EPA 1668	10129201	NELAP	PA
9120 - 2,2',3,3',4,6'-Hexachlorobiphenyl (BZ-132)	EPA 1668	10129201	NELAP	PA
9119 - 2,2',3,3',4,6,6'-Heptachlorobiphenyl (BZ-176)	EPA 1668	10129201	NELAP	PA
9121 - 2,2',3,3',4,6-Hexachlorobiphenyl (BZ-131)	EPA 1668	10129201	NELAP	PA
9122 - 2,2',3,3',4-Pentachlorobiphenyl (BZ-82)	EPA 1668	10129201	NELAP	PA
9123 - 2,2',3,3',5,5',6,6'-Octachlorobiphenyl (BZ-202)	EPA 1668	10129201	NELAP	PA
9124 - 2,2',3,3',5,5',6-Heptachlorobiphenyl (BZ-178)	EPA 1668	10129201	NELAP	PA
9125 - 2,2',3,3',5,5'-Hexachlorobiphenyl (BZ-133)	EPA 1668	10129201	NELAP	PA
8927 - 2,2',3,3',5,6'+2,2',3,5,5',6-Hexachlorobiphenyls (BZ 135+151)	EPA 1668	10129201	NELAP	PA
9127 - 2,2',3,3',5,6'-Hexachlorobiphenyl (BZ-135)	EPA 1668	10129201	NELAP	PA
9126 - 2,2',3,3',5,6,6'-Heptachlorobiphenyl (BZ-179)	EPA 1668	10129201	NELAP	PA
9128 - 2,2',3,3',5,6-Hexachlorobiphenyl	EPA 1668	10129201	NELAP	PA

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Analyte	Method Name	Method Code	Type	AB
(BZ-134)				
9129 - 2,2',3,3',5-Pentachlorobiphenyl (BZ-83)	EPA 1668	10129201	NELAP	PA
9130 - 2,2',3,3',6,6'-Hexachlorobiphenyl (BZ-136)	EPA 1668	10129201	NELAP	PA
9131 - 2,2',3,3',6-Pentachlorobiphenyl (BZ-84)	EPA 1668	10129201	NELAP	PA
9132 - 2,2',3,3'-Tetrachlorobiphenyl (BZ-40)	EPA 1668	10129201	NELAP	PA
9151 - 2,2',3,4',5',6-Hexachlorobiphenyl (BZ-149)	EPA 1668	10129201	NELAP	PA
9154 - 2,2',3,4',5'-Pentachlorobiphenyl (BZ-97)	EPA 1668	10129201	NELAP	PA
8948 - 2,2',3,4',5+2,2',4,5,5'+2,3,3',5',6-Pentachlorobiphenyl (BZ-90+101+113)	EPA 1668	10129201	NELAP	PA
9080 - 2,2',3,4',5,5',6-Heptachlorobiphenyl (BZ-187)	EPA 1668	10129201	NELAP	PA
9144 - 2,2',3,4',5,5'-Hexachlorobiphenyl (BZ-146)	EPA 1668	10129201	NELAP	PA
9147 - 2,2',3,4',5,6'-Hexachlorobiphenyl (BZ-148)	EPA 1668	10129201	NELAP	PA
8929 - 2,2',3,4',5,6+2,2',3,4',5',6-Hexachlorobiphenyl (BZ-147+149)	EPA 1668	10129201	NELAP	PA
9146 - 2,2',3,4',5,6,6'-Heptachlorobiphenyl (BZ-188)	EPA 1668	10129201	NELAP	PA
9149 - 2,2',3,4',5,6-Hexachlorobiphenyl (BZ-147)	EPA 1668	10129201	NELAP	PA
9155 - 2,2',3,4',5-Pentachlorobiphenyl (BZ-90)	EPA 1668	10129201	NELAP	PA
9159 - 2,2',3,4',6'-Pentachlorobiphenyl (BZ-98)	EPA 1668	10129201	NELAP	PA
9157 - 2,2',3,4',6,6'-Hexachlorobiphenyl (BZ-150)	EPA 1668	10129201	NELAP	PA
9160 - 2,2',3,4',6-Pentachlorobiphenyl (BZ-91)	EPA 1668	10129201	NELAP	PA
9162 - 2,2',3,4'-Tetrachlorobiphenyl (BZ-42)	EPA 1668	10129201	NELAP	PA
8942 - 2,2',3,4,4'+2,3,4,5,6-Pentachlorobiphenyl (BZ-85+116)	EPA 1668	10129201	NELAP	PA
9075 - 2,2',3,4,4',5',6-Heptachlorobiphenyl (BZ-183)	EPA 1668	10129201	NELAP	PA
9025 - 2,2',3,4,4',5'-Hexachlorobiphenyl (BZ-138)	EPA 1668	10129201	NELAP	PA
8917 - 2,2',3,4,4',5,5'+2,3,3',4',5,5',6-Heptachlorobiphenyl (BZ-180+193)	EPA 1668	10129201	NELAP	PA
9133 - 2,2',3,4,4',5,5',6-Octachlorobiphenyl (BZ-203)	EPA 1668	10129201	NELAP	PA
9134 - 2,2',3,4,4',5,5'-Heptachlorobiphenyl (BZ-180)	EPA 1668	10129201	NELAP	PA
9136 - 2,2',3,4,4',5,6'-Heptachlorobiphenyl (BZ-182)	EPA 1668	10129201	NELAP	PA
9135 - 2,2',3,4,4',5,6,6'-Octachlorobiphenyl (BZ-204)	EPA 1668	10129201	NELAP	PA
9137 - 2,2',3,4,4',5,6-Heptachlorobiphenyl (BZ-181)	EPA 1668	10129201	NELAP	PA
9138 - 2,2',3,4,4',5-Hexachlorobiphenyl	EPA 1668	10129201	NELAP	PA

Non Potable Water

Analyte	Method Name	Method Code	Type	AB
(BZ-137)				
9140 - 2,2',3,4,4',6'-Hexachlorobiphenyl (BZ-140)	EPA 1668	10129201	NELAP	PA
8928 - 2,2',3,4,4',6+2,2',3,4,4',6'-Hexachlorobiphenyl (BZ-139+140)	EPA 1668	10129201	NELAP	PA
9139 - 2,2',3,4,4',6,6'-Heptachlorobiphenyl (BZ-184)	EPA 1668	10129201	NELAP	PA
9141 - 2,2',3,4,4',6-Hexachlorobiphenyl (BZ-139)	EPA 1668	10129201	NELAP	PA
9142 - 2,2',3,4,4'-Pentachlorobiphenyl (BZ-85)	EPA 1668	10129201	NELAP	PA
9150 - 2,2',3,4,5',6-Hexachlorobiphenyl (BZ-144)	EPA 1668	10129201	NELAP	PA
8975 - 2,2',3,4,5'-Pentachlorobiphenyl (BZ-87)	EPA 1668	10129201	NELAP	PA
8946 - 2,2',3,4,5+2,2',3,4,5'+2,2',3,4',5'+2,3,3',4,5'+2,3',4,4'6+2,3',4',5'6-Pentachlorobiphenyl (BZ 86+87+97+108+119+125)	EPA 1668	10129201	NELAP	PA
9143 - 2,2',3,4,5,5',6-Heptachlorobiphenyl (BZ-185)	EPA 1668	10129201	NELAP	PA
9030 - 2,2',3,4,5,5'-Hexachlorobiphenyl (BZ-141)	EPA 1668	10129201	NELAP	PA
9152 - 2,2',3,4,5,6'-Hexachlorobiphenyl (BZ-143)	EPA 1668	10129201	NELAP	PA
9145 - 2,2',3,4,5,6,6'-Heptachlorobiphenyl (BZ-186)	EPA 1668	10129201	NELAP	PA
9148 - 2,2',3,4,5,6-Hexachlorobiphenyl (BZ-142)	EPA 1668	10129201	NELAP	PA
9153 - 2,2',3,4,5-Pentachlorobiphenyl (BZ-86)	EPA 1668	10129201	NELAP	PA
9161 - 2,2',3,4,6'-Pentachlorobiphenyl (BZ-89)	EPA 1668	10129201	NELAP	PA
9156 - 2,2',3,4,6,6'-Hexachlorobiphenyl (BZ-145)	EPA 1668	10129201	NELAP	PA
9158 - 2,2',3,4,6-Pentachlorobiphenyl (BZ-88)	EPA 1668	10129201	NELAP	PA
9163 - 2,2',3,4-Tetrachlorobiphenyl (BZ-41)	EPA 1668	10129201	NELAP	PA
8957 - 2,2',3,5'+2,2',4,4'+2,3,5,6-Tetrachlorobiphenyl (BZ-44+47+65)	EPA 1668	10129201	NELAP	PA
9166 - 2,2',3,5',6-Pentachlorobiphenyl (BZ-95)	EPA 1668	10129201	NELAP	PA
8945 - 2,2',3,5'-Tetrachlorobiphenyl (BZ-44)	EPA 1668	10129201	NELAP	PA
9035 - 2,2',3,5,5',6-Hexachlorobiphenyl (BZ-151)	EPA 1668	10129201	NELAP	PA
9164 - 2,2',3,5,5'-Pentachlorobiphenyl (BZ-92)	EPA 1668	10129201	NELAP	PA
9167 - 2,2',3,5,6'-Pentachlorobiphenyl (BZ-94)	EPA 1668	10129201	NELAP	PA
8949 - 2,2',3,5,6+2,2',4,4',6-Pentachlorobiphenyl (BZ-93+100)	EPA 1668	10129201	NELAP	PA
9165 - 2,2',3,5,6,6'-Hexachlorobiphenyl (BZ-152)	EPA 1668	10129201	NELAP	PA
9168 - 2,2',3,5,6-Pentachlorobiphenyl (BZ-	EPA 1668	10129201	NELAP	PA

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Analyte	Method Name	Method Code	Type	AB
93)				
9169 - 2,2',3,5-Tetrachlorobiphenyl (BZ-43)	EPA 1668	10129201	NELAP	PA
9171 - 2,2',3,6'-Tetrachlorobiphenyl (BZ-46)	EPA 1668	10129201	NELAP	PA
9170 - 2,2',3,6,6'-Pentachlorobiphenyl (BZ-96)	EPA 1668	10129201	NELAP	PA
9172 - 2,2',3,6-Tetrachlorobiphenyl (BZ-45)	EPA 1668	10129201	NELAP	PA
9173 - 2,2',3-Trichlorobiphenyl (BZ-16)	EPA 1668	10129201	NELAP	PA
8931 - 2,2',4,4',5,5'+2,3',4,4',5',6-Hexachlorobiphenyl (BZ-153+168)	EPA 1668	10129201	NELAP	PA
9040 - 2,2',4,4',5,5'-Hexachlorobiphenyl (BZ-153)	EPA 1668	10129201	NELAP	PA
9174 - 2,2',4,4',5,6'-Hexachlorobiphenyl (BZ-154)	EPA 1668	10129201	NELAP	PA
9175 - 2,2',4,4',5-Pentachlorobiphenyl (BZ-99)	EPA 1668	10129201	NELAP	PA
9176 - 2,2',4,4',6,6'-Hexachlorobiphenyl (BZ-155)	EPA 1668	10129201	NELAP	PA
9177 - 2,2',4,4',6-Pentachlorobiphenyl (BZ-100)	EPA 1668	10129201	NELAP	PA
9178 - 2,2',4,4'-Tetrachlorobiphenyl (BZ-47)	EPA 1668	10129201	NELAP	PA
8959 - 2,2',4,5'+2,3',4,6-Tetrachlorobiphenyl (BZ-49+69)	EPA 1668	10129201	NELAP	PA
9179 - 2,2',4,5',6-Pentachlorobiphenyl (BZ-103)	EPA 1668	10129201	NELAP	PA
8950 - 2,2',4,5'-Tetrachlorobiphenyl (BZ-49)	EPA 1668	10129201	NELAP	PA
8980 - 2,2',4,5,5'-Pentachlorobiphenyl (BZ-101)	EPA 1668	10129201	NELAP	PA
9180 - 2,2',4,5,6'-Pentachlorobiphenyl (BZ-102)	EPA 1668	10129201	NELAP	PA
9181 - 2,2',4,5-Tetrachlorobiphenyl (BZ-48)	EPA 1668	10129201	NELAP	PA
9183 - 2,2',4,6'-Tetrachlorobiphenyl (BZ-51)	EPA 1668	10129201	NELAP	PA
8961 - 2,2',4,6+2,2',5,6'-Tetrachlorobiphenyl (BZ-50+53)	EPA 1668	10129201	NELAP	PA
9182 - 2,2',4,6,6'-Pentachlorobiphenyl (BZ-104)	EPA 1668	10129201	NELAP	PA
9184 - 2,2',4,6-Tetrachlorobiphenyl (BZ-50)	EPA 1668	10129201	NELAP	PA
9185 - 2,2',4-Trichlorobiphenyl (BZ-17)	EPA 1668	10129201	NELAP	PA
8966 - 2,2',5+2,4,6-Trichlorobiphenyl (BZ-18+30)	EPA 1668	10129201	NELAP	PA
8955 - 2,2',5,5'-Tetrachlorobiphenyl (BZ-52)	EPA 1668	10129201	NELAP	PA
9186 - 2,2',5,6'-Tetrachlorobiphenyl (BZ-53)	EPA 1668	10129201	NELAP	PA
8930 - 2,2',5-Trichlorobiphenyl (BZ-18)	EPA 1668	10129201	NELAP	PA
9187 - 2,2',6,6'-Tetrachlorobiphenyl (BZ-54)	EPA 1668	10129201	NELAP	PA
9188 - 2,2',6-Trichlorobiphenyl (BZ-19)	EPA 1668	10129201	NELAP	PA
9189 - 2,2'-Dichlorobiphenyl (BZ-4)	EPA 1668	10129201	NELAP	PA

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Analyte	Method Name	Method Code	Type	AB
9224 - 2,3',4',5',6-Pentachlorobiphenyl (BZ-125)	EPA 1668	10129201	NELAP	PA
9229 - 2,3',4',5'-Tetrachlorobiphenyl (BZ-76)	EPA 1668	10129201	NELAP	PA
9222 - 2,3',4',5,5'-Pentachlorobiphenyl (BZ-124)	EPA 1668	10129201	NELAP	PA
9230 - 2,3',4',5-Tetrachlorobiphenyl (BZ-70)	EPA 1668	10129201	NELAP	PA
9237 - 2,3',4',6-Tetrachlorobiphenyl (BZ-71)	EPA 1668	10129201	NELAP	PA
9239 - 2,3',4'-Trichlorobiphenyl (BZ-33)	EPA 1668	10129201	NELAP	PA
9218 - 2,3',4,4',5',6-Hexachlorobiphenyl (BZ-168)	EPA 1668	10129201	NELAP	PA
9000 - 2,3',4,4',5'-Pentachlorobiphenyl (BZ-123)	EPA 1668	10129201	NELAP	PA
9055 - 2,3',4,4',5,5'-Hexachlorobiphenyl (BZ-167)	EPA 1668	10129201	NELAP	PA
8995 - 2,3',4,4',5-Pentachlorobiphenyl (BZ-118)	EPA 1668	10129201	NELAP	PA
9220 - 2,3',4,4',6-Pentachlorobiphenyl (BZ-119)	EPA 1668	10129201	NELAP	PA
8960 - 2,3',4,4'-Tetrachlorobiphenyl (BZ-66)	EPA 1668	10129201	NELAP	PA
9226 - 2,3',4,5',6-Pentachlorobiphenyl (BZ-121)	EPA 1668	10129201	NELAP	PA
9231 - 2,3',4,5'-Tetrachlorobiphenyl (BZ-68)	EPA 1668	10129201	NELAP	PA
9223 - 2,3',4,5,5'-Pentachlorobiphenyl (BZ-120)	EPA 1668	10129201	NELAP	PA
9232 - 2,3',4,5-Tetrachlorobiphenyl (BZ-67)	EPA 1668	10129201	NELAP	PA
9235 - 2,3',4,6-Tetrachlorobiphenyl (BZ-69)	EPA 1668	10129201	NELAP	PA
9240 - 2,3',4-Trichlorobiphenyl (BZ-25)	EPA 1668	10129201	NELAP	PA
9244 - 2,3',5',6-Tetrachlorobiphenyl (BZ-73)	EPA 1668	10129201	NELAP	PA
9246 - 2,3',5'-Trichlorobiphenyl (BZ-34)	EPA 1668	10129201	NELAP	PA
8969 - 2,3',5+2,4,5-Trichlorobiphenyl (BZ-26+29)	EPA 1668	10129201	NELAP	PA
9242 - 2,3',5,5'-Tetrachlorobiphenyl (BZ-72)	EPA 1668	10129201	NELAP	PA
8935 - 2,3',5-Trichlorobiphenyl (BZ-26)	EPA 1668	10129201	NELAP	PA
9248 - 2,3',6-Trichlorobiphenyl (BZ-27)	EPA 1668	10129201	NELAP	PA
9249 - 2,3'-Dichlorobiphenyl (BZ-6)	EPA 1668	10129201	NELAP	PA
9201 - 2,3,3',4',5',6-Hexachlorobiphenyl (BZ-164)	EPA 1668	10129201	NELAP	PA
9202 - 2,3,3',4',5'-Pentachlorobiphenyl (BZ-122)	EPA 1668	10129201	NELAP	PA
9195 - 2,3,3',4',5,5',6-Heptachlorobiphenyl (BZ-193)	EPA 1668	10129201	NELAP	PA
9197 - 2,3,3',4',5,5'-Hexachlorobiphenyl (BZ-162)	EPA 1668	10129201	NELAP	PA
9199 - 2,3,3',4',5,6-Hexachlorobiphenyl (BZ-163)	EPA 1668	10129201	NELAP	PA
9205 - 2,3,3',4',5-Pentachlorobiphenyl (BZ-107)	EPA 1668	10129201	NELAP	PA

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Analyte	Method Name	Method Code	Type	AB
8990 - 2,3,3',4',6-Pentachlorobiphenyl (BZ-110)	EPA 1668	10129201	NELAP	PA
9207 - 2,3,3',4'-Tetrachlorobiphenyl (BZ-56)	EPA 1668	10129201	NELAP	PA
9192 - 2,3,3',4,4',5',6-Heptachlorobiphenyl (BZ-191)	EPA 1668	10129201	NELAP	PA
9045 - 2,3,3',4,4',5'-Hexachlorobiphenyl (BZ-157)	EPA 1668	10129201	NELAP	PA
8932 - 2,3,3',4,4',5+2,3,3',4,4',5'-Hexachlorobiphenyl (BZ-156+157)	EPA 1668	10129201	NELAP	PA
9190 - 2,3,3',4,4',5,5',6-Octachlorobiphenyl (BZ-205)	EPA 1668	10129201	NELAP	PA
9085 - 2,3,3',4,4',5,5'-Heptachlorobiphenyl (BZ-189)	EPA 1668	10129201	NELAP	PA
9191 - 2,3,3',4,4',5,6-Heptachlorobiphenyl (BZ-190)	EPA 1668	10129201	NELAP	PA
9050 - 2,3,3',4,4',5-Hexachlorobiphenyl (BZ-156)	EPA 1668	10129201	NELAP	PA
9193 - 2,3,3',4,4',6-Hexachlorobiphenyl (BZ-158)	EPA 1668	10129201	NELAP	PA
8985 - 2,3,3',4,4'-Pentachlorobiphenyl (BZ-105)	EPA 1668	10129201	NELAP	PA
9200 - 2,3,3',4,5',6-Hexachlorobiphenyl (BZ-161)	EPA 1668	10129201	NELAP	PA
9203 - 2,3,3',4,5'-Pentachlorobiphenyl (BZ-108)	EPA 1668	10129201	NELAP	PA
9194 - 2,3,3',4,5,5',6-Heptachlorobiphenyl (BZ-192)	EPA 1668	10129201	NELAP	PA
9196 - 2,3,3',4,5,5'-Hexachlorobiphenyl (BZ-159)	EPA 1668	10129201	NELAP	PA
9198 - 2,3,3',4,5,6-Hexachlorobiphenyl (BZ-160)	EPA 1668	10129201	NELAP	PA
9204 - 2,3,3',4,5-Pentachlorobiphenyl (BZ-106)	EPA 1668	10129201	NELAP	PA
9206 - 2,3,3',4,6-Pentachlorobiphenyl (BZ-109)	EPA 1668	10129201	NELAP	PA
9208 - 2,3,3',4-Tetrachlorobiphenyl (BZ-55)	EPA 1668	10129201	NELAP	PA
9212 - 2,3,3',5',6-Pentachlorobiphenyl (BZ-113)	EPA 1668	10129201	NELAP	PA
9213 - 2,3,3',5'-Tetrachlorobiphenyl (BZ-58)	EPA 1668	10129201	NELAP	PA
9209 - 2,3,3',5,5',6-Hexachlorobiphenyl (BZ-165)	EPA 1668	10129201	NELAP	PA
9210 - 2,3,3',5,5'-Pentachlorobiphenyl (BZ-111)	EPA 1668	10129201	NELAP	PA
9211 - 2,3,3',5,6-Pentachlorobiphenyl (BZ-112)	EPA 1668	10129201	NELAP	PA
9214 - 2,3,3',5-Tetrachlorobiphenyl (BZ-57)	EPA 1668	10129201	NELAP	PA
9216 - 2,3,3'-Trichlorobiphenyl (BZ-20)	EPA 1668	10129201	NELAP	PA
9227 - 2,3,4',5,6-Pentachlorobiphenyl (BZ-117)	EPA 1668	10129201	NELAP	PA
9233 - 2,3,4',5-Tetrachlorobiphenyl (BZ-63)	EPA 1668	10129201	NELAP	PA
9236 - 2,3,4',6-Tetrachlorobiphenyl (BZ-	EPA 1668	10129201	NELAP	PA

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Analyte	Method Name	Method Code	Type	AB
64)				
9241 - 2,3,4'-Trichlorobiphenyl (BZ-22)	EPA 1668	10129201	NELAP	PA
8968 - 2,3,4+2,3',4'-Trichlorobiphenyl (BZ-21+33)	EPA 1668	10129201	NELAP	PA
9217 - 2,3,4,4',5,6-Hexachlorobiphenyl (BZ-166)	EPA 1668	10129201	NELAP	PA
9005 - 2,3,4,4',5-Pentachlorobiphenyl (BZ-114)	EPA 1668	10129201	NELAP	PA
9219 - 2,3,4,4',6-Pentachlorobiphenyl (BZ-115)	EPA 1668	10129201	NELAP	PA
9221 - 2,3,4,4'-Tetrachlorobiphenyl (BZ-60)	EPA 1668	10129201	NELAP	PA
8963 - 2,3,4,5+2,3',4',5+2,4,4',5+2,3',4',5'-Tetrachlorobiphenyls (BZ 61+70+74+76)	EPA 1668	10129201	NELAP	PA
9225 - 2,3,4,5,6-Pentachlorobiphenyl (BZ-116)	EPA 1668	10129201	NELAP	PA
9228 - 2,3,4,5-Tetrachlorobiphenyl (BZ-61)	EPA 1668	10129201	NELAP	PA
9234 - 2,3,4,6-Tetrachlorobiphenyl (BZ-62)	EPA 1668	10129201	NELAP	PA
9238 - 2,3,4-Trichlorobiphenyl (BZ-21)	EPA 1668	10129201	NELAP	PA
9243 - 2,3,5,6-Tetrachlorobiphenyl (BZ-65)	EPA 1668	10129201	NELAP	PA
9245 - 2,3,5-Trichlorobiphenyl (BZ-23)	EPA 1668	10129201	NELAP	PA
6742 - 2,3,5-Trichlorophenol	EPA 1668	10129201	NELAP	PA
9247 - 2,3,6-Trichlorobiphenyl (BZ-24)	EPA 1668	10129201	NELAP	PA
8920 - 2,3-Dichlorobiphenyl (BZ-5)	EPA 1668	10129201	NELAP	PA
8940 - 2,4',5-Trichlorobiphenyl (BZ-31)	EPA 1668	10129201	NELAP	PA
9255 - 2,4',6-Trichlorobiphenyl (BZ-32)	EPA 1668	10129201	NELAP	PA
9256 - 2,4'-Dichlorobiphenyl (BZ-8)	EPA 1668	10129201	NELAP	PA
9250 - 2,4,4',5-Tetrachlorobiphenyl (BZ-74)	EPA 1668	10129201	NELAP	PA
9251 - 2,4,4',6-Tetrachlorobiphenyl (BZ-75)	EPA 1668	10129201	NELAP	PA
9252 - 2,4,4'-Trichlorobiphenyl (BZ-28)	EPA 1668	10129201	NELAP	PA
9253 - 2,4,5-Trichlorobiphenyl (BZ-29)	EPA 1668	10129201	NELAP	PA
9254 - 2,4,6-Trichlorobiphenyl (BZ-30)	EPA 1668	10129201	NELAP	PA
9257 - 2,4-Dichlorobiphenyl (BZ-7)	EPA 1668	10129201	NELAP	PA
9258 - 2,5-Dichlorobiphenyl (BZ-9)	EPA 1668	10129201	NELAP	PA
9259 - 2,6-Dichlorobiphenyl (BZ-10)	EPA 1668	10129201	NELAP	PA
8915 - 2-Chlorobiphenyl (BZ-1)	EPA 1668	10129201	NELAP	PA
9060 - 3,3',4,4',5,5'-Hexachlorobiphenyl (BZ-169)	EPA 1668	10129201	NELAP	PA
9015 - 3,3',4,4',5-Pentachlorobiphenyl (BZ-126)	EPA 1668	10129201	NELAP	PA
8965 - 3,3',4,4'-Tetrachlorobiphenyl (BZ-77)	EPA 1668	10129201	NELAP	PA
9261 - 3,3',4,5'-Tetrachlorobiphenyl (BZ-79)	EPA 1668	10129201	NELAP	PA
9260 - 3,3',4,5,5'-Pentachlorobiphenyl (BZ-127)	EPA 1668	10129201	NELAP	PA
9262 - 3,3',4,5-Tetrachlorobiphenyl (BZ-78)	EPA 1668	10129201	NELAP	PA
9263 - 3,3',4-Trichlorobiphenyl (BZ-35)	EPA 1668	10129201	NELAP	PA
9264 - 3,3',5,5'-Tetrachlorobiphenyl (BZ-80)	EPA 1668	10129201	NELAP	PA

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Analyte	Method Name	Method Code	Type	AB
9265 - 3,3',5-Trichlorobiphenyl (BZ-36)	EPA 1668	10129201	NELAP	PA
8925 - 3,3'-Dichlorobiphenyl (BZ-11)	EPA 1668	10129201	NELAP	PA
9268 - 3,4',5-Trichlorobiphenyl (BZ-39)	EPA 1668	10129201	NELAP	PA
9269 - 3,4'-Dichlorobiphenyl (BZ-13)	EPA 1668	10129201	NELAP	PA
100098 - 3,4+3,4'-Dichlorobiphenyl (BZ-12+13)	EPA 1668	10129201	NELAP	PA
8970 - 3,4,4',5-Tetrachlorobiphenyl (BZ-81)	EPA 1668	10129201	NELAP	PA
9266 - 3,4,4'-Trichlorobiphenyl (BZ-37)	EPA 1668	10129201	NELAP	PA
9267 - 3,4,5-Trichlorobiphenyl (BZ-38)	EPA 1668	10129201	NELAP	PA
9270 - 3,4-Dichlorobiphenyl (BZ-12)	EPA 1668	10129201	NELAP	PA
9271 - 3,5-Dichlorobiphenyl (BZ-14)	EPA 1668	10129201	NELAP	PA
9272 - 3-Chlorobiphenyl (BZ-2)	EPA 1668	10129201	NELAP	PA
100368 - 3-Monochlorobiphenyl (BZ 2)	EPA 1668	10129201	NELAP	PA
9273 - 4,4'-Dichlorobiphenyl (BZ-15)	EPA 1668	10129201	NELAP	PA
9274 - 4-Chlorobiphenyl (BZ-3)	EPA 1668	10129201	NELAP	PA
8954 - 2,2',3,3'+2,3',4',6-Tetrachlorobiphenyl (BZ-40+71)	EPA 1668A	10129405	NELAP	PA
8919 - 2,2',3,3',4,4'+2,3,4,4',5,6-Hexachlorobiphenyl (BZ-128+166)	EPA 1668A	10129405	NELAP	PA
9105 - 2,2',3,3',4,4',5,5',6,6'-Decachlorobiphenyl (BZ-209)	EPA 1668A	10129405	NELAP	PA
9095 - 2,2',3,3',4,4',5,5',6-Nonachlorobiphenyl (BZ-206)	EPA 1668A	10129405	NELAP	PA
9090 - 2,2',3,3',4,4',5,5'-Octachlorobiphenyl (BZ-194)	EPA 1668A	10129405	NELAP	PA
9102 - 2,2',3,3',4,4',5,6'-Octachlorobiphenyl (BZ-196)	EPA 1668A	10129405	NELAP	PA
9101 - 2,2',3,3',4,4',5,6,6'-Nonachlorobiphenyl (BZ-207)	EPA 1668A	10129405	NELAP	PA
9103 - 2,2',3,3',4,4',5,6-Octachlorobiphenyl (BZ-195)	EPA 1668A	10129405	NELAP	PA
9065 - 2,2',3,3',4,4',5-Heptachlorobiphenyl (BZ-170)	EPA 1668A	10129405	NELAP	PA
8916 - 2,2',3,3',4,4',6+2,2',3,3',4,5,6-Heptachlorobiphenyl (BZ-171+173)	EPA 1668A	10129405	NELAP	PA
8933 - 2,2',3,3',4,4',6,6'+2,2',3,3',4,5,6,6'-Octachlorobiphenyl (BZ 197+200)	EPA 1668A	10129405	NELAP	PA
9104 - 2,2',3,3',4,4',6,6'-Octachlorobiphenyl (BZ-197)	EPA 1668A	10129405	NELAP	PA
9106 - 2,2',3,3',4,4',6-Heptachlorobiphenyl (BZ-171)	EPA 1668A	10129405	NELAP	PA
9020 - 2,2',3,3',4,4'-Hexachlorobiphenyl (BZ-128)	EPA 1668A	10129405	NELAP	PA
9114 - 2,2',3,3',4,5',6'-Heptachlorobiphenyl (BZ-177)	EPA 1668A	10129405	NELAP	PA
9112 - 2,2',3,3',4,5',6,6'-Octachlorobiphenyl (BZ-201)	EPA 1668A	10129405	NELAP	PA
9115 - 2,2',3,3',4,5',6-Heptachlorobiphenyl (BZ-175)	EPA 1668A	10129405	NELAP	PA
9117 - 2,2',3,3',4,5'-Hexachlorobiphenyl (BZ-130)	EPA 1668A	10129405	NELAP	PA
8922 - 2,2',3,3',4,5+2,2',3,4,4',5'+2,3,3',4',5,6-Hexachlorobiphenyl (BZ-129+138+163)	EPA 1668A	10129405	NELAP	PA
9108 - 2,2',3,3',4,5,5',6'-Octachlorobiphenyl	EPA 1668A	10129405	NELAP	PA

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Analyte	Method Name	Method Code	Type	AB
(BZ-199)				
8934 - 2,2',3,3',4,5,5',6+2,2',3,3',4,5,5',6'-Octachlorobiphenyl (BZ-198+199)	EPA 1668A	10129405	NELAP	PA
9107 - 2,2',3,3',4,5,5',6,6'-Nonachlorobiphenyl (BZ-208)	EPA 1668A	10129405	NELAP	PA
9109 - 2,2',3,3',4,5,5',6-Octachlorobiphenyl (BZ-198)	EPA 1668A	10129405	NELAP	PA
9110 - 2,2',3,3',4,5,5'-Heptachlorobiphenyl (BZ-172)	EPA 1668A	10129405	NELAP	PA
9116 - 2,2',3,3',4,5,6'-Heptachlorobiphenyl (BZ-174)	EPA 1668A	10129405	NELAP	PA
9111 - 2,2',3,3',4,5,6,6'-Octachlorobiphenyl (BZ-200)	EPA 1668A	10129405	NELAP	PA
9113 - 2,2',3,3',4,5,6-Heptachlorobiphenyl (BZ-173)	EPA 1668A	10129405	NELAP	PA
9118 - 2,2',3,3',4,5-Hexachlorobiphenyl (BZ-129)	EPA 1668A	10129405	NELAP	PA
9120 - 2,2',3,3',4,6'-Hexachlorobiphenyl (BZ-132)	EPA 1668A	10129405	NELAP	PA
9119 - 2,2',3,3',4,6,6'-Heptachlorobiphenyl (BZ-176)	EPA 1668A	10129405	NELAP	PA
9121 - 2,2',3,3',4,6-Hexachlorobiphenyl (BZ-131)	EPA 1668A	10129405	NELAP	PA
9122 - 2,2',3,3',4-Pentachlorobiphenyl (BZ-82)	EPA 1668A	10129405	NELAP	PA
9123 - 2,2',3,3',5,5',6,6'-Octachlorobiphenyl (BZ-202)	EPA 1668A	10129405	NELAP	PA
9124 - 2,2',3,3',5,5',6-Heptachlorobiphenyl (BZ-178)	EPA 1668A	10129405	NELAP	PA
9125 - 2,2',3,3',5,5'-Hexachlorobiphenyl (BZ-133)	EPA 1668A	10129405	NELAP	PA
8926 - 2,2',3,3',5,6'+2,2',3,5,5',6+2,2',4,4',5,6'-Hexachlorobiphenyl (BZ-135+151+154)	EPA 1668A	10129405	NELAP	PA
9127 - 2,2',3,3',5,6'-Hexachlorobiphenyl (BZ-135)	EPA 1668A	10129405	NELAP	PA
9126 - 2,2',3,3',5,6,6'-Heptachlorobiphenyl (BZ-179)	EPA 1668A	10129405	NELAP	PA
9128 - 2,2',3,3',5,6-Hexachlorobiphenyl (BZ-134)	EPA 1668A	10129405	NELAP	PA
9129 - 2,2',3,3',5-Pentachlorobiphenyl (BZ-83)	EPA 1668A	10129405	NELAP	PA
9130 - 2,2',3,3',6,6'-Hexachlorobiphenyl (BZ-136)	EPA 1668A	10129405	NELAP	PA
9131 - 2,2',3,3',6-Pentachlorobiphenyl (BZ-84)	EPA 1668A	10129405	NELAP	PA
9132 - 2,2',3,3'-Tetrachlorobiphenyl (BZ-40)	EPA 1668A	10129405	NELAP	PA
9151 - 2,2',3,4',5',6-Hexachlorobiphenyl (BZ-149)	EPA 1668A	10129405	NELAP	PA
9154 - 2,2',3,4',5'-Pentachlorobiphenyl (BZ-97)	EPA 1668A	10129405	NELAP	PA
8948 - 2,2',3,4',5+2,2',4,5,5'+2,3,3',5',6-Pentachlorobiphenyl (BZ-90+101+113)	EPA 1668A	10129405	NELAP	PA
9080 - 2,2',3,4',5,5',6-Heptachlorobiphenyl (BZ-187)	EPA 1668A	10129405	NELAP	PA

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Analyte	Method Name	Method Code	Type	AB
9144 - 2,2',3,4',5,5'-Hexachlorobiphenyl (BZ-146)	EPA 1668A	10129405	NELAP	PA
9147 - 2,2',3,4',5,6'-Hexachlorobiphenyl (BZ-148)	EPA 1668A	10129405	NELAP	PA
8929 - 2,2',3,4',5,6+2,2',3,4',5',6-Hexachlorobiphenyl (BZ-147+149)	EPA 1668A	10129405	NELAP	PA
9146 - 2,2',3,4',5,6,6'-Heptachlorobiphenyl (BZ-188)	EPA 1668A	10129405	NELAP	PA
9149 - 2,2',3,4',5,6-Hexachlorobiphenyl (BZ-147)	EPA 1668A	10129405	NELAP	PA
9155 - 2,2',3,4',5-Pentachlorobiphenyl (BZ-90)	EPA 1668A	10129405	NELAP	PA
8951 - 2,2',3,4',6'+2,2',4,5,6'-Pentachlorobiphenyl (BZ-98+102)	EPA 1668A	10129405	NELAP	PA
9159 - 2,2',3,4',6'-Pentachlorobiphenyl (BZ-98)	EPA 1668A	10129405	NELAP	PA
9157 - 2,2',3,4',6,6'-Hexachlorobiphenyl (BZ-150)	EPA 1668A	10129405	NELAP	PA
9160 - 2,2',3,4',6-Pentachlorobiphenyl (BZ-91)	EPA 1668A	10129405	NELAP	PA
9162 - 2,2',3,4'-Tetrachlorobiphenyl (BZ-42)	EPA 1668A	10129405	NELAP	PA
8941 - 2,2',3,4,4'+2,3,4,5,6+2,3,4',5,6-Pentachlorobiphenyl (BZ-85+116+117)	EPA 1668A	10129405	NELAP	PA
8918 - 2,2',3,4,4',5',6+2,2',3,4,5,5',6-Heptachlorobiphenyl (BZ-183+185)	EPA 1668A	10129405	NELAP	PA
9075 - 2,2',3,4,4',5',6-Heptachlorobiphenyl (BZ-183)	EPA 1668A	10129405	NELAP	PA
9025 - 2,2',3,4,4',5'-Hexachlorobiphenyl (BZ-138)	EPA 1668A	10129405	NELAP	PA
8917 - 2,2',3,4,4',5,5'+2,3,3',4',5,5',6-Heptachlorobiphenyl (BZ-180+193)	EPA 1668A	10129405	NELAP	PA
9133 - 2,2',3,4,4',5,5',6-Octachlorobiphenyl (BZ-203)	EPA 1668A	10129405	NELAP	PA
9134 - 2,2',3,4,4',5,5'-Heptachlorobiphenyl (BZ-180)	EPA 1668A	10129405	NELAP	PA
9136 - 2,2',3,4,4',5,6'-Heptachlorobiphenyl (BZ-182)	EPA 1668A	10129405	NELAP	PA
9135 - 2,2',3,4,4',5,6,6'-Octachlorobiphenyl (BZ-204)	EPA 1668A	10129405	NELAP	PA
9137 - 2,2',3,4,4',5,6-Heptachlorobiphenyl (BZ-181)	EPA 1668A	10129405	NELAP	PA
9138 - 2,2',3,4,4',5-Hexachlorobiphenyl (BZ-137)	EPA 1668A	10129405	NELAP	PA
9140 - 2,2',3,4,4',6'-Hexachlorobiphenyl (BZ-140)	EPA 1668A	10129405	NELAP	PA
8928 - 2,2',3,4,4',6+2,2',3,4,4',6'-Hexachlorobiphenyl (BZ-139+140)	EPA 1668A	10129405	NELAP	PA
9139 - 2,2',3,4,4',6,6'-Heptachlorobiphenyl (BZ-184)	EPA 1668A	10129405	NELAP	PA
9141 - 2,2',3,4,4',6-Hexachlorobiphenyl (BZ-139)	EPA 1668A	10129405	NELAP	PA
9142 - 2,2',3,4,4'-Pentachlorobiphenyl (BZ-85)	EPA 1668A	10129405	NELAP	PA
9150 - 2,2',3,4,5',6-Hexachlorobiphenyl (BZ-144)	EPA 1668A	10129405	NELAP	PA

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Analyte	Method Name	Method Code	Type	AB
8975 - 2,2',3,4,5'-Pentachlorobiphenyl (BZ-87)	EPA 1668A	10129405	NELAP	PA
8944 - 2,2',3,4,5+2,2',3,4,5'+2,2',3,4',5'+2,2',4,4',6-Pentachlorobiphenyl (BZ-86+87+97+100)	EPA 1668A	10129405	NELAP	PA
8946 - 2,2',3,4,5+2,2',3,4,5'+2,2',3,4',5'+2,3,3',4,5'+2,3',4,4'6+2,3',4',5'6-Pentachlorobiphenyl (BZ 86+87+97+108+119+125)	EPA 1668A	10129405	NELAP	PA
9143 - 2,2',3,4,5,5',6-Heptachlorobiphenyl (BZ-185)	EPA 1668A	10129405	NELAP	PA
9030 - 2,2',3,4,5,5'-Hexachlorobiphenyl (BZ-141)	EPA 1668A	10129405	NELAP	PA
9152 - 2,2',3,4,5,6'-Hexachlorobiphenyl (BZ-143)	EPA 1668A	10129405	NELAP	PA
9145 - 2,2',3,4,5,6,6'-Heptachlorobiphenyl (BZ-186)	EPA 1668A	10129405	NELAP	PA
9148 - 2,2',3,4,5,6-Hexachlorobiphenyl (BZ-142)	EPA 1668A	10129405	NELAP	PA
9153 - 2,2',3,4,5-Pentachlorobiphenyl (BZ-86)	EPA 1668A	10129405	NELAP	PA
9161 - 2,2',3,4,6'-Pentachlorobiphenyl (BZ-89)	EPA 1668A	10129405	NELAP	PA
8947 - 2,2',3,4,6+2,2',3,4',6-Pentachlorobiphenyl (BZ-88+91)	EPA 1668A	10129405	NELAP	PA
9156 - 2,2',3,4,6,6'-Hexachlorobiphenyl (BZ-145)	EPA 1668A	10129405	NELAP	PA
9158 - 2,2',3,4,6-Pentachlorobiphenyl (BZ-88)	EPA 1668A	10129405	NELAP	PA
9163 - 2,2',3,4-Tetrachlorobiphenyl (BZ-41)	EPA 1668A	10129405	NELAP	PA
8957 - 2,2',3,5'+2,2',4,4'+2,3,5,6-Tetrachlorobiphenyl (BZ-44+47+65)	EPA 1668A	10129405	NELAP	PA
9166 - 2,2',3,5',6-Pentachlorobiphenyl (BZ-95)	EPA 1668A	10129405	NELAP	PA
8945 - 2,2',3,5'-Tetrachlorobiphenyl (BZ-44)	EPA 1668A	10129405	NELAP	PA
8956 - 2,2',3,5+2,3',5',6-Tetrachlorobiphenyl (BZ-43+73)	EPA 1668A	10129405	NELAP	PA
9035 - 2,2',3,5,5',6-Hexachlorobiphenyl (BZ-151)	EPA 1668A	10129405	NELAP	PA
9164 - 2,2',3,5,5'-Pentachlorobiphenyl (BZ-92)	EPA 1668A	10129405	NELAP	PA
9167 - 2,2',3,5,6'-Pentachlorobiphenyl (BZ-94)	EPA 1668A	10129405	NELAP	PA
8949 - 2,2',3,5,6+2,2',4,4',6-Pentachlorobiphenyl (BZ-93+100)	EPA 1668A	10129405	NELAP	PA
9165 - 2,2',3,5,6,6'-Hexachlorobiphenyl (BZ-152)	EPA 1668A	10129405	NELAP	PA
9168 - 2,2',3,5,6-Pentachlorobiphenyl (BZ-93)	EPA 1668A	10129405	NELAP	PA
9169 - 2,2',3,5-Tetrachlorobiphenyl (BZ-43)	EPA 1668A	10129405	NELAP	PA
9171 - 2,2',3,6'-Tetrachlorobiphenyl (BZ-46)	EPA 1668A	10129405	NELAP	PA
8958 - 2,2',3,6+2,2',4,6'-	EPA 1668A	10129405	NELAP	PA

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Analyte	Method Name	Method Code	Type	AB
Tetrachlorobiphenyls (BZ 45 + 51)				
9170 - 2,2',3,6,6'-Pentachlorobiphenyl (BZ-96)	EPA 1668A	10129405	NELAP	PA
9172 - 2,2',3,6-Tetrachlorobiphenyl (BZ-45)	EPA 1668A	10129405	NELAP	PA
9173 - 2,2',3-Trichlorobiphenyl (BZ-16)	EPA 1668A	10129405	NELAP	PA
8931 - 2,2',4,4',5,5'+2,3',4,4',5',6-Hexachlorobiphenyl (BZ-153+168)	EPA 1668A	10129405	NELAP	PA
9040 - 2,2',4,4',5,5'-Hexachlorobiphenyl (BZ-153)	EPA 1668A	10129405	NELAP	PA
9174 - 2,2',4,4',5,6'-Hexachlorobiphenyl (BZ-154)	EPA 1668A	10129405	NELAP	PA
9175 - 2,2',4,4',5-Pentachlorobiphenyl (BZ-99)	EPA 1668A	10129405	NELAP	PA
9176 - 2,2',4,4',6,6'-Hexachlorobiphenyl (BZ-155)	EPA 1668A	10129405	NELAP	PA
9177 - 2,2',4,4',6-Pentachlorobiphenyl (BZ-100)	EPA 1668A	10129405	NELAP	PA
9178 - 2,2',4,4'-Tetrachlorobiphenyl (BZ-47)	EPA 1668A	10129405	NELAP	PA
8959 - 2,2',4,5'+2,3',4,6-Tetrachlorobiphenyl (BZ-49+69)	EPA 1668A	10129405	NELAP	PA
9179 - 2,2',4,5',6-Pentachlorobiphenyl (BZ-103)	EPA 1668A	10129405	NELAP	PA
8950 - 2,2',4,5'-Tetrachlorobiphenyl (BZ-49)	EPA 1668A	10129405	NELAP	PA
8980 - 2,2',4,5,5'-Pentachlorobiphenyl (BZ-101)	EPA 1668A	10129405	NELAP	PA
9180 - 2,2',4,5,6'-Pentachlorobiphenyl (BZ-102)	EPA 1668A	10129405	NELAP	PA
9181 - 2,2',4,5-Tetrachlorobiphenyl (BZ-48)	EPA 1668A	10129405	NELAP	PA
9183 - 2,2',4,6'-Tetrachlorobiphenyl (BZ-51)	EPA 1668A	10129405	NELAP	PA
8961 - 2,2',4,6+2,2',5,6'-Tetrachlorobiphenyl (BZ-50+53)	EPA 1668A	10129405	NELAP	PA
9182 - 2,2',4,6,6'-Pentachlorobiphenyl (BZ-104)	EPA 1668A	10129405	NELAP	PA
9184 - 2,2',4,6-Tetrachlorobiphenyl (BZ-50)	EPA 1668A	10129405	NELAP	PA
9185 - 2,2',4-Trichlorobiphenyl (BZ-17)	EPA 1668A	10129405	NELAP	PA
8966 - 2,2',5+2,4,6-Trichlorobiphenyl (BZ-18+30)	EPA 1668A	10129405	NELAP	PA
8955 - 2,2',5,5'-Tetrachlorobiphenyl (BZ-52)	EPA 1668A	10129405	NELAP	PA
9186 - 2,2',5,6'-Tetrachlorobiphenyl (BZ-53)	EPA 1668A	10129405	NELAP	PA
8930 - 2,2',5-Trichlorobiphenyl (BZ-18)	EPA 1668A	10129405	NELAP	PA
9187 - 2,2',6,6'-Tetrachlorobiphenyl (BZ-54)	EPA 1668A	10129405	NELAP	PA
9188 - 2,2',6-Trichlorobiphenyl (BZ-19)	EPA 1668A	10129405	NELAP	PA
9189 - 2,2'-Dichlorobiphenyl (BZ-4)	EPA 1668A	10129405	NELAP	PA
9224 - 2,3',4',5',6-Pentachlorobiphenyl (BZ-125)	EPA 1668A	10129405	NELAP	PA
9229 - 2,3',4',5'-Tetrachlorobiphenyl (BZ-76)	EPA 1668A	10129405	NELAP	PA

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Analyte	Method Name	Method Code	Type	AB
8964 - 2,3',4',5+2,4,4',5+2,3',4',5'-Tetrachlorobiphenyl (BZ-70+74+76)	EPA 1668A	10129405	NELAP	PA
9222 - 2,3',4',5,5'-Pentachlorobiphenyl (BZ-124)	EPA 1668A	10129405	NELAP	PA
9230 - 2,3',4',5-Tetrachlorobiphenyl (BZ-70)	EPA 1668A	10129405	NELAP	PA
9237 - 2,3',4',6-Tetrachlorobiphenyl (BZ-71)	EPA 1668A	10129405	NELAP	PA
9239 - 2,3',4'-Trichlorobiphenyl (BZ-33)	EPA 1668A	10129405	NELAP	PA
9218 - 2,3',4,4',5',6-Hexachlorobiphenyl (BZ-168)	EPA 1668A	10129405	NELAP	PA
9000 - 2,3',4,4',5'-Pentachlorobiphenyl (BZ-123)	EPA 1668A	10129405	NELAP	PA
9055 - 2,3',4,4',5,5'-Hexachlorobiphenyl (BZ-167)	EPA 1668A	10129405	NELAP	PA
8995 - 2,3',4,4',5-Pentachlorobiphenyl (BZ-118)	EPA 1668A	10129405	NELAP	PA
9220 - 2,3',4,4',6-Pentachlorobiphenyl (BZ-119)	EPA 1668A	10129405	NELAP	PA
8960 - 2,3',4,4'-Tetrachlorobiphenyl (BZ-66)	EPA 1668A	10129405	NELAP	PA
9226 - 2,3',4,5',6-Pentachlorobiphenyl (BZ-121)	EPA 1668A	10129405	NELAP	PA
9231 - 2,3',4,5'-Tetrachlorobiphenyl (BZ-68)	EPA 1668A	10129405	NELAP	PA
9223 - 2,3',4,5,5'-Pentachlorobiphenyl (BZ-120)	EPA 1668A	10129405	NELAP	PA
9232 - 2,3',4,5-Tetrachlorobiphenyl (BZ-67)	EPA 1668A	10129405	NELAP	PA
9235 - 2,3',4,6-Tetrachlorobiphenyl (BZ-69)	EPA 1668A	10129405	NELAP	PA
9240 - 2,3',4-Trichlorobiphenyl (BZ-25)	EPA 1668A	10129405	NELAP	PA
9244 - 2,3',5',6-Tetrachlorobiphenyl (BZ-73)	EPA 1668A	10129405	NELAP	PA
9246 - 2,3',5'-Trichlorobiphenyl (BZ-34)	EPA 1668A	10129405	NELAP	PA
8969 - 2,3',5+2,4,5-Trichlorobiphenyl (BZ-26+29)	EPA 1668A	10129405	NELAP	PA
9242 - 2,3',5,5'-Tetrachlorobiphenyl (BZ-72)	EPA 1668A	10129405	NELAP	PA
8935 - 2,3',5-Trichlorobiphenyl (BZ-26)	EPA 1668A	10129405	NELAP	PA
9248 - 2,3',6-Trichlorobiphenyl (BZ-27)	EPA 1668A	10129405	NELAP	PA
9249 - 2,3'-Dichlorobiphenyl (BZ-6)	EPA 1668A	10129405	NELAP	PA
8967 - 2,3,3'+2,4,4'-Trichlorobiphenyl (BZ-20+28)	EPA 1668A	10129405	NELAP	PA
9201 - 2,3,3',4',5',6-Hexachlorobiphenyl (BZ-164)	EPA 1668A	10129405	NELAP	PA
9202 - 2,3,3',4',5'-Pentachlorobiphenyl (BZ-122)	EPA 1668A	10129405	NELAP	PA
8936 - 2,3,3',4',5+2,3',4',5,5'-Pentachlorobiphenyl (BZ-107+124)	EPA 1668A	10129405	NELAP	PA
9195 - 2,3,3',4',5,5',6-Heptachlorobiphenyl (BZ-193)	EPA 1668A	10129405	NELAP	PA
9197 - 2,3,3',4',5,5'-Hexachlorobiphenyl (BZ-162)	EPA 1668A	10129405	NELAP	PA
9199 - 2,3,3',4',5,6-Hexachlorobiphenyl (BZ-163)	EPA 1668A	10129405	NELAP	PA

Non Potable Water

Analyte	Method Name	Method Code	Type	AB
9205 - 2,3,3',4',5-Pentachlorobiphenyl (BZ-107)	EPA 1668A	10129405	NELAP	PA
8938 - 2,3,3',4',6+2,3,4,4',6-Pentachlorobiphenyl (BZ-110+115)	EPA 1668A	10129405	NELAP	PA
8990 - 2,3,3',4',6-Pentachlorobiphenyl (BZ-110)	EPA 1668A	10129405	NELAP	PA
9207 - 2,3,3',4'-Tetrachlorobiphenyl (BZ-56)	EPA 1668A	10129405	NELAP	PA
9192 - 2,3,3',4,4',5',6-Heptachlorobiphenyl (BZ-191)	EPA 1668A	10129405	NELAP	PA
9045 - 2,3,3',4,4',5'-Hexachlorobiphenyl (BZ-157)	EPA 1668A	10129405	NELAP	PA
8932 - 2,3,3',4,4',5+2,3,3',4,4',5'-Hexachlorobiphenyl (BZ-156+157)	EPA 1668A	10129405	NELAP	PA
9190 - 2,3,3',4,4',5,5',6-Octachlorobiphenyl (BZ-205)	EPA 1668A	10129405	NELAP	PA
9085 - 2,3,3',4,4',5,5'-Heptachlorobiphenyl (BZ-189)	EPA 1668A	10129405	NELAP	PA
9191 - 2,3,3',4,4',5,6-Heptachlorobiphenyl (BZ-190)	EPA 1668A	10129405	NELAP	PA
9050 - 2,3,3',4,4',5-Hexachlorobiphenyl (BZ-156)	EPA 1668A	10129405	NELAP	PA
9193 - 2,3,3',4,4',6-Hexachlorobiphenyl (BZ-158)	EPA 1668A	10129405	NELAP	PA
8985 - 2,3,3',4,4'-Pentachlorobiphenyl (BZ-105)	EPA 1668A	10129405	NELAP	PA
9200 - 2,3,3',4,5',6-Hexachlorobiphenyl (BZ-161)	EPA 1668A	10129405	NELAP	PA
9203 - 2,3,3',4,5'-Pentachlorobiphenyl (BZ-108)	EPA 1668A	10129405	NELAP	PA
9194 - 2,3,3',4,5,5',6-Heptachlorobiphenyl (BZ-192)	EPA 1668A	10129405	NELAP	PA
9196 - 2,3,3',4,5,5'-Hexachlorobiphenyl (BZ-159)	EPA 1668A	10129405	NELAP	PA
9198 - 2,3,3',4,5,6-Hexachlorobiphenyl (BZ-160)	EPA 1668A	10129405	NELAP	PA
9204 - 2,3,3',4,5-Pentachlorobiphenyl (BZ-106)	EPA 1668A	10129405	NELAP	PA
9206 - 2,3,3',4,6-Pentachlorobiphenyl (BZ-109)	EPA 1668A	10129405	NELAP	PA
9208 - 2,3,3',4-Tetrachlorobiphenyl (BZ-55)	EPA 1668A	10129405	NELAP	PA
9212 - 2,3,3',5',6-Pentachlorobiphenyl (BZ-113)	EPA 1668A	10129405	NELAP	PA
9213 - 2,3,3',5'-Tetrachlorobiphenyl (BZ-58)	EPA 1668A	10129405	NELAP	PA
9209 - 2,3,3',5,5',6-Hexachlorobiphenyl (BZ-165)	EPA 1668A	10129405	NELAP	PA
9210 - 2,3,3',5,5'-Pentachlorobiphenyl (BZ-111)	EPA 1668A	10129405	NELAP	PA
9211 - 2,3,3',5,6-Pentachlorobiphenyl (BZ-112)	EPA 1668A	10129405	NELAP	PA
9214 - 2,3,3',5-Tetrachlorobiphenyl (BZ-57)	EPA 1668A	10129405	NELAP	PA
8962 - 2,3,3',6+2,3,4,6+2,4,4',6-Tetrachlorobiphenyl (BZ-59+62+75)	EPA 1668A	10129405	NELAP	PA

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Analyte	Method Name	Method Code	Type	AB
9215 - 2,3,3',6-Tetrachlorobiphenyl (BZ-59)	EPA 1668A	10129405	NELAP	PA
9216 - 2,3,3'-Trichlorobiphenyl (BZ-20)	EPA 1668A	10129405	NELAP	PA
9227 - 2,3,4',5,6-Pentachlorobiphenyl (BZ-117)	EPA 1668A	10129405	NELAP	PA
9233 - 2,3,4',5-Tetrachlorobiphenyl (BZ-63)	EPA 1668A	10129405	NELAP	PA
9236 - 2,3,4',6-Tetrachlorobiphenyl (BZ-64)	EPA 1668A	10129405	NELAP	PA
9241 - 2,3,4'-Trichlorobiphenyl (BZ-22)	EPA 1668A	10129405	NELAP	PA
8968 - 2,3,4+2,3',4'-Trichlorobiphenyl (BZ-21+33)	EPA 1668A	10129405	NELAP	PA
9217 - 2,3,4,4',5,6-Hexachlorobiphenyl (BZ-166)	EPA 1668A	10129405	NELAP	PA
9005 - 2,3,4,4',5-Pentachlorobiphenyl (BZ-114)	EPA 1668A	10129405	NELAP	PA
9219 - 2,3,4,4',6-Pentachlorobiphenyl (BZ-115)	EPA 1668A	10129405	NELAP	PA
9221 - 2,3,4,4'-Tetrachlorobiphenyl (BZ-60)	EPA 1668A	10129405	NELAP	PA
8963 - 2,3,4,5+2,3',4',5+2,4,4',5+2,3',4',5'-Tetrachlorobiphenyls (BZ 61+70+74+76)	EPA 1668A	10129405	NELAP	PA
9225 - 2,3,4,5,6-Pentachlorobiphenyl (BZ-116)	EPA 1668A	10129405	NELAP	PA
9228 - 2,3,4,5-Tetrachlorobiphenyl (BZ-61)	EPA 1668A	10129405	NELAP	PA
9234 - 2,3,4,6-Tetrachlorobiphenyl (BZ-62)	EPA 1668A	10129405	NELAP	PA
9238 - 2,3,4-Trichlorobiphenyl (BZ-21)	EPA 1668A	10129405	NELAP	PA
9243 - 2,3,5,6-Tetrachlorobiphenyl (BZ-65)	EPA 1668A	10129405	NELAP	PA
9245 - 2,3,5-Trichlorobiphenyl (BZ-23)	EPA 1668A	10129405	NELAP	PA
9247 - 2,3,6-Trichlorobiphenyl (BZ-24)	EPA 1668A	10129405	NELAP	PA
8920 - 2,3-Dichlorobiphenyl (BZ-5)	EPA 1668A	10129405	NELAP	PA
8940 - 2,4',5-Trichlorobiphenyl (BZ-31)	EPA 1668A	10129405	NELAP	PA
9255 - 2,4',6-Trichlorobiphenyl (BZ-32)	EPA 1668A	10129405	NELAP	PA
9256 - 2,4'-Dichlorobiphenyl (BZ-8)	EPA 1668A	10129405	NELAP	PA
9250 - 2,4,4',5-Tetrachlorobiphenyl (BZ-74)	EPA 1668A	10129405	NELAP	PA
9251 - 2,4,4',6-Tetrachlorobiphenyl (BZ-75)	EPA 1668A	10129405	NELAP	PA
9252 - 2,4,4'-Trichlorobiphenyl (BZ-28)	EPA 1668A	10129405	NELAP	PA
9253 - 2,4,5-Trichlorobiphenyl (BZ-29)	EPA 1668A	10129405	NELAP	PA
9254 - 2,4,6-Trichlorobiphenyl (BZ-30)	EPA 1668A	10129405	NELAP	PA
9257 - 2,4-Dichlorobiphenyl (BZ-7)	EPA 1668A	10129405	NELAP	PA
9258 - 2,5-Dichlorobiphenyl (BZ-9)	EPA 1668A	10129405	NELAP	PA
9259 - 2,6-Dichlorobiphenyl (BZ-10)	EPA 1668A	10129405	NELAP	PA
8915 - 2-Chlorobiphenyl (BZ-1)	EPA 1668A	10129405	NELAP	PA
9060 - 3,3',4,4',5,5'-Hexachlorobiphenyl (BZ-169)	EPA 1668A	10129405	NELAP	PA
9015 - 3,3',4,4',5-Pentachlorobiphenyl (BZ-126)	EPA 1668A	10129405	NELAP	PA
8965 - 3,3',4,4'-Tetrachlorobiphenyl (BZ-77)	EPA 1668A	10129405	NELAP	PA
9261 - 3,3',4,5'-Tetrachlorobiphenyl (BZ-79)	EPA 1668A	10129405	NELAP	PA

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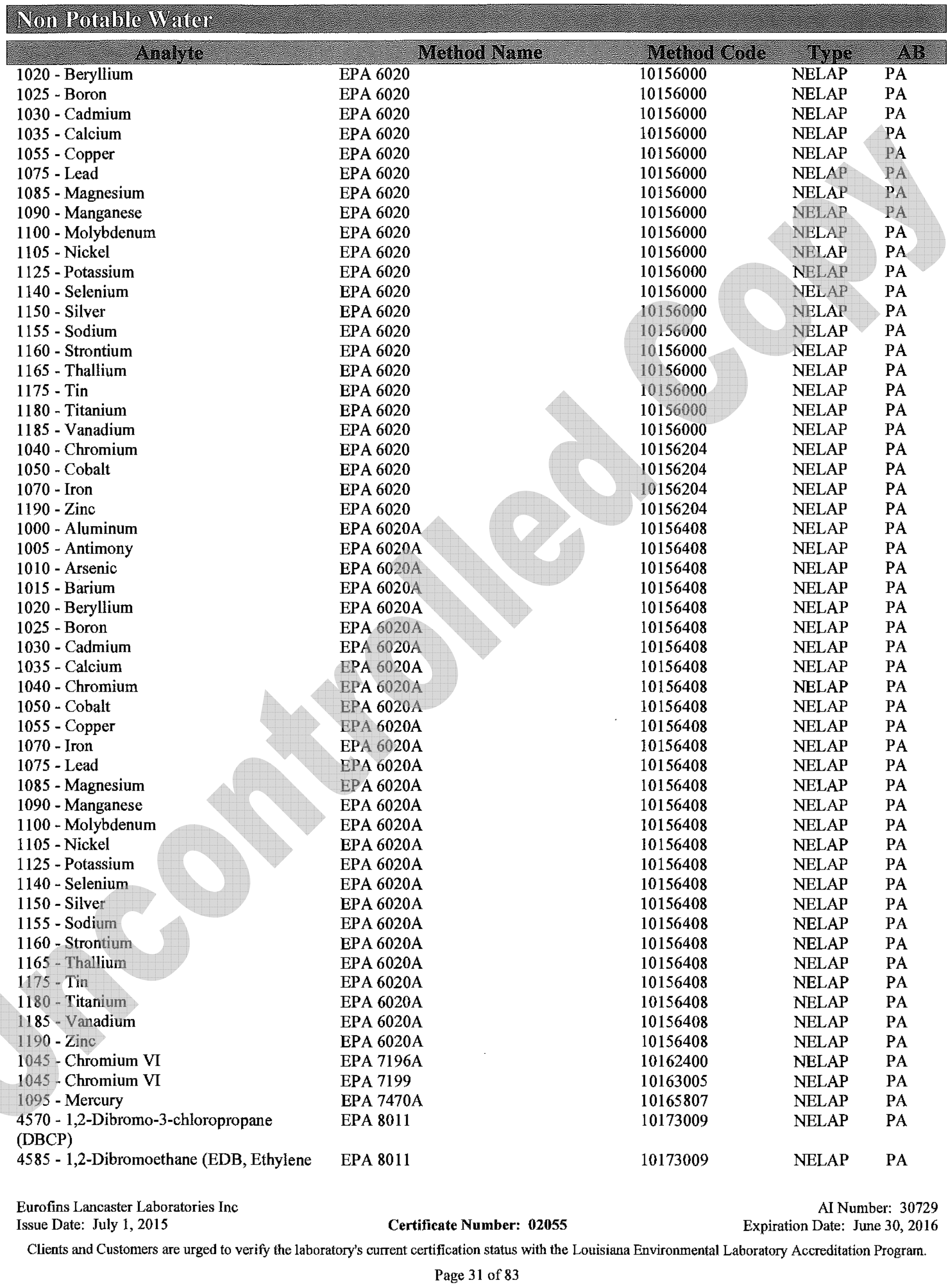
Analyte	Method Name	Method Code	Type	AB
9260 - 3,3',4,5,5'-Pentachlorobiphenyl (BZ-127)	EPA 1668A	10129405	NELAP	PA
9262 - 3,3',4,5-Tetrachlorobiphenyl (BZ-78)	EPA 1668A	10129405	NELAP	PA
9263 - 3,3',4-Trichlorobiphenyl (BZ-35)	EPA 1668A	10129405	NELAP	PA
9264 - 3,3',5,5'-Tetrachlorobiphenyl (BZ-80)	EPA 1668A	10129405	NELAP	PA
9265 - 3,3',5-Trichlorobiphenyl (BZ-36)	EPA 1668A	10129405	NELAP	PA
8925 - 3,3'-Dichlorobiphenyl (BZ-11)	EPA 1668A	10129405	NELAP	PA
9268 - 3,4',5-Trichlorobiphenyl (BZ-39)	EPA 1668A	10129405	NELAP	PA
9269 - 3,4'-Dichlorobiphenyl (BZ-13)	EPA 1668A	10129405	NELAP	PA
100098 - 3,4+3,4'-Dichlorobiphenyl (BZ-12+13)	EPA 1668A	10129405	NELAP	PA
8970 - 3,4,4',5-Tetrachlorobiphenyl (BZ-81)	EPA 1668A	10129405	NELAP	PA
9266 - 3,4,4'-Trichlorobiphenyl (BZ-37)	EPA 1668A	10129405	NELAP	PA
9267 - 3,4,5-Trichlorobiphenyl (BZ-38)	EPA 1668A	10129405	NELAP	PA
9270 - 3,4-Dichlorobiphenyl (BZ-12)	EPA 1668A	10129405	NELAP	PA
9271 - 3,5-Dichlorobiphenyl (BZ-14)	EPA 1668A	10129405	NELAP	PA
9272 - 3-Chlorobiphenyl (BZ-2)	EPA 1668A	10129405	NELAP	PA
9273 - 4,4'-Dichlorobiphenyl (BZ-15)	EPA 1668A	10129405	NELAP	PA
9274 - 4-Chlorobiphenyl (BZ-3)	EPA 1668A	10129405	NELAP	PA
8872 - PCB Aroclor Identification	EPA 1668A	10129405	NELAP	PA
8870 - PCBs	EPA 1668A	10129405	NELAP	PA
8875 - PCBs, as congeners	EPA 1668A	10129405	NELAP	PA
8876 - Total Dichlorobiphenyls	EPA 1668A	10129405	NELAP	PA
8877 - Total Heptachlorobiphenyls	EPA 1668A	10129405	NELAP	PA
8888 - Total Hexachlorobiphenyls	EPA 1668A	10129405	NELAP	PA
8889 - Total Monochlorobiphenyls	EPA 1668A	10129405	NELAP	PA
8891 - Total Nonachlorobiphenyls	EPA 1668A	10129405	NELAP	PA
8892 - Total Octachlorobiphenyls	EPA 1668A	10129405	NELAP	PA
8896 - Total Pentachlorobiphenyls	EPA 1668A	10129405	NELAP	PA
8893 - Total Tetrachlorobiphenyls	EPA 1668A	10129405	NELAP	PA
8894 - Total Trichlorobiphenyls	EPA 1668A	10129405	NELAP	PA
100003 - Acid Digestion of waters for Total Recoverable or Dissolved Metals	EPA 3005A	10133207	NELAP	PA
1401 - Acid Digestion of Aqueous samples and Extracts for Total Metals	EPA 3010	10133401	NELAP	PA
100004 - Acid Digestion of Aqueous samples and Extracts for Total Metals	EPA 3010A	10133605	NELAP	PA
100642 - Acid Digestion of Aqueous samples and Extracts for Total Metals (HNO3 only)	EPA 3020A	10134404	NELAP	PA
100005 - Acid Digestion of Aqueous samples and Extracts for Total Metals for Analysis by GFAA	EPA 3020A	10134404	NELAP	PA
1444 - Separatory Funnel Liquid-liquid extraction	EPA 3510C	10138202	NELAP	PA
1410 - Continuous Liquid-liquid extraction	EPA 3520	10138406	NELAP	PA
1406 - Purge and trap for aqueous phase samples	EPA 5030A	10153205	NELAP	PA
1000 - Aluminum	EPA 6010B	10155609	NELAP	PA
1005 - Antimony	EPA 6010B	10155609	NELAP	PA
1010 - Arsenic	EPA 6010B	10155609	NELAP	PA
1015 - Barium	EPA 6010B	10155609	NELAP	PA
1020 - Beryllium	EPA 6010B	10155609	NELAP	PA

Non Potable Water

Analyte	Method Name	Method Code	Type	AB
1025 - Boron	EPA 6010B	10155609	NELAP	PA
1030 - Cadmium	EPA 6010B	10155609	NELAP	PA
1035 - Calcium	EPA 6010B	10155609	NELAP	PA
1040 - Chromium	EPA 6010B	10155609	NELAP	PA
1050 - Cobalt	EPA 6010B	10155609	NELAP	PA
1055 - Copper	EPA 6010B	10155609	NELAP	PA
1070 - Iron	EPA 6010B	10155609	NELAP	PA
1075 - Lead	EPA 6010B	10155609	NELAP	PA
1080 - Lithium	EPA 6010B	10155609	NELAP	PA
1085 - Magnesium	EPA 6010B	10155609	NELAP	PA
1090 - Manganese	EPA 6010B	10155609	NELAP	PA
1100 - Molybdenum	EPA 6010B	10155609	NELAP	PA
1105 - Nickel	EPA 6010B	10155609	NELAP	PA
1125 - Potassium	EPA 6010B	10155609	NELAP	PA
1140 - Selenium	EPA 6010B	10155609	NELAP	PA
1150 - Silver	EPA 6010B	10155609	NELAP	PA
1155 - Sodium	EPA 6010B	10155609	NELAP	PA
1160 - Strontium	EPA 6010B	10155609	NELAP	PA
1165 - Thallium	EPA 6010B	10155609	NELAP	PA
1175 - Tin	EPA 6010B	10155609	NELAP	PA
1180 - Titanium	EPA 6010B	10155609	NELAP	PA
1185 - Vanadium	EPA 6010B	10155609	NELAP	PA
1190 - Zinc	EPA 6010B	10155609	NELAP	PA
1000 - Aluminum	EPA 6010C	10155803	NELAP	PA
1005 - Antimony	EPA 6010C	10155803	NELAP	PA
1010 - Arsenic	EPA 6010C	10155803	NELAP	PA
1015 - Barium	EPA 6010C	10155803	NELAP	PA
1020 - Beryllium	EPA 6010C	10155803	NELAP	PA
1025 - Boron	EPA 6010C	10155803	NELAP	PA
1030 - Cadmium	EPA 6010C	10155803	NELAP	PA
1035 - Calcium	EPA 6010C	10155803	NELAP	PA
1040 - Chromium	EPA 6010C	10155803	NELAP	PA
1050 - Cobalt	EPA 6010C	10155803	NELAP	PA
1055 - Copper	EPA 6010C	10155803	NELAP	PA
1070 - Iron	EPA 6010C	10155803	NELAP	PA
1075 - Lead	EPA 6010C	10155803	NELAP	PA
1080 - Lithium	EPA 6010C	10155803	NELAP	PA
1085 - Magnesium	EPA 6010C	10155803	NELAP	PA
1090 - Manganese	EPA 6010C	10155803	NELAP	PA
1100 - Molybdenum	EPA 6010C	10155803	NELAP	PA
1105 - Nickel	EPA 6010C	10155803	NELAP	PA
1125 - Potassium	EPA 6010C	10155803	NELAP	PA
1140 - Selenium	EPA 6010C	10155803	NELAP	PA
1150 - Silver	EPA 6010C	10155803	NELAP	PA
1155 - Sodium	EPA 6010C	10155803	NELAP	PA
1160 - Strontium	EPA 6010C	10155803	NELAP	PA
2017 - Sulfur	EPA 6010C	10155803	NELAP	PA
1165 - Thallium	EPA 6010C	10155803	NELAP	PA
1175 - Tin	EPA 6010C	10155803	NELAP	PA
1180 - Titanium	EPA 6010C	10155803	NELAP	PA
1185 - Vanadium	EPA 6010C	10155803	NELAP	PA
1190 - Zinc	EPA 6010C	10155803	NELAP	PA
1000 - Aluminum	EPA 6020	10156000	NELAP	PA
1005 - Antimony	EPA 6020	10156000	NELAP	PA
1010 - Arsenic	EPA 6020	10156000	NELAP	PA
1015 - Barium	EPA 6020	10156000	NELAP	PA



Non Potable Water

Analyte	Method Name	Method Code	Type	AB
1020 - Beryllium	EPA 6020	10156000	NELAP	PA
1025 - Boron	EPA 6020	10156000	NELAP	PA
1030 - Cadmium	EPA 6020	10156000	NELAP	PA
1035 - Calcium	EPA 6020	10156000	NELAP	PA
1055 - Copper	EPA 6020	10156000	NELAP	PA
1075 - Lead	EPA 6020	10156000	NELAP	PA
1085 - Magnesium	EPA 6020	10156000	NELAP	PA
1090 - Manganese	EPA 6020	10156000	NELAP	PA
1100 - Molybdenum	EPA 6020	10156000	NELAP	PA
1105 - Nickel	EPA 6020	10156000	NELAP	PA
1125 - Potassium	EPA 6020	10156000	NELAP	PA
1140 - Selenium	EPA 6020	10156000	NELAP	PA
1150 - Silver	EPA 6020	10156000	NELAP	PA
1155 - Sodium	EPA 6020	10156000	NELAP	PA
1160 - Strontium	EPA 6020	10156000	NELAP	PA
1165 - Thallium	EPA 6020	10156000	NELAP	PA
1175 - Tin	EPA 6020	10156000	NELAP	PA
1180 - Titanium	EPA 6020	10156000	NELAP	PA
1185 - Vanadium	EPA 6020	10156000	NELAP	PA
1040 - Chromium	EPA 6020	10156204	NELAP	PA
1050 - Cobalt	EPA 6020	10156204	NELAP	PA
1070 - Iron	EPA 6020	10156204	NELAP	PA
1190 - Zinc	EPA 6020	10156204	NELAP	PA
1000 - Aluminum	EPA 6020A	10156408	NELAP	PA
1005 - Antimony	EPA 6020A	10156408	NELAP	PA
1010 - Arsenic	EPA 6020A	10156408	NELAP	PA
1015 - Barium	EPA 6020A	10156408	NELAP	PA
1020 - Beryllium	EPA 6020A	10156408	NELAP	PA
1025 - Boron	EPA 6020A	10156408	NELAP	PA
1030 - Cadmium	EPA 6020A	10156408	NELAP	PA
1035 - Calcium	EPA 6020A	10156408	NELAP	PA
1040 - Chromium	EPA 6020A	10156408	NELAP	PA
1050 - Cobalt	EPA 6020A	10156408	NELAP	PA
1055 - Copper	EPA 6020A	10156408	NELAP	PA
1070 - Iron	EPA 6020A	10156408	NELAP	PA
1075 - Lead	EPA 6020A	10156408	NELAP	PA
1085 - Magnesium	EPA 6020A	10156408	NELAP	PA
1090 - Manganese	EPA 6020A	10156408	NELAP	PA
1100 - Molybdenum	EPA 6020A	10156408	NELAP	PA
1105 - Nickel	EPA 6020A	10156408	NELAP	PA
1125 - Potassium	EPA 6020A	10156408	NELAP	PA
1140 - Selenium	EPA 6020A	10156408	NELAP	PA
1150 - Silver	EPA 6020A	10156408	NELAP	PA
1155 - Sodium	EPA 6020A	10156408	NELAP	PA
1160 - Strontium	EPA 6020A	10156408	NELAP	PA
1165 - Thallium	EPA 6020A	10156408	NELAP	PA
1175 - Tin	EPA 6020A	10156408	NELAP	PA
1180 - Titanium	EPA 6020A	10156408	NELAP	PA
1185 - Vanadium	EPA 6020A	10156408	NELAP	PA
1190 - Zinc	EPA 6020A	10156408	NELAP	PA
1045 - Chromium VI	EPA 7196A	10162400	NELAP	PA
1045 - Chromium VI	EPA 7199	10163005	NELAP	PA
1095 - Mercury	EPA 7470A	10165807	NELAP	PA
4570 - 1,2-Dibromo-3-chloropropane (DBCP)	EPA 8011	10173009	NELAP	PA
4585 - 1,2-Dibromoethane (EDB, Ethylene	EPA 8011	10173009	NELAP	PA

Non Potable Water

Analyte	Method Name	Method Code	Type	AB
dibromide)				
4750 - Ethanol	EPA 8015	10173203	NELAP	PA
4785 - Ethylene glycol	EPA 8015	10173203	NELAP	PA
4895 - Isopropyl alcohol (2-Propanol, Isopropanol)	EPA 8015	10173203	NELAP	PA
4930 - Methanol	EPA 8015	10173203	NELAP	PA
4420 - tert-Butyl alcohol	EPA 8015	10173203	NELAP	PA
9369 - Diesel range organics (DRO)	EPA 8015B	10173601	NELAP	PA
4720 - Diethylene glycol	EPA 8015B	10173601	NELAP	PA
9408 - Gasoline range organics (GRO)	EPA 8015B	10173601	NELAP	PA
4875 - Isobutyl alcohol (2-Methyl-1-propanol)	EPA 8015B	10173601	NELAP	PA
6657 - Propylene Glycol	EPA 8015B	10173601	NELAP	PA
4003 - Total Petroleum Hydrocarbons (Aviation Gasoline Range)	EPA 8015B	10173601	NELAP	PA
4004 - Total Petroleum Hydrocarbons (Jet Fuel Range)	EPA 8015B	10173601	NELAP	PA
9506 - Total Petroleum Hydrocarbons (Oil Range)	EPA 8015B	10173601	NELAP	PA
2050 - Total Petroleum Hydrocarbons (TPH)	EPA 8015B	10173601	NELAP	PA
9646 - Triethylene Glycol	EPA 8015B	10173601	NELAP	PA
4425 - n-Butyl alcohol (1-Butanol, n-Butanol)	EPA 8015B	10173601	NELAP	PA
5055 - n-Propanol (1-Propanol)	EPA 8015B	10173601	NELAP	PA
9369 - Diesel range organics (DRO)	EPA 8015C	10173805	NELAP	PA
9408 - Gasoline range organics (GRO)	EPA 8015C	10173805	NELAP	PA
4875 - Isobutyl alcohol (2-Methyl-1-propanol)	EPA 8015C	10173805	NELAP	PA
1935 - Total recoverable petroleum hydrocarbons (TRPH)	EPA 8015C	10173805	NELAP	PA
4425 - n-Butyl alcohol (1-Butanol, n-Butanol)	EPA 8015C	10173805	NELAP	PA
5055 - n-Propanol (1-Propanol)	EPA 8015C	10173805	NELAP	PA
4375 - Benzene	EPA 8021B	10174808	NELAP	PA
4765 - Ethylbenzene	EPA 8021B	10174808	NELAP	PA
4900 - Isopropylbenzene	EPA 8021B	10174808	NELAP	PA
5000 - Methyl tert-butyl ether (MTBE)	EPA 8021B	10174808	NELAP	PA
5005 - Naphthalene	EPA 8021B	10174808	NELAP	PA
5140 - Toluene	EPA 8021B	10174808	NELAP	PA
5260 - Xylene (total)	EPA 8021B	10174808	NELAP	PA
5245 - m-Xylene	EPA 8021B	10174808	NELAP	PA
5250 - o-Xylene	EPA 8021B	10174808	NELAP	PA
5255 - p-Xylene	EPA 8021B	10174808	NELAP	PA
7740 - Kepone	EPA 8081A	10178606	NELAP	PA
7355 - 4,4'-DDD	EPA 8081B	10178800	NELAP	PA
7360 - 4,4'-DDE	EPA 8081B	10178800	NELAP	PA
7365 - 4,4'-DDT	EPA 8081B	10178800	NELAP	PA
7025 - Aldrin	EPA 8081B	10178800	NELAP	PA
7250 - Chlordane (tech.)	EPA 8081B	10178800	NELAP	PA
7470 - Dieldrin	EPA 8081B	10178800	NELAP	PA
7510 - Endosulfan I	EPA 8081B	10178800	NELAP	PA
7515 - Endosulfan II	EPA 8081B	10178800	NELAP	PA
7520 - Endosulfan sulfate	EPA 8081B	10178800	NELAP	PA
7540 - Endrin	EPA 8081B	10178800	NELAP	PA
7530 - Endrin aldehyde	EPA 8081B	10178800	NELAP	PA

Non Potable Water

Analyte	Method Name	Method Code	Type	AB
7535 - Endrin ketone	EPA 8081B	10178800	NELAP	PA
7685 - Heptachlor	EPA 8081B	10178800	NELAP	PA
7690 - Heptachlor epoxide	EPA 8081B	10178800	NELAP	PA
7740 - Kepone	EPA 8081B	10178800	NELAP	PA
7810 - Methoxychlor	EPA 8081B	10178800	NELAP	PA
8250 - Toxaphene (Chlorinated camphene)	EPA 8081B	10178800	NELAP	PA
7110 - alpha-BHC (alpha-Hexachlorocyclohexane)	EPA 8081B	10178800	NELAP	PA
7115 - beta-BHC (beta-Hexachlorocyclohexane)	EPA 8081B	10178800	NELAP	PA
7105 - delta-BHC	EPA 8081B	10178800	NELAP	PA
7120 - gamma-BHC (Lindane, gamma-HexachlorocyclohexanE)	EPA 8081B	10178800	NELAP	PA
8880 - Aroclor-1016 (PCB-1016)	EPA 8082	10179007	NELAP	PA
8885 - Aroclor-1221 (PCB-1221)	EPA 8082	10179007	NELAP	PA
8890 - Aroclor-1232 (PCB-1232)	EPA 8082	10179007	NELAP	PA
8895 - Aroclor-1242 (PCB-1242)	EPA 8082	10179007	NELAP	PA
8900 - Aroclor-1248 (PCB-1248)	EPA 8082	10179007	NELAP	PA
8905 - Aroclor-1254 (PCB-1254)	EPA 8082	10179007	NELAP	PA
8910 - Aroclor-1260 (PCB-1260)	EPA 8082	10179007	NELAP	PA
8912 - Aroclor-1262 (PCB-1262)	EPA 8082	10179007	NELAP	PA
8913 - Aroclor-1268 (PCB-1268)	EPA 8082	10179007	NELAP	PA
7005 - Alachlor	EPA 8141	10181803	NELAP	PA
7065 - Atrazine	EPA 8141	10181803	NELAP	PA
7075 - Azinphos-methyl (Guthion)	EPA 8141	10181803	NELAP	PA
7125 - Bolstar (Sulprofos)	EPA 8141	10181803	NELAP	PA
7300 - Chlorpyrifos	EPA 8141	10181803	NELAP	PA
7315 - Coumaphos	EPA 8141	10181803	NELAP	PA
7395 - Demeton-o	EPA 8141	10181803	NELAP	PA
7385 - Demeton-s	EPA 8141	10181803	NELAP	PA
7410 - Diazinon	EPA 8141	10181803	NELAP	PA
8610 - Dichlorovos (DDVP, Dichlorvos)	EPA 8141	10181803	NELAP	PA
8625 - Disulfoton	EPA 8141	10181803	NELAP	PA
7550 - EPN	EPA 8141	10181803	NELAP	PA
7565 - Ethion	EPA 8141	10181803	NELAP	PA
7570 - Ethoprop	EPA 8141	10181803	NELAP	PA
7580 - Famphur	EPA 8141	10181803	NELAP	PA
7600 - Fensulfothion	EPA 8141	10181803	NELAP	PA
7770 - Malathion	EPA 8141	10181803	NELAP	PA
7785 - Merphos	EPA 8141	10181803	NELAP	PA
7825 - Methyl parathion (Parathion, methyl)	EPA 8141	10181803	NELAP	PA
7835 - Metolachlor	EPA 8141	10181803	NELAP	PA
7850 - Mevinphos	EPA 8141	10181803	NELAP	PA
7905 - Naled	EPA 8141	10181803	NELAP	PA
7955 - Parathion, ethyl	EPA 8141	10181803	NELAP	PA
7985 - Phorate	EPA 8141	10181803	NELAP	PA
8110 - Ronnel	EPA 8141	10181803	NELAP	PA
8125 - Simazine	EPA 8141	10181803	NELAP	PA
8140 - Stirophos	EPA 8141	10181803	NELAP	PA
8245 - Tokuthion (Prothiophos)	EPA 8141	10181803	NELAP	PA
8275 - Trichloronate	EPA 8141	10181803	NELAP	PA
7005 - Alachlor	EPA 8141A	10182000	NELAP	PA
7065 - Atrazine	EPA 8141A	10182000	NELAP	PA
7075 - Azinphos-methyl (Guthion)	EPA 8141A	10182000	NELAP	PA
7125 - Bolstar (Sulprofos)	EPA 8141A	10182000	NELAP	PA
7300 - Chlorpyrifos	EPA 8141A	10182000	NELAP	PA

Non Potable Water

Analyte	Method Name	Method Code	Type	AB
7315 - Coumaphos	EPA 8141A	10182000	NELAP	PA
7395 - Demeton-o	EPA 8141A	10182000	NELAP	PA
7385 - Demeton-s	EPA 8141A	10182000	NELAP	PA
7410 - Diazinon	EPA 8141A	10182000	NELAP	PA
8610 - Dichlorovos (DDVP, Dichlorvos)	EPA 8141A	10182000	NELAP	PA
8625 - Disulfoton	EPA 8141A	10182000	NELAP	PA
7550 - EPN	EPA 8141A	10182000	NELAP	PA
7565 - Ethion	EPA 8141A	10182000	NELAP	PA
7570 - Ethoprop	EPA 8141A	10182000	NELAP	PA
7580 - Famphur	EPA 8141A	10182000	NELAP	PA
7600 - Fensulfothion	EPA 8141A	10182000	NELAP	PA
7770 - Malathion	EPA 8141A	10182000	NELAP	PA
7785 - Merphos	EPA 8141A	10182000	NELAP	PA
7825 - Methyl parathion (Parathion, methyl)	EPA 8141A	10182000	NELAP	PA
7835 - Metolachlor	EPA 8141A	10182000	NELAP	PA
7850 - Mevinphos	EPA 8141A	10182000	NELAP	PA
7905 - Naled	EPA 8141A	10182000	NELAP	PA
7955 - Parathion, ethyl	EPA 8141A	10182000	NELAP	PA
7985 - Phorate	EPA 8141A	10182000	NELAP	PA
8110 - Ronnel	EPA 8141A	10182000	NELAP	PA
8125 - Simazine	EPA 8141A	10182000	NELAP	PA
8140 - Stirophos	EPA 8141A	10182000	NELAP	PA
8245 - Tokuthion (Prothiophos)	EPA 8141A	10182000	NELAP	PA
8275 - Trichloronate	EPA 8141A	10182000	NELAP	PA
8655 - 2,4,5-T	EPA 8151	10183003	NELAP	PA
8545 - 2,4-D	EPA 8151	10183003	NELAP	PA
8560 - 2,4-DB	EPA 8151	10183003	NELAP	PA
8555 - Dalapon	EPA 8151	10183003	NELAP	PA
8595 - Dicamba	EPA 8151	10183003	NELAP	PA
8605 - Dichloroprop (Dichlorprop)	EPA 8151	10183003	NELAP	PA
7775 - MCPA	EPA 8151	10183003	NELAP	PA
7780 - MCPP	EPA 8151	10183003	NELAP	PA
6605 - Pentachlorophenol	EPA 8151	10183003	NELAP	PA
8645 - Picloram	EPA 8151	10183003	NELAP	PA
8650 - Silvex (2,4,5-TP)	EPA 8151	10183003	NELAP	PA
5105 - 1,1,1,2-Tetrachloroethane	EPA 8260B	10184802	NELAP	PA
5160 - 1,1,1-Trichloroethane	EPA 8260B	10184802	NELAP	PA
5110 - 1,1,2,2-Tetrachloroethane	EPA 8260B	10184802	NELAP	PA
5195 - 1,1,2-Trichloro-1,2,2-trifluoroethane	EPA 8260B	10184802	NELAP	PA
5185 - 1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)	EPA 8260B	10184802	NELAP	PA
5165 - 1,1,2-Trichloroethane	EPA 8260B	10184802	NELAP	PA
4630 - 1,1-Dichloroethane	EPA 8260B	10184802	NELAP	PA
4640 - 1,1-Dichloroethylene	EPA 8260B	10184802	NELAP	PA
4670 - 1,1-Dichloropropene	EPA 8260B	10184802	NELAP	PA
5150 - 1,2,3-Trichlorobenzene	EPA 8260B	10184802	NELAP	PA
5180 - 1,2,3-Trichloropropane	EPA 8260B	10184802	NELAP	PA
5155 - 1,2,4-Trichlorobenzene	EPA 8260B	10184802	NELAP	PA
5210 - 1,2,4-Trimethylbenzene	EPA 8260B	10184802	NELAP	PA
4570 - 1,2-Dibromo-3-chloropropane (DBCP)	EPA 8260B	10184802	NELAP	PA
4585 - 1,2-Dibromoethane (EDB, Ethylene dibromide)	EPA 8260B	10184802	NELAP	PA
4610 - 1,2-Dichlorobenzene	EPA 8260B	10184802	NELAP	PA
4635 - 1,2-Dichloroethane (Ethylene dichloride)	EPA 8260B	10184802	NELAP	PA

Non Potable Water

Analyte	Method Name	Method Code	Type	AB
4655 - 1,2-Dichloropropane	EPA 8260B	10184802	NELAP	PA
5215 - 1,3,5-Trimethylbenzene	EPA 8260B	10184802	NELAP	PA
4615 - 1,3-Dichlorobenzene	EPA 8260B	10184802	NELAP	PA
4660 - 1,3-Dichloropropane	EPA 8260B	10184802	NELAP	PA
4620 - 1,4-Dichlorobenzene	EPA 8260B	10184802	NELAP	PA
4735 - 1,4-Dioxane (1,4- Diethyleneoxide)	EPA 8260B	10184802	NELAP	PA
4665 - 2,2-Dichloropropane	EPA 8260B	10184802	NELAP	PA
4410 - 2-Butanone (Methyl ethyl ketone, MEK)	EPA 8260B	10184802	NELAP	PA
4500 - 2-Chloroethyl vinyl ether	EPA 8260B	10184802	NELAP	PA
4535 - 2-Chlorotoluene	EPA 8260B	10184802	NELAP	PA
4860 - 2-Hexanone	EPA 8260B	10184802	NELAP	PA
5020 - 2-Nitropropane	EPA 8260B	10184802	NELAP	PA
4540 - 4-Chlorotoluene	EPA 8260B	10184802	NELAP	PA
4910 - 4-Isopropyltoluene (p-Cymene)	EPA 8260B	10184802	NELAP	PA
4995 - 4-Methyl-2-pentanone (MIBK)	EPA 8260B	10184802	NELAP	PA
4315 - Acetone	EPA 8260B	10184802	NELAP	PA
4320 - Acetonitrile	EPA 8260B	10184802	NELAP	PA
4325 - Acrolein (Propenal)	EPA 8260B	10184802	NELAP	PA
4340 - Acrylonitrile	EPA 8260B	10184802	NELAP	PA
4350 - Allyl alcohol	EPA 8260B	10184802	NELAP	PA
4355 - Allyl chloride (3-Chloropropene)	EPA 8260B	10184802	NELAP	PA
4375 - Benzene	EPA 8260B	10184802	NELAP	PA
5635 - Benzyl chloride	EPA 8260B	10184802	NELAP	PA
4385 - Bromobenzene	EPA 8260B	10184802	NELAP	PA
4390 - Bromochloromethane	EPA 8260B	10184802	NELAP	PA
4395 - Bromodichloromethane	EPA 8260B	10184802	NELAP	PA
4400 - Bromoform	EPA 8260B	10184802	NELAP	PA
4450 - Carbon disulfide	EPA 8260B	10184802	NELAP	PA
4455 - Carbon tetrachloride	EPA 8260B	10184802	NELAP	PA
4475 - Chlorobenzene	EPA 8260B	10184802	NELAP	PA
4575 - Chlorodibromomethane	EPA 8260B	10184802	NELAP	PA
4485 - Chloroethane (Ethyl chloride)	EPA 8260B	10184802	NELAP	PA
4505 - Chloroform	EPA 8260B	10184802	NELAP	PA
4525 - Chloroprene (2-Chloro-1,3-butadiene)	EPA 8260B	10184802	NELAP	PA
4555 - Cyclohexane	EPA 8260B	10184802	NELAP	PA
9375 - Di-isopropylether (DIPE) (Isopropyl ether)	EPA 8260B	10184802	NELAP	PA
4580 - Dibromochloropropane	EPA 8260B	10184802	NELAP	PA
4590 - Dibromofluoromethane	EPA 8260B	10184802	NELAP	PA
4595 - Dibromomethane (Methylene bromide)	EPA 8260B	10184802	NELAP	PA
4625 - Dichlorodifluoromethane (Freon-12)	EPA 8260B	10184802	NELAP	PA
4745 - Epichlorohydrin (1-Chloro-2,3-epoxypropane)	EPA 8260B	10184802	NELAP	PA
4750 - Ethanol	EPA 8260B	10184802	NELAP	PA
4755 - Ethyl acetate	EPA 8260B	10184802	NELAP	PA
4810 - Ethyl methacrylate	EPA 8260B	10184802	NELAP	PA
4770 - Ethyl-t-butyl ether (ETBE) (2-Ethoxy-2-methylpropane)	EPA 8260B	10184802	NELAP	PA
4765 - Ethylbenzene	EPA 8260B	10184802	NELAP	PA
9408 - Gasoline range organics (GRO)	EPA 8260B	10184802	NELAP	PA
4835 - Hexachlorobutadiene	EPA 8260B	10184802	NELAP	PA
4870 - Iodomethane (Methyl iodide)	EPA 8260B	10184802	NELAP	PA
4875 - Isobutyl alcohol (2-Methyl-1-	EPA 8260B	10184802	NELAP	PA

Non Potable Water

Analyte	Method Name	Method Code	Type	AB
propanol)				
4900 - Isopropylbenzene	EPA 8260B	10184802	NELAP	PA
4925 - Methacrylonitrile	EPA 8260B	10184802	NELAP	PA
4940 - Methyl acetate	EPA 8260B	10184802	NELAP	PA
4950 - Methyl bromide (Bromomethane)	EPA 8260B	10184802	NELAP	PA
4960 - Methyl chloride (Chloromethane)	EPA 8260B	10184802	NELAP	PA
5000 - Methyl tert-butyl ether (MTBE)	EPA 8260B	10184802	NELAP	PA
4975 - Methylene chloride (Dichloromethane)	EPA 8260B	10184802	NELAP	PA
5005 - Naphthalene	EPA 8260B	10184802	NELAP	PA
5035 - Pentachloroethane	EPA 8260B	10184802	NELAP	PA
5080 - Propionitrile (Ethyl cyanide)	EPA 8260B	10184802	NELAP	PA
5100 - Styrene	EPA 8260B	10184802	NELAP	PA
4370 - T-amylmethylether (TAME)	EPA 8260B	10184802	NELAP	PA
5115 - Tetrachloroethylene (Perchloroethylene)	EPA 8260B	10184802	NELAP	PA
5120 - Tetrahydrofuran (THF)	EPA 8260B	10184802	NELAP	PA
5140 - Toluene	EPA 8260B	10184802	NELAP	PA
5170 - Trichloroethene (Trichloroethylene)	EPA 8260B	10184802	NELAP	PA
5175 - Trichlorofluoromethane (Fluorotrichloromethane, Freon 11)	EPA 8260B	10184802	NELAP	PA
5225 - Vinyl acetate	EPA 8260B	10184802	NELAP	PA
5235 - Vinyl chloride	EPA 8260B	10184802	NELAP	PA
5260 - Xylene (total)	EPA 8260B	10184802	NELAP	PA
4705 - cis & trans-1,2-Dichloroethene	EPA 8260B	10184802	NELAP	PA
4645 - cis-1,2-Dichloroethylene	EPA 8260B	10184802	NELAP	PA
4680 - cis-1,3-Dichloropropene	EPA 8260B	10184802	NELAP	PA
5240 - m+p-xylene	EPA 8260B	10184802	NELAP	PA
4425 - n-Butyl alcohol (1-Butanol, n-Butanol)	EPA 8260B	10184802	NELAP	PA
4435 - n-Butylbenzene	EPA 8260B	10184802	NELAP	PA
5085 - n-Propylamine	EPA 8260B	10184802	NELAP	PA
5090 - n-Propylbenzene	EPA 8260B	10184802	NELAP	PA
5250 - o-Xylene	EPA 8260B	10184802	NELAP	PA
4440 - sec-Butylbenzene	EPA 8260B	10184802	NELAP	PA
4420 - tert-Butyl alcohol	EPA 8260B	10184802	NELAP	PA
4445 - tert-Butylbenzene	EPA 8260B	10184802	NELAP	PA
4700 - trans-1,2-Dichloroethylene	EPA 8260B	10184802	NELAP	PA
4685 - trans-1,3-Dichloropropylene	EPA 8260B	10184802	NELAP	PA
4605 - trans-1,4-Dichloro-2-butene	EPA 8260B	10184802	NELAP	PA
6705 - 1,2,3,4-Tetrachlorobenzene	EPA 8270C	10185805	NELAP	PA
6710 - 1,2,3,5-Tetrachlorobenzene	EPA 8270C	10185805	NELAP	PA
6715 - 1,2,4,5-Tetrachlorobenzene	EPA 8270C	10185805	NELAP	PA
5155 - 1,2,4-Trichlorobenzene	EPA 8270C	10185805	NELAP	PA
4610 - 1,2-Dichlorobenzene	EPA 8270C	10185805	NELAP	PA
6220 - 1,2-Diphenylhydrazine	EPA 8270C	10185805	NELAP	PA
6885 - 1,3,5-Trinitrobenzene (1,3,5-TNB)	EPA 8270C	10185805	NELAP	PA
4615 - 1,3-Dichlorobenzene	EPA 8270C	10185805	NELAP	PA
6160 - 1,3-Dinitrobenzene (1,3-DNB)	EPA 8270C	10185805	NELAP	PA
4620 - 1,4-Dichlorobenzene	EPA 8270C	10185805	NELAP	PA
6165 - 1,4-Dinitrobenzene	EPA 8270C	10185805	NELAP	PA
4735 - 1,4-Dioxane (1,4- Diethyleneoxide)	EPA 8270C	10185805	NELAP	PA
6420 - 1,4-Naphthoquinone	EPA 8270C	10185805	NELAP	PA
6630 - 1,4-Phenylenediamine	EPA 8270C	10185805	NELAP	PA
5790 - 1-Chloronaphthalene	EPA 8270C	10185805	NELAP	PA
6380 - 1-Methylnaphthalene	EPA 8270C	10185805	NELAP	PA

Non Potable Water

Analyte	Method Name	Method Code	Type	AB
6425 - 1-Naphthylamine	EPA 8270C	10185805	NELAP	PA
6735 - 2,3,4,6-Tetrachlorophenol	EPA 8270C	10185805	NELAP	PA
6835 - 2,4,5-Trichlorophenol	EPA 8270C	10185805	NELAP	PA
6840 - 2,4,6-Trichlorophenol	EPA 8270C	10185805	NELAP	PA
6000 - 2,4-Dichlorophenol	EPA 8270C	10185805	NELAP	PA
6130 - 2,4-Dimethylphenol	EPA 8270C	10185805	NELAP	PA
6175 - 2,4-Dinitrophenol	EPA 8270C	10185805	NELAP	PA
6185 - 2,4-Dinitrotoluene (2,4-DNT)	EPA 8270C	10185805	NELAP	PA
6005 - 2,6-Dichlorophenol	EPA 8270C	10185805	NELAP	PA
6190 - 2,6-Dinitrotoluene (2,6-DNT)	EPA 8270C	10185805	NELAP	PA
5515 - 2-Acetylaminofluorene	EPA 8270C	10185805	NELAP	PA
9322 - 2-Butoxyethanol	EPA 8270C	10185805	NELAP	PA
5795 - 2-Chloronaphthalene	EPA 8270C	10185805	NELAP	PA
5800 - 2-Chlorophenol	EPA 8270C	10185805	NELAP	PA
6360 - 2-Methyl-4,6-dinitrophenol (4,6-Dinitro-2-methylphenol)	EPA 8270C	10185805	NELAP	PA
5145 - 2-Methylaniline (o-Toluidine)	EPA 8270C	10185805	NELAP	PA
6385 - 2-Methylnaphthalene	EPA 8270C	10185805	NELAP	PA
6400 - 2-Methylphenol (o-Cresol)	EPA 8270C	10185805	NELAP	PA
6430 - 2-Naphthylamine	EPA 8270C	10185805	NELAP	PA
6460 - 2-Nitroaniline	EPA 8270C	10185805	NELAP	PA
6490 - 2-Nitrophenol	EPA 8270C	10185805	NELAP	PA
5050 - 2-Picoline (2-Methylpyridime)	EPA 8270C	10185805	NELAP	PA
5945 - 3,3'-Dichlorobenzidine	EPA 8270C	10185805	NELAP	PA
6120 - 3,3'-Dimethylbenzidine	EPA 8270C	10185805	NELAP	PA
6355 - 3-Methylcholanthrene	EPA 8270C	10185805	NELAP	PA
6405 - 3-Methylphenol (m-Cresol)	EPA 8270C	10185805	NELAP	PA
6465 - 3-Nitroaniline	EPA 8270C	10185805	NELAP	PA
5540 - 4-Aminobiphenyl	EPA 8270C	10185805	NELAP	PA
5660 - 4-Bromophenyl phenyl ether	EPA 8270C	10185805	NELAP	PA
5700 - 4-Chloro-3-methylphenol	EPA 8270C	10185805	NELAP	PA
5745 - 4-Chloroaniline	EPA 8270C	10185805	NELAP	PA
5825 - 4-Chlorophenyl phenylether	EPA 8270C	10185805	NELAP	PA
6105 - 4-Dimethyl aminoazobenzene	EPA 8270C	10185805	NELAP	PA
6410 - 4-Methylphenol (p-Cresol)	EPA 8270C	10185805	NELAP	PA
6470 - 4-Nitroaniline	EPA 8270C	10185805	NELAP	PA
6500 - 4-Nitrophenol	EPA 8270C	10185805	NELAP	PA
6510 - 4-Nitroquinoline 1-oxide	EPA 8270C	10185805	NELAP	PA
6570 - 5-Nitro-o-toluidine	EPA 8270C	10185805	NELAP	PA
6115 - 7,12-Dimethylbenz(a) anthracene	EPA 8270C	10185805	NELAP	PA
5500 - Acenaphthene	EPA 8270C	10185805	NELAP	PA
5505 - Acenaphthylene	EPA 8270C	10185805	NELAP	PA
5510 - Acetophenone	EPA 8270C	10185805	NELAP	PA
5545 - Aniline	EPA 8270C	10185805	NELAP	PA
5555 - Anthracene	EPA 8270C	10185805	NELAP	PA
5560 - Aramite	EPA 8270C	10185805	NELAP	PA
5567 - Benzenethiol	EPA 8270C	10185805	NELAP	PA
5595 - Benzidine	EPA 8270C	10185805	NELAP	PA
5575 - Benzo(a)anthracene	EPA 8270C	10185805	NELAP	PA
5580 - Benzo(a)pyrene	EPA 8270C	10185805	NELAP	PA
5585 - Benzo(b)fluoranthene	EPA 8270C	10185805	NELAP	PA
5590 - Benzo(g,h,i)perylene	EPA 8270C	10185805	NELAP	PA
5600 - Benzo(k)fluoranthene	EPA 8270C	10185805	NELAP	PA
5610 - Benzoic acid	EPA 8270C	10185805	NELAP	PA
5630 - Benzyl alcohol	EPA 8270C	10185805	NELAP	PA
5640 - Biphenyl	EPA 8270C	10185805	NELAP	PA

Non Potable Water

Analyte	Method Name	Method Code	Type	AB
5670 - Butyl benzyl phthalate	EPA 8270C	10185805	NELAP	PA
7180 - Caprolactam	EPA 8270C	10185805	NELAP	PA
5680 - Carbazole	EPA 8270C	10185805	NELAP	PA
7260 - Chlorobenzilate	EPA 8270C	10185805	NELAP	PA
5855 - Chrysene	EPA 8270C	10185805	NELAP	PA
6065 - Di(2-ethylhexyl) phthalate (bis(2-Ethylhexyl)phthalate, DEHP)	EPA 8270C	10185805	NELAP	PA
5925 - Di-n-butyl phthalate	EPA 8270C	10185805	NELAP	PA
6200 - Di-n-octyl phthalate	EPA 8270C	10185805	NELAP	PA
7405 - Diallate	EPA 8270C	10185805	NELAP	PA
9354 - Dibenz(a, h) acridine	EPA 8270C	10185805	NELAP	PA
5900 - Dibenz(a, j) acridine	EPA 8270C	10185805	NELAP	PA
5895 - Dibenz(a,h) anthracene	EPA 8270C	10185805	NELAP	PA
5905 - Dibenzofuran	EPA 8270C	10185805	NELAP	PA
7475 - Dimethoate	EPA 8270C	10185805	NELAP	PA
6135 - Dimethyl phthalate	EPA 8270C	10185805	NELAP	PA
8620 - Dinoseb (2-sec-butyl-4,6-dinitrophenol, DNBP)	EPA 8270C	10185805	NELAP	PA
6205 - Diphenylamine	EPA 8270C	10185805	NELAP	PA
8625 - Disulfoton	EPA 8270C	10185805	NELAP	PA
6260 - Ethyl methanesulfonate	EPA 8270C	10185805	NELAP	PA
7580 - Famphur	EPA 8270C	10185805	NELAP	PA
6265 - Fluoranthene	EPA 8270C	10185805	NELAP	PA
6270 - Fluorene	EPA 8270C	10185805	NELAP	PA
6275 - Hexachlorobenzene	EPA 8270C	10185805	NELAP	PA
4835 - Hexachlorobutadiene	EPA 8270C	10185805	NELAP	PA
6285 - Hexachlorocyclopentadiene	EPA 8270C	10185805	NELAP	PA
4840 - Hexachloroethane	EPA 8270C	10185805	NELAP	PA
6295 - Hexachloropropene	EPA 8270C	10185805	NELAP	PA
6312 - Indene	EPA 8270C	10185805	NELAP	PA
6315 - Indeno(1,2,3-cd) pyrene	EPA 8270C	10185805	NELAP	PA
7725 - Isodrin	EPA 8270C	10185805	NELAP	PA
6320 - Isophorone	EPA 8270C	10185805	NELAP	PA
6325 - Isosafrole	EPA 8270C	10185805	NELAP	PA
7740 - Kepone	EPA 8270C	10185805	NELAP	PA
6345 - Methapyrilene	EPA 8270C	10185805	NELAP	PA
6375 - Methyl methanesulfonate	EPA 8270C	10185805	NELAP	PA
7825 - Methyl parathion (Parathion, methyl)	EPA 8270C	10185805	NELAP	PA
5005 - Naphthalene	EPA 8270C	10185805	NELAP	PA
5015 - Nitrobenzene	EPA 8270C	10185805	NELAP	PA
7955 - Parathion, ethyl	EPA 8270C	10185805	NELAP	PA
6600 - Pentachloronitrobenzene	EPA 8270C	10185805	NELAP	PA
6605 - Pentachlorophenol	EPA 8270C	10185805	NELAP	PA
6610 - Phenacetin	EPA 8270C	10185805	NELAP	PA
6615 - Phenanthrene	EPA 8270C	10185805	NELAP	PA
6625 - Phenol	EPA 8270C	10185805	NELAP	PA
7985 - Phorate	EPA 8270C	10185805	NELAP	PA
6640 - Phthalic anhydride	EPA 8270C	10185805	NELAP	PA
6650 - Pronamide (Kerb)	EPA 8270C	10185805	NELAP	PA
6665 - Pyrene	EPA 8270C	10185805	NELAP	PA
5095 - Pyridine	EPA 8270C	10185805	NELAP	PA
6670 - Quinoline	EPA 8270C	10185805	NELAP	PA
6685 - Safrole	EPA 8270C	10185805	NELAP	PA
8155 - Sulfotepp	EPA 8270C	10185805	NELAP	PA
8210 - Tetraethyl pyrophosphate (TEPP)	EPA 8270C	10185805	NELAP	PA
8235 - Thionazin (Zinophos)	EPA 8270C	10185805	NELAP	PA

Non Potable Water

Analyte	Method Name	Method Code	Type	AB
6750 - Thiophenol (Benzenethiol)	EPA 8270C	10185805	NELAP	PA
6755 - Tolualdehyde (1,2-Tolualdehyde)	EPA 8270C	10185805	NELAP	PA
6125 - a-a-Dimethylphenethylamine	EPA 8270C	10185805	NELAP	PA
5760 - bis(2-Chloroethoxy)methane	EPA 8270C	10185805	NELAP	PA
5765 - bis(2-Chloroethyl) ether	EPA 8270C	10185805	NELAP	PA
5780 - bis(2-Chloroisopropyl) ether	EPA 8270C	10185805	NELAP	PA
5025 - n-Nitroso-di-n-butylamine	EPA 8270C	10185805	NELAP	PA
6545 - n-Nitrosodi-n-propylamine	EPA 8270C	10185805	NELAP	PA
6525 - n-Nitrosodiethylamine	EPA 8270C	10185805	NELAP	PA
6530 - n-Nitrosodimethylamine	EPA 8270C	10185805	NELAP	PA
6535 - n-Nitrosodiphenylamine	EPA 8270C	10185805	NELAP	PA
6550 - n-Nitrosomethylethylamine	EPA 8270C	10185805	NELAP	PA
6555 - n-Nitrosomorpholine	EPA 8270C	10185805	NELAP	PA
6560 - n-Nitrosopiperidine	EPA 8270C	10185805	NELAP	PA
6565 - n-Nitrosopyrrolidine	EPA 8270C	10185805	NELAP	PA
8290 - o,o,o-Triethyl phosphorothioate	EPA 8270C	10185805	NELAP	PA
6105 - p-Dimethylaminoazobenzene	EPA 8270C	10185805	NELAP	PA
8310 - tris-(2,3-Dibromopropyl) phosphate (tris-BP)	EPA 8270C	10185805	NELAP	PA
6715 - 1,2,4,5-Tetrachlorobenzene	EPA 8270D	10186002	NELAP	PA
5155 - 1,2,4-Trichlorobenzene	EPA 8270D	10186002	NELAP	PA
4610 - 1,2-Dichlorobenzene	EPA 8270D	10186002	NELAP	PA
6220 - 1,2-Diphenylhydrazine	EPA 8270D	10186002	NELAP	PA
6885 - 1,3,5-Trinitrobenzene (1,3,5-TNB)	EPA 8270D	10186002	NELAP	PA
4615 - 1,3-Dichlorobenzene	EPA 8270D	10186002	NELAP	PA
6160 - 1,3-Dinitrobenzene (1,3-DNB)	EPA 8270D	10186002	NELAP	PA
4620 - 1,4-Dichlorobenzene	EPA 8270D	10186002	NELAP	PA
6165 - 1,4-Dinitrobenzene	EPA 8270D	10186002	NELAP	PA
4735 - 1,4-Dioxane (1,4- Diethyleneoxide)	EPA 8270D	10186002	NELAP	PA
6420 - 1,4-Naphthoquinone	EPA 8270D	10186002	NELAP	PA
6630 - 1,4-Phenylenediamine	EPA 8270D	10186002	NELAP	PA
5790 - 1-Chloronaphthalene	EPA 8270D	10186002	NELAP	PA
6380 - 1-Methylnaphthalene	EPA 8270D	10186002	NELAP	PA
6425 - 1-Naphthylamine	EPA 8270D	10186002	NELAP	PA
6735 - 2,3,4,6-Tetrachlorophenol	EPA 8270D	10186002	NELAP	PA
6835 - 2,4,5-Trichlorophenol	EPA 8270D	10186002	NELAP	PA
6840 - 2,4,6-Trichlorophenol	EPA 8270D	10186002	NELAP	PA
6000 - 2,4-Dichlorophenol	EPA 8270D	10186002	NELAP	PA
6130 - 2,4-Dimethylphenol	EPA 8270D	10186002	NELAP	PA
6175 - 2,4-Dinitrophenol	EPA 8270D	10186002	NELAP	PA
6185 - 2,4-Dinitrotoluene (2,4-DNT)	EPA 8270D	10186002	NELAP	PA
6005 - 2,6-Dichlorophenol	EPA 8270D	10186002	NELAP	PA
6190 - 2,6-Dinitrotoluene (2,6-DNT)	EPA 8270D	10186002	NELAP	PA
5515 - 2-Acetylaminofluorene	EPA 8270D	10186002	NELAP	PA
5795 - 2-Chloronaphthalene	EPA 8270D	10186002	NELAP	PA
5800 - 2-Chlorophenol	EPA 8270D	10186002	NELAP	PA
6360 - 2-Methyl-4,6-dinitrophenol (4,6-Dinitro-2-methylphenol)	EPA 8270D	10186002	NELAP	PA
5145 - 2-Methylaniline (o-Toluidine)	EPA 8270D	10186002	NELAP	PA
6385 - 2-Methylnaphthalene	EPA 8270D	10186002	NELAP	PA
6400 - 2-Methylphenol (o-Cresol)	EPA 8270D	10186002	NELAP	PA
6430 - 2-Naphthylamine	EPA 8270D	10186002	NELAP	PA
6460 - 2-Nitroaniline	EPA 8270D	10186002	NELAP	PA
6490 - 2-Nitrophenol	EPA 8270D	10186002	NELAP	PA
5050 - 2-Picoline (2-Methylpyridine)	EPA 8270D	10186002	NELAP	PA
5945 - 3,3'-Dichlorobenzidine	EPA 8270D	10186002	NELAP	PA

Non Potable Water

Analyte	Method Name	Method Code	Type	AB
6120 - 3,3'-Dimethylbenzidine	EPA 8270D	10186002	NELAP	PA
6355 - 3-Methylcholanthrene	EPA 8270D	10186002	NELAP	PA
6405 - 3-Methylphenol (m-Cresol)	EPA 8270D	10186002	NELAP	PA
6465 - 3-Nitroaniline	EPA 8270D	10186002	NELAP	PA
5540 - 4-Aminobiphenyl	EPA 8270D	10186002	NELAP	PA
5660 - 4-Bromophenyl phenyl ether	EPA 8270D	10186002	NELAP	PA
5700 - 4-Chloro-3-methylphenol	EPA 8270D	10186002	NELAP	PA
5745 - 4-Chloroaniline	EPA 8270D	10186002	NELAP	PA
5825 - 4-Chlorophenyl phenylether	EPA 8270D	10186002	NELAP	PA
6410 - 4-Methylphenol (p-Cresol)	EPA 8270D	10186002	NELAP	PA
6470 - 4-Nitroaniline	EPA 8270D	10186002	NELAP	PA
6500 - 4-Nitrophenol	EPA 8270D	10186002	NELAP	PA
6510 - 4-Nitroquinoline 1-oxide	EPA 8270D	10186002	NELAP	PA
6570 - 5-Nitro-o-toluidine	EPA 8270D	10186002	NELAP	PA
6115 - 7,12-Dimethylbenz(a) anthracene	EPA 8270D	10186002	NELAP	PA
5500 - Acenaphthene	EPA 8270D	10186002	NELAP	PA
5505 - Acenaphthylene	EPA 8270D	10186002	NELAP	PA
5510 - Acetophenone	EPA 8270D	10186002	NELAP	PA
5545 - Aniline	EPA 8270D	10186002	NELAP	PA
5555 - Anthracene	EPA 8270D	10186002	NELAP	PA
5560 - Aramite	EPA 8270D	10186002	NELAP	PA
5567 - Benzenethiol	EPA 8270D	10186002	NELAP	PA
5595 - Benzidine	EPA 8270D	10186002	NELAP	PA
5575 - Benzo(a)anthracene	EPA 8270D	10186002	NELAP	PA
5580 - Benzo(a)pyrene	EPA 8270D	10186002	NELAP	PA
5585 - Benzo(b)fluoranthene	EPA 8270D	10186002	NELAP	PA
5590 - Benzo(g,h,i)perylene	EPA 8270D	10186002	NELAP	PA
5600 - Benzo(k)fluoranthene	EPA 8270D	10186002	NELAP	PA
5610 - Benzoic acid	EPA 8270D	10186002	NELAP	PA
5630 - Benzyl alcohol	EPA 8270D	10186002	NELAP	PA
5635 - Benzyl chloride	EPA 8270D	10186002	NELAP	PA
5670 - Butyl benzyl phthalate	EPA 8270D	10186002	NELAP	PA
7180 - Caprolactam	EPA 8270D	10186002	NELAP	PA
5680 - Carbazole	EPA 8270D	10186002	NELAP	PA
5855 - Chrysene	EPA 8270D	10186002	NELAP	PA
6065 - Di(2-ethylhexyl) phthalate (bis(2-Ethylhexyl)phthalate, DEHP)	EPA 8270D	10186002	NELAP	PA
5925 - Di-n-butyl phthalate	EPA 8270D	10186002	NELAP	PA
6200 - Di-n-octyl phthalate	EPA 8270D	10186002	NELAP	PA
7405 - Diallate	EPA 8270D	10186002	NELAP	PA
5895 - Dibenz(a,h) anthracene	EPA 8270D	10186002	NELAP	PA
5905 - Dibenzofuran	EPA 8270D	10186002	NELAP	PA
6135 - Dimethyl phthalate	EPA 8270D	10186002	NELAP	PA
8620 - Dinoseb (2-sec-butyl-4,6-dinitrophenol, DNBP)	EPA 8270D	10186002	NELAP	PA
6205 - Diphenylamine	EPA 8270D	10186002	NELAP	PA
8625 - Disulfoton	EPA 8270D	10186002	NELAP	PA
6260 - Ethyl methanesulfonate	EPA 8270D	10186002	NELAP	PA
7580 - Famphur	EPA 8270D	10186002	NELAP	PA
6265 - Fluoranthene	EPA 8270D	10186002	NELAP	PA
6270 - Fluorene	EPA 8270D	10186002	NELAP	PA
6275 - Hexachlorobenzene	EPA 8270D	10186002	NELAP	PA
4835 - Hexachlorobutadiene	EPA 8270D	10186002	NELAP	PA
6285 - Hexachlorocyclopentadiene	EPA 8270D	10186002	NELAP	PA
4840 - Hexachloroethane	EPA 8270D	10186002	NELAP	PA
6295 - Hexachloropropene	EPA 8270D	10186002	NELAP	PA

Non Potable Water

Analyte	Method Name	Method Code	Type	AB
6315 - Indeno(1,2,3-cd) pyrene	EPA 8270D	10186002	NELAP	PA
7725 - Isodrin	EPA 8270D	10186002	NELAP	PA
6320 - Isophorone	EPA 8270D	10186002	NELAP	PA
6325 - Isosafrole	EPA 8270D	10186002	NELAP	PA
7740 - Kepone	EPA 8270D	10186002	NELAP	PA
6345 - Methapyrilene	EPA 8270D	10186002	NELAP	PA
6375 - Methyl methanesulfonate	EPA 8270D	10186002	NELAP	PA
7825 - Methyl parathion (Parathion, methyl)	EPA 8270D	10186002	NELAP	PA
5005 - Naphthalene	EPA 8270D	10186002	NELAP	PA
5015 - Nitrobenzene	EPA 8270D	10186002	NELAP	PA
7955 - Parathion, ethyl	EPA 8270D	10186002	NELAP	PA
6600 - Pentachloronitrobenzene	EPA 8270D	10186002	NELAP	PA
6605 - Pentachlorophenol	EPA 8270D	10186002	NELAP	PA
6610 - Phenacetin	EPA 8270D	10186002	NELAP	PA
6615 - Phenanthrene	EPA 8270D	10186002	NELAP	PA
6625 - Phenol	EPA 8270D	10186002	NELAP	PA
7985 - Phorate	EPA 8270D	10186002	NELAP	PA
6650 - Pronamide (Kerb)	EPA 8270D	10186002	NELAP	PA
5095 - Pyridine	EPA 8270D	10186002	NELAP	PA
6670 - Quinoline	EPA 8270D	10186002	NELAP	PA
6685 - Safrole	EPA 8270D	10186002	NELAP	PA
8155 - Sulfotepp	EPA 8270D	10186002	NELAP	PA
8235 - Thionazin (Zinophos)	EPA 8270D	10186002	NELAP	PA
6750 - Thiophenol (Benzenethiol)	EPA 8270D	10186002	NELAP	PA
6125 - a-a-Dimethylphenethylamine	EPA 8270D	10186002	NELAP	PA
5760 - bis(2-Chloroethoxy)methane	EPA 8270D	10186002	NELAP	PA
5765 - bis(2-Chloroethyl) ether	EPA 8270D	10186002	NELAP	PA
5780 - bis(2-Chloroisopropyl) ether	EPA 8270D	10186002	NELAP	PA
5025 - n-Nitroso-di-n-butylamine	EPA 8270D	10186002	NELAP	PA
6545 - n-Nitrosodi-n-propylamine	EPA 8270D	10186002	NELAP	PA
6525 - n-Nitrosodiethylamine	EPA 8270D	10186002	NELAP	PA
6530 - n-Nitrosodimethylamine	EPA 8270D	10186002	NELAP	PA
6535 - n-Nitrosodiphenylamine	EPA 8270D	10186002	NELAP	PA
6550 - n-Nitrosomethylethylamine	EPA 8270D	10186002	NELAP	PA
6555 - n-Nitrosomorpholine	EPA 8270D	10186002	NELAP	PA
6560 - n-Nitrosopiperidine	EPA 8270D	10186002	NELAP	PA
6565 - n-Nitrosopyrrolidine	EPA 8270D	10186002	NELAP	PA
8290 - o,o,o-Triethyl phosphorothioate	EPA 8270D	10186002	NELAP	PA
8310 - tris-(2,3-Dibromopropyl) phosphate (tris-BP)	EPA 8270D	10186002	NELAP	PA
9519 - 1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	EPA 8290A	10187403	NELAP	PA
9516 - 1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	EPA 8290A	10187403	NELAP	PA
9426 - 1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (1,2,3,4,6,7,8-hpcdd)	EPA 8290A	10187403	NELAP	PA
9420 - 1,2,3,4,6,7,8-Heptachlorodibenzofuran (1,2,3,4,6,7,8-hpcdf)	EPA 8290A	10187403	NELAP	PA
9423 - 1,2,3,4,7,8,9-Heptachlorodibenzofuran (1,2,3,4,7,8,9-hpcdf)	EPA 8290A	10187403	NELAP	PA
9453 - 1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (1,2,3,4,7,8-Hxcdd)	EPA 8290A	10187403	NELAP	PA
9471 - 1,2,3,4,7,8-Hexachlorodibenzofuran (1,2,3,4,7,8-Hxcdf)	EPA 8290A	10187403	NELAP	PA

Non Potable Water

Analyte	Method Name	Method Code	Type	AB
9456 - 1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin(1,2,3,6,7,8-Hxcdd)	EPA 8290A	10187403	NELAP	PA
9474 - 1,2,3,6,7,8-Hexachlorodibenzofuran (1,2,3,6,7,8-Hxcdf)	EPA 8290A	10187403	NELAP	PA
9459 - 1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (1,2,3,7,8,9-Hxcdd)	EPA 8290A	10187403	NELAP	PA
9477 - 1,2,3,7,8,9-Hexachlorodibenzofuran (1,2,3,7,8,9-Hxcdf)	EPA 8290A	10187403	NELAP	PA
9540 - 1,2,3,7,8-Pentachlorodibenzo-p-dioxin (1,2,3,7,8-Pecdd)	EPA 8290A	10187403	NELAP	PA
9543 - 1,2,3,7,8-Pentachlorodibenzofuran (1,2,3,7,8-Pecdf)	EPA 8290A	10187403	NELAP	PA
9480 - 2,3,4,6,7,8-Hexachlorodibenzofuran	EPA 8290A	10187403	NELAP	PA
9549 - 2,3,4,7,8-Pentachlorodibenzofuran	EPA 8290A	10187403	NELAP	PA
9612 - 2,3,7,8-Tetrachlorodibenzofuran	EPA 8290A	10187403	NELAP	PA
9438 - Total Hpcdd	EPA 8290A	10187403	NELAP	PA
9444 - Total Hpcdf	EPA 8290A	10187403	NELAP	PA
9468 - Total Hxcdd	EPA 8290A	10187403	NELAP	PA
9483 - Total Hxcdf	EPA 8290A	10187403	NELAP	PA
9555 - Total Pecdd	EPA 8290A	10187403	NELAP	PA
9552 - Total Pecdf	EPA 8290A	10187403	NELAP	PA
9609 - Total TCDD	EPA 8290A	10187403	NELAP	PA
9615 - Total TCDF	EPA 8290A	10187403	NELAP	PA
5500 - Acenaphthene	EPA 8310	10187607	NELAP	PA
5505 - Acenaphthylene	EPA 8310	10187607	NELAP	PA
5555 - Anthracene	EPA 8310	10187607	NELAP	PA
5575 - Benzo(a)anthracene	EPA 8310	10187607	NELAP	PA
5580 - Benzo(a)pyrene	EPA 8310	10187607	NELAP	PA
5585 - Benzo(b)fluoranthene	EPA 8310	10187607	NELAP	PA
5590 - Benzo(g,h,i)perylene	EPA 8310	10187607	NELAP	PA
5600 - Benzo(k)fluoranthene	EPA 8310	10187607	NELAP	PA
5855 - Chrysene	EPA 8310	10187607	NELAP	PA
5895 - Dibenz(a,h) anthracene	EPA 8310	10187607	NELAP	PA
6265 - Fluoranthene	EPA 8310	10187607	NELAP	PA
6270 - Fluorene	EPA 8310	10187607	NELAP	PA
6315 - Indeno(1,2,3-cd) pyrene	EPA 8310	10187607	NELAP	PA
5005 - Naphthalene	EPA 8310	10187607	NELAP	PA
6615 - Phenanthrene	EPA 8310	10187607	NELAP	PA
6665 - Pyrene	EPA 8310	10187607	NELAP	PA
6110 - 2,5-Dimethylbenzaldehyde	EPA 8315	10187801	NELAP	PA
4300 - Acetaldehyde	EPA 8315	10187801	NELAP	PA
4325 - Acrolein (Propenal)	EPA 8315	10187801	NELAP	PA
5570 - Benzaldehyde	EPA 8315	10187801	NELAP	PA
4430 - Butylaldehyde (Butanal)	EPA 8315	10187801	NELAP	PA
4545 - Crotonaldehyde	EPA 8315	10187801	NELAP	PA
4815 - Formaldehyde	EPA 8315	10187801	NELAP	PA
3825 - Hexanaldehyde (Hexanal)	EPA 8315	10187801	NELAP	PA
6330 - Isovaleraldehyde	EPA 8315	10187801	NELAP	PA
3965 - Propionaldehyde (Propanal)	EPA 8315	10187801	NELAP	PA
4040 - Valeraldehyde (Pentanal, Pentanaldehyde)	EPA 8315	10187801	NELAP	PA
4300 - Acetaldehyde	EPA 8315A	10188008	NELAP	PA
4815 - Formaldehyde	EPA 8315A	10188008	NELAP	PA
6885 - 1,3,5-Trinitrobenzene (1,3,5-TNB)	EPA 8330	10189807	NELAP	PA
6160 - 1,3-Dinitrobenzene (1,3-DNB)	EPA 8330	10189807	NELAP	PA
9651 - 2,4,6-Trinitrotoluene (2,4,6-TNT)	EPA 8330	10189807	NELAP	PA

Non Potable Water

Analyte	Method Name	Method Code	Type	AB
6185 - 2,4-Dinitrotoluene (2,4-DNT)	EPA 8330	10189807	NELAP	PA
6190 - 2,6-Dinitrotoluene (2,6-DNT)	EPA 8330	10189807	NELAP	PA
9303 - 2-Amino-4,6-dinitrotoluene (2-am-dnt)	EPA 8330	10189807	NELAP	PA
9507 - 2-Nitrotoluene	EPA 8330	10189807	NELAP	PA
9510 - 3-Nitrotoluene	EPA 8330	10189807	NELAP	PA
9306 - 4-Amino-2,6-dinitrotoluene (4-am-dnt)	EPA 8330	10189807	NELAP	PA
9513 - 4-Nitrotoluene	EPA 8330	10189807	NELAP	PA
6415 - Methyl-2,4,6-trinitrophenylnitramine (tetryl)	EPA 8330	10189807	NELAP	PA
5015 - Nitrobenzene	EPA 8330	10189807	NELAP	PA
6485 - Nitroglycerin	EPA 8330	10189807	NELAP	PA
9522 - Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)	EPA 8330	10189807	NELAP	PA
9558 - Pentaerythritoltetranitrate	EPA 8330	10189807	NELAP	PA
9432 - RDX (hexahydro-1,3,5-trinitro-1,3,5-triazine)	EPA 8330	10189807	NELAP	PA
6885 - 1,3,5-Trinitrobenzene (1,3,5-TNB)	EPA 8330A	10190008	NELAP	PA
6160 - 1,3-Dinitrobenzene (1,3-DNB)	EPA 8330A	10190008	NELAP	PA
9651 - 2,4,6-Trinitrotoluene (2,4,6-TNT)	EPA 8330A	10190008	NELAP	PA
6185 - 2,4-Dinitrotoluene (2,4-DNT)	EPA 8330A	10190008	NELAP	PA
6190 - 2,6-Dinitrotoluene (2,6-DNT)	EPA 8330A	10190008	NELAP	PA
9303 - 2-Amino-4,6-dinitrotoluene (2-am-dnt)	EPA 8330A	10190008	NELAP	PA
9507 - 2-Nitrotoluene	EPA 8330A	10190008	NELAP	PA
9510 - 3-Nitrotoluene	EPA 8330A	10190008	NELAP	PA
9306 - 4-Amino-2,6-dinitrotoluene (4-am-dnt)	EPA 8330A	10190008	NELAP	PA
9513 - 4-Nitrotoluene	EPA 8330A	10190008	NELAP	PA
6415 - Methyl-2,4,6-trinitrophenylnitramine (tetryl)	EPA 8330A	10190008	NELAP	PA
5015 - Nitrobenzene	EPA 8330A	10190008	NELAP	PA
6485 - Nitroglycerin	EPA 8330A	10190008	NELAP	PA
9522 - Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)	EPA 8330A	10190008	NELAP	PA
9558 - Pentaerythritoltetranitrate	EPA 8330A	10190008	NELAP	PA
9432 - RDX (hexahydro-1,3,5-trinitro-1,3,5-triazine)	EPA 8330A	10190008	NELAP	PA
6485 - Nitroglycerin	EPA 8332	10190406	NELAP	PA
1645 - Total Cyanide	EPA 9012	10193201	NELAP	PA
1635 - Cyanide	EPA 9012A	10193405	NELAP	PA
1645 - Total Cyanide	EPA 9012A	10193405	NELAP	PA
1900 - pH	EPA 9040B	10197203	NELAP	PA
1625 - Corrosivity (pH)	EPA 9045	10197805	NELAP	PA
1900 - pH	EPA 9045	10197805	NELAP	PA
1610 - Conductivity	EPA 9050	10198604	NELAP	PA
1610 - Conductivity	EPA 9050A	10198808	NELAP	PA
1540 - Bromide	EPA 9056	10199005	NELAP	PA
1575 - Chloride	EPA 9056	10199005	NELAP	PA
1730 - Fluoride	EPA 9056	10199005	NELAP	PA
1805 - Nitrate	EPA 9056	10199005	NELAP	PA
1835 - Nitrite	EPA 9056	10199005	NELAP	PA
2000 - Sulfate	EPA 9056	10199005	NELAP	PA
1540 - Bromide	EPA 9056	10199209	NELAP	PA
1575 - Chloride	EPA 9056	10199209	NELAP	PA

Non Potable Water

Analyte	Method Name	Method Code	Type	AB
1730 - Fluoride	EPA 9056	10199209	NELAP	PA
2000 - Sulfate	EPA 9056	10199209	NELAP	PA
1575 - Chloride	EPA 9056	10199403	NELAP	PA
1730 - Fluoride	EPA 9056	10199403	NELAP	PA
1805 - Nitrate	EPA 9056	10199403	NELAP	PA
1835 - Nitrite	EPA 9056	10199403	NELAP	PA
2000 - Sulfate	EPA 9056	10199403	NELAP	PA
1575 - Chloride	EPA 9056A	10199607	NELAP	PA
1730 - Fluoride	EPA 9056A	10199607	NELAP	PA
1805 - Nitrate	EPA 9056A	10199607	NELAP	PA
1835 - Nitrite	EPA 9056A	10199607	NELAP	PA
1840 - Nitrite as N	EPA 9056A	10199607	NELAP	PA
2000 - Sulfate	EPA 9056A	10199607	NELAP	PA
2040 - Total Organic Carbon	EPA 9060	10200201	NELAP	PA
1905 - Total Phenolics	EPA 9066	10200609	NELAP	PA
4747 - Ethane	EPA RSK-175 (GC/FID)	10212905	NELAP	PA
4752 - Ethene	EPA RSK-175 (GC/FID)	10212905	NELAP	PA
4926 - Methane	EPA RSK-175 (GC/FID)	10212905	NELAP	PA
100263 - Propane	EPA RSK-175 (GC/FID)	10212905	NELAP	PA
5007 - n-Butane	EPA RSK-175 (GC/FID)	10212905	NELAP	PA
5029 - n-Propane	EPA RSK-175 (GC/FID)	10212905	NELAP	PA
1095 - Mercury	EPA 1631E	10237204	NELAP	PA
1810 - Nitrate as N	EPA 353.2 (calc.)	10238809	NELAP	PA
6380 - 1-Methylnaphthalene	EPA 8270C SIM	10242407	NELAP	PA
5500 - Acenaphthene	EPA 8270C SIM	10242407	NELAP	PA
5505 - Acenaphthylene	EPA 8270C SIM	10242407	NELAP	PA
5555 - Anthracene	EPA 8270C SIM	10242407	NELAP	PA
5575 - Benzo(a)anthracene	EPA 8270C SIM	10242407	NELAP	PA
5580 - Benzo(a)pyrene	EPA 8270C SIM	10242407	NELAP	PA
5585 - Benzo(b)fluoranthene	EPA 8270C SIM	10242407	NELAP	PA
5590 - Benzo(g,h,i)perylene	EPA 8270C SIM	10242407	NELAP	PA
5600 - Benzo(k)fluoranthene	EPA 8270C SIM	10242407	NELAP	PA
5855 - Chrysene	EPA 8270C SIM	10242407	NELAP	PA
5895 - Dibenz(a,h) anthracene	EPA 8270C SIM	10242407	NELAP	PA
6265 - Fluoranthene	EPA 8270C SIM	10242407	NELAP	PA
6270 - Fluorene	EPA 8270C SIM	10242407	NELAP	PA
6315 - Indeno(1,2,3-cd) pyrene	EPA 8270C SIM	10242407	NELAP	PA
5005 - Naphthalene	EPA 8270C SIM	10242407	NELAP	PA
6615 - Phenanthrene	EPA 8270C SIM	10242407	NELAP	PA
6665 - Pyrene	EPA 8270C SIM	10242407	NELAP	PA
6380 - 1-Methylnaphthalene	EPA 8270D SIM	10242509	NELAP	PA
9501 - 1-Methylphenanthrene	EPA 8270D SIM	10242509	NELAP	PA
5500 - Acenaphthene	EPA 8270D SIM	10242509	NELAP	PA
5505 - Acenaphthylene	EPA 8270D SIM	10242509	NELAP	PA
5555 - Anthracene	EPA 8270D SIM	10242509	NELAP	PA
5575 - Benzo(a)anthracene	EPA 8270D SIM	10242509	NELAP	PA
5580 - Benzo(a)pyrene	EPA 8270D SIM	10242509	NELAP	PA
5585 - Benzo(b)fluoranthene	EPA 8270D SIM	10242509	NELAP	PA
5590 - Benzo(g,h,i)perylene	EPA 8270D SIM	10242509	NELAP	PA
5600 - Benzo(k)fluoranthene	EPA 8270D SIM	10242509	NELAP	PA
5855 - Chrysene	EPA 8270D SIM	10242509	NELAP	PA
5895 - Dibenz(a,h) anthracene	EPA 8270D SIM	10242509	NELAP	PA
6265 - Fluoranthene	EPA 8270D SIM	10242509	NELAP	PA
6270 - Fluorene	EPA 8270D SIM	10242509	NELAP	PA
6315 - Indeno(1,2,3-cd) pyrene	EPA 8270D SIM	10242509	NELAP	PA
5005 - Naphthalene	EPA 8270D SIM	10242509	NELAP	PA

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Analyte	Method Name	Method Code	Type	AB
6615 - Phenanthrene	EPA 8270D SIM	10242509	NELAP	PA
6665 - Pyrene	EPA 8270D SIM	10242509	NELAP	PA
1635 - Cyanide	EPA 9012B	10243206	NELAP	PA
1645 - Total Cyanide	EPA 9012B	10243206	NELAP	PA
1900 - pH	EPA 9040C	10244403	NELAP	PA
8946 - 2,2',3,4,5+2,2',3,4,5'+2,2',3,4',5'+2,3,3',4,5'+ 2,3',4,4'6+2,3',4',5'6-Pentachlorobiphenyl (BZ 86+87+97+108+119+125)	EPA 1668A	10262007	NELAP	PA
8958 - 2,2',3,6+2,2',4,6'-Tetrachlorobiphenyls (BZ 45 + 51)	EPA 1668A	10262007	NELAP	PA
8963 - 2,3,4,5+2,3',4',5+2,4,4',5+2,3',4',5'-Tetrachlorobiphenyls (BZ 61+70+74+76)	EPA 1668A	10262007	NELAP	PA
1575 - Chloride	EPA 300.0	10275408	NELAP	PA
1840 - Nitrite as N	EPA 300.0	10275408	NELAP	PA
2000 - Sulfate	EPA 300.0	10275408	NELAP	PA
1895 - Perchlorate	EPA 6850	10304606	NELAP	PA
1730 - Fluoride	SM 4500-F B	20012606	NELAP	PA
1605 - Color	SM 2120 B-1993, Online Edition	20039207	NELAP	PA
1500 - Acidity, as CaCO3	SM 2310 B, 20th ED	20044206	NELAP	PA
100410 - Alkalinity, bicarbonate	SM 2320 B, 18th ED	20044808	NELAP	LA
100411 - Alkalinity, carbonate	SM 2320 B, 18th ED	20044808	NELAP	LA
1505 - Alkalinity as CaCO3	SM 2320 B, 20th ED	20045209	NELAP	PA
1755 - Total hardness as CaCO3	SM 2340 B, 19th ED	20046008	NELAP	PA
1755 - Total hardness as CaCO3	SM 2340 B, 20th ED	20046202	NELAP	PA
1955 - Residue-filterable (TDS)	SM 2340 C, 20th ED	20047205	NELAP	PA
1610 - Conductivity	SM 2510 B, 20th ED	20048208	NELAP	PA
1610 - Conductivity	SM 2510 B, 21st ED	20048402	NELAP	PA
1950 - Residue-total	SM 2540 B, 20th ED	20049007	NELAP	PA
1950 - Residue-total	SM 2540 B-97, Online Edition	20049405	NELAP	PA
1955 - Residue-filterable (TDS)	SM 2540 C, 20th ED	20050004	NELAP	PA
1960 - Residue-nonfilterable (TSS)	SM 2540 D, 20th ED	20050800	NELAP	PA
1965 - Residue-settleable	SM 2540 F, 20th ED	20051803	NELAP	PA
2030 - Temperature, deg. C	SM 2550 B, 20th ED	20052806	NELAP	PA
1575 - Chloride	SM 4500-Cl^- C, 20th ED	20084804	NELAP	PA
1940 - Total residual chlorine	SM 4500-Cl^- F, 20th ED	20087201	NELAP	PA
1645 - Total Cyanide	SM 4500-CN^- C, 20th ED	20091605	NELAP	PA
1635 - Cyanide	SM 4500-CN^- E, 20th ED	20092404	NELAP	PA
1510 - Amenable cyanide	SM 4500-CN^- G, 20th ED	20093203	NELAP	PA
1635 - Cyanide	SM 4500-CN^- C, 21st ED	20095403	NELAP	PA
1730 - Fluoride	SM 4500-F^- B, 20th ED	20101002	NELAP	PA
1730 - Fluoride	SM 4500-F^- C, 20th ED	20102005	NELAP	OR
1730 - Fluoride	SM 4500-F C, 21st ED	20102209	NELAP	PA
1900 - pH	SM 4500-H+ B, 20th ED	20104807	NELAP	PA
1515 - Ammonia as N	SM 4500-NH3 B, 20th ED	20105606	NELAP	PA
1515 - Ammonia as N	SM 4500-NH3 C, 20th ED	20106405	NELAP	PA
1515 - Ammonia as N	SM 4500-NH3 D, 20th ED	20109006	NELAP	PA
1880 - Oxygen, dissolved	SM 4500-O G, 20th ED	20121204	NELAP	PA
1910 - Total Phosphorus	SM 4500-P B, 21st ED	20122809	NELAP	PA
1910 - Total Phosphorus	SM 4500-P B 5, 20th ED	20123200	NELAP	PA
1910 - Total Phosphorus	SM 4500-P E, 20th ED	20123802	NELAP	PA
1910 - Total Phosphorus	SM 4500-P F, 20th ED	20124601	NELAP	PA
2005 - Sulfide	SM 4500-$S2^-$ D, 20th ED	20125400	NELAP	PA
2005 - Sulfide	SM 4500-$S2^-$ F, 20th ED	20126209	NELAP	PA
1990 - Silica as SiO2	SM 4500-SiO2 C, 20th ED	20128205	NELAP	PA
2015 - Sulfite-SO3	SM 4500-SO3 B, 20th ED	20130205	NELAP	PA

Clients and Customers are urged to verify the laboratory's current certification status with the Louisiana Environmental Laboratory Accreditation Program.

Non Potable Water

Analyte	Method Name	Method Code	Type	AB
2015 - Sulfite-SO3	SM 4500-SO3 B, 21st ED	20130409	NELAP	PA
1530 - Biochemical oxygen demand	SM 5210 B, 20th ED	20134809	NELAP	PA
1555 - Carbonaceous BOD, CBOD	SM 5210 B, 20th ED	20134809	NELAP	PA
2040 - Total Organic Carbon	SM 5310 B, 20th ED	20137400	NELAP	PA
2040 - Total Organic Carbon	SM 5310 C, 20th ED	20138403	NELAP	PA
2025 - Surfactants - MBAS	SM 5540 C, 20th ED	20144609	NELAP	PA
1605 - Color	SM 2120 B, 20th ED	20224004	NELAP	PA
1645 - Total Cyanide	ASTM D7511-09	30032985	NELAP	PA
1523 - Available Cyanide	OIA 1677	60031405	NELAP	PA
1640 - Free cyanide	OIA 1677	60031405	NELAP	PA
6385 - 2-Methylnaphthalene	MADEP EPH, Rev.1.1	90017202	NELAP	PA
5500 - Acenaphthene	MADEP EPH, Rev.1.1	90017202	NELAP	PA
5505 - Acenaphthylene	MADEP EPH, Rev.1.1	90017202	NELAP	PA
5555 - Anthracene	MADEP EPH, Rev.1.1	90017202	NELAP	PA
5575 - Benzo(a)anthracene	MADEP EPH, Rev.1.1	90017202	NELAP	PA
5580 - Benzo(a)pyrene	MADEP EPH, Rev.1.1	90017202	NELAP	PA
5585 - Benzo(b)fluoranthene	MADEP EPH, Rev.1.1	90017202	NELAP	PA
5590 - Benzo(g,h,i)perylene	MADEP EPH, Rev.1.1	90017202	NELAP	PA
5600 - Benzo(k)fluoranthene	MADEP EPH, Rev.1.1	90017202	NELAP	PA
5855 - Chrysene	MADEP EPH, Rev.1.1	90017202	NELAP	PA
5895 - Dibenz(a,h) anthracene	MADEP EPH, Rev.1.1	90017202	NELAP	PA
6218 - EPH Aliphatic C19-C36	MADEP EPH, Rev.1.1	90017202	NELAP	PA
6222 - EPH Aliphatic C9-C18	MADEP EPH, Rev.1.1	90017202	NELAP	PA
6232 - EPH Aromatic C11-C22	MADEP EPH, Rev.1.1	90017202	NELAP	PA
6234 - EPH Aromatic C11-C22 Unadjusted	MADEP EPH, Rev.1.1	90017202	NELAP	PA
6265 - Fluoranthene	MADEP EPH, Rev.1.1	90017202	NELAP	PA
6270 - Fluorene	MADEP EPH, Rev.1.1	90017202	NELAP	PA
6315 - Indeno(1,2,3-cd) pyrene	MADEP EPH, Rev.1.1	90017202	NELAP	PA
5005 - Naphthalene	MADEP EPH, Rev.1.1	90017202	NELAP	PA
6615 - Phenanthrene	MADEP EPH, Rev.1.1	90017202	NELAP	PA
6665 - Pyrene	MADEP EPH, Rev.1.1	90017202	NELAP	PA
4375 - Benzene	MADEP VPH, Rev.1.1	90017406	NELAP	PA
4765 - Ethylbenzene	MADEP VPH, Rev.1.1	90017406	NELAP	PA
5000 - Methyl tert-butyl ether (MTBE)	MADEP VPH, Rev.1.1	90017406	NELAP	PA
5005 - Naphthalene	MADEP VPH, Rev.1.1	90017406	NELAP	PA
5140 - Toluene	MADEP VPH, Rev.1.1	90017406	NELAP	PA
5304 - VPH Aliphatic C5-C8	MADEP VPH, Rev.1.1	90017406	NELAP	PA
5305 - VPH Aliphatic C5-C8 Unadjusted	MADEP VPH, Rev.1.1	90017406	NELAP	PA
5306 - VPH Aliphatic C9-C12	MADEP VPH, Rev.1.1	90017406	NELAP	PA
5307 - VPH Aliphatic C9-C12 Unadjusted	MADEP VPH, Rev.1.1	90017406	NELAP	PA
5311 - VPH Aromatic C9-C10	MADEP VPH, Rev.1.1	90017406	NELAP	PA
5240 - m+p-xylene	MADEP VPH, Rev.1.1	90017406	NELAP	PA
5250 - o-Xylene	MADEP VPH, Rev.1.1	90017406	NELAP	PA
2050 - Total Petroleum Hydrocarbons (TPH)	TNRCC 1005, Rev.3	90019208	NELAP	PA

Solid Chemical Materials

Analyte	Method Name	Method Code	Type	AB
2050 - Total Petroleum Hydrocarbons (TPH)	Texas 1006	867	NELAP	PA
1540 - Bromide	EPA 300.0, Rev.2.1	10053200	NELAP	PA
1730 - Fluoride	EPA 300.0, Rev.2.1	10053200	NELAP	PA
1810 - Nitrate as N	EPA 300.0, Rev.2.1	10053200	NELAP	PA
1840 - Nitrite as N	EPA 300.0, Rev.2.1	10053200	NELAP	PA

Solid Chemical Materials

Analyte	Method Name	Method Code	Type	AB
2000 - Sulfate	EPA 300.0, Rev.2.1	10053200	NELAP	PA
1780 - Ignitability	EPA 1010	10116606	NELAP	PA
1466 - Toxicity Characteristic Leaching Procedure (TCLP)	EPA 1311	10118806	NELAP	PA
1460 - Synthetic Precipitation Leaching Procedure	EPA 1312	10119003	NELAP	PA
8954 - 2,2',3,3'+2,3',4',6-Tetrachlorobiphenyl (BZ-40+71)	EPA 1668	10129201	NELAP	PA
8919 - 2,2',3,3',4,4'+2,3,4,4',5,6-Hexachlorobiphenyl (BZ-128+166)	EPA 1668	10129201	NELAP	PA
9105 - 2,2',3,3',4,4',5,5',6,6'-Decachlorobiphenyl (BZ-209)	EPA 1668	10129201	NELAP	PA
9095 - 2,2',3,3',4,4',5,5',6-Nonachlorobiphenyl (BZ-206)	EPA 1668	10129201	NELAP	PA
9090 - 2,2',3,3',4,4',5,5'-Octachlorobiphenyl (BZ-194)	EPA 1668	10129201	NELAP	PA
9102 - 2,2',3,3',4,4',5,6'-Octachlorobiphenyl (BZ-196)	EPA 1668	10129201	NELAP	PA
9101 - 2,2',3,3',4,4',5,6,6'-Nonachlorobiphenyl (BZ-207)	EPA 1668	10129201	NELAP	PA
9103 - 2,2',3,3',4,4',5,6-Octachlorobiphenyl (BZ-195)	EPA 1668	10129201	NELAP	PA
9065 - 2,2',3,3',4,4',5-Heptachlorobiphenyl (BZ-170)	EPA 1668	10129201	NELAP	PA
8916 - 2,2',3,3',4,4',6+2,2',3,3',4,5,6-Heptachlorobiphenyl (BZ-171+173)	EPA 1668	10129201	NELAP	PA
8933 - 2,2',3,3',4,4',6,6'+2,2',3,3',4,5,6,6'-Octachlorobiphenyl (BZ 197+200)	EPA 1668	10129201	NELAP	PA
9104 - 2,2',3,3',4,4',6,6'-Octachlorobiphenyl (BZ-197)	EPA 1668	10129201	NELAP	PA
9106 - 2,2',3,3',4,4',6-Heptachlorobiphenyl (BZ-171)	EPA 1668	10129201	NELAP	PA
9020 - 2,2',3,3',4,4'-Hexachlorobiphenyl (BZ-128)	EPA 1668	10129201	NELAP	PA
9114 - 2,2',3,3',4,5',6'-Heptachlorobiphenyl (BZ-177)	EPA 1668	10129201	NELAP	PA
9112 - 2,2',3,3',4,5',6,6'-Octachlorobiphenyl (BZ-201)	EPA 1668	10129201	NELAP	PA
9115 - 2,2',3,3',4,5',6-Heptachlorobiphenyl (BZ-175)	EPA 1668	10129201	NELAP	PA
9117 - 2,2',3,3',4,5'-Hexachlorobiphenyl (BZ-130)	EPA 1668	10129201	NELAP	PA
8922 - 2,2',3,3',4,5+2,2',3,4,4',5'+2,3,3',4',5,6-Hexachlorobiphenyl (BZ-129+138+163)	EPA 1668	10129201	NELAP	PA
9108 - 2,2',3,3',4,5,5',6'-Octachlorobiphenyl (BZ-199)	EPA 1668	10129201	NELAP	PA
8934 - 2,2',3,3',4,5,5',6+2,2',3,3',4,5,5',6'-Octachlorobiphenyl (BZ-198+199)	EPA 1668	10129201	NELAP	PA
9107 - 2,2',3,3',4,5,5',6,6'-Nonachlorobiphenyl (BZ-208)	EPA 1668	10129201	NELAP	PA
9109 - 2,2',3,3',4,5,5',6-Octachlorobiphenyl (BZ-198)	EPA 1668	10129201	NELAP	PA
9110 - 2,2',3,3',4,5,5'-Heptachlorobiphenyl (BZ-172)	EPA 1668	10129201	NELAP	PA
9116 - 2,2',3,3',4,5,6'-Heptachlorobiphenyl	EPA 1668	10129201	NELAP	PA

Solid Chemical Materials

Analyte	Method Name	Method Code	Type	AB
(BZ-174)				
9111 - 2,2',3,3',4,5,6,6'-Octachlorobiphenyl (BZ-200)	EPA 1668	10129201	NELAP	PA
9113 - 2,2',3,3',4,5,6-Heptachlorobiphenyl (BZ-173)	EPA 1668	10129201	NELAP	PA
9118 - 2,2',3,3',4,5-Hexachlorobiphenyl (BZ-129)	EPA 1668	10129201	NELAP	PA
9120 - 2,2',3,3',4,6'-Hexachlorobiphenyl (BZ-132)	EPA 1668	10129201	NELAP	PA
9119 - 2,2',3,3',4,6,6'-Heptachlorobiphenyl (BZ-176)	EPA 1668	10129201	NELAP	PA
9121 - 2,2',3,3',4,6-Hexachlorobiphenyl (BZ-131)	EPA 1668	10129201	NELAP	PA
9122 - 2,2',3,3',4-Pentachlorobiphenyl (BZ-82)	EPA 1668	10129201	NELAP	PA
9123 - 2,2',3,3',5,5',6,6'-Octachlorobiphenyl (BZ-202)	EPA 1668	10129201	NELAP	PA
9124 - 2,2',3,3',5,5',6-Heptachlorobiphenyl (BZ-178)	EPA 1668	10129201	NELAP	PA
9125 - 2,2',3,3',5,5'-Hexachlorobiphenyl (BZ-133)	EPA 1668	10129201	NELAP	PA
8926 - 2,2',3,3',5,6'+2,2',3,5,5',6+2,2',4,4',5,6'-Hexachlorobiphenyl (BZ-135+151+154)	EPA 1668	10129201	NELAP	PA
8927 - 2,2',3,3',5,6'+2,2',3,5,5',6-Hexachlorobiphenyls (BZ 135+151)	EPA 1668	10129201	NELAP	PA
9127 - 2,2',3,3',5,6'-Hexachlorobiphenyl (BZ-135)	EPA 1668	10129201	NELAP	PA
9126 - 2,2',3,3',5,6,6'-Heptachlorobiphenyl (BZ-179)	EPA 1668	10129201	NELAP	PA
9128 - 2,2',3,3',5,6-Hexachlorobiphenyl (BZ-134)	EPA 1668	10129201	NELAP	PA
9129 - 2,2',3,3',5-Pentachlorobiphenyl (BZ-83)	EPA 1668	10129201	NELAP	PA
9130 - 2,2',3,3',6,6'-Hexachlorobiphenyl (BZ-136)	EPA 1668	10129201	NELAP	PA
9131 - 2,2',3,3',6-Pentachlorobiphenyl (BZ-84)	EPA 1668	10129201	NELAP	PA
9132 - 2,2',3,3'-Tetrachlorobiphenyl (BZ-40)	EPA 1668	10129201	NELAP	PA
9151 - 2,2',3,4',5',6-Hexachlorobiphenyl (BZ-149)	EPA 1668	10129201	NELAP	PA
9154 - 2,2',3,4',5'-Pentachlorobiphenyl (BZ-97)	EPA 1668	10129201	NELAP	PA
8948 - 2,2',3,4',5+2,2',4,5,5'+2,3,3',5',6-Pentachlorobiphenyl (BZ-90+101+113)	EPA 1668	10129201	NELAP	PA
9080 - 2,2',3,4',5,5',6-Heptachlorobiphenyl (BZ-187)	EPA 1668	10129201	NELAP	PA
9144 - 2,2',3,4',5,5'-Hexachlorobiphenyl (BZ-146)	EPA 1668	10129201	NELAP	PA
9147 - 2,2',3,4',5,6'-Hexachlorobiphenyl (BZ-148)	EPA 1668	10129201	NELAP	PA
8929 - 2,2',3,4',5,6+2,2',3,4',5',6-Hexachlorobiphenyl (BZ-147+149)	EPA 1668	10129201	NELAP	PA
9146 - 2,2',3,4',5,6,6'-Heptachlorobiphenyl (BZ-188)	EPA 1668	10129201	NELAP	PA

Solid Chemical Materials

Analyte	Method Name	Method Code	Type	AB
9149 - 2,2',3,4',5,6-Hexachlorobiphenyl (BZ-147)	EPA 1668	10129201	NELAP	PA
9155 - 2,2',3,4',5-Pentachlorobiphenyl (BZ-90)	EPA 1668	10129201	NELAP	PA
8951 - 2,2',3,4',6'+2,2',4,5,6'-Pentachlorobiphenyl (BZ-98+102)	EPA 1668	10129201	NELAP	PA
9159 - 2,2',3,4',6'-Pentachlorobiphenyl (BZ-98)	EPA 1668	10129201	NELAP	PA
9157 - 2,2',3,4',6,6'-Hexachlorobiphenyl (BZ-150)	EPA 1668	10129201	NELAP	PA
9160 - 2,2',3,4',6-Pentachlorobiphenyl (BZ-91)	EPA 1668	10129201	NELAP	PA
9162 - 2,2',3,4'-Tetrachlorobiphenyl (BZ-42)	EPA 1668	10129201	NELAP	PA
8941 - 2,2',3,4,4'+2,3,4,5,6+2,3,4',5,6-Pentachlorobiphenyl (BZ-85+116+117)	EPA 1668	10129201	NELAP	PA
8942 - 2,2',3,4,4'+2,3,4,5,6-Pentachlorobiphenyl (BZ-85+116)	EPA 1668	10129201	NELAP	PA
8918 - 2,2',3,4,4',5',6+2,2',3,4,5,5',6-Heptachlorobiphenyl (BZ-183+185)	EPA 1668	10129201	NELAP	PA
9075 - 2,2',3,4,4',5',6-Heptachlorobiphenyl (BZ-183)	EPA 1668	10129201	NELAP	PA
9025 - 2,2',3,4,4',5'-Hexachlorobiphenyl (BZ-138)	EPA 1668	10129201	NELAP	PA
8917 - 2,2',3,4,4',5,5'+2,3,3',4',5,5',6-Heptachlorobiphenyl (BZ-180+193)	EPA 1668	10129201	NELAP	PA
9133 - 2,2',3,4,4',5,5',6-Octachlorobiphenyl (BZ-203)	EPA 1668	10129201	NELAP	PA
9134 - 2,2',3,4,4',5,5'-Heptachlorobiphenyl (BZ-180)	EPA 1668	10129201	NELAP	PA
9136 - 2,2',3,4,4',5,6'-Heptachlorobiphenyl (BZ-182)	EPA 1668	10129201	NELAP	PA
9135 - 2,2',3,4,4',5,6,6'-Octachlorobiphenyl (BZ-204)	EPA 1668	10129201	NELAP	PA
9137 - 2,2',3,4,4',5,6-Heptachlorobiphenyl (BZ-181)	EPA 1668	10129201	NELAP	PA
9138 - 2,2',3,4,4',5-Hexachlorobiphenyl (BZ-137)	EPA 1668	10129201	NELAP	PA
9140 - 2,2',3,4,4',6'-Hexachlorobiphenyl (BZ-140)	EPA 1668	10129201	NELAP	PA
8928 - 2,2',3,4,4',6+2,2',3,4,4',6'-Hexachlorobiphenyl (BZ-139+140)	EPA 1668	10129201	NELAP	PA
9139 - 2,2',3,4,4',6,6'-Heptachlorobiphenyl (BZ-184)	EPA 1668	10129201	NELAP	PA
9141 - 2,2',3,4,4',6-Hexachlorobiphenyl (BZ-139)	EPA 1668	10129201	NELAP	PA
9142 - 2,2',3,4,4'-Pentachlorobiphenyl (BZ-85)	EPA 1668	10129201	NELAP	PA
9150 - 2,2',3,4,5',6-Hexachlorobiphenyl (BZ-144)	EPA 1668	10129201	NELAP	PA
8975 - 2,2',3,4,5'-Pentachlorobiphenyl (BZ-87)	EPA 1668	10129201	NELAP	PA
8944 - 2,2',3,4,5+2,2',3,4,5'+2,2',3,4',5'+2,2',4,4',6-Pentachlorobiphenyl (BZ-86+87+97+100)	EPA 1668	10129201	NELAP	PA
8946 -	EPA 1668	10129201	NELAP	PA

Solid Chemical Materials

Analyte	Method Name	Method Code	Type	AB
2,2',3,4,5+2,2',3,4,5'+2,2',3,4',5'+2,3,3',4,5'+ 2,3',4,4'6+2,3',4',5'6-Pentachlorobiphenyl (BZ 86+87+97+108+119+125)				
9143 - 2,2',3,4,5,5',6-Heptachlorobiphenyl (BZ-185)	EPA 1668	10129201	NELAP	PA
9030 - 2,2',3,4,5,5'-Hexachlorobiphenyl (BZ-141)	EPA 1668	10129201	NELAP	PA
9152 - 2,2',3,4,5,6'-Hexachlorobiphenyl (BZ-143)	EPA 1668	10129201	NELAP	PA
9145 - 2,2',3,4,5,6,6'-Heptachlorobiphenyl (BZ-186)	EPA 1668	10129201	NELAP	PA
9148 - 2,2',3,4,5,6-Hexachlorobiphenyl (BZ-142)	EPA 1668	10129201	NELAP	PA
9153 - 2,2',3,4,5-Pentachlorobiphenyl (BZ-86)	EPA 1668	10129201	NELAP	PA
9161 - 2,2',3,4,6'-Pentachlorobiphenyl (BZ-89)	EPA 1668	10129201	NELAP	PA
8947 - 2,2',3,4,6+2,2',3,4',6-Pentachlorobiphenyl (BZ-88+91)	EPA 1668	10129201	NELAP	PA
9156 - 2,2',3,4,6,6'-Hexachlorobiphenyl (BZ-145)	EPA 1668	10129201	NELAP	PA
9158 - 2,2',3,4,6-Pentachlorobiphenyl (BZ-88)	EPA 1668	10129201	NELAP	PA
9163 - 2,2',3,4-Tetrachlorobiphenyl (BZ-41)	EPA 1668	10129201	NELAP	PA
8957 - 2,2',3,5'+2,2',4,4'+2,3,5,6-Tetrachlorobiphenyl (BZ-44+47+65)	EPA 1668	10129201	NELAP	PA
9166 - 2,2',3,5',6-Pentachlorobiphenyl (BZ-95)	EPA 1668	10129201	NELAP	PA
8945 - 2,2',3,5'-Tetrachlorobiphenyl (BZ-44)	EPA 1668	10129201	NELAP	PA
8956 - 2,2',3,5+2,3',5',6-Tetrachlorobiphenyl (BZ-43+73)	EPA 1668	10129201	NELAP	PA
9035 - 2,2',3,5,5',6-Hexachlorobiphenyl (BZ-151)	EPA 1668	10129201	NELAP	PA
9164 - 2,2',3,5,5'-Pentachlorobiphenyl (BZ-92)	EPA 1668	10129201	NELAP	PA
9167 - 2,2',3,5,6'-Pentachlorobiphenyl (BZ-94)	EPA 1668	10129201	NELAP	PA
8949 - 2,2',3,5,6+2,2',4,4',6-Pentachlorobiphenyl (BZ-93+100)	EPA 1668	10129201	NELAP	PA
9165 - 2,2',3,5,6,6'-Hexachlorobiphenyl (BZ-152)	EPA 1668	10129201	NELAP	PA
9168 - 2,2',3,5,6-Pentachlorobiphenyl (BZ-93)	EPA 1668	10129201	NELAP	PA
9169 - 2,2',3,5-Tetrachlorobiphenyl (BZ-43)	EPA 1668	10129201	NELAP	PA
9171 - 2,2',3,6'-Tetrachlorobiphenyl (BZ-46)	EPA 1668	10129201	NELAP	PA
9170 - 2,2',3,6,6'-Pentachlorobiphenyl (BZ-96)	EPA 1668	10129201	NELAP	PA
9172 - 2,2',3,6-Tetrachlorobiphenyl (BZ-45)	EPA 1668	10129201	NELAP	PA
9173 - 2,2',3-Trichlorobiphenyl (BZ-16)	EPA 1668	10129201	NELAP	PA
8931 - 2,2',4,4',5,5'+2,3',4,4',5',6-Hexachlorobiphenyl (BZ-153+168)	EPA 1668	10129201	NELAP	PA

Solid Chemical Materials

Analyte	Method Name	Method Code	Type	AB
9040 - 2,2',4,4',5,5'-Hexachlorobiphenyl (BZ-153)	EPA 1668	10129201	NELAP	PA
9174 - 2,2',4,4',5,6'-Hexachlorobiphenyl (BZ-154)	EPA 1668	10129201	NELAP	PA
9175 - 2,2',4,4',5-Pentachlorobiphenyl (BZ-99)	EPA 1668	10129201	NELAP	PA
9176 - 2,2',4,4',6,6'-Hexachlorobiphenyl (BZ-155)	EPA 1668	10129201	NELAP	PA
9177 - 2,2',4,4',6-Pentachlorobiphenyl (BZ-100)	EPA 1668	10129201	NELAP	PA
9178 - 2,2',4,4'-Tetrachlorobiphenyl (BZ-47)	EPA 1668	10129201	NELAP	PA
8959 - 2,2',4,5'+2,3',4,6-Tetrachlorobiphenyl (BZ-49+69)	EPA 1668	10129201	NELAP	PA
9179 - 2,2',4,5',6-Pentachlorobiphenyl (BZ-103)	EPA 1668	10129201	NELAP	PA
8950 - 2,2',4,5'-Tetrachlorobiphenyl (BZ-49)	EPA 1668	10129201	NELAP	PA
8980 - 2,2',4,5,5'-Pentachlorobiphenyl (BZ-101)	EPA 1668	10129201	NELAP	PA
9180 - 2,2',4,5,6'-Pentachlorobiphenyl (BZ-102)	EPA 1668	10129201	NELAP	PA
9181 - 2,2',4,5-Tetrachlorobiphenyl (BZ-48)	EPA 1668	10129201	NELAP	PA
9183 - 2,2',4,6'-Tetrachlorobiphenyl (BZ-51)	EPA 1668	10129201	NELAP	PA
8961 - 2,2',4,6+2,2',5,6'-Tetrachlorobiphenyl (BZ-50+53)	EPA 1668	10129201	NELAP	PA
9182 - 2,2',4,6,6'-Pentachlorobiphenyl (BZ-104)	EPA 1668	10129201	NELAP	PA
9184 - 2,2',4,6-Tetrachlorobiphenyl (BZ-50)	EPA 1668	10129201	NELAP	PA
9185 - 2,2',4-Trichlorobiphenyl (BZ-17)	EPA 1668	10129201	NELAP	PA
8966 - 2,2',5+2,4,6-Trichlorobiphenyl (BZ-18+30)	EPA 1668	10129201	NELAP	PA
8955 - 2,2',5,5'-Tetrachlorobiphenyl (BZ-52)	EPA 1668	10129201	NELAP	PA
9186 - 2,2',5,6'-Tetrachlorobiphenyl (BZ-53)	EPA 1668	10129201	NELAP	PA
8930 - 2,2',5-Trichlorobiphenyl (BZ-18)	EPA 1668	10129201	NELAP	PA
9187 - 2,2',6,6'-Tetrachlorobiphenyl (BZ-54)	EPA 1668	10129201	NELAP	PA
9188 - 2,2',6-Trichlorobiphenyl (BZ-19)	EPA 1668	10129201	NELAP	PA
9189 - 2,2'-Dichlorobiphenyl (BZ-4)	EPA 1668	10129201	NELAP	PA
9224 - 2,3',4',5',6-Pentachlorobiphenyl (BZ-125)	EPA 1668	10129201	NELAP	PA
9229 - 2,3',4',5'-Tetrachlorobiphenyl (BZ-76)	EPA 1668	10129201	NELAP	PA
8964 - 2,3',4',5+2,4,4',5+2,3',4',5'-Tetrachlorobiphenyl (BZ-70+74+76)	EPA 1668	10129201	NELAP	PA
9222 - 2,3',4',5,5'-Pentachlorobiphenyl (BZ-124)	EPA 1668	10129201	NELAP	PA
9230 - 2,3',4',5-Tetrachlorobiphenyl (BZ-70)	EPA 1668	10129201	NELAP	PA
9237 - 2,3',4',6-Tetrachlorobiphenyl (BZ-71)	EPA 1668	10129201	NELAP	PA

Solid Chemical Materials

Analyte	Method Name	Method Code	Type	AB
9239 - 2,3',4'-Trichlorobiphenyl (BZ-33)	EPA 1668	10129201	NELAP	PA
9218 - 2,3',4,4',5',6-Hexachlorobiphenyl (BZ-168)	EPA 1668	10129201	NELAP	PA
9000 - 2,3',4,4',5'-Pentachlorobiphenyl (BZ-123)	EPA 1668	10129201	NELAP	PA
9055 - 2,3',4,4',5,5'-Hexachlorobiphenyl (BZ-167)	EPA 1668	10129201	NELAP	PA
8995 - 2,3',4,4',5-Pentachlorobiphenyl (BZ-118)	EPA 1668	10129201	NELAP	PA
9220 - 2,3',4,4',6-Pentachlorobiphenyl (BZ-119)	EPA 1668	10129201	NELAP	PA
8960 - 2,3',4,4'-Tetrachlorobiphenyl (BZ-66)	EPA 1668	10129201	NELAP	PA
9226 - 2,3',4,5',6-Pentachlorobiphenyl (BZ-121)	EPA 1668	10129201	NELAP	PA
9231 - 2,3',4,5'-Tetrachlorobiphenyl (BZ-68)	EPA 1668	10129201	NELAP	PA
9223 - 2,3',4,5,5'-Pentachlorobiphenyl (BZ-120)	EPA 1668	10129201	NELAP	PA
9232 - 2,3',4,5-Tetrachlorobiphenyl (BZ-67)	EPA 1668	10129201	NELAP	PA
9235 - 2,3',4,6-Tetrachlorobiphenyl (BZ-69)	EPA 1668	10129201	NELAP	PA
9240 - 2,3',4-Trichlorobiphenyl (BZ-25)	EPA 1668	10129201	NELAP	PA
9244 - 2,3',5',6-Tetrachlorobiphenyl (BZ-73)	EPA 1668	10129201	NELAP	PA
9246 - 2,3',5'-Trichlorobiphenyl (BZ-34)	EPA 1668	10129201	NELAP	PA
8969 - 2,3',5+2,4,5-Trichlorobiphenyl (BZ-26+29)	EPA 1668	10129201	NELAP	PA
9242 - 2,3',5,5'-Tetrachlorobiphenyl (BZ-72)	EPA 1668	10129201	NELAP	PA
8935 - 2,3',5-Trichlorobiphenyl (BZ-26)	EPA 1668	10129201	NELAP	PA
9248 - 2,3',6-Trichlorobiphenyl (BZ-27)	EPA 1668	10129201	NELAP	PA
9249 - 2,3'-Dichlorobiphenyl (BZ-6)	EPA 1668	10129201	NELAP	PA
8967 - 2,3,3'+2,4,4'-Trichlorobiphenyl (BZ-20+28)	EPA 1668	10129201	NELAP	PA
9201 - 2,3,3',4',5',6-Hexachlorobiphenyl (BZ-164)	EPA 1668	10129201	NELAP	PA
9202 - 2,3,3',4',5'-Pentachlorobiphenyl (BZ-122)	EPA 1668	10129201	NELAP	PA
8936 - 2,3,3',4',5+2,3',4',5,5'-Pentachlorobiphenyl (BZ-107+124)	EPA 1668	10129201	NELAP	PA
9195 - 2,3,3',4',5,5',6-Heptachlorobiphenyl (BZ-193)	EPA 1668	10129201	NELAP	PA
9197 - 2,3,3',4',5,5'-Hexachlorobiphenyl (BZ-162)	EPA 1668	10129201	NELAP	PA
9199 - 2,3,3',4',5,6-Hexachlorobiphenyl (BZ-163)	EPA 1668	10129201	NELAP	PA
9205 - 2,3,3',4',5-Pentachlorobiphenyl (BZ-107)	EPA 1668	10129201	NELAP	PA
8938 - 2,3,3',4',6+2,3,4,4',6-Pentachlorobiphenyl (BZ-110+115)	EPA 1668	10129201	NELAP	PA
8990 - 2,3,3',4',6-Pentachlorobiphenyl (BZ-110)	EPA 1668	10129201	NELAP	PA
9207 - 2,3,3',4'-Tetrachlorobiphenyl (BZ-56)	EPA 1668	10129201	NELAP	PA

Solid Chemical Materials

Analyte	Method Name	Method Code	Type	AB
9192 - 2,3,3',4,4',5',6-Heptachlorobiphenyl (BZ-191)	EPA 1668	10129201	NELAP	PA
9045 - 2,3,3',4,4',5'-Hexachlorobiphenyl (BZ-157)	EPA 1668	10129201	NELAP	PA
8932 - 2,3,3',4,4',5+2,3,3',4,4',5'-Hexachlorobiphenyl (BZ-156+157)	EPA 1668	10129201	NELAP	PA
9190 - 2,3,3',4,4',5,5',6-Octachlorobiphenyl (BZ-205)	EPA 1668	10129201	NELAP	PA
9085 - 2,3,3',4,4',5,5'-Heptachlorobiphenyl (BZ-189)	EPA 1668	10129201	NELAP	PA
9191 - 2,3,3',4,4',5,6-Heptachlorobiphenyl (BZ-190)	EPA 1668	10129201	NELAP	PA
9050 - 2,3,3',4,4',5-Hexachlorobiphenyl (BZ-156)	EPA 1668	10129201	NELAP	PA
9193 - 2,3,3',4,4',6-Hexachlorobiphenyl (BZ-158)	EPA 1668	10129201	NELAP	PA
8985 - 2,3,3',4,4'-Pentachlorobiphenyl (BZ-105)	EPA 1668	10129201	NELAP	PA
9200 - 2,3,3',4,5',6-Hexachlorobiphenyl (BZ-161)	EPA 1668	10129201	NELAP	PA
9203 - 2,3,3',4,5'-Pentachlorobiphenyl (BZ-108)	EPA 1668	10129201	NELAP	PA
9196 - 2,3,3',4,5,5'-Hexachlorobiphenyl (BZ-159)	EPA 1668	10129201	NELAP	PA
9198 - 2,3,3',4,5,6-Hexachlorobiphenyl (BZ-160)	EPA 1668	10129201	NELAP	PA
9204 - 2,3,3',4,5-Pentachlorobiphenyl (BZ-106)	EPA 1668	10129201	NELAP	PA
9206 - 2,3,3',4,6-Pentachlorobiphenyl (BZ-109)	EPA 1668	10129201	NELAP	PA
9208 - 2,3,3',4-Tetrachlorobiphenyl (BZ-55)	EPA 1668	10129201	NELAP	PA
9212 - 2,3,3',5',6-Pentachlorobiphenyl (BZ-113)	EPA 1668	10129201	NELAP	PA
9213 - 2,3,3',5'-Tetrachlorobiphenyl (BZ-58)	EPA 1668	10129201	NELAP	PA
9209 - 2,3,3',5,5',6-Hexachlorobiphenyl (BZ-165)	EPA 1668	10129201	NELAP	PA
9210 - 2,3,3',5,5'-Pentachlorobiphenyl (BZ-111)	EPA 1668	10129201	NELAP	PA
9211 - 2,3,3',5,6-Pentachlorobiphenyl (BZ-112)	EPA 1668	10129201	NELAP	PA
9214 - 2,3,3',5-Tetrachlorobiphenyl (BZ-57)	EPA 1668	10129201	NELAP	PA
8962 - 2,3,3',6+2,3,4,6+2,4,4',6-Tetrachlorobiphenyl (BZ-59+62+75)	EPA 1668	10129201	NELAP	PA
9215 - 2,3,3',6-Tetrachlorobiphenyl (BZ-59)	EPA 1668	10129201	NELAP	PA
9216 - 2,3,3'-Trichlorobiphenyl (BZ-20)	EPA 1668	10129201	NELAP	PA
9227 - 2,3,4',5,6-Pentachlorobiphenyl (BZ-117)	EPA 1668	10129201	NELAP	PA
9233 - 2,3,4',5-Tetrachlorobiphenyl (BZ-63)	EPA 1668	10129201	NELAP	PA
9236 - 2,3,4',6-Tetrachlorobiphenyl (BZ-64)	EPA 1668	10129201	NELAP	PA
9241 - 2,3,4'-Trichlorobiphenyl (BZ-22)	EPA 1668	10129201	NELAP	PA

Solid Chemical Materials

Analyte	Method Name	Method Code	Type	AB
8968 - 2,3,4+2,3',4'-Trichlorobiphenyl (BZ-21+33)	EPA 1668	10129201	NELAP	PA
9217 - 2,3,4,4',5,6-Hexachlorobiphenyl (BZ-166)	EPA 1668	10129201	NELAP	PA
9005 - 2,3,4,4',5-Pentachlorobiphenyl (BZ-114)	EPA 1668	10129201	NELAP	PA
9219 - 2,3,4,4',6-Pentachlorobiphenyl (BZ-115)	EPA 1668	10129201	NELAP	PA
9221 - 2,3,4,4'-Tetrachlorobiphenyl (BZ-60)	EPA 1668	10129201	NELAP	PA
8963 - 2,3,4,5+2,3',4',5+2,4,4',5+2,3',4',5'-Tetrachlorobiphenyls (BZ 61+70+74+76)	EPA 1668	10129201	NELAP	PA
9225 - 2,3,4,5,6-Pentachlorobiphenyl (BZ-116)	EPA 1668	10129201	NELAP	PA
9228 - 2,3,4,5-Tetrachlorobiphenyl (BZ-61)	EPA 1668	10129201	NELAP	PA
9234 - 2,3,4,6-Tetrachlorobiphenyl (BZ-62)	EPA 1668	10129201	NELAP	PA
9238 - 2,3,4-Trichlorobiphenyl (BZ-21)	EPA 1668	10129201	NELAP	PA
9243 - 2,3,5,6-Tetrachlorobiphenyl (BZ-65)	EPA 1668	10129201	NELAP	PA
9245 - 2,3,5-Trichlorobiphenyl (BZ-23)	EPA 1668	10129201	NELAP	PA
9247 - 2,3,6-Trichlorobiphenyl (BZ-24)	EPA 1668	10129201	NELAP	PA
8920 - 2,3-Dichlorobiphenyl (BZ-5)	EPA 1668	10129201	NELAP	PA
8940 - 2,4',5-Trichlorobiphenyl (BZ-31)	EPA 1668	10129201	NELAP	PA
9255 - 2,4',6-Trichlorobiphenyl (BZ-32)	EPA 1668	10129201	NELAP	PA
9256 - 2,4'-Dichlorobiphenyl (BZ-8)	EPA 1668	10129201	NELAP	PA
9250 - 2,4,4',5-Tetrachlorobiphenyl (BZ-74)	EPA 1668	10129201	NELAP	PA
9251 - 2,4,4',6-Tetrachlorobiphenyl (BZ-75)	EPA 1668	10129201	NELAP	PA
9252 - 2,4,4'-Trichlorobiphenyl (BZ-28)	EPA 1668	10129201	NELAP	PA
9253 - 2,4,5-Trichlorobiphenyl (BZ-29)	EPA 1668	10129201	NELAP	PA
9254 - 2,4,6-Trichlorobiphenyl (BZ-30)	EPA 1668	10129201	NELAP	PA
9257 - 2,4-Dichlorobiphenyl (BZ-7)	EPA 1668	10129201	NELAP	PA
9258 - 2,5-Dichlorobiphenyl (BZ-9)	EPA 1668	10129201	NELAP	PA
9259 - 2,6-Dichlorobiphenyl (BZ-10)	EPA 1668	10129201	NELAP	PA
8915 - 2-Chlorobiphenyl (BZ-1)	EPA 1668	10129201	NELAP	PA
9060 - 3,3',4,4',5,5'-Hexachlorobiphenyl (BZ-169)	EPA 1668	10129201	NELAP	PA
9015 - 3,3',4,4',5-Pentachlorobiphenyl (BZ-126)	EPA 1668	10129201	NELAP	PA
8965 - 3,3',4,4'-Tetrachlorobiphenyl (BZ-77)	EPA 1668	10129201	NELAP	PA
9261 - 3,3',4,5'-Tetrachlorobiphenyl (BZ-79)	EPA 1668	10129201	NELAP	PA
9260 - 3,3',4,5,5'-Pentachlorobiphenyl (BZ-127)	EPA 1668	10129201	NELAP	PA
9262 - 3,3',4,5-Tetrachlorobiphenyl (BZ-78)	EPA 1668	10129201	NELAP	PA
9263 - 3,3',4-Trichlorobiphenyl (BZ-35)	EPA 1668	10129201	NELAP	PA
9264 - 3,3',5,5'-Tetrachlorobiphenyl (BZ-80)	EPA 1668	10129201	NELAP	PA
9265 - 3,3',5-Trichlorobiphenyl (BZ-36)	EPA 1668	10129201	NELAP	PA
8925 - 3,3'-Dichlorobiphenyl (BZ-11)	EPA 1668	10129201	NELAP	PA
9268 - 3,4',5-Trichlorobiphenyl (BZ-39)	EPA 1668	10129201	NELAP	PA

Solid Chemical Materials

Analyte	Method Name	Method Code	Type	AB
9269 - 3,4'-Dichlorobiphenyl (BZ-13)	EPA 1668	10129201	NELAP	PA
100098 - 3,4+3,4'-Dichlorobiphenyl (BZ-12+13)	EPA 1668	10129201	NELAP	PA
8970 - 3,4,4',5-Tetrachlorobiphenyl (BZ-81)	EPA 1668	10129201	NELAP	PA
9266 - 3,4,4'-Trichlorobiphenyl (BZ-37)	EPA 1668	10129201	NELAP	PA
9267 - 3,4,5-Trichlorobiphenyl (BZ-38)	EPA 1668	10129201	NELAP	PA
9270 - 3,4-Dichlorobiphenyl (BZ-12)	EPA 1668	10129201	NELAP	PA
9271 - 3,5-Dichlorobiphenyl (BZ-14)	EPA 1668	10129201	NELAP	PA
9272 - 3-Chlorobiphenyl (BZ-2)	EPA 1668	10129201	NELAP	PA
100368 - 3-Monochlorobiphenyl (BZ 2)	EPA 1668	10129201	NELAP	PA
9273 - 4,4'-Dichlorobiphenyl (BZ-15)	EPA 1668	10129201	NELAP	PA
9274 - 4-Chlorobiphenyl (BZ-3)	EPA 1668	10129201	NELAP	PA
8954 - 2,2',3,3'+2,3',4',6-Tetrachlorobiphenyl (BZ-40+71)	EPA 1668A	10129405	NELAP	PA
8919 - 2,2',3,3',4,4'+2,3,4,4',5,6-Hexachlorobiphenyl (BZ-128+166)	EPA 1668A	10129405	NELAP	PA
9105 - 2,2',3,3',4,4',5,5',6,6'-Decachlorobiphenyl (BZ-209)	EPA 1668A	10129405	NELAP	PA
9095 - 2,2',3,3',4,4',5,5',6-Nonachlorobiphenyl (BZ-206)	EPA 1668A	10129405	NELAP	PA
9090 - 2,2',3,3',4,4',5,5'-Octachlorobiphenyl (BZ-194)	EPA 1668A	10129405	NELAP	PA
9102 - 2,2',3,3',4,4',5,6'-Octachlorobiphenyl (BZ-196)	EPA 1668A	10129405	NELAP	PA
9101 - 2,2',3,3',4,4',5,6,6'-Nonachlorobiphenyl (BZ-207)	EPA 1668A	10129405	NELAP	PA
9103 - 2,2',3,3',4,4',5,6-Octachlorobiphenyl (BZ-195)	EPA 1668A	10129405	NELAP	PA
9065 - 2,2',3,3',4,4',5-Heptachlorobiphenyl (BZ-170)	EPA 1668A	10129405	NELAP	PA
8916 - 2,2',3,3',4,4',6+2,2',3,3',4,5,6-Heptachlorobiphenyl (BZ-171+173)	EPA 1668A	10129405	NELAP	PA
8933 - 2,2',3,3',4,4',6,6'+2,2',3,3',4,5,6,6'-Octachlorobiphenyl (BZ 197+200)	EPA 1668A	10129405	NELAP	PA
9104 - 2,2',3,3',4,4',6,6'-Octachlorobiphenyl (BZ-197)	EPA 1668A	10129405	NELAP	PA
9106 - 2,2',3,3',4,4',6-Heptachlorobiphenyl (BZ-171)	EPA 1668A	10129405	NELAP	PA
9020 - 2,2',3,3',4,4'-Hexachlorobiphenyl (BZ-128)	EPA 1668A	10129405	NELAP	PA
9114 - 2,2',3,3',4,5',6'-Heptachlorobiphenyl (BZ-177)	EPA 1668A	10129405	NELAP	PA
9112 - 2,2',3,3',4,5',6,6'-Octachlorobiphenyl (BZ-201)	EPA 1668A	10129405	NELAP	PA
9115 - 2,2',3,3',4,5',6-Heptachlorobiphenyl (BZ-175)	EPA 1668A	10129405	NELAP	PA
9117 - 2,2',3,3',4,5'-Hexachlorobiphenyl (BZ-130)	EPA 1668A	10129405	NELAP	PA
8922 - 2,2',3,3',4,5+2,2',3,4,4',5'+2,3,3',4',5,6-Hexachlorobiphenyl (BZ-129+138+163)	EPA 1668A	10129405	NELAP	PA
9108 - 2,2',3,3',4,5,5',6'-Octachlorobiphenyl (BZ-199)	EPA 1668A	10129405	NELAP	PA
8934 - 2,2',3,3',4,5,5',6+2,2',3,3',4,5,5',6'-Octachlorobiphenyl (BZ-198+199)	EPA 1668A	10129405	NELAP	PA

Solid Chemical Materials

Analyte	Method Name	Method Code	Type	AB
9107 - 2,2',3,3',4,5,5',6,6'-Nonachlorobiphenyl (BZ-208)	EPA 1668A	10129405	NELAP	PA
9109 - 2,2',3,3',4,5,5',6-Octachlorobiphenyl (BZ-198)	EPA 1668A	10129405	NELAP	PA
9110 - 2,2',3,3',4,5,5'-Heptachlorobiphenyl (BZ-172)	EPA 1668A	10129405	NELAP	PA
9116 - 2,2',3,3',4,5,6'-Heptachlorobiphenyl (BZ-174)	EPA 1668A	10129405	NELAP	PA
9111 - 2,2',3,3',4,5,6,6'-Octachlorobiphenyl (BZ-200)	EPA 1668A	10129405	NELAP	PA
9113 - 2,2',3,3',4,5,6-Heptachlorobiphenyl (BZ-173)	EPA 1668A	10129405	NELAP	PA
9118 - 2,2',3,3',4,5-Hexachlorobiphenyl (BZ-129)	EPA 1668A	10129405	NELAP	PA
9120 - 2,2',3,3',4,6'-Hexachlorobiphenyl (BZ-132)	EPA 1668A	10129405	NELAP	PA
9119 - 2,2',3,3',4,6,6'-Heptachlorobiphenyl (BZ-176)	EPA 1668A	10129405	NELAP	PA
9121 - 2,2',3,3',4,6-Hexachlorobiphenyl (BZ-131)	EPA 1668A	10129405	NELAP	PA
9122 - 2,2',3,3',4-Pentachlorobiphenyl (BZ-82)	EPA 1668A	10129405	NELAP	PA
9123 - 2,2',3,3',5,5',6,6'-Octachlorobiphenyl (BZ-202)	EPA 1668A	10129405	NELAP	PA
9124 - 2,2',3,3',5,5',6-Heptachlorobiphenyl (BZ-178)	EPA 1668A	10129405	NELAP	PA
9125 - 2,2',3,3',5,5'-Hexachlorobiphenyl (BZ-133)	EPA 1668A	10129405	NELAP	PA
8926 - 2,2',3,3',5,6'+2,2',3,5,5',6+2,2',4,4',5,6'-Hexachlorobiphenyl (BZ-135+151+154)	EPA 1668A	10129405	NELAP	PA
8927 - 2,2',3,3',5,6'+2,2',3,5,5',6-Hexachlorobiphenyls (BZ 135+151)	EPA 1668A	10129405	NELAP	PA
9127 - 2,2',3,3',5,6'-Hexachlorobiphenyl (BZ-135)	EPA 1668A	10129405	NELAP	PA
9126 - 2,2',3,3',5,6,6'-Heptachlorobiphenyl (BZ-179)	EPA 1668A	10129405	NELAP	PA
9128 - 2,2',3,3',5,6-Hexachlorobiphenyl (BZ-134)	EPA 1668A	10129405	NELAP	PA
9129 - 2,2',3,3',5-Pentachlorobiphenyl (BZ-83)	EPA 1668A	10129405	NELAP	PA
9130 - 2,2',3,3',6,6'-Hexachlorobiphenyl (BZ-136)	EPA 1668A	10129405	NELAP	PA
9131 - 2,2',3,3',6-Pentachlorobiphenyl (BZ-84)	EPA 1668A	10129405	NELAP	PA
9132 - 2,2',3,3'-Tetrachlorobiphenyl (BZ-40)	EPA 1668A	10129405	NELAP	PA
9151 - 2,2',3,4',5',6-Hexachlorobiphenyl (BZ-149)	EPA 1668A	10129405	NELAP	PA
9154 - 2,2',3,4',5'-Pentachlorobiphenyl (BZ-97)	EPA 1668A	10129405	NELAP	PA
8948 - 2,2',3,4',5+2,2',4,5,5'+2,3,3',5',6-Pentachlorobiphenyl (BZ-90+101+113)	EPA 1668A	10129405	NELAP	PA
9080 - 2,2',3,4',5,5',6-Heptachlorobiphenyl (BZ-187)	EPA 1668A	10129405	NELAP	PA
9144 - 2,2',3,4',5,5'-Hexachlorobiphenyl	EPA 1668A	10129405	NELAP	PA

Solid Chemical Materials

Analyte	Method Name	Method Code	Type	AB
(BZ-146)				
9147 - 2,2',3,4',5,6'-Hexachlorobiphenyl (BZ-148)	EPA 1668A	10129405	NELAP	PA
8929 - 2,2',3,4',5,6+2,2',3,4',5',6-Hexachlorobiphenyl (BZ-147+149)	EPA 1668A	10129405	NELAP	PA
9146 - 2,2',3,4',5,6,6'-Heptachlorobiphenyl (BZ-188)	EPA 1668A	10129405	NELAP	PA
9149 - 2,2',3,4',5,6-Hexachlorobiphenyl (BZ-147)	EPA 1668A	10129405	NELAP	PA
9155 - 2,2',3,4',5-Pentachlorobiphenyl (BZ-90)	EPA 1668A	10129405	NELAP	PA
8951 - 2,2',3,4',6'+2,2',4,5,6'-Pentachlorobiphenyl (BZ-98+102)	EPA 1668A	10129405	NELAP	PA
9159 - 2,2',3,4',6'-Pentachlorobiphenyl (BZ-98)	EPA 1668A	10129405	NELAP	PA
9157 - 2,2',3,4',6,6'-Hexachlorobiphenyl (BZ-150)	EPA 1668A	10129405	NELAP	PA
9160 - 2,2',3,4',6-Pentachlorobiphenyl (BZ-91)	EPA 1668A	10129405	NELAP	PA
9162 - 2,2',3,4'-Tetrachlorobiphenyl (BZ-42)	EPA 1668A	10129405	NELAP	PA
8941 - 2,2',3,4,4'+2,3,4,5,6+2,3,4',5,6-Pentachlorobiphenyl (BZ-85+116+117)	EPA 1668A	10129405	NELAP	PA
8918 - 2,2',3,4,4',5',6+2,2',3,4,5,5',6-Heptachlorobiphenyl (BZ-183+185)	EPA 1668A	10129405	NELAP	PA
9075 - 2,2',3,4,4',5',6-Heptachlorobiphenyl (BZ-183)	EPA 1668A	10129405	NELAP	PA
9025 - 2,2',3,4,4',5'-Hexachlorobiphenyl (BZ-138)	EPA 1668A	10129405	NELAP	PA
8917 - 2,2',3,4,4',5,5'+2,3,3',4',5,5',6-Heptachlorobiphenyl (BZ-180+193)	EPA 1668A	10129405	NELAP	PA
9133 - 2,2',3,4,4',5,5',6-Octachlorobiphenyl (BZ-203)	EPA 1668A	10129405	NELAP	PA
9134 - 2,2',3,4,4',5,5'-Heptachlorobiphenyl (BZ-180)	EPA 1668A	10129405	NELAP	PA
9136 - 2,2',3,4,4',5,6'-Heptachlorobiphenyl (BZ-182)	EPA 1668A	10129405	NELAP	PA
9135 - 2,2',3,4,4',5,6,6'-Octachlorobiphenyl (BZ-204)	EPA 1668A	10129405	NELAP	PA
9137 - 2,2',3,4,4',5,6-Heptachlorobiphenyl (BZ-181)	EPA 1668A	10129405	NELAP	PA
9138 - 2,2',3,4,4',5-Hexachlorobiphenyl (BZ-137)	EPA 1668A	10129405	NELAP	PA
9140 - 2,2',3,4,4',6'-Hexachlorobiphenyl (BZ-140)	EPA 1668A	10129405	NELAP	PA
8928 - 2,2',3,4,4',6+2,2',3,4,4',6'-Hexachlorobiphenyl (BZ-139+140)	EPA 1668A	10129405	NELAP	PA
9139 - 2,2',3,4,4',6,6'-Heptachlorobiphenyl (BZ-184)	EPA 1668A	10129405	NELAP	PA
9141 - 2,2',3,4,4',6-Hexachlorobiphenyl (BZ-139)	EPA 1668A	10129405	NELAP	PA
9142 - 2,2',3,4,4'-Pentachlorobiphenyl (BZ-85)	EPA 1668A	10129405	NELAP	PA
9150 - 2,2',3,4,5',6-Hexachlorobiphenyl (BZ-144)	EPA 1668A	10129405	NELAP	PA
8975 - 2,2',3,4,5'-Pentachlorobiphenyl	EPA 1668A	10129405	NELAP	PA

Solid Chemical Materials

Analyte	Method Name	Method Code	Type	AB
(BZ-87)				
8944 - 2,2',3,4,5+2,2',3,4,5'+2,2',3,4',5'+2,2',4,4',6-Pentachlorobiphenyl (BZ-86+87+97+100)	EPA 1668A	10129405	NELAP	PA
8946 - 2,2',3,4,5+2,2',3,4,5'+2,2',3,4',5'+2,3,3',4,5'+ 2,3',4,4'6+2,3',4',5'6-Pentachlorobiphenyl (BZ 86+87+97+108+119+125)	EPA 1668A	10129405	NELAP	PA
9143 - 2,2',3,4,5,5',6-Heptachlorobiphenyl (BZ-185)	EPA 1668A	10129405	NELAP	PA
9030 - 2,2',3,4,5,5'-Hexachlorobiphenyl (BZ-141)	EPA 1668A	10129405	NELAP	PA
9152 - 2,2',3,4,5,6'-Hexachlorobiphenyl (BZ-143)	EPA 1668A	10129405	NELAP	PA
9145 - 2,2',3,4,5,6,6'-Heptachlorobiphenyl (BZ-186)	EPA 1668A	10129405	NELAP	PA
9148 - 2,2',3,4,5,6-Hexachlorobiphenyl (BZ-142)	EPA 1668A	10129405	NELAP	PA
9153 - 2,2',3,4,5-Pentachlorobiphenyl (BZ-86)	EPA 1668A	10129405	NELAP	PA
9161 - 2,2',3,4,6'-Pentachlorobiphenyl (BZ-89)	EPA 1668A	10129405	NELAP	PA
8947 - 2,2',3,4,6+2,2',3,4',6-Pentachlorobiphenyl (BZ-88+91)	EPA 1668A	10129405	NELAP	PA
9156 - 2,2',3,4,6,6'-Hexachlorobiphenyl (BZ-145)	EPA 1668A	10129405	NELAP	PA
9158 - 2,2',3,4,6-Pentachlorobiphenyl (BZ-88)	EPA 1668A	10129405	NELAP	PA
9163 - 2,2',3,4-Tetrachlorobiphenyl (BZ-41)	EPA 1668A	10129405	NELAP	PA
8957 - 2,2',3,5'+2,2',4,4'+2,3,5,6-Tetrachlorobiphenyl (BZ-44+47+65)	EPA 1668A	10129405	NELAP	PA
9166 - 2,2',3,5',6-Pentachlorobiphenyl (BZ-95)	EPA 1668A	10129405	NELAP	PA
8945 - 2,2',3,5'-Tetrachlorobiphenyl (BZ-44)	EPA 1668A	10129405	NELAP	PA
8956 - 2,2',3,5+2,3',5',6-Tetrachlorobiphenyl (BZ-43+73)	EPA 1668A	10129405	NELAP	PA
9035 - 2,2',3,5,5',6-Hexachlorobiphenyl (BZ-151)	EPA 1668A	10129405	NELAP	PA
9164 - 2,2',3,5,5'-Pentachlorobiphenyl (BZ-92)	EPA 1668A	10129405	NELAP	PA
9167 - 2,2',3,5,6'-Pentachlorobiphenyl (BZ-94)	EPA 1668A	10129405	NELAP	PA
8949 - 2,2',3,5,6+2,2',4,4',6-Pentachlorobiphenyl (BZ-93+100)	EPA 1668A	10129405	NELAP	PA
9165 - 2,2',3,5,6,6'-Hexachlorobiphenyl (BZ-152)	EPA 1668A	10129405	NELAP	PA
9168 - 2,2',3,5,6-Pentachlorobiphenyl (BZ-93)	EPA 1668A	10129405	NELAP	PA
9169 - 2,2',3,5-Tetrachlorobiphenyl (BZ-43)	EPA 1668A	10129405	NELAP	PA
9171 - 2,2',3,6'-Tetrachlorobiphenyl (BZ-46)	EPA 1668A	10129405	NELAP	PA
8958 - 2,2',3,6+2,2',4,6'-Tetrachlorobiphenyls (BZ 45 + 51)	EPA 1668A	10129405	NELAP	PA

Solid Chemical Materials

Analyte	Method Name	Method Code	Type	AB
9170 - 2,2',3,6,6'-Pentachlorobiphenyl (BZ-96)	EPA 1668A	10129405	NELAP	PA
9172 - 2,2',3,6-Tetrachlorobiphenyl (BZ-45)	EPA 1668A	10129405	NELAP	PA
9173 - 2,2',3-Trichlorobiphenyl (BZ-16)	EPA 1668A	10129405	NELAP	PA
8931 - 2,2',4,4',5,5'+2,3',4,4',5',6-Hexachlorobiphenyl (BZ-153+168)	EPA 1668A	10129405	NELAP	PA
9040 - 2,2',4,4',5,5'-Hexachlorobiphenyl (BZ-153)	EPA 1668A	10129405	NELAP	PA
9174 - 2,2',4,4',5,6'-Hexachlorobiphenyl (BZ-154)	EPA 1668A	10129405	NELAP	PA
9175 - 2,2',4,4',5-Pentachlorobiphenyl (BZ-99)	EPA 1668A	10129405	NELAP	PA
9176 - 2,2',4,4',6,6'-Hexachlorobiphenyl (BZ-155)	EPA 1668A	10129405	NELAP	PA
9177 - 2,2',4,4',6-Pentachlorobiphenyl (BZ-100)	EPA 1668A	10129405	NELAP	PA
9178 - 2,2',4,4'-Tetrachlorobiphenyl (BZ-47)	EPA 1668A	10129405	NELAP	PA
8959 - 2,2',4,5'+2,3',4,6-Tetrachlorobiphenyl (BZ-49+69)	EPA 1668A	10129405	NELAP	PA
9179 - 2,2',4,5',6-Pentachlorobiphenyl (BZ-103)	EPA 1668A	10129405	NELAP	PA
8950 - 2,2',4,5'-Tetrachlorobiphenyl (BZ-49)	EPA 1668A	10129405	NELAP	PA
8980 - 2,2',4,5,5'-Pentachlorobiphenyl (BZ-101)	EPA 1668A	10129405	NELAP	PA
9180 - 2,2',4,5,6'-Pentachlorobiphenyl (BZ-102)	EPA 1668A	10129405	NELAP	PA
9181 - 2,2',4,5-Tetrachlorobiphenyl (BZ-48)	EPA 1668A	10129405	NELAP	PA
9183 - 2,2',4,6'-Tetrachlorobiphenyl (BZ-51)	EPA 1668A	10129405	NELAP	PA
8961 - 2,2',4,6+2,2',5,6'-Tetrachlorobiphenyl (BZ-50+53)	EPA 1668A	10129405	NELAP	PA
9182 - 2,2',4,6,6'-Pentachlorobiphenyl (BZ-104)	EPA 1668A	10129405	NELAP	PA
9184 - 2,2',4,6-Tetrachlorobiphenyl (BZ-50)	EPA 1668A	10129405	NELAP	PA
9185 - 2,2',4-Trichlorobiphenyl (BZ-17)	EPA 1668A	10129405	NELAP	PA
8966 - 2,2',5+2,4,6-Trichlorobiphenyl (BZ-18+30)	EPA 1668A	10129405	NELAP	PA
8955 - 2,2',5,5'-Tetrachlorobiphenyl (BZ-52)	EPA 1668A	10129405	NELAP	PA
9186 - 2,2',5,6'-Tetrachlorobiphenyl (BZ-53)	EPA 1668A	10129405	NELAP	PA
8930 - 2,2',5-Trichlorobiphenyl (BZ-18)	EPA 1668A	10129405	NELAP	PA
9187 - 2,2',6,6'-Tetrachlorobiphenyl (BZ-54)	EPA 1668A	10129405	NELAP	PA
9188 - 2,2',6-Trichlorobiphenyl (BZ-19)	EPA 1668A	10129405	NELAP	PA
9189 - 2,2'-Dichlorobiphenyl (BZ-4)	EPA 1668A	10129405	NELAP	PA
9224 - 2,3',4',5',6-Pentachlorobiphenyl (BZ-125)	EPA 1668A	10129405	NELAP	PA
9229 - 2,3',4',5'-Tetrachlorobiphenyl (BZ-76)	EPA 1668A	10129405	NELAP	PA
8964 - 2,3',4',5+2,4,4',5+2,3',4',5'-	EPA 1668A	10129405	NELAP	PA

Solid Chemical Materials

Analyte	Method Name	Method Code	Type	AB
Tetrachlorobiphenyl (BZ-70+74+76)				
9222 - 2,3',4',5,5'-Pentachlorobiphenyl (BZ-124)	EPA 1668A	10129405	NELAP	PA
9230 - 2,3',4',5-Tetrachlorobiphenyl (BZ-70)	EPA 1668A	10129405	NELAP	PA
9237 - 2,3',4',6-Tetrachlorobiphenyl (BZ-71)	EPA 1668A	10129405	NELAP	PA
9239 - 2,3',4'-Trichlorobiphenyl (BZ-33)	EPA 1668A	10129405	NELAP	PA
9218 - 2,3',4,4',5',6-Hexachlorobiphenyl (BZ-168)	EPA 1668A	10129405	NELAP	PA
9000 - 2,3',4,4',5'-Pentachlorobiphenyl (BZ-123)	EPA 1668A	10129405	NELAP	PA
9055 - 2,3',4,4',5,5'-Hexachlorobiphenyl (BZ-167)	EPA 1668A	10129405	NELAP	PA
8995 - 2,3',4,4',5-Pentachlorobiphenyl (BZ-118)	EPA 1668A	10129405	NELAP	PA
9220 - 2,3',4,4',6-Pentachlorobiphenyl (BZ-119)	EPA 1668A	10129405	NELAP	PA
8960 - 2,3',4,4'-Tetrachlorobiphenyl (BZ-66)	EPA 1668A	10129405	NELAP	PA
9226 - 2,3',4,5',6-Pentachlorobiphenyl (BZ-121)	EPA 1668A	10129405	NELAP	PA
9231 - 2,3',4,5'-Tetrachlorobiphenyl (BZ-68)	EPA 1668A	10129405	NELAP	PA
9223 - 2,3',4,5,5'-Pentachlorobiphenyl (BZ-120)	EPA 1668A	10129405	NELAP	PA
9232 - 2,3',4,5-Tetrachlorobiphenyl (BZ-67)	EPA 1668A	10129405	NELAP	PA
9235 - 2,3',4,6-Tetrachlorobiphenyl (BZ-69)	EPA 1668A	10129405	NELAP	PA
9240 - 2,3',4-Trichlorobiphenyl (BZ-25)	EPA 1668A	10129405	NELAP	PA
9244 - 2,3',5',6-Tetrachlorobiphenyl (BZ-73)	EPA 1668A	10129405	NELAP	PA
9246 - 2,3',5'-Trichlorobiphenyl (BZ-34)	EPA 1668A	10129405	NELAP	PA
8969 - 2,3',5+2,4,5-Trichlorobiphenyl (BZ-26+29)	EPA 1668A	10129405	NELAP	PA
9242 - 2,3',5,5'-Tetrachlorobiphenyl (BZ-72)	EPA 1668A	10129405	NELAP	PA
8935 - 2,3',5-Trichlorobiphenyl (BZ-26)	EPA 1668A	10129405	NELAP	PA
9248 - 2,3',6-Trichlorobiphenyl (BZ-27)	EPA 1668A	10129405	NELAP	PA
9249 - 2,3'-Dichlorobiphenyl (BZ-6)	EPA 1668A	10129405	NELAP	PA
8967 - 2,3,3'+2,4,4'-Trichlorobiphenyl (BZ-20+28)	EPA 1668A	10129405	NELAP	PA
9201 - 2,3,3',4',5',6-Hexachlorobiphenyl (BZ-164)	EPA 1668A	10129405	NELAP	PA
9202 - 2,3,3',4',5'-Pentachlorobiphenyl (BZ-122)	EPA 1668A	10129405	NELAP	PA
8936 - 2,3,3',4',5+2,3',4',5,5'-Pentachlorobiphenyl (BZ-107+124)	EPA 1668A	10129405	NELAP	PA
9195 - 2,3,3',4',5,5',6-Heptachlorobiphenyl (BZ-193)	EPA 1668A	10129405	NELAP	PA
9197 - 2,3,3',4',5,5'-Hexachlorobiphenyl (BZ-162)	EPA 1668A	10129405	NELAP	PA
9199 - 2,3,3',4',5,6-Hexachlorobiphenyl (BZ-163)	EPA 1668A	10129405	NELAP	PA
9205 - 2,3,3',4',5-Pentachlorobiphenyl	EPA 1668A	10129405	NELAP	PA

Clients and Customers are urged to verify the laboratory's current certification status with the Louisiana Environmental Laboratory Accreditation Program.

Solid Chemical Materials

Analyte	Method Name	Method Code	Type	AB
(BZ-107)				
8938 - 2,3,3',4',6+2,3,4,4',6-Pentachlorobiphenyl (BZ-110+115)	EPA 1668A	10129405	NELAP	PA
8990 - 2,3,3',4',6-Pentachlorobiphenyl (BZ-110)	EPA 1668A	10129405	NELAP	PA
9207 - 2,3,3',4'-Tetrachlorobiphenyl (BZ-56)	EPA 1668A	10129405	NELAP	PA
9192 - 2,3,3',4,4',5',6-Heptachlorobiphenyl (BZ-191)	EPA 1668A	10129405	NELAP	PA
9045 - 2,3,3',4,4',5'-Hexachlorobiphenyl (BZ-157)	EPA 1668A	10129405	NELAP	PA
8932 - 2,3,3',4,4',5+2,3,3',4,4',5'-Hexachlorobiphenyl (BZ-156+157)	EPA 1668A	10129405	NELAP	PA
9190 - 2,3,3',4,4',5,5',6-Octachlorobiphenyl (BZ-205)	EPA 1668A	10129405	NELAP	PA
9085 - 2,3,3',4,4',5,5'-Heptachlorobiphenyl (BZ-189)	EPA 1668A	10129405	NELAP	PA
9191 - 2,3,3',4,4',5,6-Heptachlorobiphenyl (BZ-190)	EPA 1668A	10129405	NELAP	PA
9050 - 2,3,3',4,4',5-Hexachlorobiphenyl (BZ-156)	EPA 1668A	10129405	NELAP	PA
9193 - 2,3,3',4,4',6-Hexachlorobiphenyl (BZ-158)	EPA 1668A	10129405	NELAP	PA
8985 - 2,3,3',4,4'-Pentachlorobiphenyl (BZ-105)	EPA 1668A	10129405	NELAP	PA
9200 - 2,3,3',4,5',6-Hexachlorobiphenyl (BZ-161)	EPA 1668A	10129405	NELAP	PA
9203 - 2,3,3',4,5'-Pentachlorobiphenyl (BZ-108)	EPA 1668A	10129405	NELAP	PA
9194 - 2,3,3',4,5,5',6-Heptachlorobiphenyl (BZ-192)	EPA 1668A	10129405	NELAP	PA
9196 - 2,3,3',4,5,5'-Hexachlorobiphenyl (BZ-159)	EPA 1668A	10129405	NELAP	PA
9198 - 2,3,3',4,5,6-Hexachlorobiphenyl (BZ-160)	EPA 1668A	10129405	NELAP	PA
9204 - 2,3,3',4,5-Pentachlorobiphenyl (BZ-106)	EPA 1668A	10129405	NELAP	PA
9206 - 2,3,3',4,6-Pentachlorobiphenyl (BZ-109)	EPA 1668A	10129405	NELAP	PA
9208 - 2,3,3',4-Tetrachlorobiphenyl (BZ-55)	EPA 1668A	10129405	NELAP	PA
9212 - 2,3,3',5',6-Pentachlorobiphenyl (BZ-113)	EPA 1668A	10129405	NELAP	PA
9213 - 2,3,3',5'-Tetrachlorobiphenyl (BZ-58)	EPA 1668A	10129405	NELAP	PA
9209 - 2,3,3',5,5',6-Hexachlorobiphenyl (BZ-165)	EPA 1668A	10129405	NELAP	PA
9210 - 2,3,3',5,5'-Pentachlorobiphenyl (BZ-111)	EPA 1668A	10129405	NELAP	PA
9211 - 2,3,3',5,6-Pentachlorobiphenyl (BZ-112)	EPA 1668A	10129405	NELAP	PA
9214 - 2,3,3',5-Tetrachlorobiphenyl (BZ-57)	EPA 1668A	10129405	NELAP	PA
8962 - 2,3,3',6+2,3,4,6+2,4,4',6-Tetrachlorobiphenyl (BZ-59+62+75)	EPA 1668A	10129405	NELAP	PA
9215 - 2,3,3',6-Tetrachlorobiphenyl (BZ-	EPA 1668A	10129405	NELAP	PA

Solid Chemical Materials

Analyte	Method Name	Method Code	Type	AB
59)				
9216 - 2,3,3'-Trichlorobiphenyl (BZ-20)	EPA 1668A	10129405	NELAP	PA
9227 - 2,3,4',5,6-Pentachlorobiphenyl (BZ-117)	EPA 1668A	10129405	NELAP	PA
9233 - 2,3,4',5-Tetrachlorobiphenyl (BZ-63)	EPA 1668A	10129405	NELAP	PA
9236 - 2,3,4',6-Tetrachlorobiphenyl (BZ-64)	EPA 1668A	10129405	NELAP	PA
9241 - 2,3,4'-Trichlorobiphenyl (BZ-22)	EPA 1668A	10129405	NELAP	PA
8968 - 2,3,4+2,3',4'-Trichlorobiphenyl (BZ-21+33)	EPA 1668A	10129405	NELAP	PA
9217 - 2,3,4,4',5,6-Hexachlorobiphenyl (BZ-166)	EPA 1668A	10129405	NELAP	PA
9005 - 2,3,4,4',5-Pentachlorobiphenyl (BZ-114)	EPA 1668A	10129405	NELAP	PA
9219 - 2,3,4,4',6-Pentachlorobiphenyl (BZ-115)	EPA 1668A	10129405	NELAP	PA
9221 - 2,3,4,4'-Tetrachlorobiphenyl (BZ-60)	EPA 1668A	10129405	NELAP	PA
8963 - 2,3,4,5+2,3',4',5+2,4,4',5+2,3',4',5'-Tetrachlorobiphenyls (BZ 61+70+74+76)	EPA 1668A	10129405	NELAP	PA
9225 - 2,3,4,5,6-Pentachlorobiphenyl (BZ-116)	EPA 1668A	10129405	NELAP	PA
9228 - 2,3,4,5-Tetrachlorobiphenyl (BZ-61)	EPA 1668A	10129405	NELAP	PA
9234 - 2,3,4,6-Tetrachlorobiphenyl (BZ-62)	EPA 1668A	10129405	NELAP	PA
9238 - 2,3,4-Trichlorobiphenyl (BZ-21)	EPA 1668A	10129405	NELAP	PA
9243 - 2,3,5,6-Tetrachlorobiphenyl (BZ-65)	EPA 1668A	10129405	NELAP	PA
9245 - 2,3,5-Trichlorobiphenyl (BZ-23)	EPA 1668A	10129405	NELAP	PA
9247 - 2,3,6-Trichlorobiphenyl (BZ-24)	EPA 1668A	10129405	NELAP	PA
8920 - 2,3-Dichlorobiphenyl (BZ-5)	EPA 1668A	10129405	NELAP	PA
8940 - 2,4',5-Trichlorobiphenyl (BZ-31)	EPA 1668A	10129405	NELAP	PA
9255 - 2,4',6-Trichlorobiphenyl (BZ-32)	EPA 1668A	10129405	NELAP	PA
9256 - 2,4'-Dichlorobiphenyl (BZ-8)	EPA 1668A	10129405	NELAP	PA
9250 - 2,4,4',5-Tetrachlorobiphenyl (BZ-74)	EPA 1668A	10129405	NELAP	PA
9251 - 2,4,4',6-Tetrachlorobiphenyl (BZ-75)	EPA 1668A	10129405	NELAP	PA
9252 - 2,4,4'-Trichlorobiphenyl (BZ-28)	EPA 1668A	10129405	NELAP	PA
9253 - 2,4,5-Trichlorobiphenyl (BZ-29)	EPA 1668A	10129405	NELAP	PA
9254 - 2,4,6-Trichlorobiphenyl (BZ-30)	EPA 1668A	10129405	NELAP	PA
9257 - 2,4-Dichlorobiphenyl (BZ-7)	EPA 1668A	10129405	NELAP	PA
9258 - 2,5-Dichlorobiphenyl (BZ-9)	EPA 1668A	10129405	NELAP	PA
9259 - 2,6-Dichlorobiphenyl (BZ-10)	EPA 1668A	10129405	NELAP	PA
8915 - 2-Chlorobiphenyl (BZ-1)	EPA 1668A	10129405	NELAP	PA
9060 - 3,3',4,4',5,5'-Hexachlorobiphenyl (BZ-169)	EPA 1668A	10129405	NELAP	PA
9015 - 3,3',4,4',5-Pentachlorobiphenyl (BZ-126)	EPA 1668A	10129405	NELAP	PA
8965 - 3,3',4,4'-Tetrachlorobiphenyl (BZ-77)	EPA 1668A	10129405	NELAP	PA
9261 - 3,3',4,5'-Tetrachlorobiphenyl (BZ-79)	EPA 1668A	10129405	NELAP	PA
9260 - 3,3',4,5,5'-Pentachlorobiphenyl	EPA 1668A	10129405	NELAP	PA

Solid Chemical Materials

Analyte	Method Name	Method Code	Type	AB
(BZ-127)				
9262 - 3,3',4,5-Tetrachlorobiphenyl (BZ-78)	EPA 1668A	10129405	NELAP	PA
9263 - 3,3',4-Trichlorobiphenyl (BZ-35)	EPA 1668A	10129405	NELAP	PA
9264 - 3,3',5,5'-Tetrachlorobiphenyl (BZ-80)	EPA 1668A	10129405	NELAP	PA
9265 - 3,3',5-Trichlorobiphenyl (BZ-36)	EPA 1668A	10129405	NELAP	PA
8925 - 3,3'-Dichlorobiphenyl (BZ-11)	EPA 1668A	10129405	NELAP	PA
9268 - 3,4',5-Trichlorobiphenyl (BZ-39)	EPA 1668A	10129405	NELAP	PA
9269 - 3,4'-Dichlorobiphenyl (BZ-13)	EPA 1668A	10129405	NELAP	PA
100098 - 3,4+3,4'-Dichlorobiphenyl (BZ-12+13)	EPA 1668A	10129405	NELAP	PA
8970 - 3,4,4',5-Tetrachlorobiphenyl (BZ-81)	EPA 1668A	10129405	NELAP	PA
9266 - 3,4,4'-Trichlorobiphenyl (BZ-37)	EPA 1668A	10129405	NELAP	PA
9267 - 3,4,5-Trichlorobiphenyl (BZ-38)	EPA 1668A	10129405	NELAP	PA
9270 - 3,4-Dichlorobiphenyl (BZ-12)	EPA 1668A	10129405	NELAP	PA
9271 - 3,5-Dichlorobiphenyl (BZ-14)	EPA 1668A	10129405	NELAP	PA
9272 - 3-Chlorobiphenyl (BZ-2)	EPA 1668A	10129405	NELAP	PA
9273 - 4,4'-Dichlorobiphenyl (BZ-15)	EPA 1668A	10129405	NELAP	PA
9274 - 4-Chlorobiphenyl (BZ-3)	EPA 1668A	10129405	NELAP	PA
8872 - PCB Aroclor Identification	EPA 1668A	10129405	NELAP	PA
8870 - PCBs	EPA 1668A	10129405	NELAP	PA
8875 - PCBs, as congeners	EPA 1668A	10129405	NELAP	PA
8876 - Total Dichlorobiphenyls	EPA 1668A	10129405	NELAP	PA
8877 - Total Heptachlorobiphenyls	EPA 1668A	10129405	NELAP	PA
8888 - Total Hexachlorobiphenyls	EPA 1668A	10129405	NELAP	PA
8889 - Total Monochlorobiphenyls	EPA 1668A	10129405	NELAP	PA
8891 - Total Nonachlorobiphenyls	EPA 1668A	10129405	NELAP	PA
8892 - Total Octachlorobiphenyls	EPA 1668A	10129405	NELAP	PA
8896 - Total Pentachlorobiphenyls	EPA 1668A	10129405	NELAP	PA
8893 - Total Tetrachlorobiphenyls	EPA 1668A	10129405	NELAP	PA
8894 - Total Trichlorobiphenyls	EPA 1668A	10129405	NELAP	PA
100007 - Acid Digestion of Sediments, Sludges, and soils	EPA 3050B	10135601	NELAP	PA
1402 - Alkaline Digestion for Hexavalent Chromium	EPA 3060A	10136604	NELAP	PA
1444 - Separatory Funnel Liquid-liquid extraction	EPA 3510C	10138202	NELAP	PA
1452 - Soxhlet Extraction	EPA 3540C	10140202	NELAP	PA
1428 - Microwave Extraction	EPA 3546	10141205	NELAP	PA
1468 - Ultrasonic Extraction	EPA 3550C	10142004	NELAP	PA
1456 - Sulfur Clean-Up	EPA 3660B	10148400	NELAP	PA
2020 - Sulfuric acid/permanganate clean-up	EPA 3665	10148604	NELAP	PA
2020 - Sulfuric acid/permanganate clean-up	EPA 3665A	10148808	NELAP	PA
100017 - Closed-System Purge-and-Trap and Extraction for Volatile Organics in Soil and Waste Samples	EPA 5030	10153001	NELAP	PA
1406 - Purge and trap for aqueous phase samples	EPA 5030	10153001	NELAP	PA
100017 - Closed-System Purge-and-Trap and Extraction for Volatile Organics in Soil and Waste Samples	EPA 5035	10154004	NELAP	PA
1145 - Silicon	EPA 6010	10155201	NELAP	PA
1000 - Aluminum	EPA 6010B	10155609	NELAP	PA
1005 - Antimony	EPA 6010B	10155609	NELAP	PA

Solid Chemical Materials

Analyte	Method Name	Method Code	Type	AB
1010 - Arsenic	EPA 6010B	10155609	NELAP	PA
1015 - Barium	EPA 6010B	10155609	NELAP	PA
1020 - Beryllium	EPA 6010B	10155609	NELAP	PA
1025 - Boron	EPA 6010B	10155609	NELAP	PA
1030 - Cadmium	EPA 6010B	10155609	NELAP	PA
1035 - Calcium	EPA 6010B	10155609	NELAP	PA
1040 - Chromium	EPA 6010B	10155609	NELAP	PA
1050 - Cobalt	EPA 6010B	10155609	NELAP	PA
1055 - Copper	EPA 6010B	10155609	NELAP	PA
1070 - Iron	EPA 6010B	10155609	NELAP	PA
1075 - Lead	EPA 6010B	10155609	NELAP	PA
1080 - Lithium	EPA 6010B	10155609	NELAP	PA
1085 - Magnesium	EPA 6010B	10155609	NELAP	PA
1090 - Manganese	EPA 6010B	10155609	NELAP	PA
1100 - Molybdenum	EPA 6010B	10155609	NELAP	PA
1105 - Nickel	EPA 6010B	10155609	NELAP	PA
1125 - Potassium	EPA 6010B	10155609	NELAP	PA
1140 - Selenium	EPA 6010B	10155609	NELAP	PA
1150 - Silver	EPA 6010B	10155609	NELAP	PA
1155 - Sodium	EPA 6010B	10155609	NELAP	PA
1160 - Strontium	EPA 6010B	10155609	NELAP	PA
1165 - Thallium	EPA 6010B	10155609	NELAP	PA
1175 - Tin	EPA 6010B	10155609	NELAP	PA
1180 - Titanium	EPA 6010B	10155609	NELAP	PA
1185 - Vanadium	EPA 6010B	10155609	NELAP	PA
1190 - Zinc	EPA 6010B	10155609	NELAP	PA
1000 - Aluminum	EPA 6010C	10155803	NELAP	PA
1005 - Antimony	EPA 6010C	10155803	NELAP	PA
1010 - Arsenic	EPA 6010C	10155803	NELAP	PA
1015 - Barium	EPA 6010C	10155803	NELAP	PA
1020 - Beryllium	EPA 6010C	10155803	NELAP	PA
1025 - Boron	EPA 6010C	10155803	NELAP	PA
1030 - Cadmium	EPA 6010C	10155803	NELAP	PA
1035 - Calcium	EPA 6010C	10155803	NELAP	PA
1040 - Chromium	EPA 6010C	10155803	NELAP	PA
1050 - Cobalt	EPA 6010C	10155803	NELAP	PA
1055 - Copper	EPA 6010C	10155803	NELAP	PA
1070 - Iron	EPA 6010C	10155803	NELAP	PA
1075 - Lead	EPA 6010C	10155803	NELAP	PA
1080 - Lithium	EPA 6010C	10155803	NELAP	PA
1085 - Magnesium	EPA 6010C	10155803	NELAP	PA
1090 - Manganese	EPA 6010C	10155803	NELAP	PA
1100 - Molybdenum	EPA 6010C	10155803	NELAP	PA
1105 - Nickel	EPA 6010C	10155803	NELAP	PA
1125 - Potassium	EPA 6010C	10155803	NELAP	PA
1140 - Selenium	EPA 6010C	10155803	NELAP	PA
1150 - Silver	EPA 6010C	10155803	NELAP	PA
1155 - Sodium	EPA 6010C	10155803	NELAP	PA
1160 - Strontium	EPA 6010C	10155803	NELAP	PA
2017 - Sulfur	EPA 6010C	10155803	NELAP	PA
1165 - Thallium	EPA 6010C	10155803	NELAP	PA
1175 - Tin	EPA 6010C	10155803	NELAP	PA
1180 - Titanium	EPA 6010C	10155803	NELAP	PA
1185 - Vanadium	EPA 6010C	10155803	NELAP	PA
1190 - Zinc	EPA 6010C	10155803	NELAP	PA
1000 - Aluminum	EPA 6020	10156000	NELAP	PA

Solid Chemical Materials

Analyte	Method Name	Method Code	Type	AB
1005 - Antimony	EPA 6020	10156000	NELAP	PA
1010 - Arsenic	EPA 6020	10156000	NELAP	PA
1015 - Barium	EPA 6020	10156000	NELAP	PA
1020 - Beryllium	EPA 6020	10156000	NELAP	PA
1030 - Cadmium	EPA 6020	10156000	NELAP	PA
1035 - Calcium	EPA 6020	10156000	NELAP	PA
1040 - Chromium	EPA 6020	10156000	NELAP	PA
1050 - Cobalt	EPA 6020	10156000	NELAP	PA
1055 - Copper	EPA 6020	10156000	NELAP	PA
1070 - Iron	EPA 6020	10156000	NELAP	PA
1075 - Lead	EPA 6020	10156000	NELAP	PA
1085 - Magnesium	EPA 6020	10156000	NELAP	PA
1090 - Manganese	EPA 6020	10156000	NELAP	PA
1100 - Molybdenum	EPA 6020	10156000	NELAP	PA
1105 - Nickel	EPA 6020	10156000	NELAP	PA
1125 - Potassium	EPA 6020	10156000	NELAP	PA
1140 - Selenium	EPA 6020	10156000	NELAP	PA
1150 - Silver	EPA 6020	10156000	NELAP	PA
1155 - Sodium	EPA 6020	10156000	NELAP	PA
1160 - Strontium	EPA 6020	10156000	NELAP	PA
1165 - Thallium	EPA 6020	10156000	NELAP	PA
1175 - Tin	EPA 6020	10156000	NELAP	PA
1185 - Vanadium	EPA 6020	10156000	NELAP	PA
1190 - Zinc	EPA 6020	10156000	NELAP	PA
1155 - Sodium	EPA 6020	10156204	NELAP	PA
1000 - Aluminum	EPA 6020A	10156408	NELAP	PA
1005 - Antimony	EPA 6020A	10156408	NELAP	PA
1010 - Arsenic	EPA 6020A	10156408	NELAP	PA
1015 - Barium	EPA 6020A	10156408	NELAP	PA
1020 - Beryllium	EPA 6020A	10156408	NELAP	PA
1030 - Cadmium	EPA 6020A	10156408	NELAP	PA
1035 - Calcium	EPA 6020A	10156408	NELAP	PA
1040 - Chromium	EPA 6020A	10156408	NELAP	PA
1050 - Cobalt	EPA 6020A	10156408	NELAP	PA
1055 - Copper	EPA 6020A	10156408	NELAP	PA
1070 - Iron	EPA 6020A	10156408	NELAP	PA
1075 - Lead	EPA 6020A	10156408	NELAP	PA
1085 - Magnesium	EPA 6020A	10156408	NELAP	PA
1090 - Manganese	EPA 6020A	10156408	NELAP	PA
1100 - Molybdenum	EPA 6020A	10156408	NELAP	PA
1105 - Nickel	EPA 6020A	10156408	NELAP	PA
1125 - Potassium	EPA 6020A	10156408	NELAP	PA
1140 - Selenium	EPA 6020A	10156408	NELAP	PA
1150 - Silver	EPA 6020A	10156408	NELAP	PA
1155 - Sodium	EPA 6020A	10156408	NELAP	PA
1160 - Strontium	EPA 6020A	10156408	NELAP	PA
1165 - Thallium	EPA 6020A	10156408	NELAP	PA
1175 - Tin	EPA 6020A	10156408	NELAP	PA
1180 - Titanium	EPA 6020A	10156408	NELAP	PA
1185 - Vanadium	EPA 6020A	10156408	NELAP	PA
1190 - Zinc	EPA 6020A	10156408	NELAP	PA
1045 - Chromium VI	EPA 7196A	10162400	NELAP	PA
1045 - Chromium VI	EPA 7199	10163005	NELAP	PA
1095 - Mercury	EPA 7471A	10166208	NELAP	PA
1095 - Mercury	EPA 7471B	10166402	NELAP	PA
9369 - Diesel range organics (DRO)	EPA 8015B	10173601	NELAP	PA

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Solid Chemical Materials

Analyte	Method Name	Method Code	Type	AB
4750 - Ethanol	EPA 8015B	10173601	NELAP	PA
4785 - Ethylene glycol	EPA 8015B	10173601	NELAP	PA
9408 - Gasoline range organics (GRO)	EPA 8015B	10173601	NELAP	PA
4895 - Isopropyl alcohol (2-Propanol, Isopropanol)	EPA 8015B	10173601	NELAP	PA
4930 - Methanol	EPA 8015B	10173601	NELAP	PA
9369 - Diesel range organics (DRO)	EPA 8015C	10173805	NELAP	PA
4750 - Ethanol	EPA 8015C	10173805	NELAP	PA
4785 - Ethylene glycol	EPA 8015C	10173805	NELAP	PA
9408 - Gasoline range organics (GRO)	EPA 8015C	10173805	NELAP	PA
4895 - Isopropyl alcohol (2-Propanol, Isopropanol)	EPA 8015C	10173805	NELAP	PA
4930 - Methanol	EPA 8015C	10173805	NELAP	PA
4375 - Benzene	EPA 8021B	10174808	NELAP	PA
4765 - Ethylbenzene	EPA 8021B	10174808	NELAP	PA
4900 - Isopropylbenzene	EPA 8021B	10174808	NELAP	PA
5000 - Methyl tert-butyl ether (MTBE)	EPA 8021B	10174808	NELAP	PA
5005 - Naphthalene	EPA 8021B	10174808	NELAP	PA
5140 - Toluene	EPA 8021B	10174808	NELAP	PA
5260 - Xylene (total)	EPA 8021B	10174808	NELAP	PA
5245 - m-Xylene	EPA 8021B	10174808	NELAP	PA
5250 - o-Xylene	EPA 8021B	10174808	NELAP	PA
5255 - p-Xylene	EPA 8021B	10174808	NELAP	PA
7355 - 4,4'-DDD	EPA 8081A	10178606	NELAP	PA
7360 - 4,4'-DDE	EPA 8081A	10178606	NELAP	PA
7365 - 4,4'-DDT	EPA 8081A	10178606	NELAP	PA
7025 - Aldrin	EPA 8081A	10178606	NELAP	PA
7250 - Chlordane (tech.)	EPA 8081A	10178606	NELAP	PA
7470 - Dieldrin	EPA 8081A	10178606	NELAP	PA
7510 - Endosulfan I	EPA 8081A	10178606	NELAP	PA
7515 - Endosulfan II	EPA 8081A	10178606	NELAP	PA
7520 - Endosulfan sulfate	EPA 8081A	10178606	NELAP	PA
7540 - Endrin	EPA 8081A	10178606	NELAP	PA
7530 - Endrin aldehyde	EPA 8081A	10178606	NELAP	PA
7535 - Endrin ketone	EPA 8081A	10178606	NELAP	PA
7685 - Heptachlor	EPA 8081A	10178606	NELAP	PA
7690 - Heptachlor epoxide	EPA 8081A	10178606	NELAP	PA
7740 - Kepone	EPA 8081A	10178606	NELAP	PA
7810 - Methoxychlor	EPA 8081A	10178606	NELAP	PA
7870 - Mirex	EPA 8081A	10178606	NELAP	PA
8250 - Toxaphene (Chlorinated camphene)	EPA 8081A	10178606	NELAP	PA
7110 - alpha-BHC (alpha-Hexachlorocyclohexane)	EPA 8081A	10178606	NELAP	PA
7240 - alpha-Chlordane	EPA 8081A	10178606	NELAP	PA
7115 - beta-BHC (beta-Hexachlorocyclohexane)	EPA 8081A	10178606	NELAP	PA
7105 - delta-BHC	EPA 8081A	10178606	NELAP	PA
7120 - gamma-BHC (Lindane, gamma-HexachlorocyclohexanE)	EPA 8081A	10178606	NELAP	PA
7245 - gamma-Chlordane	EPA 8081A	10178606	NELAP	PA
7355 - 4,4'-DDD	EPA 8081B	10178800	NELAP	PA
7360 - 4,4'-DDE	EPA 8081B	10178800	NELAP	PA
7365 - 4,4'-DDT	EPA 8081B	10178800	NELAP	PA
7025 - Aldrin	EPA 8081B	10178800	NELAP	PA
7250 - Chlordane (tech.)	EPA 8081B	10178800	NELAP	PA
7470 - Dieldrin	EPA 8081B	10178800	NELAP	PA

Solid Chemical Materials

Analyte	Method Name	Method Code	Type	AB
7510 - Endosulfan I	EPA 8081B	10178800	NELAP	PA
7515 - Endosulfan II	EPA 8081B	10178800	NELAP	PA
7520 - Endosulfan sulfate	EPA 8081B	10178800	NELAP	PA
7540 - Endrin	EPA 8081B	10178800	NELAP	PA
7530 - Endrin aldehyde	EPA 8081B	10178800	NELAP	PA
7535 - Endrin ketone	EPA 8081B	10178800	NELAP	PA
7685 - Heptachlor	EPA 8081B	10178800	NELAP	PA
7690 - Heptachlor epoxide	EPA 8081B	10178800	NELAP	PA
7740 - Kepone	EPA 8081B	10178800	NELAP	PA
7810 - Methoxychlor	EPA 8081B	10178800	NELAP	PA
7870 - Mirex	EPA 8081B	10178800	NELAP	PA
8250 - Toxaphene (Chlorinated camphene)	EPA 8081B	10178800	NELAP	PA
7110 - alpha-BHC (alpha-Hexachlorocyclohexane)	EPA 8081B	10178800	NELAP	PA
7240 - alpha-Chlordane	EPA 8081B	10178800	NELAP	PA
7115 - beta-BHC (beta-Hexachlorocyclohexane)	EPA 8081B	10178800	NELAP	PA
7105 - delta-BHC	EPA 8081B	10178800	NELAP	PA
7120 - gamma-BHC (Lindane, gamma-HexachlorocyclohexanE)	EPA 8081B	10178800	NELAP	PA
7245 - gamma-Chlordane	EPA 8081B	10178800	NELAP	PA
8880 - Aroclor-1016 (PCB-1016)	EPA 8082	10179007	NELAP	PA
8885 - Aroclor-1221 (PCB-1221)	EPA 8082	10179007	NELAP	PA
8890 - Aroclor-1232 (PCB-1232)	EPA 8082	10179007	NELAP	PA
8895 - Aroclor-1242 (PCB-1242)	EPA 8082	10179007	NELAP	PA
8900 - Aroclor-1248 (PCB-1248)	EPA 8082	10179007	NELAP	PA
8905 - Aroclor-1254 (PCB-1254)	EPA 8082	10179007	NELAP	PA
8910 - Aroclor-1260 (PCB-1260)	EPA 8082	10179007	NELAP	PA
8912 - Aroclor-1262 (PCB-1262)	EPA 8082	10179007	NELAP	PA
8913 - Aroclor-1268 (PCB-1268)	EPA 8082	10179007	NELAP	PA
8880 - Aroclor-1016 (PCB-1016)	EPA 8082A	10179201	NELAP	PA
8885 - Aroclor-1221 (PCB-1221)	EPA 8082A	10179201	NELAP	PA
8890 - Aroclor-1232 (PCB-1232)	EPA 8082A	10179201	NELAP	PA
8895 - Aroclor-1242 (PCB-1242)	EPA 8082A	10179201	NELAP	PA
8900 - Aroclor-1248 (PCB-1248)	EPA 8082A	10179201	NELAP	PA
8905 - Aroclor-1254 (PCB-1254)	EPA 8082A	10179201	NELAP	PA
8910 - Aroclor-1260 (PCB-1260)	EPA 8082A	10179201	NELAP	PA
8912 - Aroclor-1262 (PCB-1262)	EPA 8082A	10179201	NELAP	PA
8913 - Aroclor-1268 (PCB-1268)	EPA 8082A	10179201	NELAP	PA
7600 - Fensulfothion	EPA 8141	10181803	NELAP	PA
7785 - Merphos	EPA 8141	10181803	NELAP	PA
8140 - Stirophos	EPA 8141	10181803	NELAP	PA
7005 - Alachlor	EPA 8141A	10182000	NELAP	PA
7065 - Atrazine	EPA 8141A	10182000	NELAP	PA
7075 - Azinphos-methyl (Guthion)	EPA 8141A	10182000	NELAP	PA
7125 - Bolstar (Sulprofos)	EPA 8141A	10182000	NELAP	PA
7220 - Carbophenothion	EPA 8141A	10182000	NELAP	PA
7300 - Chlorpyrifos	EPA 8141A	10182000	NELAP	PA
7395 - Demeton-o	EPA 8141A	10182000	NELAP	PA
7385 - Demeton-s	EPA 8141A	10182000	NELAP	PA
7410 - Diazinon	EPA 8141A	10182000	NELAP	PA
8610 - Dichlorovos (DDVP, Dichlorvos)	EPA 8141A	10182000	NELAP	PA
8625 - Disulfoton	EPA 8141A	10182000	NELAP	PA
7550 - EPN	EPA 8141A	10182000	NELAP	PA
7565 - Ethion	EPA 8141A	10182000	NELAP	PA
7570 - Ethoprop	EPA 8141A	10182000	NELAP	PA

Solid Chemical Materials

Analyte	Method Name	Method Code	Type	AB
7580 - Famphur	EPA 8141A	10182000	NELAP	PA
7600 - Fensulfothion	EPA 8141A	10182000	NELAP	PA
7605 - Fenthion	EPA 8141A	10182000	NELAP	PA
7770 - Malathion	EPA 8141A	10182000	NELAP	PA
7785 - Merphos	EPA 8141A	10182000	NELAP	PA
7825 - Methyl parathion (Parathion, methyl)	EPA 8141A	10182000	NELAP	PA
7850 - Mevinphos	EPA 8141A	10182000	NELAP	PA
7905 - Naled	EPA 8141A	10182000	NELAP	PA
7955 - Parathion, ethyl	EPA 8141A	10182000	NELAP	PA
7985 - Phorate	EPA 8141A	10182000	NELAP	PA
8110 - Ronnel	EPA 8141A	10182000	NELAP	PA
8125 - Simazine	EPA 8141A	10182000	NELAP	PA
8140 - Stirophos	EPA 8141A	10182000	NELAP	PA
7005 - Alachlor	EPA 8141B	10182204	NELAP	PA
7065 - Atrazine	EPA 8141B	10182204	NELAP	PA
7075 - Azinphos-methyl (Guthion)	EPA 8141B	10182204	NELAP	PA
7125 - Bolstar (Sulprofos)	EPA 8141B	10182204	NELAP	PA
7220 - Carbophenothion	EPA 8141B	10182204	NELAP	PA
7300 - Chlorpyrifos	EPA 8141B	10182204	NELAP	PA
7395 - Demeton-o	EPA 8141B	10182204	NELAP	PA
7385 - Demeton-s	EPA 8141B	10182204	NELAP	PA
7410 - Diazinon	EPA 8141B	10182204	NELAP	PA
8610 - Dichlorovos (DDVP, Dichlorvos)	EPA 8141B	10182204	NELAP	PA
8625 - Disulfoton	EPA 8141B	10182204	NELAP	PA
7550 - EPN	EPA 8141B	10182204	NELAP	PA
7565 - Ethion	EPA 8141B	10182204	NELAP	PA
7570 - Ethoprop	EPA 8141B	10182204	NELAP	PA
7580 - Famphur	EPA 8141B	10182204	NELAP	PA
7600 - Fensulfothion	EPA 8141B	10182204	NELAP	PA
7605 - Fenthion	EPA 8141B	10182204	NELAP	PA
7770 - Malathion	EPA 8141B	10182204	NELAP	PA
7785 - Merphos	EPA 8141B	10182204	NELAP	PA
7825 - Methyl parathion (Parathion, methyl)	EPA 8141B	10182204	NELAP	PA
7850 - Mevinphos	EPA 8141B	10182204	NELAP	PA
7905 - Naled	EPA 8141B	10182204	NELAP	PA
7955 - Parathion, ethyl	EPA 8141B	10182204	NELAP	PA
7985 - Phorate	EPA 8141B	10182204	NELAP	PA
8110 - Ronnel	EPA 8141B	10182204	NELAP	PA
8125 - Simazine	EPA 8141B	10182204	NELAP	PA
8655 - 2,4,5-T	EPA 8151	10183003	NELAP	PA
8545 - 2,4-D	EPA 8151	10183003	NELAP	PA
8560 - 2,4-DB	EPA 8151	10183003	NELAP	PA
8555 - Dalapon	EPA 8151	10183003	NELAP	PA
8595 - Dicamba	EPA 8151	10183003	NELAP	PA
8605 - Dichloroprop (Dichlorprop)	EPA 8151	10183003	NELAP	PA
8620 - Dinoseb (2-sec-butyl-4,6-dinitrophenol, DNBP)	EPA 8151	10183003	NELAP	PA
7775 - MCPA	EPA 8151	10183003	NELAP	PA
7780 - MCPP	EPA 8151	10183003	NELAP	PA
6605 - Pentachlorophenol	EPA 8151	10183003	NELAP	PA
8645 - Picloram	EPA 8151	10183003	NELAP	PA
8650 - Silvex (2,4,5-TP)	EPA 8151	10183003	NELAP	PA
8655 - 2,4,5-T	EPA 8151A	10183207	NELAP	PA
8545 - 2,4-D	EPA 8151A	10183207	NELAP	PA
8560 - 2,4-DB	EPA 8151A	10183207	NELAP	PA
8555 - Dalapon	EPA 8151A	10183207	NELAP	PA

Solid Chemical Materials

Analyte	Method Name	Method Code	Type	AB
8595 - Dicamba	EPA 8151A	10183207	NELAP	PA
8605 - Dichloroprop (Dichlorprop)	EPA 8151A	10183207	NELAP	PA
8620 - Dinoseb (2-sec-butyl-4,6-dinitrophenol, DNBP)	EPA 8151A	10183207	NELAP	PA
7775 - MCPA	EPA 8151A	10183207	NELAP	PA
7780 - MCPP	EPA 8151A	10183207	NELAP	PA
6605 - Pentachlorophenol	EPA 8151A	10183207	NELAP	PA
8645 - Picloram	EPA 8151A	10183207	NELAP	PA
8650 - Silvex (2,4,5-TP)	EPA 8151A	10183207	NELAP	PA
5105 - 1,1,1,2-Tetrachloroethane	EPA 8260	10184404	NELAP	PA
5160 - 1,1,1-Trichloroethane	EPA 8260	10184404	NELAP	PA
5110 - 1,1,2,2-Tetrachloroethane	EPA 8260	10184404	NELAP	PA
5185 - 1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)	EPA 8260	10184404	NELAP	PA
5165 - 1,1,2-Trichloroethane	EPA 8260	10184404	NELAP	PA
4630 - 1,1-Dichloroethane	EPA 8260	10184404	NELAP	PA
4640 - 1,1-Dichloroethylene	EPA 8260	10184404	NELAP	PA
4670 - 1,1-Dichloropropene	EPA 8260	10184404	NELAP	PA
5150 - 1,2,3-Trichlorobenzene	EPA 8260	10184404	NELAP	PA
5180 - 1,2,3-Trichloropropane	EPA 8260	10184404	NELAP	PA
5155 - 1,2,4-Trichlorobenzene	EPA 8260	10184404	NELAP	PA
5210 - 1,2,4-Trimethylbenzene	EPA 8260	10184404	NELAP	PA
4570 - 1,2-Dibromo-3-chloropropane (DBCP)	EPA 8260	10184404	NELAP	PA
4585 - 1,2-Dibromoethane (EDB, Ethylene dibromide)	EPA 8260	10184404	NELAP	PA
4610 - 1,2-Dichlorobenzene	EPA 8260	10184404	NELAP	PA
4635 - 1,2-Dichloroethane (Ethylene dichloride)	EPA 8260	10184404	NELAP	PA
4655 - 1,2-Dichloropropane	EPA 8260	10184404	NELAP	PA
5215 - 1,3,5-Trimethylbenzene	EPA 8260	10184404	NELAP	PA
4615 - 1,3-Dichlorobenzene	EPA 8260	10184404	NELAP	PA
4660 - 1,3-Dichloropropane	EPA 8260	10184404	NELAP	PA
4620 - 1,4-Dichlorobenzene	EPA 8260	10184404	NELAP	PA
4735 - 1,4-Dioxane (1,4- Diethyleneoxide)	EPA 8260	10184404	NELAP	PA
4665 - 2,2-Dichloropropane	EPA 8260	10184404	NELAP	PA
4410 - 2-Butanone (Methyl ethyl ketone, MEK)	EPA 8260	10184404	NELAP	PA
4500 - 2-Chloroethyl vinyl ether	EPA 8260	10184404	NELAP	PA
4535 - 2-Chlorotoluene	EPA 8260	10184404	NELAP	PA
4860 - 2-Hexanone	EPA 8260	10184404	NELAP	PA
4540 - 4-Chlorotoluene	EPA 8260	10184404	NELAP	PA
4910 - 4-Isopropyltoluene (p-Cymene)	EPA 8260	10184404	NELAP	PA
4995 - 4-Methyl-2-pentanone (MIBK)	EPA 8260	10184404	NELAP	PA
4315 - Acetone	EPA 8260	10184404	NELAP	PA
4320 - Acetonitrile	EPA 8260	10184404	NELAP	PA
4325 - Acrolein (Propenal)	EPA 8260	10184404	NELAP	PA
4340 - Acrylonitrile	EPA 8260	10184404	NELAP	PA
4355 - Allyl chloride (3-Chloropropene)	EPA 8260	10184404	NELAP	PA
4375 - Benzene	EPA 8260	10184404	NELAP	PA
5635 - Benzyl chloride	EPA 8260	10184404	NELAP	PA
4385 - Bromobenzene	EPA 8260	10184404	NELAP	PA
4390 - Bromochloromethane	EPA 8260	10184404	NELAP	PA
4395 - Bromodichloromethane	EPA 8260	10184404	NELAP	PA
4400 - Bromoform	EPA 8260	10184404	NELAP	PA
4450 - Carbon disulfide	EPA 8260	10184404	NELAP	PA

Solid Chemical Materials

Analyte	Method Name	Method Code	Type	AB
4455 - Carbon tetrachloride	EPA 8260	10184404	NELAP	PA
4475 - Chlorobenzene	EPA 8260	10184404	NELAP	PA
4575 - Chlorodibromomethane	EPA 8260	10184404	NELAP	PA
4485 - Chloroethane (Ethyl chloride)	EPA 8260	10184404	NELAP	PA
4505 - Chloroform	EPA 8260	10184404	NELAP	PA
4525 - Chloroprene (2-Chloro-1,3-butadiene)	EPA 8260	10184404	NELAP	PA
4555 - Cyclohexane	EPA 8260	10184404	NELAP	PA
9375 - Di-isopropylether (DIPE) (Isopropyl ether)	EPA 8260	10184404	NELAP	PA
4580 - Dibromochloropropane	EPA 8260	10184404	NELAP	PA
4595 - Dibromomethane (Methylene bromide)	EPA 8260	10184404	NELAP	PA
4625 - Dichlorodifluoromethane (Freon-12)	EPA 8260	10184404	NELAP	PA
4750 - Ethanol	EPA 8260	10184404	NELAP	PA
4755 - Ethyl acetate	EPA 8260	10184404	NELAP	PA
4810 - Ethyl methacrylate	EPA 8260	10184404	NELAP	PA
4770 - Ethyl-t-butyl ether (ETBE) (2-Ethoxy-2-methylpropane)	EPA 8260	10184404	NELAP	PA
4765 - Ethylbenzene	EPA 8260	10184404	NELAP	PA
9408 - Gasoline range organics (GRO)	EPA 8260	10184404	NELAP	PA
4835 - Hexachlorobutadiene	EPA 8260	10184404	NELAP	PA
4875 - Isobutyl alcohol (2-Methyl-1-propanol)	EPA 8260	10184404	NELAP	PA
4895 - Isopropyl alcohol (2-Propanol, Isopropanol)	EPA 8260	10184404	NELAP	PA
4900 - Isopropylbenzene	EPA 8260	10184404	NELAP	PA
4925 - Methacrylonitrile	EPA 8260	10184404	NELAP	PA
4950 - Methyl bromide (Bromomethane)	EPA 8260	10184404	NELAP	PA
4960 - Methyl chloride (Chloromethane)	EPA 8260	10184404	NELAP	PA
5000 - Methyl tert-butyl ether (MTBE)	EPA 8260	10184404	NELAP	PA
4965 - Methylcyclohexane	EPA 8260	10184404	NELAP	PA
4975 - Methylene chloride (Dichloromethane)	EPA 8260	10184404	NELAP	PA
5005 - Naphthalene	EPA 8260	10184404	NELAP	PA
5035 - Pentachloroethane	EPA 8260	10184404	NELAP	PA
5080 - Propionitrile (Ethyl cyanide)	EPA 8260	10184404	NELAP	PA
5100 - Styrene	EPA 8260	10184404	NELAP	PA
4370 - T-amylmethylether (TAME)	EPA 8260	10184404	NELAP	PA
5115 - Tetrachloroethylene (Perchloroethylene)	EPA 8260	10184404	NELAP	PA
5140 - Toluene	EPA 8260	10184404	NELAP	PA
5170 - Trichloroethene (Trichloroethylene)	EPA 8260	10184404	NELAP	PA
5175 - Trichlorofluoromethane (Fluorotrichloromethane, Freon 11)	EPA 8260	10184404	NELAP	PA
5225 - Vinyl acetate	EPA 8260	10184404	NELAP	PA
5235 - Vinyl chloride	EPA 8260	10184404	NELAP	PA
5260 - Xylene (total)	EPA 8260	10184404	NELAP	PA
4680 - cis-1,3-Dichloropropene	EPA 8260	10184404	NELAP	PA
5240 - m+p-xylene	EPA 8260	10184404	NELAP	PA
4425 - n-Butyl alcohol (1-Butanol, n-Butanol)	EPA 8260	10184404	NELAP	PA
4435 - n-Butylbenzene	EPA 8260	10184404	NELAP	PA
5090 - n-Propylbenzene	EPA 8260	10184404	NELAP	PA
5250 - o-Xylene	EPA 8260	10184404	NELAP	PA
4440 - sec-Butylbenzene	EPA 8260	10184404	NELAP	PA

Solid Chemical Materials

Analyte	Method Name	Method Code	Type	AB
4420 - tert-Butyl alcohol	EPA 8260	10184404	NELAP	PA
4445 - tert-Butylbenzene	EPA 8260	10184404	NELAP	PA
4700 - trans-1,2-Dichloroethylene	EPA 8260	10184404	NELAP	PA
4685 - trans-1,3-Dichloropropylene	EPA 8260	10184404	NELAP	PA
4605 - trans-1,4-Dichloro-2-butene	EPA 8260	10184404	NELAP	PA
5105 - 1,1,1,2-Tetrachloroethane	EPA 8260B	10184802	NELAP	PA
5160 - 1,1,1-Trichloroethane	EPA 8260B	10184802	NELAP	PA
5110 - 1,1,2,2-Tetrachloroethane	EPA 8260B	10184802	NELAP	PA
5195 - 1,1,2-Trichloro-1,2,2-trifluoroethane	EPA 8260B	10184802	NELAP	PA
5185 - 1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)	EPA 8260B	10184802	NELAP	PA
5165 - 1,1,2-Trichloroethane	EPA 8260B	10184802	NELAP	PA
4630 - 1,1-Dichloroethane	EPA 8260B	10184802	NELAP	PA
4640 - 1,1-Dichloroethylene	EPA 8260B	10184802	NELAP	PA
4670 - 1,1-Dichloropropene	EPA 8260B	10184802	NELAP	PA
5150 - 1,2,3-Trichlorobenzene	EPA 8260B	10184802	NELAP	PA
5180 - 1,2,3-Trichloropropane	EPA 8260B	10184802	NELAP	PA
5155 - 1,2,4-Trichlorobenzene	EPA 8260B	10184802	NELAP	PA
5210 - 1,2,4-Trimethylbenzene	EPA 8260B	10184802	NELAP	PA
4570 - 1,2-Dibromo-3-chloropropane (DBCP)	EPA 8260B	10184802	NELAP	PA
4585 - 1,2-Dibromoethane (EDB, Ethylene dibromide)	EPA 8260B	10184802	NELAP	PA
4610 - 1,2-Dichlorobenzene	EPA 8260B	10184802	NELAP	PA
4635 - 1,2-Dichloroethane (Ethylene dichloride)	EPA 8260B	10184802	NELAP	PA
4655 - 1,2-Dichloropropane	EPA 8260B	10184802	NELAP	PA
5215 - 1,3,5-Trimethylbenzene	EPA 8260B	10184802	NELAP	PA
4615 - 1,3-Dichlorobenzene	EPA 8260B	10184802	NELAP	PA
4660 - 1,3-Dichloropropane	EPA 8260B	10184802	NELAP	PA
4620 - 1,4-Dichlorobenzene	EPA 8260B	10184802	NELAP	PA
4735 - 1,4-Dioxane (1,4- Diethyleneoxide)	EPA 8260B	10184802	NELAP	PA
4665 - 2,2-Dichloropropane	EPA 8260B	10184802	NELAP	PA
4410 - 2-Butanone (Methyl ethyl ketone, MEK)	EPA 8260B	10184802	NELAP	PA
4500 - 2-Chloroethyl vinyl ether	EPA 8260B	10184802	NELAP	PA
4535 - 2-Chlorotoluene	EPA 8260B	10184802	NELAP	PA
4860 - 2-Hexanone	EPA 8260B	10184802	NELAP	PA
4368 - 2-methyl-2-butanol (tert-Amyl alcohol)	EPA 8260B	10184802	NELAP	PA
4540 - 4-Chlorotoluene	EPA 8260B	10184802	NELAP	PA
4910 - 4-Isopropyltoluene (p-Cymene)	EPA 8260B	10184802	NELAP	PA
4995 - 4-Methyl-2-pentanone (MIBK)	EPA 8260B	10184802	NELAP	PA
4315 - Acetone	EPA 8260B	10184802	NELAP	PA
4320 - Acetonitrile	EPA 8260B	10184802	NELAP	PA
4325 - Acrolein (Propenal)	EPA 8260B	10184802	NELAP	PA
4340 - Acrylonitrile	EPA 8260B	10184802	NELAP	PA
4355 - Allyl chloride (3-Chloropropene)	EPA 8260B	10184802	NELAP	PA
4375 - Benzene	EPA 8260B	10184802	NELAP	PA
5635 - Benzyl chloride	EPA 8260B	10184802	NELAP	PA
4380 - Bromoacetone	EPA 8260B	10184802	NELAP	PA
4385 - Bromobenzene	EPA 8260B	10184802	NELAP	PA
4390 - Bromochloromethane	EPA 8260B	10184802	NELAP	PA
4395 - Bromodichloromethane	EPA 8260B	10184802	NELAP	PA
4400 - Bromoform	EPA 8260B	10184802	NELAP	PA
4450 - Carbon disulfide	EPA 8260B	10184802	NELAP	PA

Solid Chemical Materials

Analyte	Method Name	Method Code	Type	AB
4455 - Carbon tetrachloride	EPA 8260B	10184802	NELAP	PA
4475 - Chlorobenzene	EPA 8260B	10184802	NELAP	PA
4575 - Chlorodibromomethane	EPA 8260B	10184802	NELAP	PA
4485 - Chloroethane (Ethyl chloride)	EPA 8260B	10184802	NELAP	PA
4505 - Chloroform	EPA 8260B	10184802	NELAP	PA
4525 - Chloroprene (2-Chloro-1,3-butadiene)	EPA 8260B	10184802	NELAP	PA
4555 - Cyclohexane	EPA 8260B	10184802	NELAP	PA
4560 - Cyclohexanone	EPA 8260B	10184802	NELAP	PA
9375 - Di-isopropylether (DIPE) (Isopropyl ether)	EPA 8260B	10184802	NELAP	PA
4580 - Dibromochloropropane	EPA 8260B	10184802	NELAP	PA
4595 - Dibromomethane (Methylene bromide)	EPA 8260B	10184802	NELAP	PA
4625 - Dichlorodifluoromethane (Freon-12)	EPA 8260B	10184802	NELAP	PA
4745 - Epichlorohydrin (1-Chloro-2,3-epoxypropane)	EPA 8260B	10184802	NELAP	PA
4750 - Ethanol	EPA 8260B	10184802	NELAP	PA
4755 - Ethyl acetate	EPA 8260B	10184802	NELAP	PA
4810 - Ethyl methacrylate	EPA 8260B	10184802	NELAP	PA
4770 - Ethyl-t-butyl ether (ETBE) (2-Ethoxy-2-methylpropane)	EPA 8260B	10184802	NELAP	PA
4765 - Ethylbenzene	EPA 8260B	10184802	NELAP	PA
9408 - Gasoline range organics (GRO)	EPA 8260B	10184802	NELAP	PA
4835 - Hexachlorobutadiene	EPA 8260B	10184802	NELAP	PA
4870 - Iodomethane (Methyl iodide)	EPA 8260B	10184802	NELAP	PA
4875 - Isobutyl alcohol (2-Methyl-1-propanol)	EPA 8260B	10184802	NELAP	PA
4895 - Isopropyl alcohol (2-Propanol, Isopropanol)	EPA 8260B	10184802	NELAP	PA
4900 - Isopropylbenzene	EPA 8260B	10184802	NELAP	PA
4925 - Methacrylonitrile	EPA 8260B	10184802	NELAP	PA
4940 - Methyl acetate	EPA 8260B	10184802	NELAP	PA
4950 - Methyl bromide (Bromomethane)	EPA 8260B	10184802	NELAP	PA
4960 - Methyl chloride (Chloromethane)	EPA 8260B	10184802	NELAP	PA
5000 - Methyl tert-butyl ether (MTBE)	EPA 8260B	10184802	NELAP	PA
4965 - Methylcyclohexane	EPA 8260B	10184802	NELAP	PA
4975 - Methylene chloride (Dichloromethane)	EPA 8260B	10184802	NELAP	PA
5005 - Naphthalene	EPA 8260B	10184802	NELAP	PA
5035 - Pentachloroethane	EPA 8260B	10184802	NELAP	PA
5080 - Propionitrile (Ethyl cyanide)	EPA 8260B	10184802	NELAP	PA
5100 - Styrene	EPA 8260B	10184802	NELAP	PA
4370 - T-amylmethylether (TAME)	EPA 8260B	10184802	NELAP	PA
5115 - Tetrachloroethylene (Perchloroethylene)	EPA 8260B	10184802	NELAP	PA
5140 - Toluene	EPA 8260B	10184802	NELAP	PA
5170 - Trichloroethene (Trichloroethylene)	EPA 8260B	10184802	NELAP	PA
5175 - Trichlorofluoromethane (Fluorotrichloromethane, Freon 11)	EPA 8260B	10184802	NELAP	PA
5225 - Vinyl acetate	EPA 8260B	10184802	NELAP	PA
5235 - Vinyl chloride	EPA 8260B	10184802	NELAP	PA
5260 - Xylene (total)	EPA 8260B	10184802	NELAP	PA
4705 - cis & trans-1,2-Dichloroethene	EPA 8260B	10184802	NELAP	PA
4645 - cis-1,2-Dichloroethylene	EPA 8260B	10184802	NELAP	PA
4680 - cis-1,3-Dichloropropene	EPA 8260B	10184802	NELAP	PA

Solid Chemical Materials

Analyte	Method Name	Method Code	Type	AB
5240 - m+p-xylene	EPA 8260B	10184802	NELAP	PA
4425 - n-Butyl alcohol (1-Butanol, n-Butanol)	EPA 8260B	10184802	NELAP	PA
4435 - n-Butylbenzene	EPA 8260B	10184802	NELAP	PA
5090 - n-Propylbenzene	EPA 8260B	10184802	NELAP	PA
5250 - o-Xylene	EPA 8260B	10184802	NELAP	PA
4440 - sec-Butylbenzene	EPA 8260B	10184802	NELAP	PA
4420 - tert-Butyl alcohol	EPA 8260B	10184802	NELAP	PA
4445 - tert-Butylbenzene	EPA 8260B	10184802	NELAP	PA
4700 - trans-1,2-Dichloroethylene	EPA 8260B	10184802	NELAP	PA
4685 - trans-1,3-Dichloropropylene	EPA 8260B	10184802	NELAP	PA
4605 - trans-1,4-Dichloro-2-butene	EPA 8260B	10184802	NELAP	PA
5510 - Acetophenone	EPA 8270	10185203	NELAP	PA
5560 - Aramite	EPA 8270	10185203	NELAP	PA
5900 - Dibenz(a, j) acridine	EPA 8270	10185203	NELAP	PA
5765 - bis(2-Chloroethyl) ether	EPA 8270	10185203	NELAP	PA
6550 - n-Nitrosomethylethylamine	EPA 8270	10185203	NELAP	PA
6703 - 1,1'-Biphenyl (BZ-0)	EPA 8270C	10185805	NELAP	PA
6705 - 1,2,3,4-Tetrachlorobenzene	EPA 8270C	10185805	NELAP	PA
6710 - 1,2,3,5-Tetrachlorobenzene	EPA 8270C	10185805	NELAP	PA
6715 - 1,2,4,5-Tetrachlorobenzene	EPA 8270C	10185805	NELAP	PA
5155 - 1,2,4-Trichlorobenzene	EPA 8270C	10185805	NELAP	PA
4610 - 1,2-Dichlorobenzene	EPA 8270C	10185805	NELAP	PA
6155 - 1,2-Dinitrobenzene	EPA 8270C	10185805	NELAP	PA
6220 - 1,2-Diphenylhydrazine	EPA 8270C	10185805	NELAP	PA
6885 - 1,3,5-Trinitrobenzene (1,3,5-TNB)	EPA 8270C	10185805	NELAP	PA
4615 - 1,3-Dichlorobenzene	EPA 8270C	10185805	NELAP	PA
6160 - 1,3-Dinitrobenzene (1,3-DNB)	EPA 8270C	10185805	NELAP	PA
4620 - 1,4-Dichlorobenzene	EPA 8270C	10185805	NELAP	PA
6165 - 1,4-Dinitrobenzene	EPA 8270C	10185805	NELAP	PA
4735 - 1,4-Dioxane (1,4- Diethyleneoxide)	EPA 8270C	10185805	NELAP	PA
6420 - 1,4-Naphthoquinone	EPA 8270C	10185805	NELAP	PA
6630 - 1,4-Phenylenediamine	EPA 8270C	10185805	NELAP	PA
5790 - 1-Chloronaphthalene	EPA 8270C	10185805	NELAP	PA
6380 - 1-Methylnaphthalene	EPA 8270C	10185805	NELAP	PA
6425 - 1-Naphthylamine	EPA 8270C	10185805	NELAP	PA
6735 - 2,3,4,6-Tetrachlorophenol	EPA 8270C	10185805	NELAP	PA
6835 - 2,4,5-Trichlorophenol	EPA 8270C	10185805	NELAP	PA
6840 - 2,4,6-Trichlorophenol	EPA 8270C	10185805	NELAP	PA
6000 - 2,4-Dichlorophenol	EPA 8270C	10185805	NELAP	PA
6130 - 2,4-Dimethylphenol	EPA 8270C	10185805	NELAP	PA
6175 - 2,4-Dinitrophenol	EPA 8270C	10185805	NELAP	PA
6185 - 2,4-Dinitrotoluene (2,4-DNT)	EPA 8270C	10185805	NELAP	PA
6005 - 2,6-Dichlorophenol	EPA 8270C	10185805	NELAP	PA
6190 - 2,6-Dinitrotoluene (2,6-DNT)	EPA 8270C	10185805	NELAP	PA
5515 - 2-Acetylaminofluorene	EPA 8270C	10185805	NELAP	PA
5795 - 2-Chloronaphthalene	EPA 8270C	10185805	NELAP	PA
5800 - 2-Chlorophenol	EPA 8270C	10185805	NELAP	PA
6360 - 2-Methyl-4,6-dinitrophenol (4,6-Dinitro-2-methylphenol)	EPA 8270C	10185805	NELAP	PA
5145 - 2-Methylaniline (o-Toluidine)	EPA 8270C	10185805	NELAP	PA
6385 - 2-Methylnaphthalene	EPA 8270C	10185805	NELAP	PA
6400 - 2-Methylphenol (o-Cresol)	EPA 8270C	10185805	NELAP	PA
6430 - 2-Naphthylamine	EPA 8270C	10185805	NELAP	PA
6460 - 2-Nitroaniline	EPA 8270C	10185805	NELAP	PA
6490 - 2-Nitrophenol	EPA 8270C	10185805	NELAP	PA

Solid Chemical Materials

Analyte	Method Name	Method Code	Type	AB
5050 - 2-Picoline (2-Methylpyridine)	EPA 8270C	10185805	NELAP	PA
6412 - 3+4 Methylphenol	EPA 8270C	10185805	NELAP	PA
5945 - 3,3'-Dichlorobenzidine	EPA 8270C	10185805	NELAP	PA
6100 - 3,3'-Dimethoxybenzidine	EPA 8270C	10185805	NELAP	PA
6120 - 3,3'-Dimethylbenzidine	EPA 8270C	10185805	NELAP	PA
6355 - 3-Methylcholanthrene	EPA 8270C	10185805	NELAP	PA
6405 - 3-Methylphenol (m-Cresol)	EPA 8270C	10185805	NELAP	PA
6465 - 3-Nitroaniline	EPA 8270C	10185805	NELAP	PA
6365 - 4,4'-Methylenebis(2-chloroaniline)	EPA 8270C	10185805	NELAP	PA
5540 - 4-Aminobiphenyl	EPA 8270C	10185805	NELAP	PA
5660 - 4-Bromophenyl phenyl ether	EPA 8270C	10185805	NELAP	PA
5700 - 4-Chloro-3-methylphenol	EPA 8270C	10185805	NELAP	PA
5745 - 4-Chloroaniline	EPA 8270C	10185805	NELAP	PA
5825 - 4-Chlorophenyl phenylether	EPA 8270C	10185805	NELAP	PA
6410 - 4-Methylphenol (p-Cresol)	EPA 8270C	10185805	NELAP	PA
6470 - 4-Nitroaniline	EPA 8270C	10185805	NELAP	PA
6500 - 4-Nitrophenol	EPA 8270C	10185805	NELAP	PA
6510 - 4-Nitroquinoline 1-oxide	EPA 8270C	10185805	NELAP	PA
6570 - 5-Nitro-o-toluidine	EPA 8270C	10185805	NELAP	PA
6115 - 7,12-Dimethylbenz(a) anthracene	EPA 8270C	10185805	NELAP	PA
5500 - Acenaphthene	EPA 8270C	10185805	NELAP	PA
5505 - Acenaphthylene	EPA 8270C	10185805	NELAP	PA
5510 - Acetophenone	EPA 8270C	10185805	NELAP	PA
4330 - Acrylamide	EPA 8270C	10185805	NELAP	PA
5545 - Aniline	EPA 8270C	10185805	NELAP	PA
5555 - Anthracene	EPA 8270C	10185805	NELAP	PA
5560 - Aramite	EPA 8270C	10185805	NELAP	PA
7065 - Atrazine	EPA 8270C	10185805	NELAP	PA
5570 - Benzaldehyde	EPA 8270C	10185805	NELAP	PA
5567 - Benzenethiol	EPA 8270C	10185805	NELAP	PA
5595 - Benzidine	EPA 8270C	10185805	NELAP	PA
5575 - Benzo(a)anthracene	EPA 8270C	10185805	NELAP	PA
5580 - Benzo(a)pyrene	EPA 8270C	10185805	NELAP	PA
5585 - Benzo(b)fluoranthene	EPA 8270C	10185805	NELAP	PA
5590 - Benzo(g,h,i)perylene	EPA 8270C	10185805	NELAP	PA
5600 - Benzo(k)fluoranthene	EPA 8270C	10185805	NELAP	PA
5610 - Benzoic acid	EPA 8270C	10185805	NELAP	PA
5630 - Benzyl alcohol	EPA 8270C	10185805	NELAP	PA
5670 - Butyl benzyl phthalate	EPA 8270C	10185805	NELAP	PA
7180 - Caprolactam	EPA 8270C	10185805	NELAP	PA
5680 - Carbazole	EPA 8270C	10185805	NELAP	PA
7260 - Chlorobenzilate	EPA 8270C	10185805	NELAP	PA
5855 - Chrysene	EPA 8270C	10185805	NELAP	PA
6065 - Di(2-ethylhexyl) phthalate (bis(2-Ethylhexyl)phthalate, DEHP)	EPA 8270C	10185805	NELAP	PA
5925 - Di-n-butyl phthalate	EPA 8270C	10185805	NELAP	PA
6200 - Di-n-octyl phthalate	EPA 8270C	10185805	NELAP	PA
7405 - Diallate	EPA 8270C	10185805	NELAP	PA
9354 - Dibenz(a, h) acridine	EPA 8270C	10185805	NELAP	PA
5900 - Dibenz(a, j) acridine	EPA 8270C	10185805	NELAP	PA
5895 - Dibenz(a,h) anthracene	EPA 8270C	10185805	NELAP	PA
5905 - Dibenzofuran	EPA 8270C	10185805	NELAP	PA
6070 - Diethyl phthalate	EPA 8270C	10185805	NELAP	PA
7475 - Dimethoate	EPA 8270C	10185805	NELAP	PA
6135 - Dimethyl phthalate	EPA 8270C	10185805	NELAP	PA
8620 - Dinoseb (2-sec-butyl-4,6-	EPA 8270C	10185805	NELAP	PA

Solid Chemical Materials

Analyte	Method Name	Method Code	Type	AB
dinitrophenol, DNBP)				
6205 - Diphenylamine	EPA 8270C	10185805	NELAP	PA
8625 - Disulfoton	EPA 8270C	10185805	NELAP	PA
6260 - Ethyl methanesulfonate	EPA 8270C	10185805	NELAP	PA
7580 - Famphur	EPA 8270C	10185805	NELAP	PA
6265 - Fluoranthene	EPA 8270C	10185805	NELAP	PA
6270 - Fluorene	EPA 8270C	10185805	NELAP	PA
6275 - Hexachlorobenzene	EPA 8270C	10185805	NELAP	PA
4835 - Hexachlorobutadiene	EPA 8270C	10185805	NELAP	PA
6285 - Hexachlorocyclopentadiene	EPA 8270C	10185805	NELAP	PA
4840 - Hexachloroethane	EPA 8270C	10185805	NELAP	PA
6295 - Hexachloropropene	EPA 8270C	10185805	NELAP	PA
6312 - Indene	EPA 8270C	10185805	NELAP	PA
6315 - Indeno(1,2,3-cd) pyrene	EPA 8270C	10185805	NELAP	PA
7725 - Isodrin	EPA 8270C	10185805	NELAP	PA
6320 - Isophorone	EPA 8270C	10185805	NELAP	PA
6325 - Isosafrole	EPA 8270C	10185805	NELAP	PA
7740 - Kepone	EPA 8270C	10185805	NELAP	PA
6345 - Methapyrilene	EPA 8270C	10185805	NELAP	PA
6375 - Methyl methanesulfonate	EPA 8270C	10185805	NELAP	PA
7825 - Methyl parathion (Parathion, methyl)	EPA 8270C	10185805	NELAP	PA
5005 - Naphthalene	EPA 8270C	10185805	NELAP	PA
5015 - Nitrobenzene	EPA 8270C	10185805	NELAP	PA
7955 - Parathion, ethyl	EPA 8270C	10185805	NELAP	PA
6590 - Pentachlorobenzene	EPA 8270C	10185805	NELAP	PA
6600 - Pentachloronitrobenzene	EPA 8270C	10185805	NELAP	PA
6605 - Pentachlorophenol	EPA 8270C	10185805	NELAP	PA
6610 - Phenacetin	EPA 8270C	10185805	NELAP	PA
6615 - Phenanthrene	EPA 8270C	10185805	NELAP	PA
6625 - Phenol	EPA 8270C	10185805	NELAP	PA
7985 - Phorate	EPA 8270C	10185805	NELAP	PA
6640 - Phthalic anhydride	EPA 8270C	10185805	NELAP	PA
6650 - Pronamide (Kerb)	EPA 8270C	10185805	NELAP	PA
6665 - Pyrene	EPA 8270C	10185805	NELAP	PA
5095 - Pyridine	EPA 8270C	10185805	NELAP	PA
6670 - Quinoline	EPA 8270C	10185805	NELAP	PA
6685 - Safrole	EPA 8270C	10185805	NELAP	PA
8235 - Thionazin (Zinophos)	EPA 8270C	10185805	NELAP	PA
6125 - a-a-Dimethylphenethylamine	EPA 8270C	10185805	NELAP	PA
5760 - bis(2-Chloroethoxy)methane	EPA 8270C	10185805	NELAP	PA
5765 - bis(2-Chloroethyl) ether	EPA 8270C	10185805	NELAP	PA
5780 - bis(2-Chloroisopropyl) ether	EPA 8270C	10185805	NELAP	PA
6245 - bis(2-Ethoxyethyl) phthalate	EPA 8270C	10185805	NELAP	PA
6062 - bis(2-Ethylhexyl)adipate	EPA 8270C	10185805	NELAP	PA
5025 - n-Nitroso-di-n-butylamine	EPA 8270C	10185805	NELAP	PA
6545 - n-Nitrosodi-n-propylamine	EPA 8270C	10185805	NELAP	PA
6525 - n-Nitrosodiethylamine	EPA 8270C	10185805	NELAP	PA
6530 - n-Nitrosodimethylamine	EPA 8270C	10185805	NELAP	PA
6535 - n-Nitrosodiphenylamine	EPA 8270C	10185805	NELAP	PA
6550 - n-Nitrosomethylethylamine	EPA 8270C	10185805	NELAP	PA
6555 - n-Nitrosomorpholine	EPA 8270C	10185805	NELAP	PA
6560 - n-Nitrosopiperidine	EPA 8270C	10185805	NELAP	PA
6565 - n-Nitrosopyrrolidine	EPA 8270C	10185805	NELAP	PA
8290 - o,o,o-Triethyl phosphorothioate	EPA 8270C	10185805	NELAP	PA
8310 - tris-(2,3-Dibromopropyl) phosphate (tris-BP)	EPA 8270C	10185805	NELAP	PA

Solid Chemical Materials

Analyte	Method Name	Method Code	Type	AB
6703 - 1,1'-Biphenyl (BZ-0)	EPA 8270D	10186002	NELAP	PA
6705 - 1,2,3,4-Tetrachlorobenzene	EPA 8270D	10186002	NELAP	PA
6710 - 1,2,3,5-Tetrachlorobenzene	EPA 8270D	10186002	NELAP	PA
6715 - 1,2,4,5-Tetrachlorobenzene	EPA 8270D	10186002	NELAP	PA
5155 - 1,2,4-Trichlorobenzene	EPA 8270D	10186002	NELAP	PA
4610 - 1,2-Dichlorobenzene	EPA 8270D	10186002	NELAP	PA
6155 - 1,2-Dinitrobenzene	EPA 8270D	10186002	NELAP	PA
6220 - 1,2-Diphenylhydrazine	EPA 8270D	10186002	NELAP	PA
6885 - 1,3,5-Trinitrobenzene (1,3,5-TNB)	EPA 8270D	10186002	NELAP	PA
4615 - 1,3-Dichlorobenzene	EPA 8270D	10186002	NELAP	PA
6160 - 1,3-Dinitrobenzene (1,3-DNB)	EPA 8270D	10186002	NELAP	PA
4620 - 1,4-Dichlorobenzene	EPA 8270D	10186002	NELAP	PA
6165 - 1,4-Dinitrobenzene	EPA 8270D	10186002	NELAP	PA
4735 - 1,4-Dioxane (1,4- Diethyleneoxide)	EPA 8270D	10186002	NELAP	PA
6420 - 1,4-Naphthoquinone	EPA 8270D	10186002	NELAP	PA
6630 - 1,4-Phenylenediamine	EPA 8270D	10186002	NELAP	PA
5790 - 1-Chloronaphthalene	EPA 8270D	10186002	NELAP	PA
6380 - 1-Methylnaphthalene	EPA 8270D	10186002	NELAP	PA
6425 - 1-Naphthylamine	EPA 8270D	10186002	NELAP	PA
6735 - 2,3,4,6-Tetrachlorophenol	EPA 8270D	10186002	NELAP	PA
6835 - 2,4,5-Trichlorophenol	EPA 8270D	10186002	NELAP	PA
6840 - 2,4,6-Trichlorophenol	EPA 8270D	10186002	NELAP	PA
6000 - 2,4-Dichlorophenol	EPA 8270D	10186002	NELAP	PA
6130 - 2,4-Dimethylphenol	EPA 8270D	10186002	NELAP	PA
6175 - 2,4-Dinitrophenol	EPA 8270D	10186002	NELAP	PA
6185 - 2,4-Dinitrotoluene (2,4-DNT)	EPA 8270D	10186002	NELAP	PA
6005 - 2,6-Dichlorophenol	EPA 8270D	10186002	NELAP	PA
6190 - 2,6-Dinitrotoluene (2,6-DNT)	EPA 8270D	10186002	NELAP	PA
5515 - 2-Acetylaminofluorene	EPA 8270D	10186002	NELAP	PA
5795 - 2-Chloronaphthalene	EPA 8270D	10186002	NELAP	PA
5800 - 2-Chlorophenol	EPA 8270D	10186002	NELAP	PA
6360 - 2-Methyl-4,6-dinitrophenol (4,6-Dinitro-2-methylphenol)	EPA 8270D	10186002	NELAP	PA
5145 - 2-Methylaniline (o-Toluidine)	EPA 8270D	10186002	NELAP	PA
6385 - 2-Methylnaphthalene	EPA 8270D	10186002	NELAP	PA
6400 - 2-Methylphenol (o-Cresol)	EPA 8270D	10186002	NELAP	PA
6430 - 2-Naphthylamine	EPA 8270D	10186002	NELAP	PA
6460 - 2-Nitroaniline	EPA 8270D	10186002	NELAP	PA
6490 - 2-Nitrophenol	EPA 8270D	10186002	NELAP	PA
5050 - 2-Picoline (2-Methylpyridine)	EPA 8270D	10186002	NELAP	PA
6412 - 3+4 Methylphenol	EPA 8270D	10186002	NELAP	PA
5945 - 3,3'-Dichlorobenzidine	EPA 8270D	10186002	NELAP	PA
6100 - 3,3'-Dimethoxybenzidine	EPA 8270D	10186002	NELAP	PA
6120 - 3,3'-Dimethylbenzidine	EPA 8270D	10186002	NELAP	PA
6355 - 3-Methylcholanthrene	EPA 8270D	10186002	NELAP	PA
6405 - 3-Methylphenol (m-Cresol)	EPA 8270D	10186002	NELAP	PA
6465 - 3-Nitroaniline	EPA 8270D	10186002	NELAP	PA
6365 - 4,4'-Methylenebis(2-chloroaniline)	EPA 8270D	10186002	NELAP	PA
5540 - 4-Aminobiphenyl	EPA 8270D	10186002	NELAP	PA
5660 - 4-Bromophenyl phenyl ether	EPA 8270D	10186002	NELAP	PA
5700 - 4-Chloro-3-methylphenol	EPA 8270D	10186002	NELAP	PA
5745 - 4-Chloroaniline	EPA 8270D	10186002	NELAP	PA
5825 - 4-Chlorophenyl phenylether	EPA 8270D	10186002	NELAP	PA
6410 - 4-Methylphenol (p-Cresol)	EPA 8270D	10186002	NELAP	PA
6470 - 4-Nitroaniline	EPA 8270D	10186002	NELAP	PA
6500 - 4-Nitrophenol	EPA 8270D	10186002	NELAP	PA

Solid Chemical Materials

Analyte	Method Name	Method Code	Type	AB
6510 - 4-Nitroquinoline 1-oxide	EPA 8270D	10186002	NELAP	PA
6570 - 5-Nitro-o-toluidine	EPA 8270D	10186002	NELAP	PA
6115 - 7,12-Dimethylbenz(a) anthracene	EPA 8270D	10186002	NELAP	PA
5500 - Acenaphthene	EPA 8270D	10186002	NELAP	PA
5505 - Acenaphthylene	EPA 8270D	10186002	NELAP	PA
5510 - Acetophenone	EPA 8270D	10186002	NELAP	PA
4330 - Acrylamide	EPA 8270D	10186002	NELAP	PA
5545 - Aniline	EPA 8270D	10186002	NELAP	PA
5555 - Anthracene	EPA 8270D	10186002	NELAP	PA
5560 - Aramite	EPA 8270D	10186002	NELAP	PA
7065 - Atrazine	EPA 8270D	10186002	NELAP	PA
5570 - Benzaldehyde	EPA 8270D	10186002	NELAP	PA
5567 - Benzenethiol	EPA 8270D	10186002	NELAP	PA
5595 - Benzidine	EPA 8270D	10186002	NELAP	PA
5575 - Benzo(a)anthracene	EPA 8270D	10186002	NELAP	PA
5580 - Benzo(a)pyrene	EPA 8270D	10186002	NELAP	PA
5585 - Benzo(b)fluoranthene	EPA 8270D	10186002	NELAP	PA
5590 - Benzo(g,h,i)perylene	EPA 8270D	10186002	NELAP	PA
5600 - Benzo(k)fluoranthene	EPA 8270D	10186002	NELAP	PA
5610 - Benzoic acid	EPA 8270D	10186002	NELAP	PA
5630 - Benzyl alcohol	EPA 8270D	10186002	NELAP	PA
5670 - Butyl benzyl phthalate	EPA 8270D	10186002	NELAP	PA
7180 - Caprolactam	EPA 8270D	10186002	NELAP	PA
5680 - Carbazole	EPA 8270D	10186002	NELAP	PA
7260 - Chlorobenzilate	EPA 8270D	10186002	NELAP	PA
5855 - Chrysene	EPA 8270D	10186002	NELAP	PA
6065 - Di(2-ethylhexyl) phthalate (bis(2-Ethylhexyl)phthalate, DEHP)	EPA 8270D	10186002	NELAP	PA
5925 - Di-n-butyl phthalate	EPA 8270D	10186002	NELAP	PA
6200 - Di-n-octyl phthalate	EPA 8270D	10186002	NELAP	PA
7405 - Diallate	EPA 8270D	10186002	NELAP	PA
9354 - Dibenz(a, h) acridine	EPA 8270D	10186002	NELAP	PA
5900 - Dibenz(a, j) acridine	EPA 8270D	10186002	NELAP	PA
5895 - Dibenz(a,h) anthracene	EPA 8270D	10186002	NELAP	PA
5905 - Dibenzofuran	EPA 8270D	10186002	NELAP	PA
6070 - Diethyl phthalate	EPA 8270D	10186002	NELAP	PA
7475 - Dimethoate	EPA 8270D	10186002	NELAP	PA
6135 - Dimethyl phthalate	EPA 8270D	10186002	NELAP	PA
8620 - Dinoseb (2-sec-butyl-4,6-dinitrophenol, DNBP)	EPA 8270D	10186002	NELAP	PA
6205 - Diphenylamine	EPA 8270D	10186002	NELAP	PA
8625 - Disulfoton	EPA 8270D	10186002	NELAP	PA
6260 - Ethyl methanesulfonate	EPA 8270D	10186002	NELAP	PA
7580 - Famphur	EPA 8270D	10186002	NELAP	PA
6265 - Fluoranthene	EPA 8270D	10186002	NELAP	PA
6270 - Fluorene	EPA 8270D	10186002	NELAP	PA
6275 - Hexachlorobenzene	EPA 8270D	10186002	NELAP	PA
4835 - Hexachlorobutadiene	EPA 8270D	10186002	NELAP	PA
6285 - Hexachlorocyclopentadiene	EPA 8270D	10186002	NELAP	PA
4840 - Hexachloroethane	EPA 8270D	10186002	NELAP	PA
6295 - Hexachloropropene	EPA 8270D	10186002	NELAP	PA
6312 - Indene	EPA 8270D	10186002	NELAP	PA
6315 - Indeno(1,2,3-cd) pyrene	EPA 8270D	10186002	NELAP	PA
6320 - Isophorone	EPA 8270D	10186002	NELAP	PA
6325 - Isosafrole	EPA 8270D	10186002	NELAP	PA
6345 - Methapyrilene	EPA 8270D	10186002	NELAP	PA

Solid Chemical Materials

Analyte	Method Name	Method Code	Type	AB
6375 - Methyl methanesulfonate	EPA 8270D	10186002	NELAP	PA
7825 - Methyl parathion (Parathion, methyl)	EPA 8270D	10186002	NELAP	PA
5005 - Naphthalene	EPA 8270D	10186002	NELAP	PA
5015 - Nitrobenzene	EPA 8270D	10186002	NELAP	PA
7955 - Parathion, ethyl	EPA 8270D	10186002	NELAP	PA
6590 - Pentachlorobenzene	EPA 8270D	10186002	NELAP	PA
6600 - Pentachloronitrobenzene	EPA 8270D	10186002	NELAP	PA
6605 - Pentachlorophenol	EPA 8270D	10186002	NELAP	PA
6610 - Phenacetin	EPA 8270D	10186002	NELAP	PA
6615 - Phenanthrene	EPA 8270D	10186002	NELAP	PA
6625 - Phenol	EPA 8270D	10186002	NELAP	PA
7985 - Phorate	EPA 8270D	10186002	NELAP	PA
6640 - Phthalic anhydride	EPA 8270D	10186002	NELAP	PA
6650 - Pronamide (Kerb)	EPA 8270D	10186002	NELAP	PA
6665 - Pyrene	EPA 8270D	10186002	NELAP	PA
5095 - Pyridine	EPA 8270D	10186002	NELAP	PA
6670 - Quinoline	EPA 8270D	10186002	NELAP	PA
6685 - Safrole	EPA 8270D	10186002	NELAP	PA
8235 - Thionazin (Zinophos)	EPA 8270D	10186002	NELAP	PA
6750 - Thiophenol (Benzenethiol)	EPA 8270D	10186002	NELAP	PA
6125 - a-a-Dimethylphenethylamine	EPA 8270D	10186002	NELAP	PA
5760 - bis(2-Chloroethoxy)methane	EPA 8270D	10186002	NELAP	PA
5765 - bis(2-Chloroethyl) ether	EPA 8270D	10186002	NELAP	PA
5780 - bis(2-Chloroisopropyl) ether	EPA 8270D	10186002	NELAP	PA
6062 - bis(2-Ethylhexyl)adipate	EPA 8270D	10186002	NELAP	PA
5025 - n-Nitroso-di-n-butylamine	EPA 8270D	10186002	NELAP	PA
6545 - n-Nitrosodi-n-propylamine	EPA 8270D	10186002	NELAP	PA
6525 - n-Nitrosodiethylamine	EPA 8270D	10186002	NELAP	PA
6530 - n-Nitrosodimethylamine	EPA 8270D	10186002	NELAP	PA
6535 - n-Nitrosodiphenylamine	EPA 8270D	10186002	NELAP	PA
6550 - n-Nitrosomethylethylamine	EPA 8270D	10186002	NELAP	PA
6555 - n-Nitrosomorpholine	EPA 8270D	10186002	NELAP	PA
6560 - n-Nitrosopiperidine	EPA 8270D	10186002	NELAP	PA
6565 - n-Nitrosopyrrolidine	EPA 8270D	10186002	NELAP	PA
8290 - o,o,o-Triethyl phosphorothioate	EPA 8270D	10186002	NELAP	PA
8310 - tris-(2,3-Dibromopropyl) phosphate (tris-BP)	EPA 8270D	10186002	NELAP	PA
9519 - 1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	EPA 8290	10187209	NELAP	PA
9516 - 1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	EPA 8290	10187209	NELAP	PA
9426 - 1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (1,2,3,4,6,7,8-hpcdd)	EPA 8290	10187209	NELAP	PA
9420 - 1,2,3,4,6,7,8-Heptachlorodibenzofuran (1,2,3,4,6,7,8-hpcdf)	EPA 8290	10187209	NELAP	PA
9423 - 1,2,3,4,7,8,9-Heptachlorodibenzofuran (1,2,3,4,7,8,9-hpcdf)	EPA 8290	10187209	NELAP	PA
9453 - 1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (1,2,3,4,7,8-Hxcdd)	EPA 8290	10187209	NELAP	PA
9471 - 1,2,3,4,7,8-Hexachlorodibenzofuran (1,2,3,4,7,8-Hxcdf)	EPA 8290	10187209	NELAP	PA
9456 - 1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin(1,2,3,6,7,8-Hxcdd)	EPA 8290	10187209	NELAP	PA
9474 - 1,2,3,6,7,8-Hexachlorodibenzofuran	EPA 8290	10187209	NELAP	PA

Solid Chemical Materials

Analyte	Method Name	Method Code	Type	AB
(1,2,3,6,7,8-Hxcdf)				
9459 - 1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (1,2,3,7,8,9-Hxcdd)	EPA 8290	10187209	NELAP	PA
9477 - 1,2,3,7,8,9-Hexachlorodibenzofuran (1,2,3,7,8,9-Hxcdf)	EPA 8290	10187209	NELAP	PA
9540 - 1,2,3,7,8-Pentachlorodibenzo-p-dioxin (1,2,3,7,8-Pecdd)	EPA 8290	10187209	NELAP	PA
9543 - 1,2,3,7,8-Pentachlorodibenzofuran (1,2,3,7,8-Pecdf)	EPA 8290	10187209	NELAP	PA
9480 - 2,3,4,6,7,8-Hexachlorodibenzofuran	EPA 8290	10187209	NELAP	PA
9549 - 2,3,4,7,8-Pentachlorodibenzofuran	EPA 8290	10187209	NELAP	PA
9618 - 2,3,7,8-Tetrachlorodibenzo- p-dioxin (2,3,7,8-TCDD)	EPA 8290	10187209	NELAP	PA
9612 - 2,3,7,8-Tetrachlorodibenzofuran	EPA 8290	10187209	NELAP	PA
9438 - Total Hpcdd	EPA 8290	10187209	NELAP	PA
9444 - Total Hpcdf	EPA 8290	10187209	NELAP	PA
9468 - Total Hxcdd	EPA 8290	10187209	NELAP	PA
9483 - Total Hxcdf	EPA 8290	10187209	NELAP	PA
9555 - Total Pecdd	EPA 8290	10187209	NELAP	PA
9552 - Total Pecdf	EPA 8290	10187209	NELAP	PA
9609 - Total TCDD	EPA 8290	10187209	NELAP	PA
9615 - Total TCDF	EPA 8290	10187209	NELAP	PA
9519 - 1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	EPA 8290A	10187403	NELAP	PA
9516 - 1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	EPA 8290A	10187403	NELAP	PA
9426 - 1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (1,2,3,4,6,7,8-hpcdd)	EPA 8290A	10187403	NELAP	PA
9420 - 1,2,3,4,6,7,8-Heptachlorodibenzofuran (1,2,3,4,6,7,8-hpcdf)	EPA 8290A	10187403	NELAP	PA
9423 - 1,2,3,4,7,8,9-Heptachlorodibenzofuran (1,2,3,4,7,8,9-hpcdf)	EPA 8290A	10187403	NELAP	PA
9453 - 1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (1,2,3,4,7,8-Hxcdd)	EPA 8290A	10187403	NELAP	PA
9471 - 1,2,3,4,7,8-Hexachlorodibenzofuran (1,2,3,4,7,8-Hxcdf)	EPA 8290A	10187403	NELAP	PA
9456 - 1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin(1,2,3,6,7,8-Hxcdd)	EPA 8290A	10187403	NELAP	PA
9474 - 1,2,3,6,7,8-Hexachlorodibenzofuran (1,2,3,6,7,8-Hxcdf)	EPA 8290A	10187403	NELAP	PA
9459 - 1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (1,2,3,7,8,9-Hxcdd)	EPA 8290A	10187403	NELAP	PA
9477 - 1,2,3,7,8,9-Hexachlorodibenzofuran (1,2,3,7,8,9-Hxcdf)	EPA 8290A	10187403	NELAP	PA
9540 - 1,2,3,7,8-Pentachlorodibenzo-p-dioxin (1,2,3,7,8-Pecdd)	EPA 8290A	10187403	NELAP	PA
9543 - 1,2,3,7,8-Pentachlorodibenzofuran (1,2,3,7,8-Pecdf)	EPA 8290A	10187403	NELAP	PA
9480 - 2,3,4,6,7,8-Hexachlorodibenzofuran	EPA 8290A	10187403	NELAP	PA
9549 - 2,3,4,7,8-Pentachlorodibenzofuran	EPA 8290A	10187403	NELAP	PA
9618 - 2,3,7,8-Tetrachlorodibenzo- p-dioxin (2,3,7,8-TCDD)	EPA 8290A	10187403	NELAP	PA
9612 - 2,3,7,8-Tetrachlorodibenzofuran	EPA 8290A	10187403	NELAP	PA
9438 - Total Hpcdd	EPA 8290A	10187403	NELAP	PA

Solid Chemical Materials

Analyte	Method Name	Method Code	Type	AB
9444 - Total Hpcdf	EPA 8290A	10187403	NELAP	PA
9468 - Total Hxcdd	EPA 8290A	10187403	NELAP	PA
9483 - Total Hxcdf	EPA 8290A	10187403	NELAP	PA
9555 - Total Pecdd	EPA 8290A	10187403	NELAP	PA
9552 - Total Pecdf	EPA 8290A	10187403	NELAP	PA
9609 - Total TCDD	EPA 8290A	10187403	NELAP	PA
9615 - Total TCDF	EPA 8290A	10187403	NELAP	PA
6110 - 2,5-Dimethylbenzaldehyde	EPA 8315	10187801	NELAP	PA
4300 - Acetaldehyde	EPA 8315	10187801	NELAP	PA
4325 - Acrolein (Propenal)	EPA 8315	10187801	NELAP	PA
5570 - Benzaldehyde	EPA 8315	10187801	NELAP	PA
4430 - Butylaldehyde (Butanal)	EPA 8315	10187801	NELAP	PA
4545 - Crotonaldehyde	EPA 8315	10187801	NELAP	PA
4815 - Formaldehyde	EPA 8315	10187801	NELAP	PA
3825 - Hexanaldehyde (Hexanal)	EPA 8315	10187801	NELAP	PA
6330 - Isovaleraldehyde	EPA 8315	10187801	NELAP	PA
3965 - Propionaldehyde (Propanal)	EPA 8315	10187801	NELAP	PA
6755 - Tolualdehyde (1,2-Tolualdehyde)	EPA 8315	10187801	NELAP	PA
5125 - m-Tolualdehyde (1,3-Tolualdehyde)	EPA 8315	10187801	NELAP	PA
6760 - p-Tolualdehyde (1,4-Tolualdehyde)	EPA 8315	10187801	NELAP	PA
7710 - 3-Hydroxycarbofuran	EPA 8318	10188406	NELAP	PA
7010 - Aldicarb (Temik)	EPA 8318	10188406	NELAP	PA
7015 - Aldicarb sulfone	EPA 8318	10188406	NELAP	PA
7195 - Carbaryl (Sevin)	EPA 8318	10188406	NELAP	PA
7205 - Carbofuran (Furaden)	EPA 8318	10188406	NELAP	PA
7800 - Methiocarb (Mesurol)	EPA 8318	10188406	NELAP	PA
7805 - Methomyl (Lannate)	EPA 8318	10188406	NELAP	PA
8080 - Propoxur (Baygon)	EPA 8318	10188406	NELAP	PA
7710 - 3-Hydroxycarbofuran	EPA 8318A	10188600	NELAP	PA
7010 - Aldicarb (Temik)	EPA 8318A	10188600	NELAP	PA
7015 - Aldicarb sulfone	EPA 8318A	10188600	NELAP	PA
7195 - Carbaryl (Sevin)	EPA 8318A	10188600	NELAP	PA
7205 - Carbofuran (Furaden)	EPA 8318A	10188600	NELAP	PA
7800 - Methiocarb (Mesurol)	EPA 8318A	10188600	NELAP	PA
7805 - Methomyl (Lannate)	EPA 8318A	10188600	NELAP	PA
8080 - Propoxur (Baygon)	EPA 8318A	10188600	NELAP	PA
6885 - 1,3,5-Trinitrobenzene (1,3,5-TNB)	EPA 8330	10189807	NELAP	PA
6160 - 1,3-Dinitrobenzene (1,3-DNB)	EPA 8330	10189807	NELAP	PA
9651 - 2,4,6-Trinitrotoluene (2,4,6-TNT)	EPA 8330	10189807	NELAP	PA
6185 - 2,4-Dinitrotoluene (2,4-DNT)	EPA 8330	10189807	NELAP	PA
6190 - 2,6-Dinitrotoluene (2,6-DNT)	EPA 8330	10189807	NELAP	PA
9303 - 2-Amino-4,6-dinitrotoluene (2-am-dnt)	EPA 8330	10189807	NELAP	PA
9507 - 2-Nitrotoluene	EPA 8330	10189807	NELAP	PA
9510 - 3-Nitrotoluene	EPA 8330	10189807	NELAP	PA
9306 - 4-Amino-2,6-dinitrotoluene (4-am-dnt)	EPA 8330	10189807	NELAP	PA
9513 - 4-Nitrotoluene	EPA 8330	10189807	NELAP	PA
6415 - Methyl-2,4,6-trinitrophenylnitramine (tetryl)	EPA 8330	10189807	NELAP	PA
5015 - Nitrobenzene	EPA 8330	10189807	NELAP	PA
9522 - Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)	EPA 8330	10189807	NELAP	PA
9558 - Pentaerythritoltetranitrate	EPA 8330	10189807	NELAP	PA
9432 - RDX (hexahydro-1,3,5-trinitro-1,3,5-triazine)	EPA 8330	10189807	NELAP	PA

Solid Chemical Materials

Analyte	Method Name	Method Code	Type	AB
6885 - 1,3,5-Trinitrobenzene (1,3,5-TNB)	EPA 8330A	10190008	NELAP	PA
6160 - 1,3-Dinitrobenzene (1,3-DNB)	EPA 8330A	10190008	NELAP	PA
9651 - 2,4,6-Trinitrotoluene (2,4,6-TNT)	EPA 8330A	10190008	NELAP	PA
6185 - 2,4-Dinitrotoluene (2,4-DNT)	EPA 8330A	10190008	NELAP	PA
6190 - 2,6-Dinitrotoluene (2,6-DNT)	EPA 8330A	10190008	NELAP	PA
9303 - 2-Amino-4,6-dinitrotoluene (2-am-dnt)	EPA 8330A	10190008	NELAP	PA
9507 - 2-Nitrotoluene	EPA 8330A	10190008	NELAP	PA
9510 - 3-Nitrotoluene	EPA 8330A	10190008	NELAP	PA
9306 - 4-Amino-2,6-dinitrotoluene (4-am-dnt)	EPA 8330A	10190008	NELAP	PA
9513 - 4-Nitrotoluene	EPA 8330A	10190008	NELAP	PA
6415 - Methyl-2,4,6-trinitrophenylnitramine (tetryl)	EPA 8330A	10190008	NELAP	PA
5015 - Nitrobenzene	EPA 8330A	10190008	NELAP	PA
9522 - Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)	EPA 8330A	10190008	NELAP	PA
9558 - Pentaerythritoltetranitrate	EPA 8330A	10190008	NELAP	PA
9432 - RDX (hexahydro-1,3,5-trinitro-1,3,5-triazine)	EPA 8330A	10190008	NELAP	PA
1645 - Total Cyanide	EPA 9012A	10193405	NELAP	PA
1615 - Corrosivity	EPA 9045C	10198400	NELAP	PA
1900 - pH	EPA 9045C	10198400	NELAP	PA
1610 - Conductivity	EPA 9050	10198604	NELAP	PA
1610 - Conductivity	EPA 9050A	10198808	NELAP	PA
1905 - Total Phenolics	EPA 9066	10200609	NELAP	PA
1860 - Oil & Grease	EPA 9071B	10201602	NELAP	PA
1560 - Cation exchange capacity	EPA 9081	10203404	NELAP	PA
1780 - Ignitability	EPA 1010A	10234807	NELAP	PA
6380 - 1-Methylnaphthalene	EPA 8270C SIM	10242407	NELAP	PA
5500 - Acenaphthene	EPA 8270C SIM	10242407	NELAP	PA
5505 - Acenaphthylene	EPA 8270C SIM	10242407	NELAP	PA
5555 - Anthracene	EPA 8270C SIM	10242407	NELAP	PA
5575 - Benzo(a)anthracene	EPA 8270C SIM	10242407	NELAP	PA
5580 - Benzo(a)pyrene	EPA 8270C SIM	10242407	NELAP	PA
5585 - Benzo(b)fluoranthene	EPA 8270C SIM	10242407	NELAP	PA
5590 - Benzo(g,h,i)perylene	EPA 8270C SIM	10242407	NELAP	PA
5600 - Benzo(k)fluoranthene	EPA 8270C SIM	10242407	NELAP	PA
5855 - Chrysene	EPA 8270C SIM	10242407	NELAP	PA
5895 - Dibenz(a,h) anthracene	EPA 8270C SIM	10242407	NELAP	PA
6265 - Fluoranthene	EPA 8270C SIM	10242407	NELAP	PA
6270 - Fluorene	EPA 8270C SIM	10242407	NELAP	PA
6315 - Indeno(1,2,3-cd) pyrene	EPA 8270C SIM	10242407	NELAP	PA
5005 - Naphthalene	EPA 8270C SIM	10242407	NELAP	PA
6615 - Phenanthrene	EPA 8270C SIM	10242407	NELAP	PA
6665 - Pyrene	EPA 8270C SIM	10242407	NELAP	PA
6380 - 1-Methylnaphthalene	EPA 8270D SIM	10242509	NELAP	PA
5500 - Acenaphthene	EPA 8270D SIM	10242509	NELAP	PA
5505 - Acenaphthylene	EPA 8270D SIM	10242509	NELAP	PA
5555 - Anthracene	EPA 8270D SIM	10242509	NELAP	PA
5575 - Benzo(a)anthracene	EPA 8270D SIM	10242509	NELAP	PA
5580 - Benzo(a)pyrene	EPA 8270D SIM	10242509	NELAP	PA
5585 - Benzo(b)fluoranthene	EPA 8270D SIM	10242509	NELAP	PA
5590 - Benzo(g,h,i)perylene	EPA 8270D SIM	10242509	NELAP	PA
5600 - Benzo(k)fluoranthene	EPA 8270D SIM	10242509	NELAP	PA
5855 - Chrysene	EPA 8270D SIM	10242509	NELAP	PA

Solid Chemical Materials

Analyte	Method Name	Method Code	Type	AB
5895 - Dibenz(a,h) anthracene	EPA 8270D SIM	10242509	NELAP	PA
6265 - Fluoranthene	EPA 8270D SIM	10242509	NELAP	PA
6270 - Fluorene	EPA 8270D SIM	10242509	NELAP	PA
6315 - Indeno(1,2,3-cd) pyrene	EPA 8270D SIM	10242509	NELAP	PA
5005 - Naphthalene	EPA 8270D SIM	10242509	NELAP	PA
6615 - Phenanthrene	EPA 8270D SIM	10242509	NELAP	PA
6665 - Pyrene	EPA 8270D SIM	10242509	NELAP	PA
1900 - pH	EPA 9040C	10244403	NELAP	PA
4870 - Iodomethane (Methyl iodide)	EPA 8260C	10307003	NELAP	PA
1950 - Residue-total	SM 2540 G, 21st Ed	20006206	NELAP	PA
6218 - EPH Aliphatic C19-C36	MADEP EPH, Rev.1.1	90017202	NELAP	PA
6222 - EPH Aliphatic C9-C18	MADEP EPH, Rev.1.1	90017202	NELAP	PA
6232 - EPH Aromatic C11-C22	MADEP EPH, Rev.1.1	90017202	NELAP	PA
6234 - EPH Aromatic C11-C22 Unadjusted	MADEP EPH, Rev.1.1	90017202	NELAP	PA
5304 - VPH Aliphatic C5-C8	MADEP VPH, Rev.1.1	90017406	NELAP	PA
5305 - VPH Aliphatic C5-C8 Unadjusted	MADEP VPH, Rev.1.1	90017406	NELAP	PA
5306 - VPH Aliphatic C9-C12	MADEP VPH, Rev.1.1	90017406	NELAP	PA
5307 - VPH Aliphatic C9-C12 Unadjusted	MADEP VPH, Rev.1.1	90017406	NELAP	PA
5311 - VPH Aromatic C9-C10	MADEP VPH, Rev.1.1	90017406	NELAP	PA
9369 - Diesel range organics (DRO)	TNRCC 1005, Rev.3	90019208	NELAP	PA
2050 - Total Petroleum Hydrocarbons (TPH)	TNRCC 1005, Rev.3	90019208	NELAP	PA

Biological Tissue

Analyte	Method Name	Method Code	Type	AB
1000 - Aluminum	EPA 6010	10155201	NELAP	LA
1005 - Antimony	EPA 6010	10155201	NELAP	LA
1010 - Arsenic	EPA 6010	10155201	NELAP	LA
1015 - Barium	EPA 6010	10155201	NELAP	LA
1020 - Beryllium	EPA 6010	10155201	NELAP	LA
1025 - Boron	EPA 6010	10155201	NELAP	LA
1030 - Cadmium	EPA 6010	10155201	NELAP	LA
1035 - Calcium	EPA 6010	10155201	NELAP	LA
1040 - Chromium	EPA 6010	10155201	NELAP	LA
1050 - Cobalt	EPA 6010	10155201	NELAP	LA
1055 - Copper	EPA 6010	10155201	NELAP	LA
1070 - Iron	EPA 6010	10155201	NELAP	LA
1075 - Lead	EPA 6010	10155201	NELAP	LA
1085 - Magnesium	EPA 6010	10155201	NELAP	LA
1090 - Manganese	EPA 6010	10155201	NELAP	LA
1100 - Molybdenum	EPA 6010	10155201	NELAP	LA
1105 - Nickel	EPA 6010	10155201	NELAP	LA
1125 - Potassium	EPA 6010	10155201	NELAP	LA
1140 - Selenium	EPA 6010	10155201	NELAP	LA
1150 - Silver	EPA 6010	10155201	NELAP	LA
1155 - Sodium	EPA 6010	10155201	NELAP	LA
1160 - Strontium	EPA 6010	10155201	NELAP	LA
1165 - Thallium	EPA 6010	10155201	NELAP	LA
1175 - Tin	EPA 6010	10155201	NELAP	LA
1180 - Titanium	EPA 6010	10155201	NELAP	LA
1185 - Vanadium	EPA 6010	10155201	NELAP	LA
1190 - Zinc	EPA 6010	10155201	NELAP	LA
1005 - Antimony	EPA 6020	10156000	NELAP	LA
1010 - Arsenic	EPA 6020	10156000	NELAP	LA

Biological Tissue

Analyte	Method Name	Method Code	Type	AB
1020 - Beryllium	EPA 6020	10156000	NELAP	LA
1030 - Cadmium	EPA 6020	10156000	NELAP	LA
1040 - Chromium	EPA 6020	10156000	NELAP	LA
1055 - Copper	EPA 6020	10156000	NELAP	LA
1075 - Lead	EPA 6020	10156000	NELAP	LA
1105 - Nickel	EPA 6020	10156000	NELAP	LA
1140 - Selenium	EPA 6020	10156000	NELAP	LA
1165 - Thallium	EPA 6020	10156000	NELAP	LA
1095 - Mercury	EPA 7471	10166004	NELAP	LA
7355 - 4,4'-DDD	EPA 8081	10178402	NELAP	LA
7360 - 4,4'-DDE	EPA 8081	10178402	NELAP	LA
7365 - 4,4'-DDT	EPA 8081	10178402	NELAP	LA
7025 - Aldrin	EPA 8081	10178402	NELAP	LA
7250 - Chlordane (tech.)	EPA 8081	10178402	NELAP	LA
7470 - Dieldrin	EPA 8081	10178402	NELAP	LA
7685 - Heptachlor	EPA 8081	10178402	NELAP	LA
7690 - Heptachlor epoxide	EPA 8081	10178402	NELAP	LA
8250 - Toxaphene (Chlorinated camphene)	EPA 8081	10178402	NELAP	LA
7110 - alpha-BHC (alpha-Hexachlorocyclohexane)	EPA 8081	10178402	NELAP	LA
7115 - beta-BHC (beta-Hexachlorocyclohexane)	EPA 8081	10178402	NELAP	LA
7105 - delta-BHC	EPA 8081	10178402	NELAP	LA
7120 - gamma-BHC (Lindane, gamma-HexachlorocyclohexanE)	EPA 8081	10178402	NELAP	LA
8880 - Aroclor-1016 (PCB-1016)	EPA 8082	10179007	NELAP	LA
8885 - Aroclor-1221 (PCB-1221)	EPA 8082	10179007	NELAP	LA
8890 - Aroclor-1232 (PCB-1232)	EPA 8082	10179007	NELAP	LA
8895 - Aroclor-1242 (PCB-1242)	EPA 8082	10179007	NELAP	LA
8900 - Aroclor-1248 (PCB-1248)	EPA 8082	10179007	NELAP	LA
8905 - Aroclor-1254 (PCB-1254)	EPA 8082	10179007	NELAP	LA
8910 - Aroclor-1260 (PCB-1260)	EPA 8082	10179007	NELAP	LA
6715 - 1,2,4,5-Tetrachlorobenzene	EPA 8270	10185203	NELAP	LA
6400 - 2-Methylphenol (o-Cresol)	EPA 8270	10185203	NELAP	LA
6405 - 3-Methylphenol (m-Cresol)	EPA 8270	10185203	NELAP	LA
6410 - 4-Methylphenol (p-Cresol)	EPA 8270	10185203	NELAP	LA
5855 - Chrysene	EPA 8270	10185203	NELAP	LA
6275 - Hexachlorobenzene	EPA 8270	10185203	NELAP	LA
4835 - Hexachlorobutadiene	EPA 8270	10185203	NELAP	LA
6285 - Hexachlorocyclopentadiene	EPA 8270	10185203	NELAP	LA
4840 - Hexachloroethane	EPA 8270	10185203	NELAP	LA
6290 - Hexachlorophene	EPA 8270	10185203	NELAP	LA
6590 - Pentachlorobenzene	EPA 8270	10185203	NELAP	LA
6605 - Pentachlorophenol	EPA 8270	10185203	NELAP	LA
5095 - Pyridine	EPA 8270	10185203	NELAP	LA
5025 - n-Nitroso-di-n-butylamine	EPA 8270	10185203	NELAP	LA
6525 - n-Nitrosodiethylamine	EPA 8270	10185203	NELAP	LA

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Details on method quality control (QC) processes are provided in the individual Analytical Procedures. QC limits are maintained in the LIMS. This appendix provides an overview for representative methodology.
NOTE: This appendix is not applicable to OH VAP work. See the OH VAP approved SOPs for QC information.

SW - 846
Quality Control
GC/MS Volatiles Method 8260

Type	Frequency	Corrective Action
Surrogates: Toluene-d_8 Bromofluorobenzene 1,2-Dichloroethane-d_4 Dibromofluoromethane	Each sample, MS, MSD, LCS, and blank	Reanalyze sample if outside limits; if reanalysis confirms original, document on report and/or case narrative
Matrix Spikes: Spike all compounds of interest	Each group (≤20) of samples per matrix/level	Evaluation in conjunction with acceptable LCS. Acceptable LCS would be indicative of matrix effects on the MS/MSD.
Laboratory Control Samples: Spike all compounds of interest	Each group (≤20) of samples per matrix/level	Reanalyze LCS and associated samples for compounds outside acceptance limits that are also outside MS/MSD acceptance limits. Compounds that fail high in the LCS and are ND in the samples, can be reported.
Matrix Spike Duplicates (RPD): Spike all compounds of interest	Each group (≤20) of samples per matrix/level	Evaluated by analyst in relationship to other QC results
Blanks:	Once for each 12-hour time period or ≤20 samples	Reanalyze blank and associated samples if blank outside limits
Internal Standards (ISTD): Fluorobenzene Chlorobenzene-d_5 1,4-Dichlorobenzene-d_4 tert-Butyl alcohol-d10	Each sample, MS, MSD, LCS, and blank	Reanalyze samples; if reanalysis confirms original, document on report or case narrative

Acceptance limits are based on statistical evaluation of laboratory data and are subject to change.

SW - 846
Quality Control
GC/MS Semivolatiles Method 8270

Type	Frequency	Corrective Action
Surrogate: Nitrobenzene-d_5 2-Fluorobiphenyl Terphenyl-d_{14} Phenol-d_6 2-Fluorophenol 2,4,6-Tribromophenol	Each sample, MS, MSD, LCS, and blank	Repeat extraction and analysis; if reanalysis confirms original, document on report and/or case narrative
Matrix Spikes: Spike all compounds of interest	Each group (≤20) of samples per matrix/level	Evaluation in conjunction with acceptable LCS. Acceptable LCS would be indicative of matrix effects on the MS/MSD.
Laboratory Control Sample: Spike all compounds of interest	Each group (≤20) of samples per matrix/level	Re-extract and reanalyze LCS and associated samples for compounds outside acceptance limits. Compounds that fail high in the LCS and are ND in the samples, can be reported.
Matrix Spike Duplicates (RPD): Same as for matrix spikes	Each group (≤20) of samples per matrix/level	Evaluated by analyst in relationship to other QC results
Blanks:	Once per extraction group (≤20) of samples, each matrix, level	Re-extract and reanalyze blank and associated samples
Internal Standards (ISTD): 1,4-Dichlorobenzene-d_4 Naphthalene-d_8 Acenaphthene-d_{10} Phenanthrene-d_{10} Chrysene-d_{12} Perylene-d_{12}	Each sample, MS, MSD, LCS, and blank	Reanalyze samples; if reanalysis confirms original, document on report and/or case narrative

Acceptance limits are based on statistical evaluation of laboratory data and are subject to change.

SW - 846
Quality Control
GC/MS Semivolatiles Method 8270 SIM

Type	Frequency	Corrective Action
Surrogate: **1-Methylnaphthalene-d10** **Fluoranthene-d10** **Benzo(a)pyrene-d12**	Each sample, MS, MSD, LCS, and blank	Repeat extraction and analysis; if reanalysis confirms original, document on report and/or case narrative
Matrix Spikes: Spike all compounds of interest	Each group (≤20) of samples per matrix/level	Evaluation in conjunction with acceptable LCS. Acceptable LCS would be indicative of matrix effects on the MS/MSD.
Laboratory Control Sample: Spike all compounds of interest	Each group (≤20) of samples per matrix/level	Re-extract and reanalyze LCS and associated samples for compounds outside acceptance limits. Compounds that fail high in the LCS and are ND in the samples, can be reported.
Matrix Spike Duplicates (RPD): Same as for matrix spikes	Each group (≤20) of samples per matrix/level	Evaluated by analyst in relationship to other QC results
Blanks:	Once per extraction group (≤20) of samples, each matrix, level	Re-extract and reanalyze blank and associated samples
Internal Standards (ISTD): 1,4-Dichlorobenzene-d_4 Naphthalene-d_8 Acenaphthene-d_{10} Phenanthrene-d_{10} Chrysene-d_{12} Perylene-d_{12}	Each sample, MS, MSD, LCS, and blank	Reanalyze samples; if reanalysis confirms original, document on report and/or case narrative

Acceptance limits are based on statistical evaluation of laboratory data and are subject to change.

SW - 846
Quality Control
Dioxins/Furans Method 8290

Type	Frequency	Corrective Action
Labeled Compounds: 13C Labeled Isotope of each of 17 Toxic PCDD/PCDF	Each sample, OPR, and blank	Repeat extraction and analysis; if reanalysis confirms original, document on report and/or case narrative
Ongoing Precision and Recovery Standard (OPR): Spike all compounds of interest	Each group (≤20) of samples per matrix/level	Reanalyze OPR and associated samples for compounds outside acceptance limits that are also outside MS/MSD acceptance limits. Compounds that fail high in the OPR and are ND in the samples, can be reported.
Blanks:	Once for each 12-hour time period or ≤20 samples	Reanalyze blank and associated samples if blank outside limits
Internal Standards (ISTD): 13C12-1234-TCDD 13C12-123468-HxCDD	Each sample, OPR, and blank	RT ± 15 secs of retention time in initial calibration.

Quality Control
Dioxins/Furans Method 1613B

Type	Frequency	Corrective Action
Labeled Compounds: 13C Labeled Isotope of each of 17 Toxic PCDD/PCDF	Each sample, OPR, and blank	Repeat extraction and analysis; if reanalysis confirms original, document on report and/or case narrative
Ongoing Precision and Recovery Standard (OPR): Spike all compounds of interest	Each group (≤20) of samples per matrix/level	Reanalyze OPR and associated samples for compounds outside acceptance limits that are also outside MS/MSD acceptance limits. Compounds that fail high in the OPR and are ND in the samples, can be reported.
Blanks:	Once for each 12-hour time period or ≤20 samples	Reanalyze blank and associated samples if blank outside limits
Internal Standards (ISTD): 13C12-1234-TCDD 13C12-123468-HxCDD	Each sample, OPR, and blank	RT ± 15 secs of retention time in initial calibration.

Quality Control
Congeners Method 1668

Type	Frequency	Corrective Action
Labeled Compounds: 13C Labeled Isotope of each of 18 Toxic PCBs	Each sample, OPR, and blank	Repeat extraction and analysis; if reanalysis confirms original, document on report and/or case narrative
Ongoing Precision and Recovery Standard (OPR): Spike all compounds of interest	Each group (≤20) of samples per matrix/level	Reanalyze OPR and associated samples for compounds outside acceptance limits that are also outside MS/MSD acceptance limits. Compounds that fail high in the OPR and are ND in the samples, can be reported.
Blanks:	Once for each 12-hour time period or ≤20 samples	Reanalyze blank and associated samples if blank outside limits
Internal Standards (ISTD): 13C12-PCB70 13C12-PCB111 13C12-PCB141 13C12-PCB170	Each sample, OPR, and blank	RT ± 15 secs of retention time in initial calibration.

SW-846
Quality Control
Pesticides/PCBs Methods 8081; 8082; 8141; 8151

Type	Frequency	Corrective Action
Surrogate: Organochlorine Pesticides & PCBs Decachlorobiphenyl (DCB) Tetrachloro-*m*-xylene (TCMX) Herbicides: Dichloroacetic acid (DCAA) Organophosphorous Pesticides: 2-nitro-*m*-xylene (2NMX)	Added to each sample, MS/MSD, blank, LCS/LCSD during the extraction phase	Repeat extraction and analysis. If reanalysis confirms original result, report results and comment in case narrative
Matrix Spikes: Organochlorine Pesticides: Spike all compounds of interest, except PCBs, chlordane, and toxaphene Herbicides & Organophosphorous Pesticides: all compounds of interest PCBs: Aroclor 1016 & Aroclor 1260	Each extraction group (≤20) of samples per matrix/level	Evaluation in conjunction with acceptable LCS. Acceptable LCS would be indicative of matrix effects on the MS/MSD.
Laboratory Control Sample: Organochlorine Pesticides: Spike all compounds of interest, except PCBs, chlordane, and toxaphene Herbicides & Organophosphorous Pesticides: all compounds of interest PCBs: Aroclor 1016 & Aroclor 1260	Each group (≤20) when MS/MSD falls outside established limits	Re-extract and reanalyze LCS and associated samples for compounds outside acceptance limits. Compounds that fail high in the LCS and are ND in the samples can be reported.

SW-846
Quality Control
Pesticides/PCBs Methods 8081; 8082; 8141; 8151
(continued)

Type	Frequency	Corrective Action
Matrix Spike Duplicates (RPD): Organochlorine Pesticides: Spike all compounds of interest, except PCBs, chlordane, and toxaphene Herbicides & Organophosphorous Pesticides: all compounds of interest PCBs: Aroclor 1016 & Aroclor 1260	Each extraction group (≤20) of samples per matrix/level	Evaluated in conjunction with acceptable LCS. Acceptable LCS would be indicative of matrix effects on the MS/MSD.
Blanks:	Once per extraction group (≤20) of samples, each matrix, level	Inject a hexane or solvent blank first to be sure the analytical system is clean then reinject the blank itself. If the reinjected blank is acceptable, any samples extracted with this blank should be reinjected if they, too, contain the analyte which was contaminating the blank. If the reinjected blank is unacceptable, any affected samples must be reextracted.
Internal Standards (ISTD): Herbicides: 4,4'-dibromo octafluorobiphenyl (DBOB)	Each sample, MS, MSD, LCS, and blank	Internal standard criteria is advisory only.

Acceptance limits are based on statistical evaluation of laboratory data and are subject to change.

SW-846
Quality Control
Volatiles by GC
8021

Type	Frequency	Corrective Action
Surrogates: Aromatics; α,α,α-Trifluorotoluene (TFT)	Each sample, MS, MSD, LCS and blank	Reanalyze if the surrogate recovery is outside the limits unless matrix-related problems are evident.
Matrix Spikes: Spike all compounds of interest	Each group of samples (≤20) of similar matrix/level each method	Evaluation in conjunction with acceptable LCS. Acceptable LCS would be indicative of matrix effects on the MS/MSD.
Laboratory Control Sample: Spike all compounds of interest	Each group (≤20); LCSD is analyzed if sufficient volume is not available for MS/MSD	Reanalyze LCS and associated samples for compounds outside of acceptance limits. Compounds that fail high in the LCS and are ND in the samples can be reported.
Internal Standard (ISTD): Aromatics; 1-chloro-3-fluorobenzene	Each sample, LCS , MS, MSD, blank, and standard	Reanalyze samples; if reanalysis confirms original, document on report and/or case narrative. In cases where the sample matrix is elevating the ISTD recovery, a dilution and reanalysis may be performed.
Matrix Spike Duplicate (RPD): Same compounds as matrix spikes	Each group (≤20) of samples per matrix/level	Evaluated by analyst in relationship to other QC results
Blanks:	At least once per batch (≤20 samples) and once per 24 hours	Reanalyze blank and associated samples if blank is outside limits

Acceptance limits are based on statistical evaluation of laboratory data and are subject to change.

SW-846
Quality Control
TPH-DRO
8015B

Type	Frequency	Corrective Action
Surrogate: *o*-Terphenyl	Added to each sample, MS/MSD, blank, LCS/LCSD during the extraction phase	Repeat extraction and analysis. If reanalysis confirms original result, report results and comment in case narrative.
Matrix Spike: # 2 Fuel	Each group (≤20) of samples per matrix/level	Reinject if surrogates appear low. If still out of spec, evaluate for matrix effect. If matrix effect, accept based on LCS data. If no matrix effect, repeat batch.
Laboratory Control Sample: # 2 Fuel	Each group (≤20) of samples per matrix/level	Reinject if surrogates appear low. If still out of spec, reextract batch. LCS that fails high and DRO is ND in the samples can be reported.
Laboratory Control Duplicates (RPD): # 2 Fuel	Each group (≤20) of samples per matrix/level	Evaluated by analyst in relationship to other QC results
Blanks:	Once per extraction group (≤20) of samples, each matrix, level	Inject a solvent blank first to be sure the analytical system is clean then reinject the blank itself. If the reinjected blank is acceptable, any samples extracted with this blank should be reinjected, if they, too, contain the analyte which was contaminating the blank. If the reinjected blank is unacceptable, any affected samples must be re-extracted.

Acceptance limits are based on statistical evaluation of laboratory data and are subject to change.

SW-846
Quality Control
TPH-GRO
8015B

Type	Frequency	Corrective Action
Surrogate: Trifluorotoluene (FID)	Each sample, MS/MSD, LCS, and blank	Reanalyze if the surrogate recovery is outside the limits unless matrix-related problems are evident
Matrix Spike: Gasoline standard	Each group of samples of similar matrix/level (≤20) each method	Evaluation in conjunction with acceptable LCS. Acceptable LCS would be indicative of matrix effects on the MS/MSD.
Laboratory Control Sample Gasoline standard	Each group (≤20) of samples. LCSD analyzed if sufficient volume is not available for MS/MSD.	Reanalyze LCS and associated samples. LCS that fails high and GRO is ND in the samples can be reported.
Matrix Spike Duplicate (RPD): Same compounds as matrix spikes	Each group (≤20) of samples per matrix/level	Evaluated by analyst in relationship to other QC results
Blanks:	At least one per 20 samples and at least once per 24 hours.	Reanalyze blank and associated samples if blank is outside limits

Acceptance limits are based on statistical evaluation of laboratory data and are subject to change

SW-846
Quality Control*
Inorganics (Metals)

Type	Frequency	Corrective Action
Internal Standard (ICP & ICP/MS only):	Each sample, standard and QC (Unspiked, Dup., MS, MSD, LCS, dilution, post digestion spike and blank)	If the internal standard response falls outside the specified range, then the samples would be reanalyzed.
Matrix Spikes:	Each group of samples of similar matrix/level (≤20) each method	Analyze post-digestion spike sample
Matrix Spike Duplicate (RPD):	Each group of samples of similar matrix/level (20) each method	Analyze post-digestion spike sample if not already run for MS, flag the data
Duplicates (RPD):	Each group of samples of similar matrix/level (≤20) each method	Flag the data

SW-846 Quality Control* Inorganics (Metals)		
Type	**Frequency**	**Corrective Action**
Blanks: Initial Calibration (ICB) Continuing Calibration (CCB)	Each element immediately after calibration verification at 10% frequency or every 2 hours (beginning and end of run min.)	Correct problem, recalibrate, and rerun
Preparation Blank	Each SDG or batch (≤20 samples)	Redigest and reanalyze blank and associated samples if sample result is greater than the LOQ and <20× blank result
Serial Dilutions (ICP, ICP/MS only):	Each group of (≤20) of similar matrix/level	Flag the data
Interference Check Sample (ICP, ICP/MS only):	Each element after Initial Calibration Verification at beginning and end of the run or min. of 2× per 8 hour	Correct for interference, recalibrate the instrument
Laboratory Control Sample:	Each SDG or batch (≤20 samples), each method	Redigest and reanalyze LCS and associated samples. Elements in the LCS that fail high and are ND in the samples can be reported.
Post Digestion Spike:	When matrix spikes are outside 75 % - 125% range, or the statistical window (whichever is tighter).	Flag the data

Acceptance limits are based on statistical evaluation of laboratory data and are subject to change.

QC Table for SW-846 Miscellaneous Water Tests			
Test	**QC Type**	**Frequency**	**Corrective Action**
Sulfide	Blank	Each group of samples of similar matrix (≤20)	Prepare the entire batch again and re-analyze.
	Laboratory Control Sample	Each group of samples of similar matrix (≤20)	Prepare the entire batch again and re-analyze. LCSs that fail high (and associated samples are ND) can be reported.
	Duplicate	Each group of samples of similar matrix (≤20)	Ensure that LCS meets acceptance criteria.
	Matrix Spike/ Matrix Spike Duplicate	Each group of samples of similar matrix (≤20)	Ensure that LCS meets acceptance criteria.
	Blank	Each group of samples of similar matrix (≤20)	Prepare the entire batch again and re-analyze.

Bromide (IC) Chloride (IC) Cyanide (total) Fluoride (IC) Nitrate/Nitrite (IC) Sulfate (IC)	Laboratory Control Sample	Each group of samples of similar matrix (≤20)	Prepare the entire batch again and re-analyze. LCSs that fail high (and associated samples are ND) can be reported.
	Duplicate	Each group of samples of similar matrix (≤10)	Ensure that LCS meets acceptance criteria.
	Matrix Spike	Each group of samples of similar matrix (≤10)	Ensure that LCS meets acceptance criteria.
Phenols TOC Quad	Blank	Each group of samples of similar matrix (≤20)	Prepare the entire batch again and re-analyze.
	Laboratory Control Sample	Each group of samples of similar matrix (≤20)	Prepare the entire batch again and re-analyze. LCSs that fail high (and associated samples are ND) can be reported.
	Matrix Spike/ Matrix Spike Duplicate	Each group of samples of similar matrix (≤10)	Ensure that LCS meets acceptance criteria.
pH Moisture	Laboratory Control Sample	Each group of samples of similar matrix (≤20)	Re-analyze samples.
	Duplicate	Each group of samples of similar matrix (≤10)	Ensure that LCS meets acceptance criteria.
Microbiology	Organism control	Each lot of media (minimum of one per month)	Investigate cause
	Negative control	Each lot of media (minimum of one per month)	Investigate cause

Acceptance limits are based on statistical evaluation of laboratory data and are subject to change.

Drinking Water
Quality Control
Inorganics (Metals)

Type	Frequency	Corrective Action
Internal Standard (ICP & ICP/MS only):	Each sample, standard and QC (Unspiked, Dup., MS, LFB, Post Digestion Spike, dilution and blank)	If the internal standard response falls outside the specified range, then the samples would be reanalyzed.
Matrix Spikes:	Each group of samples of similar matrix/level (≤10) each method	Analyze post-digestion spike sample
Duplicates (RPD):	Each group of samples of similar matrix/level (≤10) each method	Flag the data
Blanks: Initial Calibration (ICB) Continuing Calibration (CCB)	Each wavelength immediately after calibration verification at 10% frequency	Correct problem, recalibrate, and rerun
Preparation Blank	Each batch (≤10 samples)	Redigest and reanalyze blank and associated samples if sample result <10 times blank result or >LOQ
Laboratory Fortified Blank (LFB):	Each batch (≤10 samples)	Redigest and reanalyze LFB and associated samples. Elements that fail high in the LFB and are ND in the samples can be reported.
Post Digestion Spike:	When matrix spikes are outside range	Flag the data

Drinking Water
EPA Method 525.2
Quality Control

Type	Frequency	Corrective Action
Lab Reagent Blank (LRB):	One per extraction batch of (≤20) samples	Re-extract and reanalyze blank and associated samples
Lab Fortified Blank (LFB): Spike all compounds of interest	One per extraction batch of (≤20) samples	Re-extract and reanalyze LFB and associated samples for compounds outside acceptance limits. Compounds that fail high in the LFB and are ND in the samples can be reported.
Matrix Spike/Matrix Spike Duplicate (MS/MSD): Spike all compounds of interest	One per extraction batch of (≤20) samples	Recoveries for LFB must be within criteria. If there is insufficient sample for MSD, then a duplicate (extraction and analysis) of another sample in the batch must be performed.
Surrogates: 1,3-Dimethyl-2-nitrobenzene Perylene-d_{12} Triphenylphosphate	Each sample, LFB, MS, MSD, and blank	Re-extract and reanalyze the sample
Internal Standards (ISTD): Acenaphthene-d_{10} Phenanthrene-d_{10} Chrysene-d_{12}	Each sample, LFB, MS, MSD, and blank	Reanalyze samples

QC Table for Miscellaneous Water Tests			
Test	**QC Type**	**Frequency**	**Corrective Action**
Alkalinity **Ammonia (ISE)** **Ammonia (Distill)** **Dissolved Solids** **Fluoride (ISE)** **Hardness** **Sulfate (TURB)** **Sulfide** **Total Solids** **Turbidity**	Blank	Each group of samples of similar matrix (≤20)	Prepare the entire batch again and re-analyze.
	Laboratory Fortified Blank	Each group of samples of similar matrix (≤20)	Prepare the entire batch again and re-analyze.*
	Duplicate	Each group of samples of similar matrix (≤20) Alkalinity, Dissolved Solids, Total Solids, Turbidity each group of similar matrix (≤10)	Ensure that LFB meets acceptance criteria.
	Matrix Spike/ Matrix Spike Duplicate	Each group of samples of similar matrix (≤20) (not for Turbidity)	Ensure that LFB meets acceptance criteria.
Bromide (IC) **Chloride (IC)** **Cyanide (total & free)** **Fluoride (IC)** **Nitrogen (TKN)** **Nitrate/Nitrite** **Sulfate (IC)** **Total Phosphorus** **TOC**	Blank	Each group of samples of similar matrix (≤20)	Prepare the entire batch again and re-analyze.
	Laboratory Fortified Blank	Each group of samples of similar matrix (≤20)	Prepare the entire batch again and re-analyze.*
	Duplicate	Each group of samples of similar matrix (≤10)	Ensure that LFB meets acceptance criteria.
	Matrix Spike	Each group of samples of similar matrix (≤10)	Ensure that LFB meets acceptance criteria.
Phenols	Blank	Each group of samples of similar matrix (≤20)	Prepare the entire batch again and re-analyze.
	Laboratory Fortified Blank/Laboratory Control Sample	Each group of samples of similar matrix (≤20)	Prepare the entire batch again and re-analyze.*
	Matrix Spike/ Matrix Spike Duplicate	Each group of samples of similar matrix (≤10)	Ensure that LFB meets acceptance criteria.
pH **Moisture**	Laboratory Fortified Blank	Each group of samples of similar matrix (≤20)	Re-analyze samples.
	Duplicate	Each group of samples of similar matrix (≤10)	Ensure that LFB meets acceptance criteria.
Microbiology	Organism control (+)	Each lot of media (minimum of one per month)	Investigate cause
	Negative control (-)	Each lot of media (minimum of one per month)	Investigate cause

*LFBs that fail high and associated samples are ND can be reported.

QC Table for Drinking Water Methods: 507, 515.1, 531.1		
Type of QC	**Frequency**	**Corrective Action**
Blank	Each batch of (≤20) samples	Inject a solvent blank to check for analytical system contamination. Re-inject the blank. If the re-injected blank is acceptable then any samples with positive results must be re-injected. If the re-injected blank is unacceptable, all associated samples must be re-extracted.
Surrogate 507 – 2-NMX 515 – DCAA 531 – BDMC	Added to each field and QC sample during the extraction.	Recovery must be within specifications unless matrix-related problems are evident, in which case report results and comment.
Matrix Spike/Matrix Spike Duplicate Spike all compounds of interest, except multipeak compounds	Each batch (≤20) of samples if sample volume is available.	Evaluate in conjunction with the LFB.
Laboratory Fortified Blank (LFB) Spike all compounds of interest, rotate multipeak compounds	Each batch of (≤20) samples. LCSD may be used if insufficient sample for MS/MSD is submitted.	If LFB compounds are outside of acceptance limits, re-extract and re-analyze the batch. Compounds that fail high in the LFB and are ND in the samples can be reported.

QC Table for Drinking Water Method: 524.2

Type of QC	Frequency	Corrective Action
Blank	One blank for each 12-hour period or batch of ≤20 samples	Reanalyze blank and associated samples if blank is unacceptable.
Surrogate 4-Bromofluorobenzene 1,2-Dichlorobenzene-d_4	Added to each field and QC sample prior to analysis	Reanalyze sample if outside limits. If reanalysis confirms original, document on report.
Matrix Spike/Matrix Spike Duplicate Spike all compounds of interest	At client request.	Evaluate in conjunction with the LFB.
Laboratory Fortified Blank (LFB) Spike all compounds of interest	One LFB for each 12 hour period.	If target compounds are outside of acceptance limits, re-analyze the LFB. If second LFB fails, recalibrate instrument, re-analyze LFB and any associated samples. Compounds that fail high in the LFB and are ND in the samples can be reported.
Internal standard (ISTD) Fluorobenzene	Added to each field and QC sample prior to analysis	Reanalyze sample if outside limits. If reanalysis confirms original, document on report.

EPA 624
Quality Control
GC/MS Volatiles

Type	Frequency	Corrective Action
Surrogates: 4-Bromofluorobenzene 1,2-Dichloroethane-d_4 Fluorobenzene	Each sample, MS, MSD, LCS, and blank	Reanalyze sample if outside limits; if reanalysis is within limits, the reanalysis data is reported. If surrogates confirm original, document on report and/or case narrative
Matrix Spikes: Spike all compounds of interest	Each batch (≤20) of samples	Evaluated by analyst in conjunction with the LCS. Acceptable LCS would be indicative of matrix effects on the MS/MSD.
Laboratory Control Samples: Spike all compounds of interest	Each batch (≤20) of samples	Reanalyze LCS and associated samples for compounds outside acceptance limits that are also outside MS/MSD acceptance limits. Compounds that fail high in the LCS and are ND in the samples can be reported.
Matrix Spike Duplicates (RPD): Spike all compounds of interest	Each batch (≤20) of samples	Evaluated by analyst in relationship to other QC results
Blanks:	Once every 24-hour tune period and/or 20 samples, whichever comes first	Reanalyze blank and associated samples if blank outside QC limits
Internal Standards (ISTD): Bromochloromethane 2-Bromo-1-chloropropane 1,4-Difluorobenzene	Each sample, MS, MSD, LCS, and blank	Reanalyze sample if outside limits; if reanalysis is within limits, the reanalysis data is reported. If internals confirm original, document on report and/or case narrative

Acceptance limits are based on statistical evaluation of laboratory data and are subject to change.

EPA 625
Quality Control
GC/MS Semivolatiles

Type	Frequency	Corrective Action
Surrogate: Nitrobenzene-d_5 2-Fluorobiphenyl Terphenyl-d_{14} Phenol-d_6 2-Fluorophenol 2,4,6-Tribromophenol	Each sample, MS, MSD, LCS, and blank	Re-extract and reanalyze if more than one surrogate out per fraction (acid/base) or any recovery <10%; if re-extraction and reanalysis confirms originals, document on report and/or case narrative
Matrix Spikes: Spike all compounds of interest	Each group (≤20) of samples per matrix/level	Evaluate in conjunction with the LCS. Acceptable LCS would be indicative of matrix effects on the MS/MSD.
Laboratory Control Sample: Spike all compounds of interest	Each group (≤20) of samples per matrix/level	Re-extract and reanalyze LCS and associated samples for compounds outside acceptance limits. Compounds that fail high in the LCS and are ND in the samples can be reported.
Matrix Spike Duplicates (RPD): Same as for matrix spikes	Each group (≤20) of samples per matrix/level	Evaluated by analyst in relationship to other QC results
Blanks:	Once per extraction group (≤20) of samples, each matrix, level, instrument	Re-extract and reanalyze blank and associated samples
Internal Standards (ISTD): 1,4-Dichlorobenzene-d_4 2-Fluoronaphthalene Acenaphthene-d_{10} Phenanthrene-d_{10} Chrysene-d_{12} Perylene-d_{12}	Each sample, MS, MSD, LCS, and blank	Reanalyze samples; if reanalysis confirms original, document on report and/or case narrative

Acceptance limits are based on statistical evaluation of laboratory data and are subject to change.

EPA 608
Quality Control
Pesticides/PCBs

Type	Frequency	Corrective Action
Surrogate: Organochlorine Pesticides & PCBs DCB TCMX	Each sample, MS, MSD, LCS, and blank	Repeat extraction and analysis if reanalysis confirms original report results and comment in case narrative
Matrix Spikes: Organochlorine Pesticides: Spike all compounds of interest, except PCBs, chlordane, and toxaphene PCBs: Aroclor 1016 and Aroclor 1260	Each batch (≤20) of samples	Evaluate in conjunction with LCS. Acceptable LCS would be indicative of matrix effects on the MS/MSD.
Matrix Spike Duplicates (RPD): Organochlorine Pesticides: Spike all compounds of interest, except PCBs, chlordane, and toxaphene PCBs: Aroclor 1016 and Aroclor 1260	Each batch (≤20) of samples	Evaluated by analyst in relationship to other QC results
Laboratory Control Sample: Organochlorine Pesticides: Spike all compounds of interest, except PCBs, chlordane, and toxaphene PCBs: Aroclor 1016 and Aroclor 1260	Each batch (≤20) of samples	Re-extract and reanalyze LCS and associated samples for compounds outside acceptance limits. Compounds in the LCS that fail high and are ND in the samples can be reported.
Blanks:	Each batch (≤20) of samples	Inject a hexane or solvent blank first to be sure the analytical system is clean then reinject the blank itself. If the reinjected blank is acceptable, any samples extracted with this blank should be reinjected if they, too, contain the analyte which was contaminating the blank. If the reinjected blank is unacceptable, any affected samples must be reextracted.

Acceptance limits are based on statistical evaluation of laboratory data and are subject to change.

EPA Method 602
Petroleum Analysis
Acceptance Criteria

Type	Frequency	Corrective Action
Surrogate: α,α,α-Trifluorotoluene (PID)	Each sample, MS, MSD, LCS, and blank	Reanalyze if the surrogate recovery is outside the limits unless matrix-related problems are evident.
Matrix Spike: Spike all compounds of interest	Each group (≤20) of samples	Evaluate in conjunction with LCS. Acceptable LCS would be indicative of matrix effects on the MS/MSD.
Laboratory Control Sample: Spike all compounds of interest	Each group (≤20) of samples. LCSD analyzed if sufficient volume is not available for MS/MSD	Reanalyze LCS and associated samples for compounds outside acceptance limits. Compounds in the LCS that fail high and are ND in the samples can be reported.
Matrix Spike Duplicates (RPD): Same compounds as the matrix spike	Each group (≤20) of samples	Evaluated by an analyst in relationship to other QC results
Blanks:	At least once per 24 hours	Reanalyze blank and associated samples if blank is outside limits
Internal Standards (ISTD): 1-Chloro-3-fluorobenzene (PID)	Each sample, MS, MSD, LCS, and blank	Reanalyze samples; if reanalysis confirms original result, document on report or case narrative. In cases where the sample matrix is elevating the ISTD recovery, a dilution and reanalysis may be performed.

Acceptance limits are based on statistical evaluation of laboratory data and are subject to change

EPA Method 600 Series (Method 200.8 for ICP/MS)
Quality Control
Inorganics (Metals)

Type	Frequency	Corrective Action
Internal Standard:	Each sample, standard and QC (Unspiked, Dup., MS, LCS, dilution, Post Digestion Spike and blank)	If the internal standard response falls outside the specified range, then the samples would be reanalyzed.
Matrix Spikes:	Each group of samples of similar matrix/level (≤10) each method	Analyze post-digestion spike sample
Matrix Spike Duplicate (RPD):	Not required	N/A
Duplicates (RPD):	Each group of samples of similar matrix/level (≤10) each method	Flag the data
Blanks: Initial Calibration (ICB) Continuing Calibration (CCB)	Each wavelength immediately after calibration verification at 10% frequency or every 2 hours (beginning and end of run min.)	Correct problem, recalibrate, and rerun
Preparation Blank	Each SDG or batch (≤10 samples)	Redigest and reanalyze blank and associated samples if sample result is greater than the LOQ and <10× blank result
Serial Dilutions:	Each group of (≤10) of similar matrix/level	Flag the data
Interference Check Sample:	Each wavelength after Initial Calibration Verification at beginning and end of the run or min. of 2 times per 8 hour	Correct for interference, recalibrate the instrument
Laboratory Control Sample:	Each SDG or batch (≤10 samples), each method	Redigest and reanalyze LCS and associated samples. Elements in the LCS that fail high and are ND in the samples can be reported.
Post Digestion Spike:	When matrix spikes are outside 70% to 130% range or within the statistical window (whichever is tighter)	Flag the data
Analytical Spike:	One per 10 field samples	ICP-MS – flag the data

Quality Control for Miscellaneous 600 Series Water Tests

Test	QC Type	Frequency	Corrective Action
Alkalinity **Ammonia (ISE)** **Ammonia (Distill.)** **Dissolved Solids** **Fluoride (ISE)** **Hardness** **Sulfate (turb)** **Sulfide** **Total Solids** **Turbidity**	Blank	Each batch (≤20) of samples	Prepare the entire batch again and re-analyze.
	Laboratory Control Sample	Each batch (≤20) of samples	Prepare the entire batch again and re-analyze.*
	Duplicate	Each batch (≤20) of samples	Ensure that LCS meets acceptance criteria.
	Matrix Spike/ Matrix Spike Duplicate	Each batch (≤20) of samples (not for turbidity)	Ensure that LCS meets acceptance criteria.
Bromide (IC) **Chloride (IC)** **Sulfate (IC)** **Cyanide (total & free)** **Fluoride (IC)** **Nitrogen (TKN)** **Nitrate/Nitrite** **Total Phosphorus** **TOC**	Blank	Each batch (≤20) of samples	Prepare the entire batch again and re-analyze.
	Laboratory Control Sample	Each batch (≤20) of samples	Prepare the entire batch again and re-analyze.*
	Duplicate	Each batch (≤10) of samples	Ensure that LCS meets acceptance criteria.
	Matrix Spike	Each batch (≤10) of samples	Ensure that LCS meets acceptance criteria.
Phenols	Blank	Each batch (≤20) of samples	Prepare the entire batch again and re-analyze.
	Laboratory Control Sample	Each batch (≤20) of samples	Prepare the entire batch again and re-analyze.*
	Matrix Spike/ Matrix Spike Duplicate	Each batch (≤10) of samples	Ensure that LCS meets acceptance criteria.

Acceptance limits are based on statistical evaluation of laboratory data and are subject to change.

*LCSs that fail high and associated samples are ND can be reported.

TO-15
Volatile Organics in Air

Type	Frequency	Corrective Action
Laboratory Control Sample: Spike all compounds of interest	Each group (≤20) of samples	Reanalyze LCS and associated samples for compounds outside acceptance limits. Compounds that fail high in the LCS and are ND in the samples, can be reported.
Blanks:	Once for each 24-hour time period or ≤20 samples	Reanalyze blank and associated samples if blank outside limits
Internal Standards (ISTD): Bromochloromethane 1,4-Difluorobenzene Chlorobenzene-d_5	Each sample, LCS, and blank	Reanalyze samples; if reanalysis confirms original, document on report and/or case narrative

Acceptance limits are based on statistical evaluation of laboratory data and are subject to change.

TO-14A
Volatile Organics in Air

Type	Frequency	Corrective Action
Laboratory Control Sample: Spike all compounds of interest	Each group (≤20) of samples	Reanalyze LCS and associated samples for compounds outside acceptance limits. Compounds that fail high in the LCS and are ND in the samples, can be reported.
Blanks:	Once for each 24-hour time period or ≤20 samples	Reanalyze blank and associated samples if blank outside limits
Internal Standards (ISTD): Bromochloromethane 1,4-Difluorobenzene Chlorobenzene-d_5	Each sample, LCS, and blank	Reanalyze samples; if reanalysis confirms original, document on report and/or case narrative

Acceptance limits are based on statistical evaluation of laboratory data and are subject to change.

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MICROBIOLOGICAL TESTING

1. MICROBIOLOGICAL SAMPLE HANDLING

1.1. Microbiological Sample Collection

The containers for environmental microbiology are typically sterile, screw-cap plastic bottles. A minimum of 100 mL of sample is required. The sampling containers are purchased with a sterility certification. The sterility, absence of autofluoresence, and volume of each purchased lot of containers is verified by randomly selecting a container from each purchased lot and inoculating it with approximately 100 mL of sterile tryptic soy broth and placing it in incubation for 24 hours at 35° ± 0.5°C. Each lot of bottles is also checked for absence of autofluoresence with a 366-nm UV light with a 6-Watt bulb. The 100-mL calibration line on the container is verified using a 100-mL Class A graduated cylinder to 2.5% tolerance.

Samples collected for microbiological analyses must follow a specific protocol:

- The sampling taps are to be free of aerators, strainers, hose attachments, and purification devices; they should not be mixing type faucets, and avoid leaky faucets.
- Maintain a steady water flow for 3 to 5 minutes before collecting the sample.
- Using aseptic techniques, fill the container to just above the 100-mL mark on the container. This will allow for mixing and chlorine residual analysis.
- Do not overfill the container.
- If another environmental microbial analysis is required, or if the water is discolored (to act as a color standard), a separate container will be required.

1.2. Microbiological Sample Storage

Because sample integrity can be compromised by improper storage, the environmental microbiology samples are refrigerated with the temperature monitored until requested by the microbiologist for analysis.

Holding times for samples are monitored and analysis is scheduled accordingly. For Safe Drinking Water Act (SDWA) compliance purposes, no sample (for total coliform analysis) with over 30 hours elapsed time from collection will be analyzed. HPC samples from SDWA surface water systems must be tested within 8 hours of collection. Fecal coliform tests on effluents for National Pollutant Discharge Elimination System (NPDES) compliance purposes must be transported to the laboratory within 6 hours of collection. Samples that arrive past 6 hours of when they were collected cannot be tested. Whenever possible, the sample should be tested within 2 hours of receipt.

1.3. Microbiological Sample Return/Disposal

All solid wastes generated from the microbiological analyses are disposed of in bags designated as “BioHazard”, sterilized via autoclave and disposed of by incineration. The laboratory uses a sophisticated, laboratory information management system (LIMS), which includes programming to assist in the identification of hazardous wastes at time of discard. In most cases, a sample for coliform testing is collected in a container that will also be the test vessel. When this occurs, samples are discarded in the laboratory immediately after analysis is completed. When samples are not tested in the sample container, the sample containers are returned to sample storage for disposal.

2. MICROBIOLOGICAL TECHNICAL REQUIREMENTS AND TRACEABILITY OF MEASUREMENTS

2.1. Media

- Within the microbiology laboratory, procedures are in place to address preparation, labeling, storage, expiration, documentation, and quality/sterility evaluation requirements for these materials. Only commercially prepared or manufactured dehydrated media is used for SDWA water work. Media may not be formulated from basic ingredients. Each new lot of dehydrated or commercially prepared medium is checked against positive and negative culture controls. Each purchased lot of MMO-MUG media is tested for performance using *E. coli*, *K. pneumoniae*, and *Ps. aeruginosa*, or equivalent organisms following a standard operating procedure. The positive/negative organism check is performed on each new lot of purchased or prepared media for QC purposes.

- Each analytical method includes a list of media needed for the test. These are fully described, including name, purity, and description of preparation. Where applicable, shelf life and storage conditions are also listed.

- The Microbiology Department is responsible for maintaining an inventory of the media needed. New supplies of media are checked by the Purchasing Department to ensure that they match the purchase order. The laboratory is responsible for checking that new supplies meet the method requirements.

- In addition to the name and concentration, the media containers are labeled with the storage conditions, the date opened, and an expiration or re-evaluation date. Subsequent media preparations at the laboratory are fully documented in a logbook and are traceable to, or labeled to include:

    1. Name of media
    2. Concentration, as appropriate
    3. Date prepared
    4. Name of analyst preparing or reference to logbook
    5. Storage conditions
    6. Expiration/re-evaluation date
    7. Manufacturer name and lot #
    8. Sterilization time and temperature
    9. Final pH, where required
    10. Sterility check result

2.2. Microbiological Standard Sources, Calibration, and Preparation

Microbial Control Species - Where required, laboratory cultures are obtained from the American Type Culture Collection (ATCC). Cultures used in testing are no more than five transfers from ATCC freeze-dried cultures.

2.3. Microbiological Equipment Maintenance

Equipment maintenance and calibration is addressed in instrument-specific Operation, Maintenance, and Calibration Procedures (OMC) or instrument-specific instruction manuals located within the department.

The general process for sterilization procedures are outlined below:

2.3.1. All autoclaving is done at 121° ± 1°C, with times as specified below (in minutes):

Carbohydrate media	25
Rinse water	60
Contaminated materials	minimum of 70

2.3.2. Sterile disposable single use membrane filter units or sterile glass filter funnels are used for methods that require filtration.

2.4. Microbiological Labware Cleaning

Sterile disposable plastic ware is primarily used for microbiological analysis. However, procedures are in place to outline the washing process for each type of labware used in the laboratory. Most glassware is machine-washed. Labware that is washed by hand is either air dried or dried in specifically designed ovens and sterilized appropriately. Each new lot, or at least annually, of detergents used to wash glassware for Environmental Microbiology labware, is tested using the Inhibitory Residue Test, as outlined in SM20 9020.B.4.a.2).

MICROBIOLOGICAL INTERNAL QUALITY CONTROL CHECKS

2.5. Microbiological Laboratory Quality Control Samples and Acceptance Criteria

Quality control (QC) samples are analyzed with each batch of samples or new lot of reagents, as required by the referenced methods, to demonstrate that all aspects of the analysis are in control within established limits of precision and accuracy. Chromofluorogenic media QC tests are lot-specific and performed on each newly received lot.

Each laboratory analytical method specifies (or includes cross-references to) the type of QC sample, frequency of analysis, acceptance criteria for QC sample results, and corrective action to be taken if QC sample results fall outside of the acceptance range. The handling of QC data is described in section 9.2 of the Environmental Quality Policy Manual. The types of QC samples and the information each provides are discussed in the following paragraphs.

2.5.1. Negative System Control - The QC on this is method specific and can be found in 1-P-QM-PRO-9018209, Quality Control/Quality Assurance Procedure for Environmental Microbiology.

2.5.2. Positive and Negative Organism Controls - Each lot/batch of media is tested using positive and negative organism controls.

2.5.3. Duplicate Counting (Test Variability/Reproducibility) - duplicate counting is performed monthly on HPC and fecal MF plates. Each analyst who counted samples for a month, counts the plates and their results are evaluated. Counts must be within 10% difference of the total average for all analysts to be acceptable.

2.5.4. Duplicates - For heterotrophic plate count samples, a duplicate is a second aliquot of a sample that is treated identically to the original to determine precision of the test. The plate counts are averaged.

2.5.5. Serial Dilutions - Fecal coliform, biosolids analyses, and heterotrophic plate counts may require serial dilution of the sample.

2.6. Microbiological Quality Control Sample Frequency and Corrective Action

Each analytical method defines the frequency for the required QC samples, where appropriate. The corrective action required when a QC result fails to meet the acceptance criteria is also given, where appropriate.

The QC acceptance criteria are available to analysts in the laboratory. If the results are not within the acceptance criteria, corrective action suitable to the situation must be taken. This may include, but is not limited to, checking calculations, examining other quality control analyzed with the same batch of samples, qualifying results with a comment stating the observed deviation, and invalidating results. It should be noted that resampling may be required in the case of invalidated results for SDWA, Environmental Protection Agency (EPA), Pennsylvania Department of Environmental Protection (PADEP), or Pennsylvania Department of Health (DOH) compliance samples due to the short hold-times in microbiological analysis.

2.7. Microbiological Water Systems

Laboratory Reagent Water Suitability Testing - On an annual basis, a sample is sent to a PADEP certified laboratory for suitability analyses. These serve as confirmation of our analyses, as well as to supply additional data on the water suitability.

2.8. Microbiological Reporting Limits

For microbiological analysis, the limits are method-specified and/or project-specific. This information is programmed into the LIMS for reporting purposes.

PERRY JOHNSON LABORATORY ACCREDITATION, INC.

Certificate of Accreditation

Perry Johnson Laboratory Accreditation, Inc. has assessed the Laboratory of:

Gulf Coast Analytical Laboratories, LLC

7979 Innovation Park Drive, Baton Rouge, LA 70820

(Hereinafter called the Organization) and hereby declares that Organization has met the requirements of ISO/IEC 17025:2005 "General Requirements for the competence of Testing and Calibration Laboratories" and the DoD Quality Systems Manual for Environmental Laboratories Version 5.1 January 2017 and is accredited is accordance with the:

United States Department of Defense Environmental Laboratory Accreditation Program (DoD-ELAP)

This accreditation demonstrates technical competence for the defined scope:

Environmental Testing

(As detailed in the supplement)

Accreditation claims for such testing and/or calibration services shall only be made from addresses referenced within this certificate. This Accreditation is granted subject to the system rules governing the Accreditation referred to above, and the Organization hereby covenants with the Accreditation body's duty to observe and comply with the said rules.

For PJLA:

Initial Accreditation Date:	*Issue Date:*	*Expiration Date:*
October 2, 2013	September 24, 2016	December 31, 2018
Revision Date:	*Accreditation No.:*	*Certificate No.:*
June 1, 2017	74960	L16-398-R3

Tracy Szerszen
President/Operations Manager

Perry Johnson Laboratory
Accreditation, Inc. (PJLA)
755 W. Big Beaver, Suite 1325
Troy, Michigan 48084

The validity of this certificate is maintained through ongoing assessments based on a continuous accreditation cycle. The validity of this certificate should be confirmed through the PJLA website: www.pjlabs.com

Accreditation is granted to the facility to perform the following testing:

Matrix	Standard/Method	Technology	Analyte
Aqueous	EPA 1664A	Gravimetric	Oil & Grease
Aqueous	EPA 200.8	ICP-MS	Aluminum
Aqueous	EPA 200.8	ICP-MS	Antimony
Aqueous	EPA 200.8	ICP-MS	Arsenic
Aqueous	EPA 200.8	ICP-MS	Barium
Aqueous	EPA 200.8	ICP-MS	Beryllium
Aqueous	EPA 200.8	ICP-MS	Cadmium
Aqueous	EPA 200.8	ICP-MS	Calcium
Aqueous	EPA 200.8	ICP-MS	Chromium
Aqueous	EPA 200.8	ICP-MS	Cobalt
Aqueous	EPA 200.8	ICP-MS	Copper
Aqueous	EPA 200.8	ICP-MS	Iron
Aqueous	EPA 200.8	ICP-MS	Lead
Aqueous	EPA 200.8	ICP-MS	Magnesium
Aqueous	EPA 200.8	ICP-MS	Manganese
Aqueous	EPA 200.8	ICP-MS	Molybdenum
Aqueous	EPA 200.8	ICP-MS	Nickel
Aqueous	EPA 200.8	ICP-MS	Potassium
Aqueous	EPA 200.8	ICP-MS	Selenium
Aqueous	EPA 200.8	ICP-MS	Silver
Aqueous	EPA 200.8	ICP-MS	Sodium
Aqueous	EPA 200.8	ICP-MS	Strontium
Aqueous	EPA 200.8	ICP-MS	Thallium
Aqueous	EPA 200.8	ICP-MS	Tin
Aqueous	EPA 200.8	ICP-MS	Titanium
Aqueous	EPA 200.8	ICP-MS	Total Hardness (as CaCO3)
Aqueous	EPA 200.8	ICP-MS	Vanadium
Aqueous	EPA 200.8	ICP-MS	Zinc
Aqueous	EPA 200.8	ICP-MS	Zirconium
Aqueous	EPA 245.2	CVAA	Mercury
Aqueous	EPA 300.0	IC	Bromide
Aqueous	EPA 300.0	IC	Chloride
Aqueous	EPA 300.0	IC	Fluoride
Aqueous	EPA 300.0	IC	Nitrate and Nitrite as N
Aqueous	EPA 300.0	IC	Nitrate as N
Aqueous	EPA 300.0	IC	Nitrite as N

Accreditation is granted to the facility to perform the following testing:

Matrix	Standard/Method	Technology	Analyte
Aqueous	EPA 300.0	IC	Sulfate
Aqueous	EPA 420.4	FIA	Total Phenolics (4AAP)
Aqueous	EPA 624	GC-MS	1,1,1,2-Tetrachloroethane
Aqueous	EPA 624	GC-MS	1,1,1-Trichloroethane
Aqueous	EPA 624	GC-MS	1,1,2,2-Tetrachloroethane
Aqueous	EPA 624	GC-MS	1,1,2-Trichloroethane
Aqueous	EPA 624	GC-MS	1,1-Dichloroethane
Aqueous	EPA 624	GC-MS	1,1-Dichloroethene
Aqueous	EPA 624	GC-MS	1,1-Dichloropropene
Aqueous	EPA 624	GC-MS	1,2 Dichlorobenzene
Aqueous	EPA 624	GC-MS	1,2 Dichloroethane
Aqueous	EPA 624	GC-MS	1,2,3-Trichlorobenzene
Aqueous	EPA 624	GC-MS	1,2,3-Trichloropropane
Aqueous	EPA 624	GC-MS	1,2,4-Trichlorobenzene
Aqueous	EPA 624	GC-MS	1,2,4-Trimethylbenzene
Aqueous	EPA 624	GC-MS	1,2-Dibromo-3-chloropropane (DBCP)
Aqueous	EPA 624	GC-MS	1,2-Dibromoethane (EDB)
Aqueous	EPA 624	GC-MS	1,2-Dichloropropane
Aqueous	EPA 624	GC-MS	1,3 Dichlorobenzene
Aqueous	EPA 624	GC-MS	1,3,5-Trimethylbenzene
Aqueous	EPA 624	GC-MS	1,3-Dichloropropane
Aqueous	EPA 624	GC-MS	1,4 Dichlorobenzene
Aqueous	EPA 624	GC-MS	2,2-Dichloropropane
Aqueous	EPA 624	GC-MS	2-Butanone (MEK)
Aqueous	EPA 624	GC-MS	2-Chloroethylvinylether
Aqueous	EPA 624	GC-MS	2-Chlorotoluene
Aqueous	EPA 624	GC-MS	2-Hexanone
Aqueous	EPA 624	GC-MS	4-Chlorotoluene
Aqueous	EPA 624	GC-MS	4-Methyl-2-pentanone (MIBK)
Aqueous	EPA 624	GC-MS	Acetone
Aqueous	EPA 624	GC-MS	Acetonitrile
Aqueous	EPA 624	GC-MS	Acrolein
Aqueous	EPA 624	GC-MS	Acrylonitrile
Aqueous	EPA 624	GC-MS	Benzene
Aqueous	EPA 624	GC-MS	Bromochloromethane
Aqueous	EPA 624	GC-MS	Bromodichloromethane

Matrix	Standard/Method	Technology	Analyte
Aqueous	EPA 624	GC-MS	Bromoform
Aqueous	EPA 624	GC-MS	Bromomethane
Aqueous	EPA 624	GC-MS	Carbon disulfide
Aqueous	EPA 624	GC-MS	Carbon tetrachloride
Aqueous	EPA 624	GC-MS	Chlorobenzene
Aqueous	EPA 624	GC-MS	Chloroethane
Aqueous	EPA 624	GC-MS	Chloroform
Aqueous	EPA 624	GC-MS	Chloromethane
Aqueous	EPA 624	GC-MS	cis-1,2-Dichloroethene
Aqueous	EPA 624	GC-MS	cis-1,3-Dichloropropylene
Aqueous	EPA 624	GC-MS	Dibromochloromethane
Aqueous	EPA 624	GC-MS	Dibromomethane
Aqueous	EPA 624	GC-MS	Dichlorodifluoromethane
Aqueous	EPA 624	GC-MS	Ethylbenzene
Aqueous	EPA 624	GC-MS	Hexachlorobutadiene
Aqueous	EPA 624	GC-MS	Isopropylbenzene
Aqueous	EPA 624	GC-MS	m+p-Xylene
Aqueous	EPA 624	GC-MS	Methyl tert-butyl ether (MTBE)
Aqueous	EPA 624	GC-MS	Methylene Chloride
Aqueous	EPA 624	GC-MS	Naphthalene
Aqueous	EPA 624	GC-MS	n-Butylbenzene
Aqueous	EPA 624	GC-MS	n-Propylbenzene
Aqueous	EPA 624	GC-MS	o-Xylene
Aqueous	EPA 624	GC-MS	p-Isopropyltoluene
Aqueous	EPA 624	GC-MS	sec-Butylbenzene
Aqueous	EPA 624	GC-MS	Styrene
Aqueous	EPA 624	GC-MS	tert-Butylbenzene
Aqueous	EPA 624	GC-MS	Tetrachloroethene
Aqueous	EPA 624	GC-MS	Toluene
Aqueous	EPA 624	GC-MS	trans-1,2-Dichloroethene
Aqueous	EPA 624	GC-MS	trans-1,3-Dichloropropene
Aqueous	EPA 624	GC-MS	Trichloroethene
Aqueous	EPA 624	GC-MS	Trichlorofluoromethane
Aqueous	EPA 624	GC-MS	Vinyl acetate
Aqueous	EPA 624	GC-MS	Vinyl chloride
Aqueous	EPA 624	GC-MS	Xylenes, total

Certificate of Accreditation: Supplement

ISO/IEC 17025:2005 and DoD-ELAP

Gulf Coast Analytical Laboratories, LLC

7979 Innovation Park Drive, Baton Rouge, LA 70820
Contact Name: Randy Whittington Phone: 225-769-4900

Accreditation is granted to the facility to perform the following testing:

Matrix	Standard/Method	Technology	Analyte
Aqueous	EPA 625	GC-MS	1,2,4,5-Tetrachlorobenzene
Aqueous	EPA 625	GC-MS	1,2,4-Trichlorobenzene
Aqueous	EPA 625	GC-MS	1-Methylnaphthalene
Aqueous	EPA 625	GC-MS	2,3,4,6-Tetrachlorophenol
Aqueous	EPA 625	GC-MS	2,4,5-Trichlorophenol
Aqueous	EPA 625	GC-MS	2,4,6-Trichlorophenol
Aqueous	EPA 625	GC-MS	2,4-Dichlorophenol
Aqueous	EPA 625	GC-MS	2,4-Dimethylphenol
Aqueous	EPA 625	GC-MS	2,4-Dinitrophenol
Aqueous	EPA 625	GC-MS	2,4-Dinitrotoluene
Aqueous	EPA 625	GC-MS	2,6-Dichlorophenol
Aqueous	EPA 625	GC-MS	2,6-Dinitrotoluene
Aqueous	EPA 625	GC-MS	2-Chloronaphthalene
Aqueous	EPA 625	GC-MS	2-Chlorophenol
Aqueous	EPA 625	GC-MS	2-Methyl-4,6-Dinitrophenol
Aqueous	EPA 625	GC-MS	2-Methylnaphthalene
Aqueous	EPA 625	GC-MS	2-Methylphenol
Aqueous	EPA 625	GC-MS	2-Nitroaniline
Aqueous	EPA 625	GC-MS	2-Nitrophenol
Aqueous	EPA 625	GC-MS	3,3'-Dichlorobenzidine
Aqueous	EPA 625	GC-MS	3-Nitroaniline
Aqueous	EPA 625	GC-MS	4-Bromophenyl-phenylether
Aqueous	EPA 625	GC-MS	4-Chloro-3-methylphenol
Aqueous	EPA 625	GC-MS	4-Chloroaniline
Aqueous	EPA 625	GC-MS	4-Chlorophenyl-phenylether
Aqueous	EPA 625	GC-MS	4-Methylphenol (and/or 3-Methylphenol)
Aqueous	EPA 625	GC-MS	4-Nitroaniline
Aqueous	EPA 625	GC-MS	4-Nitrophenol
Aqueous	EPA 625	GC-MS	Acenaphthene
Aqueous	EPA 625	GC-MS	Acenaphthylene
Aqueous	EPA 625	GC-MS	Aniline
Aqueous	EPA 625	GC-MS	Anthracene
Aqueous	EPA 625	GC-MS	Benzidine
Aqueous	EPA 625	GC-MS	Benzo(a)anthracene
Aqueous	EPA 625	GC-MS	Benzo(a)pyrene
Aqueous	EPA 625	GC-MS	Benzo(b)fluoranthene

Accreditation is granted to the facility to perform the following testing:

Matrix	Standard/Method	Technology	Analyte
Aqueous	EPA 625	GC-MS	Benzo(g,h,i)perylene
Aqueous	EPA 625	GC-MS	Benzo(k)fluoranthene
Aqueous	EPA 625	GC-MS	Benzoic acid
Aqueous	EPA 625	GC-MS	Benzyl alcohol
Aqueous	EPA 625	GC-MS	bis(2-Chloroethoxy)methane
Aqueous	EPA 625	GC-MS	bis(2-Chloroethyl)ether
Aqueous	EPA 625	GC-MS	bis(2-Chloroiospropyl) ether
Aqueous	EPA 625	GC-MS	bis(2-ethylhexyl) phthalate
Aqueous	EPA 625	GC-MS	Butyl benzyl phthalate
Aqueous	EPA 625	GC-MS	Carbazole
Aqueous	EPA 625	GC-MS	Chrysene
Aqueous	EPA 625	GC-MS	Dibenzo(a,h)anthracene
Aqueous	EPA 625	GC-MS	Dibenzofuran
Aqueous	EPA 625	GC-MS	Diethyl phthalate
Aqueous	EPA 625	GC-MS	Dimethyl phthalate
Aqueous	EPA 625	GC-MS	Di-n-butylphthalate
Aqueous	EPA 625	GC-MS	Di-n-octylphthalate
Aqueous	EPA 625	GC-MS	Fluoranthene
Aqueous	EPA 625	GC-MS	Fluorene
Aqueous	EPA 625	GC-MS	Hexachlorobenzene
Aqueous	EPA 625	GC-MS	Hexachlorocyclopentadiene
Aqueous	EPA 625	GC-MS	Indeno(1,2,3, cd)pyrene
Aqueous	EPA 625	GC-MS	Isophorone
Aqueous	EPA 625	GC-MS	Naphthalene
Aqueous	EPA 625	GC-MS	Nitrobenzene
Aqueous	EPA 625	GC-MS	N-Nitrosodiethylamine
Aqueous	EPA 625	GC-MS	N-Nitrosodimethylamine
Aqueous	EPA 625	GC-MS	N-Nitroso-di-n-propylamine
Aqueous	EPA 625	GC-MS	N-Nitrosodiphenylamine
Aqueous	EPA 625	GC-MS	o-Toluidine
Aqueous	EPA 625	GC-MS	Pentachlorobenzene
Aqueous	EPA 625	GC-MS	Pentachlorophenol
Aqueous	EPA 625	GC-MS	Phenanthrene
Aqueous	EPA 625	GC-MS	Phenol
Aqueous	EPA 625	GC-MS	Pyrene
Aqueous	EPA 625	GC-MS	Pyridine

Accreditation is granted to the facility to perform the following testing:

Matrix	Standard/Method	Technology	Analyte
Aqueous	EPA 7470A	CVAA	Mercury
Aqueous	EPA 8011	GC-ECD	1,2-Dibromo-3-chloropropane (DBCP)
Aqueous	EPA 8011	GC-ECD	1,2-Dibromoethane (EDB)
Aqueous	EPA 9040C	pH Meter	Corrosivity (pH)
Aqueous	HACH 8000	Spectrophotometer	COD
Aqueous	RSK175	GC-FID	Acetylene
Aqueous	RSK175	GC-FID	Butane
Aqueous	RSK175	GC-TCD	Carbon Dioxide
Aqueous	RSK175	GC-FID	Ethane
Aqueous	RSK175	GC-FID	Ethene
Aqueous	RSK175	GC-FID	Methane
Aqueous	RSK175	GC-FID	Propane
Aqueous	SM 2130B	Turbidimetric	Turbidity
Aqueous	HACH 10242	Spectrophotometer	Total Kieldahl Nitrogen
Aqueous	SM 2310B	Titration	Acidity(as CaCO3)
Aqueous	SM 2320B	Titration	Total Alkalinity(as CaCO3)
Aqueous	SM 2340 B	ICP-MS	Total Hardness (as CaCO3)
Aqueous	SM 2540B	Gravimetric	Total Solids
Aqueous	SM 2540C	Gravimetric	Total Dissolved Solids (TDS)
Aqueous	SM 2540D	Gravimetric	Non-Filterable Residue (TSS)
Aqueous	SM 3500-Fe B	Spectrophotometer	Ferrous Iron
Aqueous	SM 4500-Cl E	Autotitrator	Chloride
Aqueous	SM 4500-H+ B	pH Meter	Corrosivity (pH)
Aqueous	SM 4500-H+ B	pH Meter	pH
Aqueous	SM 4500-PE	Spectrophotometer	Orthophosphate as P
Aqueous	SM 4500-S2 D	Spectrophotometer	Sulfide
Aqueous	SM 4500-S2 F	Titration	Sulfide
Aqueous	SM 4500-SiO2 C	Spectrophotometer	Silica
Aqueous	SM 4500-SO4 E	IC	Sulfate
Aqueous	SM 5310B	TOC Analyzer	TOC
Aqueous	EPA 9020B	TOX Analyzer	Total Organic Halides
Drinking Water	EPA 537	LC/MS/MS	NMeFOSAA
Drinking Water	EPA 537	LC/MS/MS	NEtFOSAA
Drinking Water	EPA 537	LC/MS/MS	PFBS
Drinking Water	EPA 537	LC/MS/MS	PFDA
Drinking Water	EPA 537	LC/MS/MS	PFDoA

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Gulf Coast Analytical Laboratories, LLC

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Contact Name: Randy Whittington   Phone: 225-769-4900

Accreditation is granted to the facility to perform the following testing:

Matrix	Standard/Method	Technology	Analyte
Drinking Water	EPA 537	LC/MS/MS	PFHpA
Drinking Water	EPA 537	LC/MS/MS	PFHxS
Drinking Water	EPA 537	LC/MS/MS	PFHxA
Drinking Water	EPA 537	LC/MS/MS	PFNA
Drinking Water	EPA 537	LC/MS/MS	PFOS
Drinking Water	EPA 537	LC/MS/MS	PFOA
Drinking Water	EPA 537	LC/MS/MS	PFTA
Drinking Water	EPA 537	LC/MS/MS	PFTrDA
Drinking Water	EPA 537	LC/MS/MS	PFUnA
Solids	EPA 1030	N/A	Ignitability
Solids	EPA 3060A	N/A	Hexavalent Chromium Preparation
Solids	EPA 7471B	CVAA	Mercury
Solids	EPA 9045D	pH Meter	Corrosivity (pH)
Solids	EPA 9095B	N/A	Paint Filter Test
Solids	SM 2540G	Gravimetric	Percent Moisture
Solids	SM 2540G	Gravimetric	Total Solids
Aqueous/Solids	ASTM D-1385	Spectrophotometer	Hydrazine
Aqueous/Solids	EPA 1010A	Automated FP Analyzer	Ignitability
Aqueous/Solids	EPA 314.0	Spectrophotometer	Perchlorate
Aqueous/Solids	EPA 353.2	FIA	Nitrate and Nitrite as N
Aqueous/Solids	EPA 353.2	FIA	Nitrate as N
Aqueous/Solids	EPA 353.2	FIA	Nitrite as N
Aqueous/Solids	EPA 365.1	FIA	Total Phosphorous
Aqueous/Solids	EPA 537 MOD QSM 5.1 Compliant with Table B-15 Requirements	LC/MS/MS	N-ethylperfluorooctanesulfonamidoacetic acid (NEtFOSAA)
Aqueous/Solids	EPA 537 MOD QSM 5.1 Compliant with Table B-15 Requirements	LC/MS/MS	Fluorotelomer sulfonate 8:2 (8:2 FTS)
Aqueous/Solids	EPA 537 MOD QSM 5.1 Compliant with Table B-15 Requirements	LC/MS/MS	Fluorotelomer sulfonate 4:2 (4:2 FTS)
Aqueous/Solids	EPA 537 MOD QSM 5.1 Compliant with Table B-15 Requirements	LC/MS/MS	Fluorotelomer sulfonate 6:2 (6:2 FTS)
Aqueous/Solids	EPA 537 MOD QSM 5.1 Compliant with Table B-15 Requirements	LC/MS/MS	N-methylperfluorooctanesulfonamidoacetic acid (NMeFOSAA)

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Accreditation is granted to the facility to perform the following testing:

Matrix	Standard/Method	Technology	Analyte
Aqueous/Solids	EPA 537 MOD QSM 5.1 Compliant with Table B-15 Requirements	LC/MS/MS	Perfluorobutanesulfonate (PFBS)
Aqueous/Solids	EPA 537 MOD QSM 5.1 Compliant with Table B-15 Requirements	LC/MS/MS	Perfluorobutanoic acid (PFBA)
Aqueous/Solids	EPA 537 MOD QSM 5.1 Compliant with Table B-15 Requirements	LC/MS/MS	Perfluorodecanesulfonate (PFDS)
Aqueous/Solids	EPA 537 MOD QSM 5.1 Compliant with Table B-15 Requirements	LC/MS/MS	Perfluorodecanoic acid (PFDA)
Aqueous/Solids	EPA 537 MOD QSM 5.1 Compliant with Table B-15 Requirements	LC/MS/MS	Perfluorododecanoic acid (PFDoA)
Aqueous/Solids	EPA 537 MOD QSM 5.1 Compliant with Table B-15 Requirements	LC/MS/MS	Perfluoroheptanesulfonate (PFHpS)
Aqueous/Solids	EPA 537 MOD QSM 5.1 Compliant with Table B-15 Requirements	LC/MS/MS	Perfluoroheptanoic acid (PFHpA)
Aqueous/Solids	EPA 537 MOD QSM 5.1 Compliant with Table B-15 Requirements	LC/MS/MS	Perfluorohexanesulfonate (PFHxS)
Aqueous/Solids	EPA 537 MOD QSM 5.1 Compliant with Table B-15 Requirements	LC/MS/MS	Perfluorohexanoic acid (PFHxA)
Aqueous/Solids	EPA 537 MOD QSM 5.1 Compliant with Table B-15 Requirements	LC/MS/MS	Perfluorononanesulfonate (PFNS)
Aqueous/Solids	EPA 537 MOD QSM 5.1 Compliant with Table B-15 Requirements	LC/MS/MS	Perfluorononanoic acid (PFNA)
Aqueous/Solids	EPA 537 MOD QSM 5.1 Compliant with Table B-15 Requirements	LC/MS/MS	Perfluorooctane sulfonamide (FOSA)
Aqueous/Solids	EPA 537 MOD QSM 5.1 Compliant with Table B-15 Requirements	LC/MS/MS	Perfluorooctanesulfonate (PFOS)
Aqueous/Solids	EPA 537 MOD QSM 5.1 Compliant with Table B-15 Requirements	LC/MS/MS	Perfluorooctanoic acid (PFOA)
Aqueous/Solids	EPA 537 MOD QSM 5.1 Compliant with Table B-15 Requirements	LC/MS/MS	Perfluoropentanoic acid (PFPeA)

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Matrix	Standard/Method	Technology	Analyte
Aqueous/Solids	EPA 537 MOD QSM 5.1 Compliant with Table B-15 Requirements	LC/MS/MS	Perfluoropentansulfonate (PFPeS)
Aqueous/Solids	EPA 537 MOD QSM 5.1 Compliant with Table B-15 Requirements	LC/MS/MS	Perfluorotetradecanoic acid (PFTeDA)
Aqueous/Solids	EPA 537 MOD QSM 5.1 Compliant with Table B-15 Requirements	LC/MS/MS	Perfluorotridecanoic acid (PFTrDA)
Aqueous/Solids	EPA 537 MOD QSM 5.1 Compliant with Table B-15 Requirements	LC/MS/MS	Perfluoroundecanoic acid (PFUdA)
Aqueous/Solids	EPA 6020A	ICP-MS	Aluminum
Aqueous/Solids	EPA 6020A	ICP-MS	Antimony
Aqueous/Solids	EPA 6020A	ICP-MS	Arsenic
Aqueous/Solids	EPA 6020A	ICP-MS	Barium
Aqueous/Solids	EPA 6020A	ICP-MS	Beryllium
Aqueous/Solids	EPA 6020A	ICP-MS	Cadmium
Aqueous/Solids	EPA 6020A	ICP-MS	Calcium
Aqueous/Solids	EPA 6020A	ICP-MS	Chromium
Aqueous/Solids	EPA 6020A	ICP-MS	Cobalt
Aqueous/Solids	EPA 6020A	ICP-MS	Copper
Aqueous/Solids	EPA 6020A	ICP-MS	Iron
Aqueous/Solids	EPA 6020A	ICP-MS	Lead
Aqueous/Solids	EPA 6020A	ICP-MS	Magnesium
Aqueous/Solids	EPA 6020A	ICP-MS	Manganese
Aqueous/Solids	EPA 6020A	ICP-MS	Molybdenum
Aqueous/Solids	EPA 6020A	ICP-MS	Nickel
Aqueous/Solids	EPA 6020A	ICP-MS	Potassium
Aqueous/Solids	EPA 6020A	ICP-MS	Selenium
Aqueous/Solids	EPA 6020A	ICP-MS	Silver
Aqueous/Solids	EPA 6020A	ICP-MS	Sodium
Aqueous/Solids	EPA 6020A	ICP-MS	Strontium
Aqueous/Solids	EPA 6020A	ICP-MS	Thallium
Aqueous/Solids	EPA 6020A	ICP-MS	Tin
Aqueous/Solids	EPA 6020A	ICP-MS	Titanium
Aqueous/Solids	EPA 6020A	ICP-MS	Vanadium
Aqueous/Solids	EPA 6020A	ICP-MS	Zinc
Aqueous/Solids	EPA 6020A	ICP-MS	Zirconium

Accreditation is granted to the facility to perform the following testing:

Matrix	Standard/Method	Technology	Analyte
Aqueous/Solids	EPA 6020B	ICP-MS	Aluminum
Aqueous/Solids	EPA 6020B	ICP-MS	Antimony
Aqueous/Solids	EPA 6020B	ICP-MS	Arsenic
Aqueous/Solids	EPA 6020B	ICP-MS	Barium
Aqueous/Solids	EPA 6020B	ICP-MS	Beryllium
Aqueous/Solids	EPA 6020B	ICP-MS	Cadmium
Aqueous/Solids	EPA 6020B	ICP-MS	Calcium
Aqueous/Solids	EPA 6020B	ICP-MS	Chromium
Aqueous/Solids	EPA 6020B	ICP-MS	Cobalt
Aqueous/Solids	EPA 6020B	ICP-MS	Copper
Aqueous/Solids	EPA 6020B	ICP-MS	Iron
Aqueous/Solids	EPA 6020B	ICP-MS	Lead
Aqueous/Solids	EPA 6020B	ICP-MS	Magnesium
Aqueous/Solids	EPA 6020B	ICP-MS	Manganese
Aqueous/Solids	EPA 6020B	ICP-MS	Molybdenum
Aqueous/Solids	EPA 6020B	ICP-MS	Nickel
Aqueous/Solids	EPA 6020B	ICP-MS	Potassium
Aqueous/Solids	EPA 6020B	ICP-MS	Selenium
Aqueous/Solids	EPA 6020B	ICP-MS	Silver
Aqueous/Solids	EPA 6020B	ICP-MS	Sodium
Aqueous/Solids	EPA 6020B	ICP-MS	Strontium
Aqueous/Solids	EPA 6020B	ICP-MS	Thallium
Aqueous/Solids	EPA 6020B	ICP-MS	Tin
Aqueous/Solids	EPA 6020B	ICP-MS	Titanium
Aqueous/Solids	EPA 6020B	ICP-MS	Vanadium
Aqueous/Solids	EPA 6020B	ICP-MS	Zinc
Aqueous/Solids	EPA 6020B	ICP-MS	Zirconium
Aqueous/Solids	EPA 7196A	Spectrophotometer	Chromium VI
Aqueous/Solids	EPA 8015C	GC-FID	Diesel
Aqueous/Solids	EPA 8015C	GC-FID	Diesel range organics (DRO)
Aqueous/Solids	EPA 8015C	GC-FID	Gasoline range organics (GRO)
Aqueous/Solids	EPA 8015C	GC-FID	Oil Range Organics (ORO)
Aqueous/Solids	EPA 8081B	GC-ECD	Aldrin
Aqueous/Solids	EPA 8081B	GC-ECD	alpha-BHC
Aqueous/Solids	EPA 8081B	GC-ECD	alpha-Chlordane
Aqueous/Solids	EPA 8081B	GC-ECD	beta-BHC

Accreditation is granted to the facility to perform the following testing:

Matrix	Standard/Method	Technology	Analyte
Aqueous/Solids	EPA 8081B	GC-ECD	Chlordane
Aqueous/Solids	EPA 8081B	GC-ECD	Chlordane (total)
Aqueous/Solids	EPA 8081B	GC-ECD	DDD (4,4')
Aqueous/Solids	EPA 8081B	GC-ECD	DDE (4,4')
Aqueous/Solids	EPA 8081B	GC-ECD	DDT (4,4')
Aqueous/Solids	EPA 8081B	GC-ECD	delta-BHC
Aqueous/Solids	EPA 8081B	GC-ECD	Dieldrin
Aqueous/Solids	EPA 8081B	GC-ECD	Endosulfan I
Aqueous/Solids	EPA 8081B	GC-ECD	Endosulfan II
Aqueous/Solids	EPA 8081B	GC-ECD	Endosulfan sulfate
Aqueous/Solids	EPA 8081B	GC-ECD	Endrin
Aqueous/Solids	EPA 8081B	GC-ECD	Endrin aldehyde
Aqueous/Solids	EPA 8081B	GC-ECD	Endrin ketone
Aqueous/Solids	EPA 8081B	GC-ECD	gamma-BHC (Lindane)
Aqueous/Solids	EPA 8081B	GC-ECD	gamma-Chlordane
Aqueous/Solids	EPA 8081B	GC-ECD	Heptachlor
Aqueous/Solids	EPA 8081B	GC-ECD	Heptachlor Epoxide (beta)
Aqueous/Solids	EPA 8081B	GC-ECD	Methoxychlor
Aqueous/Solids	EPA 8081B	GC-ECD	Toxaphene
Aqueous/Solids	EPA 8081B	GC-ECD	Toxaphene (total)
Aqueous/Solids	EPA 8082A	GC-ECD	Aroclor 1016
Aqueous/Solids	EPA 8082A	GC-ECD	Aroclor 1221
Aqueous/Solids	EPA 8082A	GC-ECD	Aroclor 1232
Aqueous/Solids	EPA 8082A	GC-ECD	Aroclor 1242
Aqueous/Solids	EPA 8082A	GC-ECD	Aroclor 1248
Aqueous/Solids	EPA 8082A	GC-ECD	Aroclor 1254
Aqueous/Solids	EPA 8082A	GC-ECD	Aroclor 1260
Aqueous/Solids	EPA 8082A	GC-ECD	Aroclor 1262
Aqueous/Solids	EPA 8082A	GC-ECD	Aroclor 1268
Aqueous/Solids	EPA 8141B	GC-NPD	Azinphos-methyl (Guthion)
Aqueous/Solids	EPA 8141B	GC-NPD	Diazinon
Aqueous/Solids	EPA 8141B	GC-NPD	Disulfoton
Aqueous/Solids	EPA 8141B	GC-NPD	Malathion
Aqueous/Solids	EPA 8141B	GC-NPD	Parathion, ethyl
Aqueous/Solids	EPA 8141B	GC-NPD	Parathion, methyl
Aqueous/Solids	EPA 8141B	GC-NPD	Phorate

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Gulf Coast Analytical Laboratories, LLC

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Contact Name: Randy Whittington Phone: 225-769-4900

Accreditation is granted to the facility to perform the following testing:

Matrix	Standard/Method	Technology	Analyte
Aqueous/Solids	EPA 8141B	GC-NPD	Ronnel
Aqueous/Solids	EPA 8141B	GC-NPD	Stirophos
Aqueous/Solids	EPA 8151A	GC-ECD	2, 4, DB
Aqueous/Solids	EPA 8151A	GC-ECD	2, 4-D
Aqueous/Solids	EPA 8151A	GC-ECD	2,4,5-T
Aqueous/Solids	EPA 8151A	GC-ECD	2,4,5-TP (Silvex)
Aqueous/Solids	EPA 8151A	GC-ECD	2,4-DP (Dichlorprop)
Aqueous/Solids	EPA 8151A	GC-ECD	3,5-Dichlorobenzoic acid
Aqueous/Solids	EPA 8151A	GC-ECD	4-Nitrophenol
Aqueous/Solids	EPA 8151A	GC-ECD	Acifluorfen
Aqueous/Solids	EPA 8151A	GC-ECD	Bentazon
Aqueous/Solids	EPA 8151A	GC-ECD	Chloramben
Aqueous/Solids	EPA 8151A	GC-ECD	Dacthal (DCPA)
Aqueous/Solids	EPA 8151A	GC-ECD	Dalapon
Aqueous/Solids	EPA 8151A	GC-ECD	Dicamba
Aqueous/Solids	EPA 8151A	GC-ECD	Dinoseb
Aqueous/Solids	EPA 8151A	GC-ECD	MCPA
Aqueous/Solids	EPA 8151A	GC-ECD	MCPP
Aqueous/Solids	EPA 8151A	GC-ECD	Pentachlorophenol
Aqueous/Solids	EPA 8260B	GC-MS	1,1,1,2-Tetrachloroethane
Aqueous/Solids	EPA 8260B	GC-MS	1,1,1-Trichloroethane
Aqueous/Solids	EPA 8260B	GC-MS	1,1,2,2-Tetrachloroethane
Aqueous/Solids	EPA 8260B	GC-MS	1,1,2-trichloro-1,2,2-trifluoroethane
Aqueous/Solids	EPA 8260B	GC-MS	1,1,2-Trichloroethane
Aqueous/Solids	EPA 8260B	GC-MS	1,1-Dichloroethane
Aqueous/Solids	EPA 8260B	GC-MS	1,1-Dichloroethene
Aqueous/Solids	EPA 8260B	GC-MS	1,1-Dichloropropene
Aqueous/Solids	EPA 8260B	GC-MS	1,2 Dichlorobenzene
Aqueous/Solids	EPA 8260B	GC-MS	1,2 Dichloroethane
Aqueous/Solids	EPA 8260B	GC-MS	1,2,3-Trichlorobenzene
Aqueous/Solids	EPA 8260B	GC-MS	1,2,3-Trichloropropane
Aqueous/Solids	EPA 8260B	GC-MS	1,2,4,5-Tetrachlorobenzene
Aqueous/Solids	EPA 8260B	GC-MS	1,2,4-Trichlorobenzene
Aqueous/Solids	EPA 8260B	GC-MS	1,2,4-Trimethylbenzene
Aqueous/Solids	EPA 8260B	GC-MS	1,2-Dibromo-3-chloropropane (DBCP)
Aqueous/Solids	EPA 8260B	GC-MS	1,2-Dibromoethane (EDB)

Certificate of Accreditation: Supplement

ISO/IEC 17025:2005 and DoD-ELAP

Gulf Coast Analytical Laboratories, LLC

7979 Innovation Park Drive, Baton Rouge, LA 70820
Contact Name: Randy Whittington   Phone: 225-769-4900

Accreditation is granted to the facility to perform the following testing:

Matrix	Standard/Method	Technology	Analyte
Aqueous/Solids	EPA 8260B	GC-MS	1,2-Dichloropropane
Aqueous/Solids	EPA 8260B	GC-MS	1,3 Dichlorobenzene
Aqueous/Solids	EPA 8260B	GC-MS	1,3,5-Trimethylbenzene
Aqueous/Solids	EPA 8260B	GC-MS	1,3-Dichloropropane
Aqueous/Solids	EPA 8260B	GC-MS	1,4 Dichlorobenzene
Aqueous/Solids	EPA 8260B	GC-MS	1-Chlorohexane
Aqueous/Solids	EPA 8260B	GC-MS	2,2-Dichloropropane
Aqueous/Solids	EPA 8260B	GC-MS	2-Butanone (MEK)
Aqueous/Solids	EPA 8260B	GC-MS	2-Chloroethylvinylether
Aqueous/Solids	EPA 8260B	GC-MS	2-Chlorotoluene
Aqueous/Solids	EPA 8260B	GC-MS	2-Hexanone
Aqueous/Solids	EPA 8260B	GC-MS	4-Chlorotoluene
Aqueous/Solids	EPA 8260B	GC-MS	4-Methyl-2-pentanone (MIBK)
Aqueous/Solids	EPA 8260B	GC-MS	Acetone
Aqueous/Solids	EPA 8260B	GC-MS	Acetonitrile
Aqueous/Solids	EPA 8260B	GC-MS	Acrolein
Aqueous/Solids	EPA 8260B	GC-MS	Acrylonitrile
Aqueous/Solids	EPA 8260B	GC-MS	Benzene
Aqueous/Solids	EPA 8260B	GC-MS	Bromobenzene
Aqueous/Solids	EPA 8260B	GC-MS	Bromochloromethane
Aqueous/Solids	EPA 8260B	GC-MS	Bromodichloromethane
Aqueous/Solids	EPA 8260B	GC-MS	Bromoform
Aqueous/Solids	EPA 8260B	GC-MS	Bromomethane
Aqueous/Solids	EPA 8260B	GC-MS	Carbon disulfide
Aqueous/Solids	EPA 8260B	GC-MS	Carbon tetrachloride
Aqueous/Solids	EPA 8260B	GC-MS	Chlorobenzene
Aqueous/Solids	EPA 8260B	GC-MS	Chloroethane
Aqueous/Solids	EPA 8260B	GC-MS	Chloroform
Aqueous/Solids	EPA 8260B	GC-MS	Chloromethane
Aqueous/Solids	EPA 8260B	GC-MS	cis-1,2-Dichloroethene
Aqueous/Solids	EPA 8260B	GC-MS	cis-1,3-Dichloropropylene
Aqueous/Solids	EPA 8260B	GC-MS	Dibromochloromethane
Aqueous/Solids	EPA 8260B	GC-MS	Dibromomethane
Aqueous/Solids	EPA 8260B	GC-MS	Dichlorodifluoromethane
Aqueous/Solids	EPA 8260B	GC-MS	DIPE
Aqueous/Solids	EPA 8260B	GC-MS	ETBE

Matrix	Standard/Method	Technology	Analyte
Aqueous/Solids	EPA 8260B	GC-MS	Ethylbenzene
Aqueous/Solids	EPA 8260B	GC-MS	Hexachlorobutadiene
Aqueous/Solids	EPA 8260B	GC-MS	Isopropylbenzene
Aqueous/Solids	EPA 8260B	GC-MS	m+p-Xylene
Aqueous/Solids	EPA 8260B	GC-MS	Methyl tert-butyl ether (MTBE)
Aqueous/Solids	EPA 8260B	GC-MS	Methylcyclohexane
Aqueous/Solids	EPA 8260B	GC-MS	Methylene Chloride
Aqueous/Solids	EPA 8260B	GC-MS	Methyl Acetate
Aqueous/Solids	EPA 8260B	GC-MS	MTBE
Aqueous/Solids	EPA 8260B	GC-MS	Naphthalene
Aqueous/Solids	EPA 8260B	GC-MS	n-Butylbenzene
Aqueous/Solids	EPA 8260B	GC-MS	n-Propylbenzene
Aqueous/Solids	EPA 8260B	GC-MS	o-Xylene
Aqueous/Solids	EPA 8260B	GC-MS	p-Isopropyltoluene
Aqueous/Solids	EPA 8260B	GC-MS	sec-Butylbenzene
Aqueous/Solids	EPA 8260B	GC-MS	Styrene
Aqueous/Solids	EPA 8260B	GC-MS	TAME
Aqueous/Solids	EPA 8260B	GC-MS	tert-Butyl alcohol
Aqueous/Solids	EPA 8260B	GC-MS	tert-Butylbenzene
Aqueous/Solids	EPA 8260B	GC-MS	Tetrachloroethene
Aqueous/Solids	EPA 8260B	GC-MS	Toluene
Aqueous/Solids	EPA 8260B	GC-MS	trans-1,2-Dichloroethene
Aqueous/Solids	EPA 8260B	GC-MS	trans-1,3-Dichloropropene
Aqueous/Solids	EPA 8260B	GC-MS	Trichloroethene
Aqueous/Solids	EPA 8260B	GC-MS	Trichlorofluoromethane
Aqueous/Solids	EPA 8260B	GC-MS	Vinyl acetate
Aqueous/Solids	EPA 8260B	GC-MS	Vinyl chloride
Aqueous/Solids	EPA 8260B	GC-MS	Xylenes, total
Aqueous/Solids	EPA 8260B	GC-MS VOC	Cyclohexane
Aqueous/Solids	EPA 8260B	GC-MS VOC	Ethyl Acetate
Aqueous/Solids	EPA 8260B	GC-MS VOC	n-Butanol
Aqueous/Solids	EPA 8260C	GC-MS	1,1,1,2-Tetrachloroethane
Aqueous/Solids	EPA 8260C	GC-MS	1,1,1-Trichloroethane
Aqueous/Solids	EPA 8260C	GC-MS	1,1,2,2-Tetrachloroethane
Aqueous/Solids	EPA 8260C	GC-MS	1,1,2-trichloro-1,2,2-trifluoroethane
Aqueous/Solids	EPA 8260C	GC-MS	1,1,2-Trichloroethane

Certificate of Accreditation: Supplement

ISO/IEC 17025:2005 and DoD-ELAP

Gulf Coast Analytical Laboratories, LLC

7979 Innovation Park Drive, Baton Rouge, LA 70820
Contact Name: Randy Whittington Phone: 225-769-4900

Accreditation is granted to the facility to perform the following testing:

Matrix	Standard/Method	Technology	Analyte
Aqueous/Solids	EPA 8260C	GC-MS	1,1-Dichloroethane
Aqueous/Solids	EPA 8260C	GC-MS	1,1-Dichloroethene
Aqueous/Solids	EPA 8260C	GC-MS	1,1-Dichloropropene
Aqueous/Solids	EPA 8260C	GC-MS	1,2 Dichlorobenzene
Aqueous/Solids	EPA 8260C	GC-MS	1,2 Dichloroethane
Aqueous/Solids	EPA 8260C	GC-MS	1,2,3-Trichlorobenzene
Aqueous/Solids	EPA 8260C	GC-MS	1,2,3-Trichloropropane
Aqueous/Solids	EPA 8260C	GC-MS	1,2,4,5-Tetrachlorobenzene
Aqueous/Solids	EPA 8260C	GC-MS	1,2,4-Trichlorobenzene
Aqueous/Solids	EPA 8260C	GC-MS	1,2,4-Trimethylbenzene
Aqueous/Solids	EPA 8260C	GC-MS	1,2-Dibromo-3-chloropropane (DBCP)
Aqueous/Solids	EPA 8260C	GC-MS	1,2-Dibromoethane (EDB)
Aqueous/Solids	EPA 8260C	GC-MS	1,2-Dichloropropane
Aqueous/Solids	EPA 8260C	GC-MS	1,3 Dichlorobenzene
Aqueous/Solids	EPA 8260C	GC-MS	1,3,5-Trimethylbenzene
Aqueous/Solids	EPA 8260C	GC-MS	1,3-Dichloropropane
Aqueous/Solids	EPA 8260C	GC-MS	1,4 Dichlorobenzene
Aqueous/Solids	EPA 8260C	GC-MS	1-Chlorohexane
Aqueous/Solids	EPA 8260C	GC-MS	2,2-Dichloropropane
Aqueous/Solids	EPA 8260C	GC-MS	2-Butanone (MEK)
Aqueous/Solids	EPA 8260C	GC-MS	2-Chloroethylvinylether
Aqueous/Solids	EPA 8260C	GC-MS	2-Chlorotoluene
Aqueous/Solids	EPA 8260C	GC-MS	2-Hexanone
Aqueous/Solids	EPA 8260C	GC-MS	4-Chlorotoluene
Aqueous/Solids	EPA 8260C	GC-MS	4-Methyl-2-pentanone (MIBK)
Aqueous/Solids	EPA 8260C	GC-MS	Acetone
Aqueous/Solids	EPA 8260C	GC-MS	Acetonitrile
Aqueous/Solids	EPA 8260C	GC-MS	Acrolein
Aqueous/Solids	EPA 8260C	GC-MS	Acrylonitrile
Aqueous/Solids	EPA 8260C	GC-MS	Benzene
Aqueous/Solids	EPA 8260C	GC-MS	Bromobenzene
Aqueous/Solids	EPA 8260C	GC-MS	Bromochloromethane
Aqueous/Solids	EPA 8260C	GC-MS	Bromodichloromethane
Aqueous/Solids	EPA 8260C	GC-MS	Bromoform
Aqueous/Solids	EPA 8260C	GC-MS	Bromomethane
Aqueous/Solids	EPA 8260C	GC-MS	Carbon disulfide

Accreditation is granted to the facility to perform the following testing:

Matrix	Standard/Method	Technology	Analyte
Aqueous/Solids	EPA 8260C	GC-MS	Carbon tetrachloride
Aqueous/Solids	EPA 8260C	GC-MS	Chlorobenzene
Aqueous/Solids	EPA 8260C	GC-MS	Chloroethane
Aqueous/Solids	EPA 8260C	GC-MS	Chloroform
Aqueous/Solids	EPA 8260C	GC-MS	Chloromethane
Aqueous/Solids	EPA 8260C	GC-MS	cis-1,2-Dichloroethene
Aqueous/Solids	EPA 8260C	GC-MS	cis-1,3-Dichloropropylene
Aqueous/Solids	EPA 8260C	GC-MS	Dibromochloromethane
Aqueous/Solids	EPA 8260C	GC-MS	Dibromomethane
Aqueous/Solids	EPA 8260C	GC-MS	Dichlorodifluoromethane
Aqueous/Solids	EPA 8260C	GC-MS	DIPE
Aqueous/Solids	EPA 8260C	GC-MS	ETBE
Aqueous/Solids	EPA 8260C	GC-MS	Ethylbenzene
Aqueous/Solids	EPA 8260C	GC-MS	Hexachlorobutadiene
Aqueous/Solids	EPA 8260C	GC-MS	Isopropylbenzene
Aqueous/Solids	EPA 8260C	GC-MS	m+p-Xylene
Aqueous/Solids	EPA 8260C	GC-MS	Methyl tert-butyl ether (MTBE)
Aqueous/Solids	EPA 8260C	GC-MS	Methylcyclohexane
Aqueous/Solids	EPA 8260C	GC-MS	Methylene Chloride
Aqueous/Solids	EPA 8260C	GC-MS	Methyl Acetate
Aqueous/Solids	EPA 8260C	GC-MS	MTBE
Aqueous/Solids	EPA 8260C	GC-MS	Naphthalene
Aqueous/Solids	EPA 8260C	GC-MS	n-Butylbenzene
Aqueous/Solids	EPA 8260C	GC-MS	n-Propylbenzene
Aqueous/Solids	EPA 8260C	GC-MS	o-Xylene
Aqueous/Solids	EPA 8260C	GC-MS	p-Isopropyltoluene
Aqueous/Solids	EPA 8260C	GC-MS	sec-Butylbenzene
Aqueous/Solids	EPA 8260C	GC-MS	Styrene
Aqueous/Solids	EPA 8260C	GC-MS	TAME
Aqueous/Solids	EPA 8260C	GC-MS	tert-Butyl alcohol
Aqueous/Solids	EPA 8260C	GC-MS	tert-Butylbenzene
Aqueous/Solids	EPA 8260C	GC-MS	Tetrachloroethene
Aqueous/Solids	EPA 8260C	GC-MS	Toluene
Aqueous/Solids	EPA 8260C	GC-MS	trans-1,2-Dichloroethene
Aqueous/Solids	EPA 8260C	GC-MS	trans-1,3-Dichloropropene
Aqueous/Solids	EPA 8260C	GC-MS	Trichloroethene

Accreditation is granted to the facility to perform the following testing:

Matrix	Standard/Method	Technology	Analyte
Aqueous/Solids	EPA 8260C	GC-MS	Trichlorofluoromethane
Aqueous/Solids	EPA 8260C	GC-MS	Vinyl acetate
Aqueous/Solids	EPA 8260C	GC-MS	Vinyl chloride
Aqueous/Solids	EPA 8260C	GC-MS	Xylenes, total
Aqueous/Solids	EPA 8260C	GC-MS VOC	Cyclohexane
Aqueous/Solids	EPA 8260C	GC-MS VOC	Ethyl Acetate
Aqueous/Solids	EPA 8260C	GC-MS VOC	n-Butanol
Aqueous/Solids	EPA 8270C	GC-MS	1,2 Dichlorobenzene
Aqueous/Solids	EPA 8270C	GC-MS	1,2,4,5-Tetrachlorobenzene
Aqueous/Solids	EPA 8270C	GC-MS	1,2,4-Trichlorobenzene
Aqueous/Solids	EPA 8270C	GC-MS	1,2-Diphenylhydrazine
Aqueous/Solids	EPA 8270C	GC-MS	1,3 Dichlorobenzene
Aqueous/Solids	EPA 8270C	GC-MS	1,4 Dichlorobenzene
Aqueous/Solids	EPA 8270C	GC-MS	1-Methylnaphthalene
Aqueous/Solids	EPA 8270C	GC-MS	2,3,4,6-Tetrachlorophenol
Aqueous/Solids	EPA 8270C	GC-MS	2,4,5-Trichlorophenol
Aqueous/Solids	EPA 8270C	GC-MS	2,4,6-Trichlorophenol
Aqueous/Solids	EPA 8270C	GC-MS	2,4-Dichlorophenol
Aqueous/Solids	EPA 8270C	GC-MS	2,4-Dimethylphenol
Aqueous/Solids	EPA 8270C	GC-MS	2,4-Dinitrophenol
Aqueous/Solids	EPA 8270C	GC-MS	2,4-Dinitrotoluene
Aqueous/Solids	EPA 8270C	GC-MS	2,6-Dichlorophenol
Aqueous/Solids	EPA 8270C	GC-MS	2,6-Dinitrotoluene
Aqueous/Solids	EPA 8270C	GC-MS	2-Chloronaphthalene
Aqueous/Solids	EPA 8270C	GC-MS	2-Chlorophenol
Aqueous/Solids	EPA 8270C	GC-MS	2-Methyl-4,6-Dinitrophenol
Aqueous/Solids	EPA 8270C	GC-MS	2-Methylnaphthalene
Aqueous/Solids	EPA 8270C	GC-MS	2-Methylphenol
Aqueous/Solids	EPA 8270C	GC-MS	2-Nitroaniline
Aqueous/Solids	EPA 8270C	GC-MS	2-Nitrophenol
Aqueous/Solids	EPA 8270C	GC-MS	3,3'-Dichlorobenzidine
Aqueous/Solids	EPA 8270C	GC-MS	3-Nitroaniline
Aqueous/Solids	EPA 8270C	GC-MS	4-Bromophenyl-phenylether
Aqueous/Solids	EPA 8270C	GC-MS	4-Chloro-3-methylphenol
Aqueous/Solids	EPA 8270C	GC-MS	4-Chloroaniline
Aqueous/Solids	EPA 8270C	GC-MS	4-Chlorophenyl-phenylether

Accreditation is granted to the facility to perform the following testing:

Matrix	Standard/Method	Technology	Analyte
Aqueous/Solids	EPA 8270C	GC-MS	4-Methylphenol (and/or 3-Methylphenol)
Aqueous/Solids	EPA 8270C	GC-MS	4-Nitroaniline
Aqueous/Solids	EPA 8270C	GC-MS	4-Nitrophenol
Aqueous/Solids	EPA 8270C	GC-MS	Acenaphthene
Aqueous/Solids	EPA 8270C	GC-MS	Acenaphthylene
Aqueous/Solids	EPA 8270C	GC-MS	Acetophenone
Aqueous/Solids	EPA 8270C	GC-MS	Aniline
Aqueous/Solids	EPA 8270C	GC-MS	Anthracene
Aqueous/Solids	EPA 8270C	GC-MS	Atrazine
Aqueous/Solids	EPA 8270C	GC-MS	Benzaldehyde
Aqueous/Solids	EPA 8270C	GC-MS	Benzidine
Aqueous/Solids	EPA 8270C	GC-MS	Benzo(a)anthracene
Aqueous/Solids	EPA 8270C	GC-MS	Benzo(a)pyrene
Aqueous/Solids	EPA 8270C	GC-MS	Benzo(b)fluoranthene
Aqueous/Solids	EPA 8270C	GC-MS	Benzo(g,h,i)perylene
Aqueous/Solids	EPA 8270C	GC-MS	Benzo(k)fluoranthene
Aqueous/Solids	EPA 8270C	GC-MS	Benzoic acid
Aqueous/Solids	EPA 8270C	GC-MS	Benzyl alcohol
Aqueous/Solids	EPA 8270C	GC-MS	Biphenyl
Aqueous/Solids	EPA 8270C	GC-MS	bis(2-Chloroethoxy)methane
Aqueous/Solids	EPA 8270C	GC-MS	bis(2-Chloroethyl)ether
Aqueous/Solids	EPA 8270C	GC-MS	bis(2-Chloroiospropyl) ether
Aqueous/Solids	EPA 8270C	GC-MS	bis(2-ethylhexyl) phthalate
Aqueous/Solids	EPA 8270C	GC-MS	bis(2-ethylhexyl) phthalate
Aqueous/Solids	EPA 8270C	GC-MS	Butyl benzyl phthalate
Aqueous/Solids	EPA 8270C	GC-MS	Butyl benzyl phthalate
Aqueous/Solids	EPA 8270C	GC-MS	Caprolactom
Aqueous/Solids	EPA 8270C	GC-MS	Carbazole
Aqueous/Solids	EPA 8270C	GC-MS	Carbazole
Aqueous/Solids	EPA 8270C	GC-MS	Chrysene
Aqueous/Solids	EPA 8270C	GC-MS	Chrysene
Aqueous/Solids	EPA 8270C	GC-MS	Dibenzo(a,h)anthracene
Aqueous/Solids	EPA 8270C	GC-MS	Dibenzo(a,h)anthracene
Aqueous/Solids	EPA 8270C	GC-MS	Dibenzofuran
Aqueous/Solids	EPA 8270C	GC-MS	Dibenzofuran
Aqueous/Solids	EPA 8270C	GC-MS	Diethyl phthalate

Accreditation is granted to the facility to perform the following testing:

Matrix	Standard/Method	Technology	Analyte
Aqueous/Solids	EPA 8270C	GC-MS	Diethyl phthalate
Aqueous/Solids	EPA 8270C	GC-MS	Dimethyl phthalate
Aqueous/Solids	EPA 8270C	GC-MS	Dimethyl phthalate
Aqueous/Solids	EPA 8270C	GC-MS	Di-n-butylphthalate
Aqueous/Solids	EPA 8270C	GC-MS	Di-n-butylphthalate
Aqueous/Solids	EPA 8270C	GC-MS	Di-n-octylphthalate
Aqueous/Solids	EPA 8270C	GC-MS	Di-n-octylphthalate
Aqueous/Solids	EPA 8270C	GC-MS	Fluoranthene
Aqueous/Solids	EPA 8270C	GC-MS	Fluoranthene
Aqueous/Solids	EPA 8270C	GC-MS	Fluorene
Aqueous/Solids	EPA 8270C	GC-MS	Fluorene
Aqueous/Solids	EPA 8270C	GC-MS	Hexachlorobenzene
Aqueous/Solids	EPA 8270C	GC-MS	Hexachlorobenzene
Aqueous/Solids	EPA 8270C	GC-MS	Hexachlorobutadiene
Aqueous/Solids	EPA 8270C	GC-MS	Hexachlorobutadiene
Aqueous/Solids	EPA 8270C	GC-MS	Hexachlorocyclopentadiene
Aqueous/Solids	EPA 8270C	GC-MS	Hexachloroethane
Aqueous/Solids	EPA 8270C	GC-MS	Indeno(1,2,3, cd)pyrene
Aqueous/Solids	EPA 8270C	GC-MS	Isophorone
Aqueous/Solids	EPA 8270C	GC-MS	Naphthalene
Aqueous/Solids	EPA 8270C	GC-MS	Nitrobenzene
Aqueous/Solids	EPA 8270C	GC-MS	N-Nitrosodiethylamine
Aqueous/Solids	EPA 8270C	GC-MS	N-Nitrosodimethylamine
Aqueous/Solids	EPA 8270C	GC-MS	N-Nitroso-di-n-propylamine
Aqueous/Solids	EPA 8270C	GC-MS	N-Nitrosodiphenylamine
Aqueous/Solids	EPA 8270C	GC-MS	o-Toluidine
Aqueous/Solids	EPA 8270C	GC-MS	p-Dioxane
Aqueous/Solids	EPA 8270C	GC-MS	Pentachlorobenzene
Aqueous/Solids	EPA 8270C	GC-MS	Pentachlorophenol
Aqueous/Solids	EPA 8270C	GC-MS	Phenanthrene
Aqueous/Solids	EPA 8270C	GC-MS	Phenol
Aqueous/Solids	EPA 8270C	GC-MS	Pyrene
Aqueous/Solids	EPA 8270C	GC-MS	Pyridine
Aqueous/Solids	EPA 8270C SIM	GC-MS	1-Methylnaphthalene
Aqueous/Solids	EPA 8270C SIM	GC-MS	2-Methylnaphthalene
Aqueous/Solids	EPA 8270C SIM	GC-MS	Acenaphthene

Accreditation is granted to the facility to perform the following testing:

Matrix	Standard/Method	Technology	Analyte
Aqueous/Solids	EPA 8270C SIM	GC-MS	Acenaphthylene
Aqueous/Solids	EPA 8270C SIM	GC-MS	Anthracene
Aqueous/Solids	EPA 8270C SIM	GC-MS	Benzo(a)anthracene
Aqueous/Solids	EPA 8270C SIM	GC-MS	Benzo(a)pyrene
Aqueous/Solids	EPA 8270C SIM	GC-MS	Benzo(b)fluoranthene
Aqueous/Solids	EPA 8270C SIM	GC-MS	Benzo(g,h,i)perylene
Aqueous/Solids	EPA 8270C SIM	GC-MS	Benzo(k)fluoranthene
Aqueous/Solids	EPA 8270C SIM	GC-MS	Chrysene
Aqueous/Solids	EPA 8270C SIM	GC-MS	Dibenz(a,h) anthracene
Aqueous/Solids	EPA 8270C SIM	GC-MS	Fluoranthene
Aqueous/Solids	EPA 8270C SIM	GC-MS	Fluorene
Aqueous/Solids	EPA 8270C SIM	GC-MS	Indeno(1,2,3-cd) pyrene
Aqueous/Solids	EPA 8270C SIM	GC-MS	Naphthalene
Aqueous/Solids	EPA 8270C SIM	GC-MS	Phenanthrene
Aqueous/Solids	EPA 8270C SIM	GC-MS	Pyrene
Aqueous/Solids	EPA 8270D	GC-MS	1,2 Dichlorobenzene
Aqueous/Solids	EPA 8270D	GC-MS	1,2,4,5-Tetrachlorobenzene
Aqueous/Solids	EPA 8270D	GC-MS	1,2,4-Trichlorobenzene
Aqueous/Solids	EPA 8270D	GC-MS	1,2-Diphenylhydrazine
Aqueous/Solids	EPA 8270D	GC-MS	1,3 Dichlorobenzene
Aqueous/Solids	EPA 8270D	GC-MS	1,4 Dichlorobenzene
Aqueous/Solids	EPA 8270D	GC-MS	1-Methylnaphthalene
Aqueous/Solids	EPA 8270D	GC-MS	2,3,4,6-Tetrachlorophenol
Aqueous/Solids	EPA 8270D	GC-MS	2,4,5-Trichlorophenol
Aqueous/Solids	EPA 8270D	GC-MS	2,4,6-Trichlorophenol
Aqueous/Solids	EPA 8270D	GC-MS	2,4-Dichlorophenol
Aqueous/Solids	EPA 8270D	GC-MS	2,4-Dimethylphenol
Aqueous/Solids	EPA 8270D	GC-MS	2,4-Dinitrophenol
Aqueous/Solids	EPA 8270D	GC-MS	2,4-Dinitrotoluene
Aqueous/Solids	EPA 8270D	GC-MS	2,6-Dichlorophenol
Aqueous/Solids	EPA 8270D	GC-MS	2,6-Dinitrotoluene
Aqueous/Solids	EPA 8270D	GC-MS	2-Chloronaphthalene
Aqueous/Solids	EPA 8270D	GC-MS	2-Chlorophenol
Aqueous/Solids	EPA 8270D	GC-MS	2-Methyl-4,6-Dinitrophenol
Aqueous/Solids	EPA 8270D	GC-MS	2-Methylnaphthalene
Aqueous/Solids	EPA 8270D	GC-MS	2-Methylphenol

Certificate of Accreditation: Supplement

ISO/IEC 17025:2005 and DoD-ELAP

Gulf Coast Analytical Laboratories, LLC

7979 Innovation Park Drive, Baton Rouge, LA 70820
Contact Name: Randy Whittington Phone: 225-769-4900

Accreditation is granted to the facility to perform the following testing:

Matrix	Standard/Method	Technology	Analyte
Aqueous/Solids	EPA 8270D	GC-MS	2-Nitroaniline
Aqueous/Solids	EPA 8270D	GC-MS	2-Nitrophenol
Aqueous/Solids	EPA 8270D	GC-MS	3,3'-Dichlorobenzidine
Aqueous/Solids	EPA 8270D	GC-MS	3-Nitroaniline
Aqueous/Solids	EPA 8270D	GC-MS	4-Bromophenyl-phenylether
Aqueous/Solids	EPA 8270D	GC-MS	4-Chloro-3-methylphenol
Aqueous/Solids	EPA 8270D	GC-MS	4-Chloroaniline
Aqueous/Solids	EPA 8270D	GC-MS	4-Chlorophenyl-phenylether
Aqueous/Solids	EPA 8270D	GC-MS	4-Methylphenol (and/or 3-Methylphenol)
Aqueous/Solids	EPA 8270D	GC-MS	4-Nitroaniline
Aqueous/Solids	EPA 8270D	GC-MS	4-Nitrophenol
Aqueous/Solids	EPA 8270D	GC-MS	Acenaphthene
Aqueous/Solids	EPA 8270D	GC-MS	Acenaphthylene
Aqueous/Solids	EPA 8270D	GC-MS	Aniline
Aqueous/Solids	EPA 8270D	GC-MS	Anthracene
Aqueous/Solids	EPA 8270D	GC-MS	Atrazine
Aqueous/Solids	EPA 8270D	GC-MS	Benzidine
Aqueous/Solids	EPA 8270D	GC-MS	Benzo(a)anthracene
Aqueous/Solids	EPA 8270D	GC-MS	Benzo(a)pyrene
Aqueous/Solids	EPA 8270D	GC-MS	Benzo(b)fluoranthene
Aqueous/Solids	EPA 8270D	GC-MS	Benzo(g,h,i)perylene
Aqueous/Solids	EPA 8270D	GC-MS	Benzo(k)fluoranthene
Aqueous/Solids	EPA 8270D	GC-MS	Benzoic acid
Aqueous/Solids	EPA 8270D	GC-MS	Benzyl alcohol
Aqueous/Solids	EPA 8270D	GC-MS	bis(2-Chloroethoxy)methane
Aqueous/Solids	EPA 8270D	GC-MS	bis(2-Chloroethyl)ether
Aqueous/Solids	EPA 8270D	GC-MS	bis(2-Chloroiospropyl) ether
Aqueous/Solids	EPA 8270D	GC-MS	bis(2-ethylhexyl) phthalate
Aqueous/Solids	EPA 8270D	GC-MS	Butyl benzyl phthalate
Aqueous/Solids	EPA 8270D	GC-MS	Caprolactom
Aqueous/Solids	EPA 8270D	GC-MS	Carbazole
Aqueous/Solids	EPA 8270D	GC-MS	Chrysene
Aqueous/Solids	EPA 8270D	GC-MS	Dibenzo(a,h)anthracene
Aqueous/Solids	EPA 8270D	GC-MS	Dibenzofuran
Aqueous/Solids	EPA 8270D	GC-MS	Diethyl phthalate
Aqueous/Solids	EPA 8270D	GC-MS	Dimethyl phthalate

Accreditation is granted to the facility to perform the following testing:

Matrix	Standard/Method	Technology	Analyte
Aqueous/Solids	EPA 8270D	GC-MS	Di-n-butylphthalate
Aqueous/Solids	EPA 8270D	GC-MS	Di-n-octylphthalate
Aqueous/Solids	EPA 8270D	GC-MS	Fluoranthene
Aqueous/Solids	EPA 8270D	GC-MS	Fluorene
Aqueous/Solids	EPA 8270D	GC-MS	Hexachlorobenzene
Aqueous/Solids	EPA 8270D	GC-MS	Hexachlorobutadiene
Aqueous/Solids	EPA 8270D	GC-MS	Hexachlorocyclopentadiene
Aqueous/Solids	EPA 8270D	GC-MS	Hexachloroethane
Aqueous/Solids	EPA 8270D	GC-MS	Indeno(1,2,3, cd)pyrene
Aqueous/Solids	EPA 8270D	GC-MS	Isophorone
Aqueous/Solids	EPA 8270D	GC-MS	Naphthalene
Aqueous/Solids	EPA 8270D	GC-MS	Nitrobenzene
Aqueous/Solids	EPA 8270D	GC-MS	N-Nitrosodiethylamine
Aqueous/Solids	EPA 8270D	GC-MS	N-Nitrosodimethylamine
Aqueous/Solids	EPA 8270D	GC-MS	N-Nitroso-di-n-propylamine
Aqueous/Solids	EPA 8270D	GC-MS	N-Nitrosodiphenylamine
Aqueous/Solids	EPA 8270D	GC-MS	o-Toluidine
Aqueous/Solids	EPA 8270D	GC-MS	Pentachlorobenzene
Aqueous/Solids	EPA 8270D	GC-MS	Pentachlorophenol
Aqueous/Solids	EPA 8270D	GC-MS	Phenanthrene
Aqueous/Solids	EPA 8270D	GC-MS	Phenol
Aqueous/Solids	EPA 8270D	GC-MS	Pyrene
Aqueous/Solids	EPA 8270D	GC-MS	Pyridine
Aqueous/Solids	EPA 8270D SIM	GC-MS	1-Methylnaphthalene
Aqueous/Solids	EPA 8270D SIM	GC-MS	2-Methylnaphthalene
Aqueous/Solids	EPA 8270D SIM	GC-MS	Acenaphthene
Aqueous/Solids	EPA 8270D SIM	GC-MS	Acenaphthylene
Aqueous/Solids	EPA 8270D SIM	GC-MS	Anthracene
Aqueous/Solids	EPA 8270D SIM	GC-MS	Benzo(a)anthracene
Aqueous/Solids	EPA 8270D SIM	GC-MS	Benzo(a)pyrene
Aqueous/Solids	EPA 8270D SIM	GC-MS	Benzo(b)fluoranthene
Aqueous/Solids	EPA 8270D SIM	GC-MS	Benzo(g,h,i)perylene
Aqueous/Solids	EPA 8270D SIM	GC-MS	Benzo(k)fluoranthene
Aqueous/Solids	EPA 8270D SIM	GC-MS	Chrysene
Aqueous/Solids	EPA 8270D SIM	GC-MS	Dibenz(a,h) anthracene
Aqueous/Solids	EPA 8270D SIM	GC-MS	Fluoranthene

Accreditation is granted to the facility to perform the following testing:

Matrix	Standard/Method	Technology	Analyte
Aqueous/Solids	EPA 8270D SIM	GC-MS	Fluorene
Aqueous/Solids	EPA 8270D SIM	GC-MS	Indeno(1,2,3-cd) pyrene
Aqueous/Solids	EPA 8270D SIM	GC-MS	Naphthalene
Aqueous/Solids	EPA 8270D SIM	GC-MS	Phenanthrene
Aqueous/Solids	EPA 8270D SIM	GC-MS	Pyrene
Aqueous/Solids	EPA 8330A	HPLC	1,3,5-Trinitrobenzene
Aqueous/Solids	EPA 8330A	HPLC	1,3-Dinitrobenzene
Aqueous/Solids	EPA 8330A	HPLC	2,4,6-Trinitrotoluene
Aqueous/Solids	EPA 8330A	HPLC	2,4-Dinitrotoluene
Aqueous/Solids	EPA 8330A	HPLC	2,6-Dinitrotoluene
Aqueous/Solids	EPA 8330A	HPLC	2-Amino-4,6-dinitrotoluene
Aqueous/Solids	EPA 8330A	HPLC	2-Nitrotoluene
Aqueous/Solids	EPA 8330A	HPLC	3,5-Dinitroaniline
Aqueous/Solids	EPA 8330A	HPLC	3-Nitrotoluene
Aqueous/Solids	EPA 8330A	HPLC	4-Amino-2,6-dinitrotoluene
Aqueous/Solids	EPA 8330A	HPLC	4-Nitrotoluene
Aqueous/Solids	EPA 8330A	HPLC	HMX (Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine)
Aqueous/Solids	EPA 8330A	HPLC	Nitrobenzene
Aqueous/Solids	EPA 8330A	HPLC	Nitroglycerin
Aqueous/Solids	EPA 8330A	HPLC	Pentaerythritoltetranitrate
Aqueous/Solids	EPA 8330A	HPLC	RDX (Hexahydro-1,3,5-trinitro-1,3,5-triazine)
Aqueous/Solids	EPA 8330A	HPLC	Tetryl (Methyl-2,4,6-trinitrophenylnitramine)
Aqueous/Solids	EPA 8330B	HPLC	1,3,5-Trinitrobenzene
Aqueous/Solids	EPA 8330B	HPLC	1,3-Dinitrobenzene
Aqueous/Solids	EPA 8330B	HPLC	2,4,6-Trinitrotoluene
Aqueous/Solids	EPA 8330B	HPLC	2,4-Dinitrotoluene
Aqueous/Solids	EPA 8330B	HPLC	2,6-Dinitrotoluene
Aqueous/Solids	EPA 8330B	HPLC	2-amino-4,6-dinitrotoluene
Aqueous/Solids	EPA 8330B	HPLC	2-Nitrotoluene
Aqueous/Solids	EPA 8330B	HPLC	3,5-Dinitroaniline
Aqueous/Solids	EPA 8330B	HPLC	3-Nitrotoluene
Aqueous/Solids	EPA 8330B	HPLC	4-amino-2,6-dinitrotoluene
Aqueous/Solids	EPA 8330B	HPLC	4-Nitrotoluene
Aqueous/Solids	EPA 8330B	HPLC	HMX (Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine)

Accreditation is granted to the facility to perform the following testing:

Matrix	Standard/Method	Technology	Analyte
Aqueous/Solids	EPA 8330B	HPLC	Nitrobenzene
Aqueous/Solids	EPA 8330B	HPLC	Nitroglycerin
Aqueous/Solids	EPA 8330B	HPLC	Pentaerythritoltetranitrate
Aqueous/Solids	EPA 8330B	HPLC	RDX (Hexahydro-1,3,5-trinitro-1,3,5-triazine)
Aqueous/Solids	EPA 8330B	HPLC	Tetryl (Methyl-2,4,6-trinitrophenylnitramine)
Aqueous/Solids	EPA 9012B	FIA	Total Cyanide
Aqueous/Solids	EPA 9038	Spectrophotometer	Sulfate
Aqueous/Solids	EPA 9056A	IC	Bromide
Aqueous/Solids	EPA 9056A	IC	Chloride
Aqueous/Solids	EPA 9056A	IC	Fluoride
Aqueous/Solids	EPA 9056A	IC	Nitrate and Nitrite as N
Aqueous/Solids	EPA 9056A	IC	Nitrate as N
Aqueous/Solids	EPA 9056A	IC	Nitrite as N
Aqueous/Solids	EPA 9056A	IC	Sulfate
Aqueous/Solids	EPA 9060A	TOC Analyzer	TOC
Aqueous/Solids	EPA 9066	FIA	Total Phenolics (4AAP)
Aqueous/Solids	EPA 9251	FIA	Chloride
Aqueous/Solids	FL-PRO	GC-FID	Petroleum Hydrocarbons
Aqueous/Solids	GCAL SOP WL-070	IC	Acetic Acid
Aqueous/Solids	GCAL SOP WL-070	IC	Butyric Acid
Aqueous/Solids	GCAL SOP WL-070	IC	Formic Acid
Aqueous/Solids	GCAL SOP WL-070	IC	Lactic Acid
Aqueous/Solids	GCAL SOP WL-070	IC	Propionic Acid
Aqueous/Solids	MADEP EPH	GC-FID	C11-C22 Aromatic Hydrocarbons
Aqueous/Solids	MADEP EPH	GC-FID	C19-C36 Aliphatic Hydrocarbons
Aqueous/Solids	MADEP EPH	GC-FID	C9-C18 Aliphatic Hydrocarbons
Aqueous/Solids	MADEP VPH	GC-FID	C5-C8 Aliphatic Hydrocarbons
Aqueous/Solids	MADEP VPH	GC-FID	C9-C10 Aromatic Hydrocarbons
Aqueous/Solids	MADEP VPH	GC-FID	C9-C12 Aliphatic Hydrocarbons
Aqueous/Solids	SM2320 B	Alkalinity	Bicarbonate
Aqueous/Solids	SM2320 B	Alkalinity	Carbonate
Aqueous/Solids	SM2320 B	Alkalinity	Hydroxide
Aqueous/Solids	SM2320 B	Alkalinity	Phenolphthalein
Aqueous/Solids	SM5210 B	Assay	BODs
Aqueous/Solids	SM4500-NH3 B & C	Titration	Ammonia as N

Certificate of Accreditation: Supplement

ISO/IEC 17025:2005 and DoD-ELAP

Gulf Coast Analytical Laboratories, LLC

7979 Innovation Park Drive, Baton Rouge, LA 70820
Contact Name: Randy Whittington   Phone: 225-769-4900

Accreditation is granted to the facility to perform the following testing:

Matrix	Standard/Method	Technology	Analyte
Aqueous/Solids	SM4500-NH3 B & C	Titration	Kjeldahl Nitrogen
Aqueous/Solids	SM4500-NH3 B & D	ISE	Ammonia as N
Aqueous/Solids	SW846 Sec 7.3	FIA	Reactive Cyanide
Aqueous/Solids	SW846 Sec 7.3	Titration	Reactive sulfide
Aqueous/Solids	TCEQ 1005	GC-FID	Total Petroleum Hydrocarbon
Aqueous/Solids	TNRCC 1006	GC-FID	DRO-aplhatic
Aqueous/Solids	TNRCC 1006	GC-FID	DRO-aromatic
Aqueous/Solids	TNRCC 1006	GC-FID	DRO-Total
Aqueous/Solids	TNRCC 1006	GC-FID	GRO-aliphatic
Aqueous/Solids	TNRCC 1006	GC-FID	GRO-aromatic
Aqueous/Solids	TNRCC 1006	GC-FID	GRO-Total
Aqueous/Solids	TNRCC 1006	GC-FID	ORO-aliphatic
Aqueous/Solids	TNRCC 1006	GC-FID	ORO-aromatic
Aqueous/Solids	TNRCC 1006	GC-FID	ORO-Total
Aqueous/Solids	TNRCC 1006	GC-FID	Total Petroleum Hydrocarbon

Certificate of Accreditation: Supplement

ISO/IEC 17025:2005 and DoD-ELAP

Gulf Coast Analytical Laboratories, LLC

7979 Innovation Park Drive, Baton Rouge, LA 70820
Contact Name: Randy Whittington   Phone: 225-769-4900

Accreditation is granted to the facility to perform the following testing:

Matrix	Standard/Method	Technology	Analyte
Aqueous	EPA 3010A	Acid Digestion - Metals	Prep Method
Aqueous	EPA 3510C	Separatory Funnel	Prep Method
Aqueous	EPA 3535A	Solid Phase Extraction	Prep Method
Solids	EPA 3050B	Acid Digestion	Prep Method
Solids	EPA 3550C	Extraction - Sonication	Prep Method
Solids	EPA 5035	Purge and Trap	Prep Method
Aqueous/Solids	EPA 1311	TCLP	Prep Method
Aqueous/Solids	EPA 3540C	Extraction - Soxhlet	Prep Method
Aqueous/Solids	EPA 5030B	Purge and Trap	Prep Method

QUALITY ASSURANCE MANUAL

FOR

Gulf Coast Analytical Laboratories, LLC (GCAL)

7979 Innovation Park Drive
Baton Rouge, Louisiana 70820
225-769-4900

Revision 37
November 3, 2017

Approval Signatures:

11/03/17
Randy Whittington, Chief Executive Officer Date

11/03/17
Robert Olivier, Laboratory Manager Date

11/03/17
Chris Weathington, Technical Director Date

11/03/17
William Perry, Quality Assurance Manager Date

1 Quality Assurance Policy Statement

Quality Assurance consists of a planned system of activities necessary to provide confidence in the results of laboratory analytical determinations. The principal objective of Gulf Coast Analytical Laboratories, LLC (GCAL) is the production of high quality analytical data through the use of measurements that are accurate and reliable for the intended purpose. We are dedicated to providing analytical data and services that conform to all requirements specified and expected by our clients. This Quality Assurance Manual (QAM) details facilities, personnel and equipment necessary for accomplishing this objective along with general procedures and practices that will be followed to maintain adherence to the objective. All policies and procedures have been structured in accordance with the ISO/IEC 17025 Standard, The NELAC Institute (TNI) Standard, the Department of Defense (DOD) Environmental Laboratory Accreditation Program requirements, and in accordance with applicable state and federal regulations, approved reference methods, and guidance documents. GCAL's management staff is dedicated to maintaining compliance with state and federal regulations, TNI Standards and the DOD requirements.

There is a commitment and dedication by all laboratory staff to produce data of known and documented quality. This commitment and dedication to quality is fully supported from the bench level to upper management in order to meet the objectives of our laboratory and best serve our clients.

GCAL's approach to quality assurance starts with the Chief Executive Officer (CEO) who delineates policy and sets goals in conjunction with senior management personnel. Management staff and laboratory personnel implement policies. All departments are involved in the process by providing assessment of operating procedures along with recommendations for improvements or corrections. The QAM and the appropriate Standard Operating Procedures (SOP's) are distributed to all laboratory personnel as controlled documents according to SOP QA-001 (Document Control and Control of Records). All personnel are required to read and comply with this program.

The Quality Assurance Manager (QA Manager) oversees prevention, assessment, and correction procedures for the analytical laboratory for the entire facility. These three functions; prevention, assessment, and correction, comprise the foundation of the laboratory's approach to quality. Through this foundation, GCAL's management staff is committed to continually improve the quality system.

Prevention covers positive actions taken before or during analyses to ensure that analytical systems are functioning properly. Prevention includes such things as instrument calibration and maintenance, personnel training and quality control planning.

Assessment is a component of quality control that includes monitoring of performance to determine precision and accuracy. Examples include duplicate and spike analyses, performance evaluation samples, peer review of calculations and validation of methodology.

Correction is action taken to determine the causes of quality non-conformances and to restore proper functioning of the analytical system. This includes, but is not limited to, troubleshooting to correct instrument malfunctions, or retraining of personnel.

All quality assurance activity requires constant monitoring and documentation to provide evidence of consistent, valid analytical data. GCAL maintains records of all supporting documentation in order to have available for its clients' documented assurance that the data they receive quantitatively reflect the parameters requested.

The policies and practices of quality assurance/quality control presented in this plan are set forth as minimums. Additional quality assurance/quality control measures are defined by a specific project plan.

In the case of discrepancies between this document and SOPs, the SOP shall take precedence. A list of supporting SOPs including technical procedures is located in Appendix G of this document.

Randy Whittington, CEO

2 ETHICS POLICY

GCAL utilizes a clearly stated ethics policy in the form of the following Ethics and Data Integrity Agreement. This agreement is discussed with all new employees during orientation and is then signed and retained with the employee's training file. Violation of the agreement is basis for termination of employment. Employees receive training in data integrity and their ethical responsibilities annually. Each employee must sign GCAL's Ethics and Data Integrity Agreement annually. The signed document will be kept in the employee training records.

GCAL's management takes seriously any allegations of improper, unethical or illegal activities. All allegations shall be investigated, fully documented and treated as confidential. The identity of the employee reporting the possible ethics violation shall be maintained as confidential. GCAL's management shall not retaliate against any employee raising ethical questions.

Corrective action on any instances of inappropriate and prohibited laboratory practices discovered during any internal or external assessment or investigation shall be reported to the Accreditation Body (PJLA) as soon as practicable. See QA-010 (Data Integrity).

GULF COAST ANALYTICAL LABORATORIES, LLC

ETHICS AND DATA INTEGRITY AGREEMENT

I, ______________________, state that I understand the high standards of integrity required of me with regard to the duties I perform and the data I report in connection with my employment at GCAL. Our core values are honesty, success, service and integrity. I understand that it is critical for our long-term success that each and every employee aligns with all company core values.

I agree that in the performance of my duties for GCAL and its clients, I shall conform to the following ethics standards and will report immediately to the QA Manager and the appropriate supervisor any information concerning misrepresentation of analytical data that includes, but is not limited to:

1. Fabrication, falsification, or misrepresentation of data;
2. Misrepresenting an analyst's identity;
3. Changing raw data documents with correction fluid or obliteration;
4. Changing reported results without proper documentation and approval;
5. Improper clock setting (time traveling) or improper date/time recording;
6. Unwarranted manipulation of samples, software, or analytical conditions;
7. Disposing of or deleting electronic data files or hardcopies of raw data;
8. Misrepresenting or misreporting QC samples;
9. Improper calibrations;
10. Failure to comply with SOP's or methods without proper documentation and approval;
11. Concealing a known analytical or sample problem;
12. Concealing a known improper or unethical behavior or action;
13. Failing to report the occurrence of a prohibited practice or known improper or unethical act to the appropriate laboratory or contract representative, or to an appropriate government official.
14. Engaging in any practice that ultimately misrepresents data or narratives in any way.

I will not knowingly participate in any such activity and will not tolerate unethical practices by others. I understand that confidentiality will be strictly enforced by GCAL when dealing with these matters. As a further extension of my commitment to this program, I am responsible for seeking approval to report data resulting from techniques or procedures that deviate from SOP's, methods, or industry standard practices. Any such reporting of data will include a laboratory narrative that must be approved by the appropriate supervisor and / or management staff.

If I am unsure of how to properly handle data generated by me, I am responsible for seeking advice and approval from the QA Manager and the appropriate supervisor. I agree to inform the QA Manager and the appropriate supervisor of any accidental reporting of non-authentic data by others or myself within 24 hours of discovery.

I understand that if I knowingly participate in any prohibited activity, I will be subject to disciplinary action that may include immediate termination by GCAL. I also understand that I face individual suspension and debarment from all Federal programs should I be convicted of such practices. I understand that suspension and debarment from all Federal programs affects my ability to work in the environmental field, as well as, any other profession where government funding or loans may be involved. I understand the most serious consequence of unethical conduct can be imprisonment if convicted.

I understand that it is not the company's intent to punish anyone for an accidental mistake or oversight. Employees will not face disciplinary actions for an accidental mistake or oversight. Repeated careless or neglectful behavior will be subject to corrective action. Covering up an accidental mistake or oversight is not acceptable behavior and will result in termination. Mistakes or oversights are immediately reported to the appropriate supervisor and/or QA Manager.

My signature affirms my understanding of the consequences of violating GCAL's ETHICS AND DATA INTEGRITY AGREEMENT and my commitment to its intent. My signature further affirms that I have received formal training on this topic.

____
Printed Name

____
Signature Date

3 ELECTRONIC SIGNATURE POLICY

GCAL produces three types of documents that require signature to make them official:

- Controlled documents – plans and procedures
- Reports – official output and basic component of GCAL's record
- Agreements – proposals and contracts

These documents primarily take the form of PDF and are potentially completed with electronic signing.

Signatories are generally restricted to supervisory or managerial employees as defined in the Quality Assurance Manual or procedures relating to the management of change, production of standard operating procedures, and the validation and assembly of reports. See these document for specifics on signatory responsibility.

All signers have the option of not using electronic signatures by printing the most complete version (one with all electronic signatures that will appear on the document) and physically signing their name. In these cases, the Quality Assurance Manager, the Director of Electronic Deliverables, or the CEO will take responsibility for coordination and completion of these documents by printing the copy to be signed, scanning the hardcopy, merging with the remaining pages of the electronic document, deleting the pre-existing signatory page, and final lockdown of the electronic document.

Any electronic signatory may print the signatory page following addition of their signature as their personal copy.

GCAL uses two approaches for affixing electronic signature to these documents:

- LIMS controlled image of the signature, applicable to Level I reports only. Image is applied in the report compilation processes controlled by the LIMS.
- Dynamically applied e-signatures using "ePad" hardware (plans, procedures, reports and agreements). Once the signing process begins, further modification of the document is controlled by the pdf application through the settings on the e-signature application.

When all applicable signatures are applied, the document placed in the appropriate GCAL intranet storage location and the document is considered published.

4 ADMINISTRATIVE ORGANIZATION

GCAL consists of a single laboratory facility located at 7979 Innovation Park Drive, Baton Rouge, LA 70820. All testing conducted under GCAL's scope of accreditation is performed at the Baton Rouge Laboratory. Additionally, GCAL operates two service centers which facilitate sales, courier service, and shipping to the main laboratory. The service centers are located in Westlake, LA, and Alpharetta, GA. GCAL's primary NELAP accreditation number is 01955.

GCAL is organized along clear lines of authority to provide our clients with service that is efficient and reliable. The key personnel of the laboratory and their ISO/DoD QSM Equivalent titles / functions are given in Section 3.1; the organizational structure is depicted in Appendix A (Organization and Management Structure). Personnel authorized as signatories for the lab include: CEO, Laboratory Manager, Technical Director and IT Director.

It is the policy of the laboratory that each key personnel have a designated deputy or deputies to maintain continuity of service and other functions whenever key staff is absent. The deputies are responsible for the completion of duties during the staff member's absence. In the event that the Technical Director is not able to perform his/her duties for more than 35 consecutive calendar days, GCAL will notify the accrediting authorities in writing and will identify the temporary Technical Director. Temporary deputies are defined in the chart below.

GCAL Position	**GCAL Deputy**
Chief Executive Officer (CEO)	Lab Manager or Technical Director
Laboratory Manager	CEO or Technical Director
Technical Director	Laboratory Manager or QA Manager
QA Manager	Technical Director
Department Manager	Department Supervisor
Department Supervisor	Group Leader or designee
IT Director	CEO
Project Manager/ Customer Service Manager	Client Services Supervisor or Technical Director
Purchasing Manager	CEO

4.1 Roles, Responsibilities, and Qualifications

The following lists the general roles and responsibilities in each level of the laboratory. Resumes are attached in Appendix B (Resumes of Key Personnel). Management ensures that each employee is independent from commercial, financial, or other pressures that might adversely affect the quality of test and reporting of results.

All employees are responsible for complying with GCAL's quality system. It is the responsibility of every employee to perform the duties outlined in this QAM or as assigned by management.

The CEO, Technical Director, Laboratory Manager, QA Manager, Department Managers or any Supervisor may halt work and withhold reports when non-conforming work is identified. In addition, management may halt work if an employee is observed not following laboratory procedures. Work will not resume until such time as the CEO, Technical Director, Laboratory Manager and/or QA Manager has deemed the process to be compliant with GCAL's policies and procedures.

4.1.1 The Chief Executive Officer (CEO) bears the primary responsibility for data quality at GCAL and directs laboratory policies. The CEO:

- Is responsible for the laboratory and its employees.
- Directs the functional areas of marketing and finance.
- Makes financial decisions for the laboratory.
- Sets goals and objectives for the laboratory.
- Supervises the IT Director, Technical Director, Laboratory Manager and the Safety/Regulatory Compliance Officer.
- As a member of management participates in strategic planning to develop short-term and long-term goals for the laboratory.

4.1.2 The Laboratory Manager (Lab Manager) (ISO title – Laboratory Director) is responsible for the supervision of laboratory operations and reporting results as well as for meeting data quality requirements as defined by this document and analytical SOPs. The Lab Manager must have a degree in chemical, environmental, biological sciences, physical science or engineering with at least 24 college credit hours in chemistry and at least 5 years of experience in environmental testing. The Lab Manager:

- Reports to the CEO
- Reviews, approves and implements the QAM, all policies and SOP's in the laboratory.
- Sets goals and objectives for the laboratory and employees.
- Makes personnel and financial decisions.
- Assures the laboratory has sufficient resources for the timely generation of data.
- Provides day-to-day supervision, conducts performance appraisals, and delegates work assignments to personnel.
- Monitors standards of performance in quality control and quality assurance.
- Monitors the validity of the analyses performed and data generated in the laboratory to assure data are of known and documented quality.
- Directs the development, validation, and implementation of new test methods as necessary.
- Is responsible for maintaining a productive work environment, which encourages open, constructive problem solving and continuous improvement.

- As a member of management participates in strategic planning to develop short-term and long-term goals for the laboratory.

4.1.3 Technical Director (ISO title – Technical Director) is responsible for coordinating the activities of the Quality Assurance Department, the Sample Administration Department, Client Services Department, and administrative support personnel. The Technical Director must have a degree in chemical, environmental, biological sciences, physical science or engineering with at least 24 college credit hours in chemistry and at least 5 years of experience in environmental testing. The Technical Director:

- Reports to the CEO
- Approves the QAM and applicable SOP's for the laboratory.
- Defines, communicates and enforces quality standards.
- Provides day-to-day supervision, conducts performance appraisals, and delegates work assignments for QA personnel.
- Assists the lab in method development and implementation.
- Is responsible for ensuring that all quality related requirements are understood and implemented by the laboratory.
- Is responsible for effectively communicating with clients all quality related requirements.
- Identifies new opportunities to improve GCAL's methods and employee training.
-
- As a member of management participates in strategic planning to develop short-term and long-term goals for the technical services department and the laboratory.
- Oversees the laboratory's certification status to ISO 17025, DoD QSM, the TNI Standard and state certifications as applicable.
- monitors standards of performance in quality control and quality assurance, and
- monitors the validity of the analyses performed and data generated in the laboratory to assure reliable data.

4.1.4 The Information Technology Director (ISO title – LIMS Manager) manages the implementation and development of information technology tools. The IT Director is responsible for the automated data collection systems used by the laboratory. The IT Director:

- Reports to the CEO
- Works with management and employees to assess and respond to GCAL's IT needs.
- Provides day-to-day supervision, conducts performance appraisals, and delegates work assignments to IT personnel.
- Is responsible for maintaining the integrity and continual operations of GCAL's network and LIMS.

- Is responsible for developing and ensuring that all system backups are performed as scheduled.
- Is responsible for developing, reviewing and certifying all back-up and disaster recovery procedures.
- Maintains security and privacy of LIMS and computer systems.
- Oversees the development, design and implementation of new applications and changes to the existing computer systems and software packages.
- Interacts with clients to determine IT requirements such as electronic data deliverables.
- As a member of management participates in strategic planning to develop short-term and long-term goals for the IT department and the laboratory.

4.1.5 IT Assistant:

- Reports to the IT Director
- Assist in maintaining the LIMS system.
- Assist in performing system backups.
- Assist in maintaining the integrity and continual operations of GCAL's network and LIMS.
- Performs other duties as assigned.

4.1.6 Accounts Payable and Purchasing (ISO title - Purchasing Manager)

- Maintains Approved Vendors List on the GCAL Intranet
- Orders laboratory supplies and services as requested per GEN-025 (Purchasing Services and Supplies).
- Acceptance of supplies and verification that the supply received matches the level of quality or cleanliness ordered and required.

4.1.7 The Director of Data Deliverables:

- Reports to the Laboratory Manager
- Provides day-to-day supervision, conducts performance appraisals, and delegates work assignments to personnel.
- Is responsible for report validation and review.
- Is responsible for reviewing final reports. Any discrepancies found in the data are reported to the appropriate Department Supervisor for review and correction if necessary.
- Is responsible for signing final reports.
- Supervises the report generation groups.
- Performs other duties as assigned.

4.1.8 The QA Manager (ISO title – Quality Manager) is responsible for implementing, maintaining and improving the quality system throughout the laboratory. The Quality Department operates independent of the production pressures of the laboratory. The QA Manager must have a degree in chemical, environmental, biological sciences, physical science or engineering with at least 24 college credit hours in chemistry and at least 2 years of experience in environmental testing. The QA Manager:

- Reports to the Technical Director
- Supervises the Quality Assurance Technician(s).
- Operates independently from the laboratory operations.
- Is responsible for maintaining the laboratory's certification status to ISO 17025, DoD QSM and state certifications as applicable.
- Serves as the focal point for the quality system and is responsible for oversight and/or review of quality system.
- Is responsible for the preparation and maintenance of GCAL's QAM.
- Acts as the liaison between the laboratory and external parties on matters relating to GCAL's quality system and/or external assessments and audits.
- Is the contact for performance testing studies and project-specific quality control issues.
- Oversees GCAL's Proficiency Testing (PT) Program.
- Monitors analysts' training records and verifies that training records are adequate and current.
- Management of the Corrective and Preventive Action System; approves and confirms the implementation of corrective actions.
- Is responsible for the approval and distribution of controlled documents.
- Has the authority to intercede in all areas where quality related problems exist. No work will be released until the related quality deficiency has been corrected and approval has been given to proceed forward.
- Must have training in QA/QC and a general knowledge of the tests included in GCAL's scope of accreditation.
- Ensures that all personnel understand their contributions to the quality system.
- Ensures communication takes place at all levels within the laboratory regarding the effectiveness of the quality system.
- Evaluates the effectiveness of training.
- Conducts internal audits annually and provides documentation of these audits to management.
- Meets with laboratory staff to disclose issues of non-compliance identified during internal audits to develop corrective action strategies.
- Uses internal audits, third party assessments, control charts, proficiency testing results, data analysis, corrective and preventive actions, customer feedback, and management reviews in an efforts to monitor trends and continually improve the quality system.
- Performs other duties as assigned.

4.1.9 Quality Assurance Technician:

- Reports to the QA Manager
- Tracks and assists in developing laboratory logbooks including assembling, retrieving and archiving.
- Tracks and verifies internal calibration programs.
- Assists with revising SOPs as assigned and uploads the SOPs into GCAL's intranet.
- Obtains purchase orders for and schedules calibration services.
- Assists with employee training and assists in maintaining the employee training records.
- Assists in preparing for and assists during internal audits, external audits and assessments.
- Assists with GCAL's proficiency testing program.
- Assists the QA Manager in implementing the quality system and in ensuring that the quality system is followed at all times.
- Assists in obtaining and updating documents for training and/or experience in QA/QC procedures and is knowledgeable in the quality system as defined by State Regulations and TNI standards.
- Completes applications for renewal of accreditation.
- Performs other duties as assigned.

4.1.10 Inorganic / Organic Managers (ISO title – Section Supervisor):

- Report to the Laboratory Manager
- Are responsible for the overall flow of work and data through their departments.
- Provide day-to-day supervision, conduct performance appraisals, and delegate work assignments to personnel in the laboratory.
- Are responsible for the maintenance of accurate SOPs with input from the QA/QC Department.
- Are responsible for training laboratory personnel.
- Are responsible for reviewing and validating data released from the department.
- Supervise the quality control activities performed as part of routine analytical operations
- Perform other duties as assigned.

4.1.11 Department Supervisors (ISO title – Section Supervisor):

- Report to the Inorganic / Organic Manager or Laboratory Manager
- Are responsible for the overall flow of work and data through their section/area.
- Provide day-to-day supervision, conduct performance appraisals, and delegate work assignments to personnel in the laboratory.
- Are responsible for the maintenance of accurate SOPs with input from the QA/QC Department.

- Are responsible for all activities within their section/area, ensuring that all instrumentation and equipment meet performance criteria and calibration requirements.
- Are responsible for training laboratory personnel.
- Are responsible for validating data released from their section/area of the laboratory.
- Inform the Department Manager or Laboratory Manager of project status and any laboratory capacity issues.
- Must have experience in the methods performed in their section/area and experience in data review and validation.
- Perform other duties as assigned.

4.1.12 Group Leaders:

- Report to the Department Supervisor
- Are the temporary deputies in the event the Department Supervisor is absent.
- Guide the scheduling of sample analysis.
- Ensure there is sufficient staff available.
- Perform other duties as directed by the Department Supervisor or member of management.

4.1.13 Lab Analysts/chemists:

- Report to the Department Supervisor
- Are responsible for the generation of data by analyzing samples in accordance with GCAL's approved and implemented SOP's in a manner that meets regulatory and reference method requirements.
- Are responsible for recording all observations during analysis and for ensuring that all documentation related to the analysis is accurate and complete.
- Are required to notify the Department Supervisor, Department Manager, Lab Director or QA Manager of any quality issues immediately upon discovery.
- Have the authority to accept or reject data based on compliance with QC acceptance criteria.
- Are responsible for the initial data review.
- Are required to be familiar with reference methods cited in GCAL approved SOPs.
- Are required to be familiar with state and federal regulation that apply to analytical testing procedures.
- Perform other duties as assigned.

4.1.14 Project Managers/Client Services (ISO title – Customer Services Managers and Project Managers):

- Report to the Client Services Supervisor
- Are responsible for scheduling client projects.
- Communicate to laboratory personnel any project-specific requirements.

- Review log-in summaries.
- Notify the client of sample receipt and/or analytical problems.
- Monitor the progress of analytical work and provides data to the client in a timely manner.
- Documents client inquiries.
- Perform other duties as assigned.

4.1.15 Safety/Compliance Officer

- Reports to the CEO
- Provides safety training for GCAL's employees.
- Is responsible for checking and maintaining safety equipment.
- Has knowledge of waste disposal regulations.
- Coordinates waste disposal activities including documenting waste disposal.
- Performs safety audits and reports findings to management.
- Performs other duties as assigned.
- Maintains OSHA 300 and 300A Logs

4.1.16 Sample Receipt Technicians

- Report to the Sample Receipt Supervisor
- Receive all samples delivered by common carrier, GCAL Courier, or customer representative.
- Evaluate containers received for proper preservation, container type, and holding time.
- Documents sample integrity and/or discrepancies between samples received and chain of custody.
- Log all samples into the LIMS and label samples with GCAL label.
- Distribute containers to the proper laboratories.
- Prepare bottle kits for pick-up and delivery.
- Coordinate with Project Management to schedule and deliver samples to sub-contract laboratories.

4.1.17 Couriers

- Report to the Sample Receipt Supervisor.
- Responsible for pickup and delivery of client samples to the laboratory.
- Responsible for sample collection on an as needed basis.
- Perform other duties as assigned.

4.2 Personnel Training

GCAL's training procedures are documented in SOP GEN-007 (Training). It is the policy of the laboratory to engage competent staff that are appropriately qualified and/or trained to perform their respective duties. If it is necessary to employ temporary or contract staff, the laboratory shall ensure that the same criteria as those governing regular staff apply with respect to training and qualifications. On-the-job training takes place for all new employees based on needs identified by the job description and tasks required by the position.

It is the responsibility of every employee to perform their job duties as outlined in this QAM and in accordance with GCAL's SOPs. All quality system documents are communicated to the appropriate personnel. Documents that are included in the quality system are available to all employees on GCAL's Intranet site.

4.2.1 GCAL's training program begins with an orientation designed to familiarize the new employee with safety and chemical hygiene issues, the importance of QA/QC in an analytical laboratory, general laboratory procedures, and GCAL's policies. All employees undergo training in ethical responsibilities including the potential penalties for improper, unethical, or illegal actions. Each employee must read and sign GCAL's Ethics and Data Integrity Agreement. Employees are required to read the laboratory QAM at the time of hire and any time the QAM is revised. All technical personnel undergo a training process involving lecture tapes that cover basic laboratory tasks. A written test follows each tape. Employees who perform or review manual integrations as part of their job duties receive training on GCAL's manual integration policy. Employees performing manual integrations must sign GCAL's Manual Integration Policy Statement.

4.2.2 New employees are under the direct supervision of experienced analysts and/or the department supervisors who are responsible for instructing the Trainee on the analytical procedures including the applicable QA/QC. Training includes reviewing SOP's appropriate to the Trainee's job duties and hands-on training with instruments and/or equipment. Reference methods are available to laboratory personnel either in hardcopy or electronically. The analyst in training must perform an acceptable initial demonstration of capability (IDOC) before being allowed to analyze samples without direct supervision. The IDOC consists of successfully analyzing four consecutive laboratory control samples (LCS) that have been prepared at a specified concentration using a certified stock standard. The 4 aliquots shall be analyzed either concurrently or over a period of days if necessary. The IDOC will be deemed acceptable if the precision and accuracy meet the requirements established by GCAL.

4.2.3 Analysts are required to complete a continuing demonstration of capabilities (DOC) whenever there is a significant change to the instrument or test method or at minimum annually unless otherwise required by the reference method. The DOC shall include one of the following: acceptable performance of a Proficiency Test sample or performance of 4 consecutive LCS samples that meet the laboratory's requirements for precision and accuracy. Refer to SOP QA-014 (Demonstration of Capability) for additional information on demonstrations of capabilities.

4.2.4 GCAL recognizes developmental training as a means to increase the effectiveness of the employee and the organization. Therefore, GCAL utilizes other training methods along with on-the-job training. Examples include seminars, specialized training by instrument manufacturers, and internal training courses. GCAL encourages employees to take college courses appropriate to the work performed by the laboratory.

4.2.5 On-going proficiency is documented using the Demonstration of Capability Statement form and must be signed by the Analyst, the Laboratory Manager and the QA Manager. The signed Certification Statement and supporting data are kept in the employee's training records.

4.2.6 Additional training will be required for an employee whose performance does not meet standard requirements.

4.2.7 Periodic performance reviews are given to all personnel. The purpose of these reviews is to give recognition for good work when desired, outline personnel and departmental objectives, suggestions for improvement and clarification of responsibilities

4.3 Training Records

The QA/QC Department maintains training records for each employee. The records include the demonstration of capability, training course certificates, in-house or external training seminar documentation, ethics and integrity agreement and manual integration agreements if required

5 Quality Assurance/Quality Control

5.1 Quality Assurance Responsibilities

Quality Assurance (QA) is defined as an integrated system of management activities involving planning, implementation, assessment, reporting, and quality improvement to ensure that a process, item, or service is of the type and quality needed and expected by the client. QA is an integral part of GCAL's quality system. The ultimate responsibility for assuring data quality at GCAL rests with the CEO. The CEO collaborates with management staff and department supervisors to develop QA policies and strategies that make GCAL a valued partner in the industry. At GCAL, QA is everyone's responsibility and takes a team effort to meet our goals and objectives.

QA at GCAL begins at the bench level with the laboratory analyst. The analyst is responsible for performing the work as prescribed in SOP's, documenting it, and verifying that all laboratory and client expectations have been met. In order to accomplish this, analyst must have a working knowledge of GCAL's QA policies, including data quality objectives, preventive maintenance techniques, an understanding of detection limits, and calibration techniques and requirements prior to conducting analyses in the laboratory. Each staff member is required to review and follow all applicable SOP's and GCAL's QAM and to seek clarification when something is not clear.

The second level of QA at GCAL lies with the management staff and department supervisors. Management is responsible for the proper training of analysts, maintaining a quality first atmosphere, and ensuring that all analytical data produced meets GCAL's clientele's high expectations. This responsibility includes data validation, internal audits, and conducting periodic training sessions. Ultimately, GCAL's management team and department supervisors are responsible for the quality of all analytical data produced and initiating corrective action when needed.

Finally, the QA Manager and their staff, is responsible for the oversight of the QA/QC program. This includes the administration of the program, the maintenance of QA records, preparation of reports to management covering QA activities, management of the internal audit program, oversight of the Corrective and Preventive Action (CAPA) program, and coordination of the proficiency testing program, as outlined in this document. In addition, the QA Manager is responsible for annual management system review and maintaining GCAL's numerous accreditations.

5.2 Proficiency Testing (PT studies)

GCAL participates in a minimum of two TNI and State approved proficiency test studies each year and performs corrective action PT studies as necessary. The QA/QC Department orders the required PT studies at approximately six-month intervals from a TNI and/or state approved Proficiency Test Provider. When PT samples are received, the QA Technician or designee will log the PT samples into the LIMS and assign a work order number to the Study. PT samples are handled as client samples throughout the analytical process. PT samples will not be analyzed in multiple replicates or dilutions unless specified by GCAL's analytical SOP. The QA/QC Department and department supervisor will be notified immediately of any problems encountered with the PT sample.

The QA/QC Department is responsible for reviewing and reporting PT results to the PT provider. PT results and associated batch QC are reviewed in the same manner as a client's sample result. The review includes sample prep for appropriate dilution, reported concentration, consistency across methods, logical results, and transcription errors. Batch QC failures will necessitate re-analysis of the PT sample, or comments in the case narrative. If GCAL must withdraw from a PT study, the primary accrediting authority and PT provider will be informed in writing prior to the close of the study. PT results are reported to the PT provider by electronic submission.

The Technical Director or QA Manager shall review scored results for performance and accuracy. For all PT Study analytes that yield unacceptable results, a corrective action shall be initiated that investigates the root cause for the failure. A remedial PT may be performed to re-establish acceptable performance (acceptable results in 2 of 3 studies) or to maintain accreditation. The decision to perform a remedial study shall be made by the QA/QC

Department. Documentation of scored PT results, raw data, and corrective action shall be kept on file. Once the corrective action and proficiency testing (if performed) are complete, this information must be submitted to GCALs primary accrediting authority for NELAC and DOD ELAP, and any other accrediting bodies that request this information.

It is inappropriate for any employee to share results or to attempt to obtain results from any other laboratory participating in the PT or from the PT provider. GCAL will not knowingly accept PT samples or portions of PT samples from other laboratories.

GCAL utilizes the first WP Study of the year allowed by EPA to meet DMRQA requirements for clients that use GCAL for analysis of samples regulated by a discharge permit. Samples are analyzed, reviewed, and the applicable results are reported to the client.

It is the responsibility of the QA Manager to maintain compliance with the TNI Standard, Louisiana Administrative Code and DOD regulations regarding PT analysis and reporting. Compliance includes passing two of the three most recent studies and performing PT studies for every matrix/method/analyte offered by approved PT providers. If required, GCAL will notify the appropriate entity in the case where a matrix/method/analyte combination cannot be obtained from any PT provider; an intra- or inter-laboratory comparison may be required. The QA/QC department shall suspend any matrix/method/analyte combination that fails two of the three most recent PT studies until the laboratory meets the requirements of initial acceptability. Refer to SOP QA-015 (Proficiency Testing Studies) for more details.

5.3 Accreditation

GCAL has multiple state and federal program accreditations. GCAL’s National Environmental Laboratory Accreditation Program (NELAP) is administered and maintained through the Louisiana Department of Environmental Quality (LDEQ). Our NELAP certificate number is 01955. GCAL’s Department of Defense Environmental Laboratory Accreditation Program (DOD ELAP) and ISO/IEC 17025:2005 accreditations are administered and maintained through Perry Johnson Laboratory Accreditation, Inc. Our DOD ELAP certificate number is L14-243. In addition, GCAL maintains numerous state accreditations through either NELAP reciprocity or through other existing programs. A master list of accreditations and their scopes is maintained by the QA/QC department and is available upon request. A summary of accreditations is included in Appendix E (GCAL Certifications) of this document.

Scopes of accreditation and certificates shall be kept on file in the QA/QC Department and stored to the appropriate electronic file on the server. All correspondence with accrediting authorities will be kept on file in the QA/QC Department.

5.4 Quality Control

Quality control is defined as the overall system of technical activities that measures the attributes and performance of a process, item, or service against defined standards to verify that they meet the stated requirements established by the customer; operational techniques and activities that are used to fulfill requirements for quality; also the system of activities and checks used to ensure that measurement systems are maintained within prescribed limits, providing protection against “out of control” conditions and ensuring that the results are of acceptable quality. (NELAC 2009). This section describes the types of quality control samples used in the laboratory and how they are used to determine precision and accuracy. When the analysis of a sample set is completed, the results will be reviewed and evaluated to assess the validity of the data set. All QC samples are processed and analyzed using the same conditions as the samples.

5.4.1 A blank is a sample that has not been exposed to the analyzed sample stream in order to monitor contamination during sampling, transport, storage or analysis. The blank is subjected to the usual analytical and measurement process to establish a zero baseline or background value. A reagent and/or method blank is prepared and analyzed with each set of samples. Field blanks (if provided by the client) are analyzed to determine possible contamination during sample collection. Trip blanks are applicable to volatile organics analysis (VOA) where volatile contaminants may be introduced during shipment to the laboratory. Storage blanks are placed in refrigerators used for volatile sample storage at the laboratory and analyzed every two weeks.

5.4.2 The reagent and/or method results are evaluated for contamination. If high blank values are observed, laboratory glassware and reagents will be checked for contamination. Analysis will be halted until the source of contamination has been determined and corrective action taken. For more information on quality control of all blanks used by the laboratory, refer to SOP GEN-010 (Laboratory Monitoring of Reagents and Solvents).

5.4.3 A Laboratory Control Sample (LCS) is made from a matrix known to be free of the analytes of interest and spiked with a known and verified concentration of target compounds. The LCS is prepared and analyzed with each batch of samples. The full list of target compounds or a representative list of target compounds for the method may be spiked into the LCS. If a representative list is used, the laboratory will ensure that all target analytes are included in the spike mixture over a two year period. Some projects, such as DOD, require that all target analytes are spiked. Project specific information is documented by the project manager in the project profile in the LIMS.

5.4.4 Analysts are responsible for reviewing project profiles for client requirements. A purified solid matrix such as Ottawa sand, Teflon beads, or sodium sulfate is used to prepare the LCS for soil or solid samples. For those tests where it is difficult to obtain a suitable solid matrix for spiking, analyte free reagent water is taken through the preparation and analysis procedure. A certified reference material may be used as an LCS. The analyte concentration range must be within the calibration range of the method. Because some analytes may interfere with an accurate assessment if spiked simultaneously, the spike chosen will represent the elution patterns of the target analytes. Specific information regarding the preparation, analysis, and evaluation of an LCS is detailed in the test method SOPs.

5.4.5 A matrix spike is a sample to which known concentrations of target analytes have been added. The matrix spike is also referred to as the MS. The analytes to be spiked are specified in the reference method, SOP, client request or by regulation. Because some analytes may interfere with an accurate assessment if spiked simultaneously, the spike chosen will represent the elution patterns of the target analytes. The observed recovery of the spike versus the theoretical spike recovery is used to calculate accuracy as defined by percent recovery. If the accuracy value is outside the control limits for the given parameter, the LCS is reviewed to verify that the analytical system is in control. Generally, matrix spike control limits are set as the LCS control limits. The same spike list and concentration as required for the LCS will be used for the MS.

5.4.6 A duplicate for each matrix type is included in each batch of samples. Routinely, the laboratory includes a replicate (a sample the laboratory divides into two aliquots sometimes referred to as a duplicate sample) or a matrix spike duplicate (a duplicate of the matrix spike) in each analytical batch. The type of duplicate to include in a batch is based on specific project requirements and method requirements. The MS/MSD pair is analyzed with each batch of samples if sufficient sample is available. Duplicate sample analysis for the sample set is used to determine the precision of the analytical method for the sample matrix. The duplicate results are used to calculate the precision as defined by the relative percent difference (RPD).

5.4.7 If required by the method, each sample is spiked with the method specified surrogate(s) prior to extraction and analysis. The results of the surrogate(s) are compared with the true values spiked into the sample. The percent recoveries of the surrogates are calculated and reported with the sample results. If recoveries are outside the control limits, corrective action is required or a comment in the case narrative is required. Surrogates are reported as diluted out, in an analysis requiring extraction, if a dilution greater or equal to 10X is performed on the sample. Surrogates are used to monitor instrument performance, extraction performance, and matrix affects in each sample analyzed. Required corrective actions for surrogate failures can be found in the analytical SOPs.

5.4.8 Internal Standards are added if required by the method. Internal standards are used to correct for minor variations in retention times and/or response. In most cases internal standards are defined in the method. If not defined an internal standard that is similar in response but not present in the sample such as deuterated or less common isotopes shall be used. Internal standard performance is monitored as part of the method performance for response and, if applicable, retention time.

5.4.9 An initial calibration verification (ICV) is analyzed following the initial calibration and before any samples are analyzed. The ICV is a certified standard from a different manufacturer than the standard used for the initial calibration. If a second source standard is not available, then GCAL will use a certified standard from the same vendor but with an independent lot number.

5.5 Statistical Control

As part of the analytical quality control program, the precision and accuracy for each analytical method is established by the use of control charts. The charts are used to assess the method performance over a period of time. A minimum of twenty points are used to establish a control chart. Control limits of ± three standard deviations are utilized.

5.5.1 Control charts are used to evaluate trends (positive or negative) in the analytical processes and to determine when an analysis is out of control. Examples of situations that show up in control charts are:

- Shift in mean - is usually caused by incorrectly prepared standards or reagents, contamination of sample, problems in instrument calibration, or analyst error.
- Trend of mean downward - is usually caused by deterioration of standards or reagents.
- Trend of mean upward - is usually caused by concentration of standard due to solvent evaporation or deterioration of reagents.
- Increase in variability - is usually caused by poor technique by the analyst or deviation from procedure.

5.5.2 Precision is defined as the degree to which a set of observations or measurements of the same property, obtained under similar conditions, conform to themselves, i.e., agree with each other. Precision is a data quality indicator that is usually expressed as standard deviation, variance or range, in either absolute or relative terms. To determine the precision of the method and/or laboratory analyst, a routine program of duplicate analyses is performed. The results of the duplicate analyses are used to calculate the relative percent difference (RPD), which is the governing quality control parameter for precision. See Appendix H (Glossary) for more information on this term.

Accuracy is defined as 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) components that are due to sampling and analytical operations; a data quality indicator. Accuracy is the measure of the closeness of an observed value to the "true" value (theoretical or reference value or population mean). The accuracy of an analytical method and/or the laboratory analyst is based on the analysis of laboratory control standards. LCS results are used to calculate the quality control parameter for accuracy evaluation.

5.5.3 Uncertainty can be calculated using the Quality Control based Nested approach as described in SOP QA-013 (Estimation of Analytical Measurement Uncertainty). Uncertainty will only be calculated if requested by the client. The approach uses batch QC over a period of time. This approach can also incorporate sample uncertainty if field QC is available. A minimum of twenty measurements is required.

5.6 Audits and Assessments

Internal audits are scheduled and documented by the QA/QC Department. A member of the QA/QC Department or designee performs the internal audits. Audits are documented through the use of method specific checklists and written reports maintained in the QA/QC Department. Internal audits are used to determine if lab activities meet the requirements of GCAL's quality system and state regulations. Refer to SOP QA-004 (Internal Audits and Management Reviews) for more details.

5.6.1 Internal audits are performed to ensure that all aspects of the QA program are implemented in the laboratory. The QA Manager reviews all information pertaining to the quality system and notes any areas of nonconformance. In addition, observations may be documented in the report. Observations are issues that while compliant with state regulation, TNI standards and GCAL's quality system, have the potential to develop into nonconforming conditions in the future. Areas where the analyst's performance exceeds expectation will be noted in the report. The report is prepared based on the audit findings and is distributed to management in a timely manner. The report findings are discussed with the appropriate laboratory personnel and department supervisor so that a concerted effort can be made to correct any non-conformances as well as to provide positive feedback. At a minimum, the QA Manager or designee will review the following aspects of the program annually:

- Sample handling, including custody and storage procedures
- Sample analysis, including a raw data review
- SOPs and associated reference methods; see QA-004 (Internal Audits and Management Reviews)
- Bench sheets required for the analytical procedure
- Traceability of stock and working standards and reagents.
- Records such as certificates of analysis for reagents and standards, certificates for support equipment, maintenance records, etc.

- Preventive maintenance
- Proficiency Testing
- Training Records
- Project Management
- Report Generation

5.6.2 When the findings or nonconformances identified during an internal audit cast doubt on the validity or accuracy of a test result, GCAL will initiate the corrective action process and begin an investigation to determine the cause. During the investigation analytical results will be reviewed to determine the effect if any on the data. If any finding casts doubt upon validity of results, Project Management will notify client within 15 calendar days.

5.6.3 Client and regulatory assessments are scheduled through the QA Manager. It is GCAL's policy to have all information pertaining to the client or to our scope of accreditation readily available for review by the assessor or assessment team. Client confidentiality will be maintained throughout the assessment process. The QA Manager coordinates and monitors all on-site assessments, reviews all findings, issues a corrective action plan, and follows-up to ensure agreed changes are implemented. All documentation pertaining to an assessment will be kept on file in the QA/QC Department.

5.6.4 A management review will be conducted annually. The management staff will review the laboratory quality system and environmental testing activities to ensure suitability, effectiveness, and identify areas of improvement. This is a system wide assessment. The QA Manager will write a report summarizing the findings and any new policy decisions. The review will include at a minimum the following:

- Matters arising from the previous review
- Suitability of policies and procedures
- Reports from managerial and supervisory personnel
- Outcome of recent internal audits
- Corrective and preventive actions
- Assessments by external bodies
- Results of inter-laboratory comparisons or proficiency tests
- Changes in volume and type of work
- Client feedback and complaints
- Adequacy of staff, equipment and facilities.
- Personnel including issues and training for new and existing employees
- Quality control activities
- Goals for upcoming year and status of goals from the previous management review

5.6.5 Supporting the annual management review are informal review meetings held roughly on a weekly basis with primary focus on:

- NCR reviews
- Internal and external audit findings
- PT test results
- Issue resolution where coordination with non-technical elements of the lab are required (IT, project management, sales, etc.).
- Internal audits are performed to ensure that all aspects of the QA program are implemented in the laboratory. The QA Manager reviews all information pertaining to the quality system and notes any areas of nonconformance. In addition, observations may be documented in the report. Observations are issues that while compliant with state regulation, TNI standards and GCAL's quality system, have the potential to develop into nonconforming conditions in the future. Areas where the analyst's performance exceeds expectation will be noted in the report. The report is prepared based on the audit findings and is distributed to management in a timely manner. The report findings are discussed with the appropriate laboratory personnel and department supervisor so that a concerted effort can be made to correct any non-conformances as well as to provide positive feedback. At a minimum, the QA Manager or designee will review the following aspects of the program annually:
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- Bench sheets required for the analytical procedure
- Traceability of stock and working standards and reagents.
- Records such as certificates of analysis for reagents and standards, certificates for support equipment, maintenance records, etc.
- Preventive maintenance
- Proficiency Testing
- Training Records
- Project Management
- Report Generation
-
- When the findings or nonconformances identified during an internal audit cast doubt on the validity or accuracy of a test result, GCAL will initiate the corrective action process and begin an investigation to determine the cause. During the investigation analytical results will be reviewed to determine the effect if any on the data. If any finding casts doubt upon validity of results, Project Management will notify client within 15 calendar days.
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scope of accreditation readily available for review by the assessor or assessment team. Client confidentiality will be maintained throughout the assessment process. The QA Manager coordinates and monitors all on-site assessments, reviews all findings, issues a corrective action plan, and follows-up to ensure agreed changes are implemented. All documentation pertaining to an assessment will be kept on file in the QA/QC Department.

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- Suitability of policies and procedures
- Reports from managerial and supervisory personnel
- Outcome of recent internal audits
- Corrective and preventive actions
- Assessments by external bodies
- Results of inter-laboratory comparisons or proficiency tests
- Changes in volume and type of work
- Client feedback and complaints
- Adequacy of staff, equipment and facilities.
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- NCR reviews
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- Issue resolution where coordination with non-technical elements of the lab are required (IT, project management, sales, etc.).

5.7 Nonconformance / Corrective Actions

A nonconformance is any indication or judgment that a product or service has not met the requirements of the relevant contract specification, GCAL-QMS goal, standard requirement, or regulation. It is the state of failing to meet requirements. Corrective action is the action(s) taken to eliminate the cause(s) of existing non-conformance and to prevent recurrence. Nonconformance identification and corrective action are an integral part of GCAL's plan for quality assurance in sample analysis. Every attempt is made by laboratory staff to comply with any requirements set forth in methods, SOP's, GCAL's QAM, and client or program-specific requirements.

When nonconformances occur and are not correctable immediately at the bench, the occurrence is documented in the case narrative of the final report and the client is notified of the non-conformance. When errors, deficiencies or out-of-control situations develop, corrective action is initiated. SOP GEN-018 (Corrective and Preventive Action) details GCAL's procedures for identification of nonconforming work and corrective actions. The following non-conformance identification and corrective action programs are used in the laboratory and are described below.

- Laboratory nonconformances and corrective actions are documented using the Corrective and Preventive Action (CAPA) System. Nonconformance sources include customer complaints, performance testing failures, external and internal audit findings, and employee and/or QA group observations. Any GCAL employee who identifies a nonconformance has the authority to initiate corrective action.
- The CAPA process begins with notification of the QA manager, a supervisor or a member of management. The QA Manager initiates the process by creating a Nonconformance Report (NCR). Once initiated, it is the responsibility of the QA Manager to enter the NCR into the CAPA System and to track corrective action to completion. The process of completing the NCR is a joint activity of the QA Manager and the identified subject matter expert for the issue, generally the Laboratory Manager, or designee.
- The process involves root cause analysis (RCA), proposal and acceptance of a resolution, and follow up corrective action (CA) implementation. If corrective action is determined to be unsuccessful, the process is repeated.

NOTE: Select topics require special handling per the QSM 5.1 standards. These topics include fraudulent practices and include deadlines for notification of AB and development of CA. A comprehensive discussion of these special handling requirements, and more details on the NCR/CAPA process can be found in SOP GEN-018.

5.7.1 When identified nonconformances result in a change to reported data, a corrected report is prepared, the client is notified of the change, and the corrected report is submitted to the client. The corrected report file copy is then attached to the top of the original report file copy.

Sample integrity problems determined at login are documented on a Login Discrepancy Form. The form is completed at the time the discrepancy is noted during the login process and forwarded to the assigned project manager. The assigned project manager will contact the client for instructions on how to proceed with the sample. These instructions are documented on the form. If the client's instructions are to proceed with analysis, the project manager will notify sample receiving personnel and the samples will be released for analysis. If the client's instructions state that re-sampling will occur then original samples will be sent for disposal or returned to the client if requested. The Login Discrepancy Form is kept in the report file copy.

5.7.2 On-the-spot or immediate corrective action refers to corrective actions that are taken at the time the nonconformance is identified and usually applies to spontaneous problems, such as an instrument malfunction. This type of corrective action is handled by the analyst at the bench. Any staff member who detects/suspects non-conformance to previously established criteria or procedure in equipment, instruments, data, methods, etc. shall immediately notify the appropriate department supervisor and/or Laboratory Manager. In many cases, the staff member will be able to correct the problem. Acceptable on-the-spot corrective actions are defined in SOPs and documented in the appropriate logbooks. Examples include re-analysis of a failing LCS, re-extraction, etc.

NOTE: Only those QC CA (on-the-spot CA) that are identified to have a root cause capable of continued repetition outside a given batch route into the CAPA process described in SOP QA-018.

5.7.3 Prep non-conformances are documented on a Re-extract Form and are logged and tracked in a controlled logbook maintained in the QA/QC Department. Reasons for prep batch re-extraction can include method blank failures, LCS failures, and surrogate failures.

5.7.4 If the result of a corrective action or audit cast doubt on the validity of a sample result, the client must be notified within 3 business days. Client notification and further instructions must be documented.

5.8 Customer Inquiries / Complaints

5.8.1 Customer inquiries are received by project managers. If the inquiry requires follow-up action, the project manager enters the necessary information into the Client Inquiry Database. The inquiry is then sent to the supervisor of the lab or to a member of management for investigation. Following the investigation, a response is recorded in the database and the client is notified of the outcome of the investigation. This investigation can include a complete review of the raw data and re-analysis of the sample if applicable. If the inquiry uncovers a lab error and involves further corrective action, the project manager then submits a request to the QA/QC Department for initiation of a Nonconformance Report (NCR) as specified in GEN-018 (Corrective and Preventive Action). At this point, the corrective action is turned over to the QA/QC Department for follow-up and review. If required, the final report is re-issued with the appropriate corrections. The report is marked as resubmitted and the reason for the re-submittal is documented in the case narrative.

5.8.2 The employee that receives a customer complaint forwards the details of the complaint to the QA manager. The details of the complaint must include at a minimum the client/customer, date of complaint, and a description of the issue. The responsible party is identified. The complaint details and the associated corrective action form are sent to the appropriate employee for resolution. Complaints are handled as corrective actions in accordance with SOP GEN-018 (Corrective and Preventive Action).

5.9 Service to Clients

GCAL will seek feedback, both positive and negative, from customers in an effort to identify areas where improvement is needed. The customer satisfaction questionnaire will be hosted on a third party site and maintained by the Client Services Supervisor. This feedback will be used to improve our quality system, testing activities, and service to our clientele.

5.10 Management of Change (MOC) Process

Changes in laboratory name, ownership, location, personnel, facilities, methodology, or any factors significantly affecting the performance of analyses for which the laboratory was originally accredited shall be reported to GCAL's Accreditation Bodies (AB) within 30 days. Changes to the Quality system, either temporary or permanent, are documented and maintained by appropriate means.

5.10.1 Controlled documents such as the QAM and accredited method SOPs will be reviewed annually and revised when necessary. This will be documented through the use of a revision number, approval date on each document as referenced in QA-001 (Document Control and Control of Records). Approval signatures for SOPs are located on the cover page. The QAM approval signatures are located on the front page of the document. The SOP will include a document review and revision history. Notification of Updated SOP form will be used to document that employees are aware that an SOP has been updated and by signing the form agree to follow the revised/updated SOP.

5.10.2 Any requested change to the LIMS must have approval from the appropriate supervisor, manager and management. Changes to the LIMS will be made in a test environment and must be completely functional (de-bugged) before the change can be implemented. Employees will be notified of changes to the LIMS and trained on said changes.

5.10.3 All significant changes to Laboratory equipment must be reported to the QA Department when purchased and before being placed into service to ensure the appropriate external agencies are notified if required.

5.10.4 All changes in personnel must be reported to the QA Department as they occur. The QA Department will evaluate the impact of the change to the Quality System and notify appropriate regulatory agencies if necessary.

5.10.5 Significant changes to the Quality Management System that require long-term planning may be documented and tracked to completion utilizing the Corrective and Preventive Action (CAPA) System. See GEN-027 (Management of Change) and GEN-018 (Corrective and Preventive Action).

6 DATA DOCUMENTATION, VALIDATION, AND REPORTING

Internal data validation is performed to check data integrity and to verify that the data is correct and of an acceptable quality. Data integrity involves reviewing all documentation for errors and mistakes. It includes review for correct documentation of sample ID's, verification that holding times were met, transcription errors, correct calculations, complete records, and for acceptable chain of custody documentation. A review of the data is performed to verify the results and to assure that all QC is within acceptable criteria. The data is reviewed according to the method specified criteria and according to the client specific project requirements. The reviewer will identify unacceptable data and initiate the appropriate corrective actions. The documentation of data shall be performed in a manner that allows for the historical reconstruction of results by internal or third party validators.

6.1 Recording Data

All raw data is stored electronically, recorded in bound log books and/or by instrument printout. This includes calibration, LCS, matrix spikes, duplicates, reagent blanks, calculations, dilutions and any notations concerning a given analysis. If data are recorded by hand, it must be done in ink. It is inappropriate to have pencils, erasers, or correction fluid at the bench for any reason. Data are kept either as hardcopy, electronically, or both. All instruments with audit trail capabilities will have the audit trail function turned on. Computers used in data capture and instruments capable of password protection will be password protected. Log books used in the laboratory for data capture will be controlled. QA/QC Department is responsible for creating and archiving log books. If changes or corrections are necessary to either hard copy or electronic data, it must be performed in a way that maintains the original observation and the integrity of the data. Changes made to hard copy data will require the analyst to use a single line strike though, initial and date, and the reason for the correction if other than transcription error. If the record does not allow space to clearly show the change, write it in the comments section of the log book or at the bottom of the page. If electronic files must be changed, the file must be renamed so that the original data is not lost. Reasons for doing so must be documented in the comments section of the run logs. At no time shall data be obliterated or deleted for any reasons.

Electronic data is backed up and protected by the IT Department. All schedules and procedures are fully documented in IT SOPs.

6.2 Data Reduction

Data reduction includes all activities that convert instrument/computer responses into reportable results. This involves all calculations and compound identification. Final results are obtained by direct reading from the instrument or calculations based on instrument readings, output, or responses. Manual data reduction is performed by calculating results with the appropriate formula. Manually entered information is reviewed for accuracy on the hard copy. Computer data reduction requires that the analyst verify information used in final calculations is entered accurately. The analyst must also review the raw data for properly identified components, possible interferences, confirmation requirements, and acceptable integrations.

6.3 Data Review

6.3.1 All data undergoes an extensive review process. The analyst performs the first level data review and validation. Data is uploaded or manually entered into the LIMS. The first level reviewer will verify that:

- The calibration meets SOP and or project criteria and frequency, and the calibration supports the required detection limit.
- All reagents and standards used are within expiration date.
- The method blank meets acceptance criteria.
- The appropriate QC has been performed and meets acceptance criteria.
- Dilutions were performed as necessary, and the reason documented.
- There isn't anything unusual about the sample that is affecting the data. This includes submitted duplicates that are obviously different, presence of interference, analysis past hold time, etc.
- All documentation is complete and accurate.

Refer to SOP QA-002 (Data Reduction / Validation) for more details on analyst review.

It is the analyst's responsibility to document any problems and communicate these to the department supervisor. An analyst is not authorized to continue with an analysis if the calibration or QC results do not meet the acceptance criteria established by the SOP or project without documented approval by the department supervisor or member of management.

6.3.2 Second Level data review and validation is performed by the department supervisor or their designee. Data is validated in the LIMS. The second level reviewer will verify:

- That the data meets SOP and/or project requirements, including acceptance criteria, frequency of calibrations, frequency of QC samples, and detection limits.
- The data for the analytical group is logical. For example, nitrite is not greater than nitrate + nitrite.
- That all calibration or QC failures are clearly described in the batch exception reports. This includes descriptions of allowed failures such as the number of marginal exceedances allowed for the LCS.
- That dilutions are described in the batch exceptions report.
- That times and dates are logical and correct.
- That documentation is accurate and complete so that the data can be reconstructed based on the information provided.
- That the appropriate standards and reagents were used for their intended purpose.

- That data is consistent with historical results when available.
- That calculations are correct.
- That manual integrations are appropriate and documented.

Refer to SOP QA-002 (Data Reduction / Validation) for more details on second level supervisor review.

6.4 Data Validation

After the complete package is assembled, the Director of Data Deliverables or designee will review the data. The level three reviewer will verify:

- That the correct package has been prepared.
- That the package is complete and includes all requested analysis, forms, reports, chain of custody, and raw data as appropriate.
- That project specific data quality objectives and/or GCAL's requirements have been achieved.
- That exceptions and any information that can impact the data are clearly identified in the case narrative.
- That data is flagged appropriately and that the data flags are clearly defined.
- That raw data and data reports are consistent.
- That all samples associated with the report have been analyzed and that the sample IDs are correct.
- That reporting limits are supported by the calibration.
- That dilution schemes are justified and correct.
- That all calculations are correct.

6.5 Data Reporting

Hardcopy and electronic reports are the products of GCAL. It is therefore imperative that the report accurately and completely reflects the results determined by the lab. Any modifications or departures from GCAL's SOPs will be clearly communicated in the report through the use of data qualifiers and the case narrative.

When all requested analyses have been reviewed and validated by the supervisor(s) a preliminary report may be sent via e-mail if requested by the client. The preliminary report is subject to change if the third level review of the data indicates an issue. The client will be notified of any changes in the preliminary report as soon as changes are identified and the report corrected. The final report will then be printed. GCAL has the capabilities to produce several levels of reports and electronic data deliverables. These include a LIMS report with batch QC, a CLP like forms package, a full CLP like deliverable package, and various other formats. The client specifies the level of reporting when the samples are submitted.

The QA Manager's designees, which is the Director of Data Deliverables or a member of their staff, must review 100% of all final reports in real time for technical completeness and accuracy during the management review. Once signed, it is the responsibility of the project manager to verify that the report level is correct and that the report has been signed prior to release to the client. After final approval, various electronic data deliverables can be produced to submit data electronically. Refer to SOP LAD-003 (Report Generation) and LAD-020 (Report Validation) for more details on assembling and reviewing final reports.

6.5.1 All test reports include the following:

- A cover page that includes a title, "Analytical Results", name, address, and telephone number of the laboratory, work order number which uniquely identifies the report, and the name and address of the client, contact, and project name, and NELAP certificate number,
- GCAL contact person for questions,
- Sequentially numbered pages with the total number of pages written in the Laboratory Endorsement page, or numbered as # of # (for example 1 of 50),
- Signature of Director of Data Deliverables or designee,
- Statement that the report relates only to the samples reported,
- Statement that the report shall be reproduced only in full and with the written permission of GCAL,
- Case narrative indicating any anomalies, method or QC failures during sample analysis,
- A report sample summary including the sample ID, lab ID, matrix, and collection and receipt date/time.
- The test results that include prep and analytical methods, prep and analysis date and time, prep and analysis batch, weight or volume of sample prepped/analyzed, units, indication of dry weight correction where applicable, results, reporting limits, and data qualifiers,
- QC summary with qualifiers as appropriate, and
- Chain of custody, log-in check sheets, and log-in discrepancy form where applicable.

6.5.2 Additional information shall be provided to clients when requested through reports. This information includes:

- Copies of raw data and logbook entries for submitted analysis,
- Instrument calibration summary and raw data,
- Detection limits,
- Summaries for surrogate recoveries, internal standards, instrument tune, and method blank summary,
- Manual Integration Summary
- Additional information as requested.
- Identification of sub-contracted work.

6.6 Sub-contracting

Laboratories that GCAL sub-contract to will be reviewed with an emphasis on their overall quality control practices and compliance to GCAL's quality assurance requirements. GCAL bears the responsibility for all sub-contracted work performed by a sub-contractor selected by GCAL Management. Any laboratory used for subcontracting must be certified or accredited if required for the project and documentation of such must be kept on file. The QA/QC Department or project manager will submit a request to the subcontractor to provide verification of certification or will notify the appropriate accrediting authority to verify certification. Project requirements must be communicated to the sub-contracted lab in a timely manner. Subcontract reports are incorporated into the GCAL report before issuing to the client. GCAL will facilitate any client comments or complaints regarding sub-contracted data. The sub-contract laboratory must have successfully completed an assessment and maintain current accreditation to the DOD Environmental Laboratory Accreditation Program (ELAP) for use in all DOD work. The sales representative and project manager verifies compliance with the DOD QSM or other project criteria before the start of the project. Records of compliance must be supplied by the sub-contracted lab and kept on file. If testing is sub-contracted to another laboratory, the client will be notified in writing.

6.7 Data Storage

All written and printed records are scanned and stored on hard disk free from magnetic sources at the GCAL site, as well as, copied to Amazon S3 cloud storage daily. All electronic data is backed up on-site and off-site as well as replicated to a co-location daily. Electronic data greater than 10 years of age is deleted from the local site and kept only in cloud storage. Data removed from the local site can be reloaded from cloud storage by submitting a request to IT. It is the goal of GCAL to have redundant copies (hard and electronic) to prevent loss of records due to records being misplaced, environmental deterioration or catastrophe. All archived reports, bench sheets, logbooks, electronic printouts, corrective actions, PT results, training records, and other QA/QC reports are stored on-site until capacity is met. The oldest archived data is then moved to a secure storage facility. The storage and on-site facility are monitored and protected from fire and theft. The safety/compliance officer keeps safety and disposal records. The Human Resources department is responsible for keeping personnel information in controlled files.

See SOP -QA-007 (Data Archive) for additional information.

7 FACILITY DESCRIPTION AND EQUIPMENT

7.1 Laboratories Facilities

GCAL is a full service environmental laboratory. The laboratory was established in 1978 with a staff of two and has grown to its present size of over 75 employees operating in a modern laboratory space of 22,000 square feet.

The laboratory's working areas are subdivided into areas for instrumental analysis, general chemistry, and sample preparation. These areas are designed to allow for a safe working environment with special attention having been given to ventilation, airflow patterns and environmental controls. Administrative and Marketing areas are located for optimization of supervision and to allow for efficient handling of paperwork and results. The laboratory is protected by a video monitoring system and fire monitoring system. A floor plan of the facility is included in Appendix D (Facility Floor Plan).

7.2 Procurements and Inventory Control

Chemical reagents, solvents, gases, glassware and general chromatographic supplies are ordered as needed to maintain sufficient quantities on hand for use. Purchase orders are maintained as an inventory control of materials ordered by the laboratory. All orders are processed through receiving and routed to the appropriate departments. Routine supplies are maintained on site in an inventory control stock room.

The purchase of analytical instrumentation is based on anticipated sample volume and the need to maintain superior quality data. Specifications are carefully examined to be sure new instrumentation meets current and anticipated needs. Warranty and service contract information is gathered at the time bids are reviewed and this information is considered in making the final selection. An extensive performance check-out before the instrument is accepted is mandatory. New equipment must undergo a rigorous method validation before being put into production. Operators of new instruments are sent to training courses if necessary.

7.3 Capitol Equipment

Laboratory equipment and instrumentation are maintained in compliance with instrumentation manuals. Inventory records are maintained for all major capital equipment. All equipment is kept in working condition to allow for conformity to each approved method; service contracts are maintained as needed. A list of instrumentation and equipment is maintained by the QA/QC Department and is included in Appendix C (Analytical Instrumentation).

7.4 Equipment Operation and Calibration

7.4.1 The calibration of instruments and support equipment is required to ensure that the analytical system is operating correctly and functioning within acceptable precision, accuracy and sensitivity limits. Calibration is defined as the systematic determination of the relationship of the response of the measurement system to a known standard. The calibrations or calibration checks are performed with reference standards traceable to primary standards (e.g. NIST or other certified standards). If traceable chemical standards are not available, standards are prepared according to the laboratory quality control procedures or the project's requirements. The calibration requirements for each type of equipment or instrument are defined in theSOP’s. Additionally, specific requirements are defined in a project plan. Table 6-1 summarizes the calibration requirements of the lab.

7.4.2 It is the responsibility of the analyst to verify that the instrument configuration and operating conditions used satisfy the analytical requirements and to maintain quality control data confirming instrument performance and analytical results. The inability to achieve satisfactory calibration is an indication that the equipment may require maintenance. It is not acceptable for an analyst to repeat analysis of calibration or QC standards beyond what is allowed by the SOP until “acceptable” results are achieved.

7.4.3 If equipment outside the permanent control of the laboratory is used, it must meet the same criteria. The laboratory shall ensure that the function and calibration status of the equipment is checked and shown to be satisfactory before it is put into service.

7.5 Equipment Maintenance

Maintenance is defined as cleaning and/or replacing equipment components to assure that the equipment has been properly and periodically serviced and is in satisfactory condition. The equipment manual is a good guideline to determine preventive and routine maintenance schedules. These manuals also assist in identification of commonly needed replacement parts so that an inventory of these parts can be properly maintained.

7.5.1 A maintenance log is issued for each piece of equipment. It shall be maintained by the analyst to describe problems, the maintenance performed on the instrument and outcome. This includes routine service checks by laboratory personnel (unless described in the SOP) as well as factory service calls. This log also provides a written source for future use in preventive maintenance.

7.5.2 In order to prevent system down time, minimize corrective maintenance cost and to help ensure data validity, GCAL uses a system of preventive maintenance. All routine maintenance is performed as recommended by the manufacturer and documented in logbooks. Maintenance contracts are purchased as appropriate. This ensures preventive maintenance visits by factory authorized service representatives and immediate service for corrective actions if required. See GEN-012 (Equipment/Instrument Preventive Maintenance and Troubleshooting).

7.5.3 When a piece of equipment is deemed defective, it is taken out of service and identified with an "OUT OF SERVICE" label that includes the date the equipment was taken out of service. For support equipment such as balances, ovens, coolers, and pipettes, the QA/QC Department is notified so that repair can be scheduled. Analysts perform routine and preventive maintenance for instruments and document the maintenance in the appropriate equipment log book. If outside service is necessary, the Department Supervisor schedules the service with approval from the Laboratory Manager. Satisfactory instrument performance must be verified prior to returning to service any repaired equipment. See GEN-012 (Equipment/ Instrument Preventive Maintenance and Troubleshooting).

7.5.4 Table 6-1 is a list of analytical and support equipment calibration frequencies. In addition to the stated frequencies, calibrations are performed prior to first use and upon evidence of deterioration. Refer to SOP GEN-023 (Laboratory Monitoring of Support Equipment) for more details.

Table 7-1 Equipment Calibration

Equipment	Calibration*	Frequency
Analytical Instrument	Traceable standard	Each day of use or as required by analytical SOP
Thermometers	NIST Thermometer	Annually (Mercury), Quarterly (Digital)
NIST Thermometer	Certified off-site	As required by certificate
Balance	Certified weights	Each day of use, certified semi-annually
Weights	Certified off-site	As required by certificate
Adjustable pipettes	Weight	Each day of use
Non-standard lab ware	Weight	By lot
Non-class A volumetric	Weight	Quarterly
Agitators (TCLP, SPLP)	Stop watch / Count	Monthly

* Acceptance criteria are included in log books used to document verification or may be found on the certificate affiliated with the thermometer, weights or stop watch.

7.6 Reagents

7.6.1 All solvents used for preparation of standards must be of acceptable purity to not interfere or invalidate the test. Purity of reagents must meet the reference method requirements and must not invalidate the test as shown by the acceptability of method blanks.

7.6.2 Reagents must be stored as recommended by the manufacturer, and must be disposed of after the expiration date. If no expiration date is supplied, label acids and bases for five years from receipt, and other reagents as one year from receipt.

7.6.3 Neat chemicals must be stored as specified by the manufacturer, and must be disposed of after the expiration date. If no expiration date is supplied, label the neat chemicals for 10 years from receipt.

7.6.4 All reagents must be in labeled bottles with the date of receipt and date opened marked in permanent marker.

7.6.5 Reagent water is available throughout the lab. GCAL uses de-ionized water. In addition, for ICP-MS analysis the DI water is treated using a UV system to further enhance water quality. GCAL has two supply systems that provide water throughout the facility. The water conductivity is monitored daily at one of the stations for each of the supply systems. Should the conductivity fail acceptance criteria at any one of the stations for a supply system, the entire system will be taken out- of- service. Indicator lights on the DI system are monitored each morning and the service provider will be notified when service is necessary.

7.7 Standards

Preparation of standards for calibration or QC must be made from materials of known purity, (98% or better preferred) or from purchased concentrates certified by NIST, EPA, or other acceptable agencies.

7.7.1 An expiration date of one year from the date received will be assigned to all stock standards without a manufacturer's specified expiration date. Upon receipt into the laboratory, a unique identification number (ID) is assigned to the standard. The following information is recorded on the standard container: laboratory assigned ID, standard name, concentration, initials of the analyst opening the standard, date opened, and expiration date. All other information regarding the standard including lot number, the analyte purity, expiration date, concentration, must be entered in the standards log maintained by the QA/QC Department.

7.7.2 Preparation of intermediate or working standard solutions is necessary for many analyses. These working standards include calibration standards, spiking solutions, surrogate solutions, internal standard solutions, etc., and must be stored as suggested by the manufacturer when not in use. Working standards for the analysis of volatile organic constituents must be prepared every two weeks or more often if required by the method or if performance is compromised. Working standards for the analysis of semi-volatile organic constituents and pesticides are prepared as needed and expire 6 months from the date prepared or no later than the expiration date on the stock standard whichever is sooner. Working standards expiration dates cannot be longer than the expiration date of the parent standard or reagents used. Standard expiration may be extended by approval of the QA Manager in an emergency. Acceptable performance must be demonstrated and documentation kept on file.

7.7.3 The identification of each standard prepared must be unique and all documents related to sample analysis in which the standard was used must contain this unique identification. The documentation shall be such that traceability of all standards and reagents used is maintained and can be related to raw data from sample analysis.

7.7.4 Freezers and refrigerators are designated for storage of standards. Samples are not stored with standards. Refrigerators or freezers used for storage of standards or samples are monitored for temperature compliance seven days a week. Refrigerators are maintained at 0-6°C. Freezers are maintained at ≤ -10°C.

8 ANALYTICAL METHODS

GCAL utilizes methods of analysis that provide evidence of analyte identification, separation from interfering substances, limits of measurement appropriate to that of analyte concentration and reasonable measures of precision and accuracy of the data obtained. Reference methods are noted in the SOP References Section when applicable. Analyses will be performed in accordance with the methods cited herein unless specific project requirements or needs dictate adoption of an alternate method or modification of the cited methods. Modification of a method due to sample matrix shall be discussed with and authorized by the client and documented in the narrative section of the final report.

If analysis is performed in an alternate manner, the method shall be documented. Documentation is dependent upon the specific instrumentation and data collection and reduction methods used within the lab. Methods used directly from official or standard procedures are referenced as such. Routinely used procedures are available in each department and are also available electronically. Official protocols are used when required or requested.

8.1 Method Validation

Before the performance of methods for reporting to client, each method must be validated. This shall include achieving acceptable calibration and a demonstration of capability.

8.1.1 Every instrument used to determine results for client samples or QC shall be appropriately calibrated daily before each use. Calibration shall include an initial calibration and continuing calibration as defined in the reference method and described in the SOP. Acceptable performance as defined in the reference method/SOP shall be demonstrated before proceeding with sample analysis. Initial calibrations are verified using an independent standard. Additionally, the following shall apply to all calibrations performed:

- Raw data shall be retained to allow reconstruction of the calibration and process to reduce instrument response to concentration. Records shall also include the analyst, date performed, and instrument.
- Samples and QC shall be quantitated using the initial calibration unless the cited method uses alternative procedures.
- The calibration range shall define the working range of the instrument with the exception of metals analysis. For all other analysis the low level standard defines the lowest reporting limit (PQL or LOQ) that is reported to a client. Sample results exceeding the concentration range (or linear range for metals analysis) shall be diluted.
- The analyst is allowed to drop points out of a calibration curve at the high and/or low ends of the calibration curve if the minimum number of points and the project required detection limits are maintained. Points shall not be removed from the middle of a calibration unless there is a documented reason. The analyst is allowed to re-analyze and replace the suspect point within the same analytical batch or remove the point for all analytes with approval from the QA Manager, Technical Director or Laboratory Manager.

8.1.2 Before the implementation of a test method or analyte to a test method, a satisfactory demonstration of method capability is required. This shall include the analysis of four LCS samples with acceptable accuracy and precision. Accuracy and precision is generally defined in the test method. Thereafter, each analyst shall perform a demonstration of capability as part of their initial training and annually. This demonstration shall include acceptable performance in one of the following:

- Acceptable performance of a blind sample;
- An initial demonstration of capability as defined by SOP QA-014 (Demonstration of Capability); or
- If the first two cannot be performed, analysis of samples with results statistically indistinguishable from a trained analyst.

All demonstrations shall be documented on the certification statement form and maintained in the analyst’s training filed by the QA/QC Department.

8.1.3 Detection Limit studies are performed during initial method development, whenever a new instrument is placed into service, and if changes are made to the procedure or instrument that may affect sensitivity.

8.1.4 Limit of Detection (LOD) study is performed following each DL determination and quarterly per instrument, method, and matrix including any confirmation column or detector. Alternately, for infrequently performed tests, the LOD may be performed on a per-batch basis.

8.1.5 Limit of Quantitation (LOQ) study is performed quarterly per instrument, method, and matrix including any confirmation column or detector. Alternately, for infrequently performed tests, the LOQ may be performed on a per-batch basis.

8.1.6 See SOP QA-009 (Determining Detection and Quantitation Limits) for a full description of DL, LOD, and LOQ requirements.

8.1.7 Precision and accuracy of measurement shall be monitored as an ongoing method validation measure. Control charts shall be generated at least annually and control limits monitored and compared to method or laboratory historical limits. A copy of the control chart shall be kept on file in the QA/QC Department

8.2 Methods Outside of Scope of Accreditation

Occasionally a client will request analysis for informational or non-regulatory purposes. Work outside of the scope of accreditation does not require validation in the same manner as other analysis. Method development will be discussed with the client to meet the client's needs. A letter stating the intent of the work shall be obtained from the client and kept on file.

Reports issued outside of the scope of accreditation shall be identified. This identification shall include either the removal of the appropriate certification graphic (i.e., LELAP, DOD ELAP, etc.), or in the case of a mixed report, those methods outside of the scope of accreditation shall be clearly identified in the case narrative.

8.3 Review of New Work

For the laboratory to perform additional work within its scope or to expand its scope of testing a thorough review must be undertaken. Laboratory management considers available resources and current and pending workload prior to accepting new work. It is the responsibility of the Laboratory Manager, with input from the Technical Director, and department supervisors to assess the ability of the laboratory to accept new work. Before new work is accepted the QA Manager must assess the accreditation needs and obtain all necessary certifications. GCAL's procedures for review of requests, tenders, and contracts are outlined in SOP GEN-024 (Review of Requests, Tenders, and Contracts).

8.4 Analytical Methods

A list of methods under which the laboratory performs its accredited testing is listed in the following table.

Organic Tests Performed	
Analyte (Parameter)	**Method**
Aromatic Volatile Organics	8021B 602
Explosives	8330A and 8330B
Organochlorine Pesticides	608 8081B
PCBs	8082A
TPH-GRO	8015C
TPH-DRO	8015C
TPH-ORO	8015C
Petroleum Range Organics	FL-PRO
Total Petroleum Hydrocarbons	TX1005/TX1006
Extractable Petroleum Hydrocarbons	MADEP EPH
Volatile Petroleum Hydrocarbons	MADEP VPH
Organophosphorus Pesticides	8141B
Chlorinated Herbicides	8151A
Dissolved Gases	RSK175
Semivolatile Organics	625 8270C, 8270D
Volatile Organics	624 8260B, 8260C
SIM Semivolatile Organics	8270C, 8270D
Solvents	8015C
Alcohols	8015C
Perfluorinated Organic Compounds	537
Extractions and Preparations	
TCLP	1311
SPLP	1312
Separatory Funnel	3510C
Liquid/Liquid	3520C
Ultrasonic	3550C
Waste Dilution	3580A
Soxhlet	3540C
Purge and Trap	5030B, 5030C
Closed System Purge and Trap	5035A

Inorganic Test Performed	
Analyte (Parameter)	**Method**
Metals	
Trace Metals ICP-MS Mercury CVAA	200.8 6020A & 6020B 245.2 7470A 7471B
Metal Preparation Methods	
Acid Digestion Aqueous ICP-MS	200.8 3010A
Acid Digestion Solids	3050B
General Chemistry	
Acidity	2310 B
Alkalinity	2320 B
Ash	D482
BOD/BODC	5210 B
Bromide	300.0 9056A
BTU-Heat of Combustion	D240
Cation Exchange Capacity Saturated Paste Sodium Absorption Ratio Electronic Conductivity Exchange Sodium Percentage Leachable Chloride Test True Total Barium Leachable TPH Test	LADNR 29B
COD	HACH 8000
Chloride	300.0 9056A 9251
Residual Chlorine	4500-Cl G
Fecal Coliform	9222D
Color	2120 C
Conductivity	2510 B 9050A
Corrosivity Toward Steel	1110A
Cyanide -Total -Amenable to Chlorination	 335.4 9012B 335.4 9012B

Inorganic Test Performed	
Analyte (Parameter)	**Method**
Fluoride	300.0 9056A
Hardness Calculation	2340 B
Ignitibility	1010A 1030
% Moisture	2540 G
Nitrogen	
-Ammonia	4500-NH_3 B/D
-Kjeldahl	HACH 10242
-Nitrate	300.0 9056A 353.2
-Nitrite	300.0 353.2
-Total Nitrate/Nitrite (N+N)	
Oil and Grease	1664A 9071B
Oxygen, Dissolved	4500-O G
Paint Filters Liquid Test	9095A
Phenolics	420.1/420.4 9066
pH	4500-H^+ B 9040C 9045D
Phosphorus	
-Orthophosphate	4500-P E
-Total Phosphorus	365.1
Reactivity	
-Cyanide	7.3.3.2/9012B
-Sulfide	7.3.4.2/9034
Silica, Dissolved	4500-SiO_2 C
Solids	
-Total Dissolved	2540 C
-Total Suspended	2540 D
-Total Solids	2540 B
-Total Volatile Solids	2540 E
-Volatile Suspended Solids	2540 E
-Settleable Solids	2540 F
Specific Gravity / Density	2710 F
Sulfate	4500-SO_4 E 300.0

Inorganic Test Performed	
Analyte (Parameter)	**Method**
	9038 9056A
Sulfide	4500-S_2 D 4500-S_2 F 9034
Sulfite	4500-SO_3 B
Surfactants (MBAS)	5540 C
Total Organic Carbon (TOC)	5310 B 9060A
Turbidity	180.1 2130 B
Sample Preparation Procedures	
Alkaline Digestion Cr^{6+}	3060A
Bomb Prep Method for Solid Wastes	5050
Distillation Sulfides	9030B

9 SAMPLE CUSTODY AND INTEGRITY

GCAL utilizes a Laboratory Information Management System (LIMS) that was specifically developed for the needs of environmental laboratories. Horizon© developed by Chemware, Inc., tracks samples and data throughout the laboratory. Results are available from the LIMS in a variety of hard copy formats. Furthermore, web access can be provided to clients who wish to view their data. A password security system prevents clients from viewing any data other than their own.

The following is an example of some of the information that is entered into the system:

1. Sample number (unique to this sample)

2. Job number (unique to this job or set of samples)

3. Date received

4. Time received

5. Date analytical results due

6. Sample description

7. Customer's name

8. Customer's address

9. Project Name

10. Storage location

11. Notation of any special handling instructions or priority assignments

12. Billing information - purchase orders

13. Analyses requested

GCAL understands that sample integrity is a vital part of quality assurance. Samples submitted to the laboratory shall be logged in immediately, or other action taken to preserve integrity of the sample until it can be logged into the system. Any sample that is suspected of being contaminated, improperly stored or preserved, or improperly prepared, shall be reported to the client immediately. Storage blanks located in the volatiles refrigerators are analyzed every two weeks. Records of these analyses are maintained in the GC and GC/MS Volatiles laboratories.

After the sample analyses are complete and the final report is issued to the client, samples are held for 60 days from receipt before disposal. Samples are held longer per the customer request. GCAL does not accept evidentiary samples.

9.1 Sample Acceptance Policy

Delivery of samples to GCAL shall constitute acceptance by Client of GCAL's Terms and Conditions. Until GCAL accepts delivery of samples by notation on a chain of custody document, or otherwise in writing, GCAL is not responsible for loss of or damage to samples. GCAL, at its sole discretion, reserves the right to refuse or revoke Acknowledgment of Receipt for any sample due to insufficient sample volume, improper sample container, or risk of handling for any health, safety, environmental, or other reason. GCAL does not accept samples that contain asbestos, biohazards, or radiological materials. Regardless of prior acceptance, GCAL may return samples at its sole discretion if it is determined that the samples may pose a risk in handling, transport or processing, for any health, safety, environmental or other reason. GCAL also reserves the right to return excessive sample volume to the Client, at the Client's expense.

Samples not consumed in testing will normally be retained for a maximum of sixty (60) days before disposal. Samples will be returned to the Client when requested in writing or when they would pose a disposal problem as a hazardous waste as determined by GCAL, at its sole discretion. The cost of returning samples will be invoiced to the Client. GCAL, in its sole discretion, may also agree in writing to retain samples at a monthly storage charge, agreed upon and payable in advance.

If the Client is ordering the work on behalf of another, the Client represents and warrants that the Client is the duly authorized agent for the purpose of ordering and directing said work unless otherwise stated in writing, and accepted by GCAL.

Sample acceptance policy is available electronically upon request.

9.2 Chain of Custody

Each sample when submitted to GCAL is accompanied by a Chain of Custody form. These forms contain pertinent information about the sample including specific analytical requests, sampling notes, sample condition, customer name and address.

Additionally, information concerning the site name, field identification marks, date and time of collection, sampler signature, and preservation data is recorded.

Samples are labeled, preserved if necessary and stored appropriately (i.e. refrigerator, freezer or shelf). Samples to be analyzed for volatile organic compounds are stored in refrigerators located in the volatile organic analytical laboratories.

9.3 Internal Chain of Custody

Sample labels include a bar code. All samples must be scanned each time custody of the container is transferred. This information is stored in the LIMS, and includes a complete record of the sample custody from receipt to disposal. Information includes the location of the sample, the date and time of each custody transfer, unique initials of each person assuming custody, and a reason for the transfer.

9.4 Custody Transfer

If a sample requires additional work to be performed by a qualified outside laboratory, a GCAL chain of custody form is completed and submitted with a representative portion of the sample. A copy of this form is maintained on file. The sub-contracted laboratory must sign and date the COC upon receipt and return it, along with a report once analysis has been completed.

9.5 Sample Kits

Customers will request a sampling kit (bottles, vials, etc.) with which to collect samples. Sample kits are prepared according to SOP SAD-003 (Sample Kit Preparation). Chain of Custody (COC) forms are sent with the kit to ensure proper sample custody. The COC form is completed at the time of sample collection and is returned with the samples.
A laboratory file is maintained listing sample kits prepared for clients. It contains the client name, address, form of delivery, preservative (if requested), sample bottle distribution, and analyses to be performed. Additionally, the date the kit is requested, sent and expected arrival date is included, along with any pertinent miscellaneous information.

9.6 Shipping Requirements

The Department of Transportation (DOT) regulations shall be used for packaging and shipment. Shipping containers shall be secured using impact strapping material. Copies of the signed Chain of Custody (COC) forms must be delivered with the containers. Any samples being split with another party must be properly labeled, contain a COC, and be packed and shipped according to DOT regulations. Sample containers which contain chemical preservatives are labeled in accordance with the Global Harmonization Standard.

10 STANDARD OPERATING PROCEDURES

GCAL employs standard procedures for all work performed. These standard procedures ensure that work is completed in a professional and timely manner and that all contractual obligations are met.

Standard safety procedures are also part of GCAL SOP's. Confidentiality and security agreements on all work performed are strictly enforced.

Analytical SOPs must incorporate or reference the following topics:

- Scope and Application
- Applicable matrix or matrices
- Summary of test method
- Definitions
- Personnel Qualifications and Responsibilities
- Interferences
- Safety
- Equipment and supplies
- Reagents and standards
- Sample collection, preservation, shipment, storage and handling
- Quality control
- Calibration
- Procedure
- Calculations
- Method performance
- Reporting and Detection limits
- Pollution prevention
- Data assessment and acceptance criteria
- Corrective action for out-of-control data
- Handling out-of-control data
- Waste management
- Method Modifications
- References
- Tables, Diagrams, Flowcharts

SOPs are reviewed annually and are the basis for internal method audits. If no changes are made to an SOP during review, an SOP review form is completed and appended to the last page of the original SOP kept on file. Refer to SOP QA-001 (Document Control and Control of Records) for document control procedures.

11 SAMPLE HANDLING GUIDELINES

Sample container, quantity or volume, preservation and holding times are specified in SAD-001 (Sample Receiving and LIMS Log-In). Specific information with regards to the Parameters listed can be found in 40CFR Part 136 Tables IA, IB, IC, ID & IE and Table II., SW846 Table 4-1 and Table 3-1, SW846 Method 1311 Section 8.5.

11.1 Waste Collection and Storage

Samples are stored in the appropriate cooler for 60 days after receipt. After 60 days, samples are scanned out for disposal in the LIMS. Samples are then stored in the staging area until disposal. Hazardous samples are returned to the client whenever possible to be disposed of with larger quantities of the sample material. Laboratory waste is segregated by laboratory personnel into waste streams, which have been established by the Safety and Regulatory Compliance Officer. The waste streams are determined by analysis of the waste and through process knowledge. All laboratory wastes are disposed of in the proper container. Waste disposal service is provided by approved vendors who will incinerate, landfill, treat, or reclaim the waste based on the characteristics. See GEN-009 (Waste Collection, Storage and Disposal) for additional information.

11.2 Pollution Prevention

Environmental concerns, risks to employees, the public, and high disposal costs have increased the need and effort of the laboratory to minimize or prevent waste generation. The quantity of chemicals and standards purchased is based on expected usage during its shelf life and the disposal cost of the unused material. The volume of standards and reagents prepared in the laboratory reflect stability and anticipated usage. If possible, methods requiring the use of hazardous chemicals or that produce hazardous waste are replaced with an alternative method. Sample containers are selected based on the minimum volume that is necessary to perform a test, thereby reducing sample waste. Sample sizes are reduced in some cases, therefore reducing the quantities of extraction solvents and reagents.

12 SAFETY PROCEDURES

GCAL has a comprehensive safety program outlined for all employees. A safety manual is distributed to each employee followed by a training seminar to familiarize the employee with the safety procedures at GCAL.

12.1 Basic Safety Rules

1. All injuries are reported to a supervisor or member of management immediately.
2. All hazards are reported to a supervisor or member of management immediately.
3. Running and horseplay are not permitted in the laboratory.
4. Smoking is not permitted in the laboratory. Smoking is only allowed outside of the building in the designated area.
5. Laboratory glassware is not to be used for eating or drinking.
6. Laboratory reagents such as sucrose or sodium chloride shall not be used for food.
7. Eating on the premises is confined to designated areas. Eating is not allowed in the laboratory.

8. Proper personal protective equipment is always utilized. Safety glasses are to be worn in designated areas.
9. Contacts are not to be worn in designated laboratory areas.

12.2 Arrangement of Furniture and Equipment

Furniture is arranged for maximum use of available space while providing working conditions that are efficient and safe.

Aisles are kept at least 4 feet wide to provide for safe passage of personnel and equipment, and are kept free of obstructions.

Stepladders or footstools are supplied for reaching high objects and are kept out of the way when not in use.

Eyewash stations, safety showers and fire extinguishers are located centrally and care is taken to avoid blocking access to them.

12.3 Hoods and Ventilation

Adequate fume hoods with an adjustable sash are installed for personal protection from splash and / or fumes where toxic or flammable materials are handled. Hoods are kept clean, velocities are checked quarterly, and are not to be used for storage.

12.4 Spills

Spilled materials are cleaned up promptly. All spills shall be handled as if corrosive or dangerous unless definitely known to be harmless. Spill Kits are located throughout the laboratory.

Corrosive or toxic materials are not placed in waste cans in the laboratory. When in doubt a supervisor is consulted.

Broken glass is swept up immediately and discarded so as to avoid any injury or cuts.

12.5 Emergency Equipment

Fire extinguishers are centrally located throughout the laboratory. The paths to these are kept free and clear at all times.

An extinguisher that has been used shall not be returned to its holder until it has been recharged and checked.

Any fire that appears to be too large to extinguish immediately is reported to the fire department at once. All fires, regardless of size are to be reported to a supervisor. Causes shall be determined and necessary steps to prevent a similar accident shall be taken.

Eyewashes are located in the laboratories for irrigation of the eyes if corrosive liquids or any other materials are splashed into the eyes. Tubing attached to faucets in the sink shall also be used to wash the eyes if necessary.

Safety showers are centrally located throughout the laboratory and are used whenever corrosive materials are spilled on an analysts' skin or clothing.

All safety equipment is periodically checked to be sure everything is in working order and is easily accessible.

General first aid kits are located throughout the laboratory. These kits contain first aid products for the treatment of minor cuts and bruises, burns or abrasions, and personal discomfort.

12.6 Protective Equipment

Lab coats and aprons are supplied for all employees of GCAL. Protective clothing is available to prevent damage to clothing and persons.

Shoes must be worn at all times and must be closed-toe; high heels or sandals are not acceptable in lab areas.

Eye Protection is mandatory for all personnel working in the laboratory. Safety glasses or goggles shall be worn by analysts to protect the full eye area in designated areas. Placards identifying area that require the use of safety glasses are located throughout the laboratory. Guest visiting the laboratory will be required to wear safety glasses in specified areas.

Various types of gloves are provided for employees: Insulated gloves are provided for use when handling hot or cold items; Heavy rubber gloves are to be used when handling corrosive liquids or unknown substances; Lightweight disposable gloves are provided for use with toxic or irritating substances.

12.7 Storage of Laboratory Materials

All chemicals, reagents and glassware are stored in such a manner that they are easily located and do not present a danger. Heavy items are kept near the floor.

Flammable solvents are stored in solvent cabinets. Only quantities required for immediate use are stored in analytical areas.

Reagents are grouped to prevent danger from hazardous combinations. Acids and bases are stored separately. Oxidizing chemicals are stored away from acids and bases.

Compressed gases are stored away from heat and open flames. Compressed gas cylinders are secured to the wall or cabinet with chains or belts to prevent rolling or toppling. A special cart is used to transport replacement cylinders and empties.

12.8 Chemical and Sample Handling

If there are questions about proper chemical handling the Safety Data Sheet (SDS) is used as reference.

- Samples are always treated as if they were hazardous chemicals.
- Rubber pipette bulbs are used for drawing samples or chemicals into pipettes.
- Procedures that produce flames or toxic vapors are performed under a hood.
- Chemicals are returned to their proper storage area after use.
- All prepared solutions are labeled with the name of the solution, ID number for the solution, concentration, lot number if applicable, date prepared, analyst preparing the solution, and expiration date.
- Acids are always poured into water when diluting.
- Large amounts of alkali are never added to water at one time.
- Glass-stopper containers are not used for storing alkaline solutions.
- Labels for Acid and Caustic solutions must include the concentrations and the lab assigned expiration date.

13 CONFIDENTIALITY

GCAL understands that it must retain in confidence all information obtained through the analysis of samples or the information disclosed to GCAL in order to adequately perform and interpret analytical data.

GCAL will maintain the secrecy and confidentiality of any proprietary information it receives or generates.

GCAL will not submit final analytical reports to anyone other than the client requesting the analytical services or consultation services.

Entities that would like copies of reports released to other parties must provide GCAL with explicit written authorization. Reports will not be released to anyone other than the client without GCAL having first received authorization.

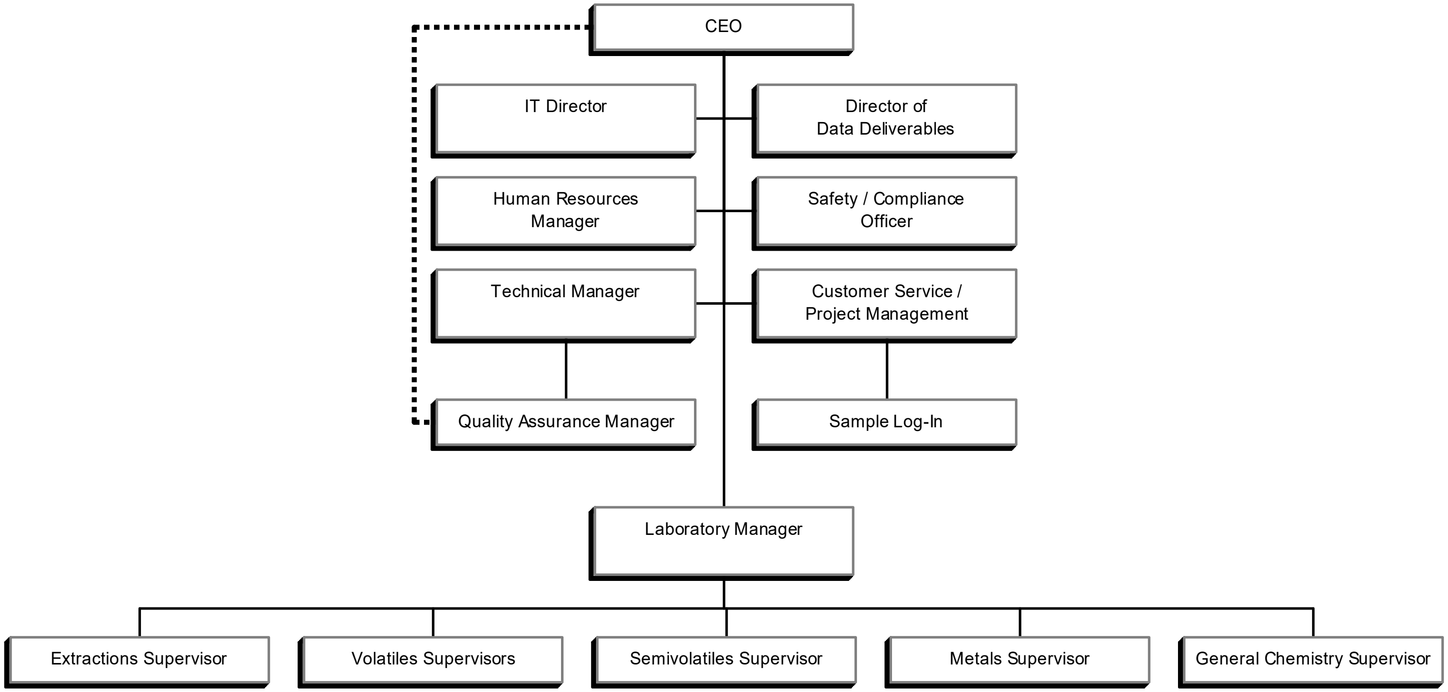
14 CONFLICT OF INTEREST

GCAL will not knowingly allow any employee to engage in any activity for which they have a conflict of interest. Employees are obligated to immediately report any potential conflict of interest to a member of GCAL management.

GCAL
ANALYTICAL LABORATORIES, LLC

Appendix-A
ORGANIZATION AND MANAGEMENT STRUCTURE

Modified 05/12/16



Appendix B - Resumes of Key Personnel

RANDY K. WHITTINGTON

Current Position:	**CEO, Gulf Coast Analytical Laboratories, Baton Rouge, LA, October 2009 - present** Responsible for financial and marketing functions. Responsible for long range planning and structuring of future business operations..
Previous Experience:	**Technical Services Manager, Gulf Coast Analytical Laboratories, Baton Rouge, LA, January 1997 – April 2007** Responsible for the management and supervision of Sample Management, Project Management, and Report Generation. Duties include implementing systems for increased productivity in all three sections. Also coordinates communication among these departments and other areas of the laboratory and marketing. **Technical Services Manager, ITS-Environmental Laboratories, Baton Rouge, LA, October 1996 - January 1997** Responsible for the management and supervision of Sample Management, Client Services, and Report Generation. Duties include implementing systems for increased productivity in all three sections. Also coordinates communication among these departments and other areas of the laboratory and marketing. **Project Manager and Data Validation Manager, Terra Consulting Group, Baton Rouge, LA, 1993 - 1996** Performed organic data validation for CLP and RCRA data packages for pesticides, PCBs, volatile and semi-volatile analytical fractions. Responsible for the design and implementation of the analytical aspects needed to generate legally defensible data for a Remedial Feasibility Investigation (RFI) at various large chemical plants. Ensured data validation issues were addressed in the day-to-day operations of the investigation. **Gas Chromatography Supervisor, West-Paine Laboratories, Baton Rouge, LA, 1991-1993** Directly responsible for the supervision of the organics laboratory in Randy

environmental and hazardous waste matrices following current SW-846, 500 and 600 series methodologies. Responsibilities include coordinating and managing of QA/QC for all Gas Chromatography data from sample log-in, extraction, analysis, review and preparation of computerized reports.

Gas Chromatography Laboratory Manager, ETC/Toxicon, Baton Rouge, LA, 1987-1991

Supervised the Gas Chromatography laboratory in the analysis of Organochlorine and Organophosphorus Pesticides, PCBs, Herbicides, PNAs, VOA and Semi-VOAs; supervised all aspects of the GC laboratory including analysis, data interpretation, report preparation, instrument maintenance, method development, and problem solving. In 1990 temporarily relocated to Edison, New Jersey to restructure the Gas Chromatography division while also implementing USEPA CLP and Finnigan QA Formaster; maintained efficiency of twenty-two various Gas Chromatographs.

Education: BS, Environmental Engineering , Columbia Southern University

Inchcape Managerial Training Skills Workshop - 1993

Finnigan QA Formaster Training

Restek Chromatography Class

Bank One Managing and Financing Independent Business - 16 Hours - October 1998

B. CHRIS WEATHINGTON

Current Position:

Technical Director, Gulf Coast Analytical Laboratories, Baton Rouge, LA, December 2017 to present
Responsible for managing all technical aspects of the laboratory facility. Responsible for ensuring the laboratory produces quality data, while generating and implementing strategies to improve service levels, quality and efficiency throughout the organization.

Previous Experience:

Division Manager, Microbac, Baltimore, MD, March 2014 to May 2016
Managed 32 technical personnel and support staff in two laboratories (MD and NJ) to meet the production needs for environmental chemistry and food/microbiological/biology testing. Primary responsibilities included certification acquisition, profit/loss, revenue growth, quality and performance improvement. Secondary responsibilities included development and provision of special analytical services, validation and certification of microbiological and engineering processes.

General Manager, Pace Analytical Services, Inc., St. Rose, LA, January 2006 – December 2013
Managed 48 technical personnel and support staff in two laboratories (LA and PR) to meet the production needs for full range environmental testing. Primary responsibilities included profit/loss, revenue growth, quality and performance improvement. Secondary responsibilities included briefing of legal staff associated with 24-hour a day analytical services to BP Oil Spill and Hurricane Isaac responses.

Division Manager, TestAmerica Analytical Testing Corporation, Inc., Dayton, OH, December 1998 to January 2006
Managed 65 technical personnel and support staff in three laboratories (OH, IN and MI) to meet the production needs for full environmental testing. Primary responsibilities included profit/loss, revenue growth, quality and performance improvement. Negotiated and designed a new 26,000-foot facility and installed LIMS system.

Director of Operations and Information Services Manager, Quanterra, Inc. (now TestAmerica), St. Louis, MO, October 1993 to November 1998
Director of Operations - Managed 45 technical personnel and support staff to meet the production needs for full environmental testing (including dioxin and radiochemistry). Primary responsibilities included profit/loss, revenue growth, quality and performance improvement.
Information Services Manager – System administration for a 6-server, 60-user, 75 PCs, 20 printers/scanner network. Designed/developed automated tracking, scheduling programs, interface for instruments for data acquisition, forms and reporting. Oversaw conversion from cable to CAT5, and preparations for Y2K.

Analytical Services Manager, RMC Analytics, Pottstown, PA, June 1988 to September 1993
Managed 43 technical personnel and support staff to meet the production needs for full environmental chemical testing. Primary responsibilities included profit/loss, revenue growth, quality and performance improvement. Role included partner/owner responsibilities.

QA/QC and Program Manager, Marketing and Technical Manager, Hittman EBASCO Associates, Inc., Columbia, MD, March 1982 to June 1998

Senior Analytical Chemist, Midwest Research Institute, Kansas City, MO, February 1980 to February 1982

Support Scientist (Chemist), USDA, Beltsville, MD, February 1977 to February 1980

Education: BS Chemistry, Auburn University, Auburn, AL, 1979. (Attended graduate school of chemistry, 1974-1977, received BS from graduate level course work)

ROBERT J. OLIVIER

Current Position:

Laboratory Manager, Gulf Coast Analytical Laboratories, Baton Rouge, LA, November 2015-present

Responsible for coordinating the overall activities of all preparatory and analytical departments on a daily basis and providing long-term direction. Responsibilities include monitoring the scheduling of analytical testing and releasing testing data and results.

Previous Experience:

Inorganics Manager, Gulf Coast Analytical Laboratories, LLC, November 2013 – November 2015

Responsible for the supervision and training of personnel, conducting inorganic general chemistry and metals analyses using EPA methodologies, correlation and validation of data, maintenance of Standard Operating Procedures (SOPs) and instrumentation, method set up and day-to-day management of the general chemistry and metals laboratories.

Metals Departmental Supervisor, Gulf Coast Analytical Laboratories, LLC, August 2013 – November 2013

Responsible for the supervision of metals analysis and sample preparation by EPA methods 6010, 6020, 7470, 7471, 245.1, and the 3500 series. Directly responsible for the operation of a 7700 Agilent ICP/MS and the supervision of two Perkin Elmer ICP-OES systems, and a FIMS 400 Hg analyzer. Directly involved in interviewing and hiring departmental staff. Responsible for editing departmental SOP's. Assisted in training and development of departmental staff. Developed and implemented production strategies that exceeded management goals. Responsible for departmental renovations which met service agreement terms. Directly supervised 5 staff members.

Organic Extractions Manager, GULF COAST ANALYTICAL LABORATORIES, August 2012 – August 2013

Responsible for the supervision of organic extractions for water and various solid matrices by EPA methods in series 3000, 6000 and 8000, TCLP extraction and oil and grease extraction by EPA method 1664. Duties included sample preparation, sample tracking, data validation and overall laboratory maintenance. Developed and edited departmental SOP's. Participated in the interviewing and hiring of staff. Developed and implemented a schedule which allowed 7 day a week coverage. Assisted in training and development of departmental staff. Participated in internal and external audits. Responsible for the management of all section purchases and expenditures. Directly supervised 12 staff members.

GC/MS Volatiles Supervisor, Gulf Coast Analytical Laboratories, Inc., June 2004 – August 2012
Responsible for GC/MS analysis of water, soil, and organic samples by EPA methodologies 8260 and 624 and other laboratory validated methodologies. Duties include instrument operation and maintenance; sample preparation, sample analysis, and data interpretation; data package preparation, sample tracking, and data validation; and overall laboratory maintenance. Actively assist in developing and editing departmental SOP's. Assist in training and development of departmental staff. Participate in internal and external audits.

GC/MS Volatiles Group Leader, Gulf Coast Analytical Laboratories, Inc., March 2004 – June 2004
Responsible for GC/MS analysis of water, soil, and organic samples by EPA methodologies 8260 and 624. Duties include instrument operation and maintenance; sample preparation, analysis, and interpretation;, tracking, and review of groups analysis.

GC/MS Volatiles Analyst, Gulf Coast Analytical Laboratories, Inc., Baton Rouge, LA, December 2000 – March 2004
Responsible for GC/MS analysis of various types of samples by EPA methodologies and other laboratory validated methodologies. Duties include instrument operation and maintenance; sample and standard preparation, sample analysis, data interpretation and review, and data reporting.

Chemist, La-Mar-K, Inc., June 1999 – December 2000
Prepare custom standard solutions following an ISO 9002 certified system. Perform calibrations on conductivity meter, spectrophotometer, Dosimat titrators, KF titrator, and on analytical and top-load balances. Experience with several titration methods, conductivity meter, spectrophotometer, and pH. Performed maintenance checks on reverse osmosis water system.

Research Assistant, Nicholls State University, Thibodaux, LA, September 1998 – April 1999
Conducted evolutionary research on *Hyla squirella* and *Hyla cinerea* using starch gel electrophoresis. Prepared reagents.

Lab Assistant, Nicholls State University, Thibodaux, LA, August 1998 – December 1998
Organized and maintained molecular biology lab. Prepared agarose gels.

Research Assistant, Nicholls State University, Thibodaux, LA, May 1997 – December 1997
Conducted toxicology studies on *Pimephales promelas* after sub-lethal exposures to heavy metals.

Surgical Assistant, Durocher Veterinary Clinic, Thibodaux, LA, August 1996 – January 1997
Prepared animals for surgical procedures and assisted in surgery.

Research Assistant, Nicholls State University, Thibodaux, LA, December 1995 – May 1996
Performed immunological studies on the secretor gene.

Education: BS Biology, Nicholls State University, Thibodaux, LA May 1999

William R. Perry

Current Position:

Quality Assurance Manager, Gulf Coast Analytical Laboratories Baton Rouge, LA, May 2016 – Present
Responsible for implementing and monitoring the laboratory Quality Assurance Program Plan, conducting internal audits, reviewing reports, investigating problems, generating/updating control-charts, establishing data-quality acceptance criteria, verifying corrective actions are being pursued, and monitoring performance studies. Additional duties include reporting QA concerns to management and supporting project management with technical issue resolution, as requested..

Previous Experience:

Quality Assurance Manager, ARS International, LLC, Port Allen, LA, April 2015 – May 2016
Supervision of an environmental analytical laboratory QA program covering compliance with USDOE and USDoD (QSM), NELAP (TNI) and AIHA (ISO 17025) standards, including radio- and stable chemistry methodology. Interfaced with certification agencies, performance testing suppliers, and internal/external auditors. Formulated and improved QC tools, including development of LIMS. Supported method development activities including IDOC, MDL/LOQ and SOP development. Represent company during customer and quality system audits; promote quality culture through development and delivery of technical training.

Quality Curriculum Development and Training Consultant, Louisiana Economic Development/FastStart Program, Baton Rouge, LA, April 2014 – April 2015
Curriculum delivery and development focusing on topics of quality, chemistry and safety. Courses developed and/or delivered: Standard Documents, Root Cause Analysis, ISO 9000 Introduction and SOP Development Workshop. Chemical process overview development: LNG terminals in Lake Charles area.

Chemistry Coordinator – USEPA Region 6 START Program, Ecology & Environment, Inc., Baton Rouge, LA, July 1997 – December 2009
Subcontracted laboratory service management including environmental laboratory audit and QA Program Plan reviews; bidding and specification package development, review and award; analytical data package validation and conflict resolution. Field analytical services delivery including Sampling and Analysis Plan creation and review; field testing of samples and management of subcontracted (fixed base) laboratory services; and transportation and disposal coordination for hazardous wastes.

Project Chemist and Organics Preparations Group Leader, OHM Corporation (and ETC Laboratories), Nationwide, July 1986 – May 1997

Field analytical unit management including development of Sampling and Analysis Plans and related procedures; hazardous waste characterization; PBC and metals analysis. Fix-based laboratory GC and organic preparations laboratory management.

Education: BS Chemistry (ACS program), Southern Illinois University, Carbondale, IL, May 1986.

Lean Six-Sigma Change Management course, Villanova University, 2010.

ROBYN B. MIGUES

Current Position: **Director of Data Deliverables, Gulf Coast Analytical Laboratories Baton Rouge, LA, April 2005 – Present**

Responsible for report validation and review. Responsible for review of Quality Assurance Project Plans on incoming projects and implementation of such plans throughout the laboratory. Assists the lab in method implementation and development. Additional duties include advising the laboratory on reference methods and improving method performance.

Previous Experience: **QA/QC Manager, Gulf Coast Analytical Laboratories Baton Rouge, LA, January 1997 – April 2005**

Responsible for implementing and monitoring the laboratory Quality Assurance Program Plan, conducting internal audits, reviewing reports, investigating problem areas, control-chart generation, establishing data-quality criteria, verifying corrective actions are being taken when necessary, and monitoring performance evaluation studies. Additional duties include providing reports concerning QA matters to management.

QA/QC Manager, ITS Environmental Laboratories, Baton Rouge, LA October 1994 - January 1997

Responsible for implementing and monitoring the laboratory Quality Assurance Program Plan, conducting internal audits, reviewing reports, investigating problem areas, control-chart generation, establishing data-quality criteria, verifying corrective actions are being taken when necessary, and monitoring performance evaluation studies. Additional duties include providing reports concerning QA matters to management.

General Chemistry Supervisor, ITS Environmental Laboratories, Baton Rouge, LA, June 1994 - October 1994

Responsibility includes the management and training of personnel conducting inorganic analysis using EPA methodologies. Duties include data validation, QC review, instrument maintenance and method set up.

Metals Supervisor, ITS Environmental Laboratories, Baton Rouge, LA, October 1993 - June 1994

Responsible for the management and supervision of the Metals section which includes supervision of metals sample preparation, supervision and training of analysts, scheduling sample workload, analysis of samples by various analytical instrumentation and reviewing and validating all data.

Research Associate, Louisiana State University, Agronomy Department, Baton Rouge, LA, September 1990 - March 1993

Prepared and analyzed samples by ICP, maintained ICP and other laboratory equipment, assisted associate Professor of soil and environmental chemistry with laboratory courses and research projects and supervised student workers. Computer experience includes Quattro Pro and WordPerfect.

Previous Experience: **Spectroscopy and Water Departments Supervisor, James Laboratories, Lafayette, LA, February 1987 - September 1990**
Laboratory Technician

Prepared and analyzed samples by ICP, Flame Atomic Absorption & Emission, Mercury Hydride System and Graphite Furnace. Performed quality control coordination, trained laboratory technicians, maintained equipment . Prepared and analyzed various sample types.

Education: BS Geology, University of Southwestern Louisiana, Lafayette, LA, May 1985.

Member - American Society for Quality Control

Perkin Elmer Spectroscopy training course - 1987

Basic Statistics - Pittsburgh Conference Continuing Education Program - March 1995

Quality Management/Quality Assurance in Industry and in the Laboratory - ACS Short Course - March 1995

Inchcape Managerial Training Skills Workshop - 1994

Inchcape Testing Services - Environmental Laboratories, Baton Rouge, Manager and Supervisor Training Retreat - June 1996

Executrain Microsoft Excel 5.0 Beginning For Windows - July, 1996

ERTCO - Thermometer Calibration per ISO - October 1997

Assuring Ethical Practices in The Environmental Laboratory, A Training Short Course – Analytical Excellence – October 27, 2000

Member - LADEQ Laboratory Accreditation Task Force

Appendix-C
Analytical Instrumentation

Volatile Organics	Number
Gas Chromatographs/Mass Spectrometers	8
Gas Chromatographs	4
Thermal Desorber	1
Autosamplers (P&T)	10
Semivolatile Organics	
Gas Chromatographs/Mass Spectrometers	3
Gas Chromatographs	9
High Performance Liquid Chromatographs	2
Liquid Chromatograph Triple Quad Mass Spectrometer.	1
Metals	
Inductively Coupled Plasma/Mass Spectrometers	2
Mercury-Cold Vapor	1
Acid Distillation System	1
Inorganics	
Ion Chromatographs	2
Total Organic Carbon Analyzers	2
UV/Visible Spectrometers	2
Automated Electrochemical Titrator	1
Discrete Analyzer	1
Sample Preparation	
Metals – Block Digestors	4
Solid Phase Extractor	3
Microdistillation System	2

GCAL continues to add and upgrade instrumentation, ensuring that the latest technology is utilized to enhance our Quality and sample capacity as we continue to grow. Service contracts are maintained on the more technical instrumentation as well as on-site inventory of instrument supplies and consumables.

GCAL
ANALYTICAL LABORATORIES, LLC

Appendix D
Facility Floor Plan

Approximate Square Footage: 22,000 Sq. Ft.

Scale: 1 in. = 25 ft.

Sample Receiving/Bottle Prep:	1420
Extractions/Prep:	3206
General Chemistry:	2025
Metals:	890
Metals Prep:	450
Supply Room:	616
Offices/Storage:	8251

GCMS Volatiles:	1229
GCMS Semi-Volatiles:	394
GC Volatiles:	423
GC Semi-Volatiles:	906
Report Generation:	713
Sample Coolers:	734

Revised: 05/12/16

Appendix E

GCAL CERTIFICATIONS

Certification	**Certification Number**
DOD ELAP	L16-398
Alabama	01955
Arkansas	16-058-0
Colorado	01955
Delaware	01955
Florida	E87854
Georgia	01955
Hawaii	01955
Idaho	01955
Illinois	004101
Indiana	01955
Kansas	E-10354
Kentucky	123054
Louisiana	01955
Maryland	01955
Massachusetts	01955
Michigan	01955
Mississippi	01955
Missouri	01955
Montana	N/A
Nebraska	01955
New Mexico	01955
North Carolina	618
North Dakota	R-195
Oklahoma	2016-86
South Carolina	73006001
South Dakota	01955
Tennessee	01955
Texas	T104704178
Vermont	01955
Virginia	460215
USDA Soil Permit	P330-16-00234

APPENDIX G - Master Standard Operating Procedures List

Area	Num.	Rev.	Title	Publish Date
EXT	001	26	Ultrasonic Extraction for Solid Samples	8/28/2017
EXT	004	12	Continuous Liquid-Liquid Extraction for Base/Neutral and Acid Compounds (BNA)	8/23/2017
EXT	017	25	Solid Phase Extraction (SPE) for Chlorinated Herbicides	10/26/2017
EXT	026	16.1	Toxicity Characteristic Leaching Procedure (TCLP) and Synthetic Precipitation Leaching Procedure (SPLP) Non-Volatile Extraction	11/1/2017
EXT	029	18	Separatory Funnel Liquid-Liquid Extraction for Extractable Petroleum Hydrocarbons (EPH)	8/18/2016
EXT	031	23	Ultrasonic Extraction and Derivatization for Chlorinated Herbicides	2/6/2017
EXT	032	18	Measurement of pH in Waters, Solids and Waste Samples	10/26/2017
EXT	034	15	Soxhlet Extraction for Organophosphorus Pesticides	7/28/2017
EXT	036	16	Toxicity Characteristic Leaching Procedure (TCLP) and Synthetic Precipitation Leaching Procedure (SPLP) Zero Headspace Extraction (ZHE)	9/2/2016
EXT	037	13	Waste Dilution for Pesticides, PCBs, and Base, Neutral and Acid Extractables	7/7/2017
EXT	052	21	N-Hexane Extractable Material (Oil and Grease) in Aqueous Samples by Extraction and Gravimetry	6/8/2017
EXT	064	12	N-Hexane Extractable Material (Oil and Grease) in Solid Samples by Soxhlet Extraction and Gravimetry	2/21/2017
EXT	066	14	Solid Phase Extraction (SPE) for Explosives	9/25/2017
EXT	073	7	Tissue Extraction	9/13/2017
EXT	074	9	Analysis of Lipids in Tissue Samples	9/18/2017
EXT	080	7	Ultrasonic Extraction for Explosives	3/13/2017
EXT	081	02	Separatory Funnel Liquid-Liquid Extractions	8/28/2017
EXT	082	00	Incremental Sampling Methodology (ISM)	8/10/2017
EXT	083	00	Microwave Extraction of Solids	9/29/2017
GCSV	004	25	Analysis of Petroleum Hydrocarbons (DRO/ORO/EPH/RRO) by GC	6/1/2017
GCSV	007	14	Total Petroleum Hydrocarbons (TPH) by Gas Chromatography	7/30/2016
GCSV	008	11	Organophosphorus Compounds by Gas Chromatography	7/30/2016
GCSV	011	14	Chlorinated Herbicides by Gas Chromatography	3/27/2017
GCSV	012	16.1	Organochlorine Pesticides and PCBs by Gas Chromatography (8081B/8082A)	8/28/2017
GCSV	025	14	Determination of Extractable Petroleum Hydrocarbons (EPH) by GC	6/14/2017
GCSV	029	10	Nonhalogenated Organic Compounds by Gas Chromatography (8015C)	10/19/2016
GCSV	031	13	Determination of Petroleum Range Organics (PRO)	8/22/2016
GCSV	033	7	Triazine Pesticides by Gas Chromatography	4/5/2016
GCSV	034	16	Determination of 1,2-dibromoethane (EDB) and 1,2-dibromo-3-chloropropane (DBCP) by Microextraction and Gas Chromatography	6/1/2017
MSSV	001	26	Analysis of Semi-Volatile Organic Compounds (SVOC) by GC/MS	8/30/2017
MSSV	002	16	Analysis of Semi-Volatile Organic Compounds (SVOC) by GC/MS (625)	4/4/2017
MSSV	004	15	Analysis of Semi-Volatile Organic Compounds (SVOC) by GC/MS (8270D)	8/30/2017
HPLC	008	4.1	Analysis of Nitroaromatics and Nitramines by HPLC	10/16/2017
LCMS	001	1	Extraction and HPLC/MS/MS Analysis of Tributyl Tetradecyl Phosphonium Chloride (TTPC)	1/18/2016

Date: 11/2/2017

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Area	Num.	Rev.	Title	Publish Date
LCMS	011	02	PerFluorinated Alkyl Acids by EPA 537, modified	10/12/2017
GCV	006	26	Analysis of Gasoline Range Organics (GRO) by GC	6/1/2017
GCV	022	15	Aromatic and Halogenated Volatiles by Gas Chromatography	10/10/2016
GCV	024	13.1	Dissolved Gas Analysis by GC Headspace Equilibrium Technique	7/25/2017
GCV	032	9	Determination of Volatiles Petroleum Hydrocarbons (VPH) by GC	3/13/2017
MSV	002	14	Analysis of Volatile Organic Compounds (VOC) by GC/MS (624)	4/4/2017
MSV	003	30	Analysis of Volatile Organic Compounds (VOC) by GC/MS (8260B)	6/1/2017
MSV	005	3	Analysis of Volatile Organic Compounds (VOC) by GC/MS (8260C)	4/4/2017
MSV	006	04	SOP for Thermal Desorption/Gas Chromatography Analysis of Volatile Organic Compounds	2/28/2017
LADNR	001	7	Sample Preparation	4/7/2017
LADNR	002	3	Saturated Paste	11/21/2016
LADNR	003	3	Soluble Cations and Sodium Absorption Ration (SAR)	2/28/2017
LADNR	004	4	Cation Exchange Capacity (CEC)	2/17/2017
LADNR	005	3	Electrical Conductivity (EC)	8/2/2017
LADNR	006	2	Exchangeable Sodium Percentage (ESP)	2/28/2017
LADNR	007	2	Leachable Chlorides Test	12/22/2016
LADNR	008	2	True Total Barium: LDNR Lab Procedures for Analysis of E&P Waste	12/22/2016
MET	004	22.1	Acid Digestion of Solid Samples for Metals Analysis	9/15/2017
MET	006	24	Acid Digestion of Aqueous and Solid Samples for Mercury Analysis (EPA 245.2)	2/21/2017
MET	008	23	Analysis of Aqueous and Solid Samples for Mercury (EPA 245.2)	4/28/2017
MET	013	8	Hardness by Calculation	10/26/2016
MET	020	9	Acid Digestion of Aqueous Samples for Metals Analysis	10/12/2017
MET	021	14	Metals Analysis by Inductively Coupled Plasma-Mass Spectrometry (ICP-MS) (200.8-6020A-6020B)	4/28/2017
MET	022	0	Acid Distillation	10/30/2015
WL	042	20	Anions by Ion Chromatography (IC)	9/15/2017
WL	043	16	Total Organic Carbon (TOC) Water Samples	4/18/2017
WL	057	7.1	Total Organic Carbon (TOC) Soil Samples	9/11/2017
WL	070	8	Volatile Fatty Acids by Ion Chromatography (IC)	8/5/2016
WL	045	13	Total Kjeldahl Nitrogen (TKN) by Digestion, Distillation, and Titration	3/17/2017
WL	061	07	Water Content Determination by Karl Fisher Titration	10/13/2017
WL	063	13	Alkalinity by Titration	9/26/2017
WL	069	06	Acidity (Titrator)	8/8/2016
WL	079	05	Ammonia by Microdistillation and Titration	4/7/2017
WL	007	11	Sulfite by Titration	8/25/2017

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Area	Num.	Rev.	Title	Publish Date
WL	009	15	Free Liquid/Paint Filter Liquids Test	8/23/2017
WL	018	26	Biochemical Oxygen Demand (BOD) and Dissolved Oxygen (DO)	7/6/2017
WL	019	14	Specific Gravity and Density	9/20/2017
WL	022	14	Ash	10/19/2016
WL	026	19	Fecal Coliforms	10/3/2016
WL	029	12	Conductivity and Salinity (Calculation)	8/23/2017
WL	032	14	Turbidity	4/7/2017
WL	044	11	Bomb Preparation for Waste Samples and Determination of Heat of Combustion	10/7/2016
WL	051	13	Sulfide by Titration and Hydrogen Sulfide (Calculation)	8/7/2017
WL	054	13	Reactive Cyanide and Reactive Sulfide Preparation	10/23/2017
WL	056	11	Corrosivity Toward Steel	4/7/2017
WL	060	11	Flashpoint	7/18/2017
WL	066	08	Ignitability of Solids	7/28/2017
WL	073	06	Dessicator Monitoring	8/25/2017
WL	076	04.1	Solids (TS/TDS/TSS/TVS/VSS/SS)	9/15/2017
WL	080	03	Ammonia by Microdistillation and Ion Selective Electrode (ISE)	10/14/2016
WL	087	01	TKN by HACH	5/2/2017
WL	041	13	Nitrate/Nitrite/N + N (Lachat)	8/8/2016
WL	083	2	Phosphorus (SEAL)	9/8/2017
WL	084	2	Phenolics by Microdistillation and Automated Colorimetry (SEAL)	10/5/2016
WL	085	2	Nitrate/Nitrite/N + N (SEAL)	9/26/2017
WL	086	1.1	Cyanide, Total and Amenable (SEAL)	7/24/2017
WL	006	14	Sulfate (Turbidimetric)	7/18/2017
WL	008	13	Color, True and Apparent	4/24/2017
WL	012	17	Hexavalent Chromium	3/15/2017
WL	016	13	Chlorine (Free & Residual)	8/23/2017
WL	021	15	Chemical Oxygen Demand (COD)	2/28/2017
WL	025	11	Surfactants as Methylene Blue Active Substances (MBAS)	9/16/2016
WL	028	12	Silica	9/19/2016
WL	033	17	Sulfide Methylene Blue	4/26/2017
WL	047	9	Ferrous Iron	4/22/2016
WL	048	14	Orthophosphate as Phosphorus (HACH)	9/16/2016
QA	001	13	Document Control and Control of Records	3/1/2016
QA	002	12	Data Reduction/Validation	4/13/2016

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Area	Num.	Rev.	Title	Publish Date
QA	004	10	Internal Audits and Management Reviews	5/1/2017
QA	007	8	Data Archive	9/4/2015
QA	008	8	Standard Operating Procedures	9/11/2015
QA	009	14	Determining Detection and Quantitation Limits	6/1/2017
QA	010	7	Data Integrity	6/25/2015
QA	012	7	Control Charts	4/7/2016
QA	013	4	Estimation of Analytical Measurement Uncertainty	4/15/2015
QA	014	5	Demonstration of Capability	3/16/2017
QA	015	5	Proficiency Testing Studies	6/9/2015
SAD	001	28	Sample Receiving and LIMS Log-In	1/5/2017
SAD	002	15.1	Sample Chain of Custody and Sample Integrity	10/17/2017
SAD	003	14	Sample Kit Preparation	10/7/2016
SAD	006	04	Sample Couriers	10/12/2016
SAD	007	00	Collection of Composite and Grab Samples	4/1/2015
GEN	001	6	Cleaning Laboratory Glassware	4/11/2013
GEN	006	9	Standard/Reagent Traceability, Documentation, and Preparation	5/8/2015
GEN	007	13	Training	3/16/2017
GEN	009	11	Waste Collection, Storage and Disposal	2/6/2017
GEN	010	12	Laboratory Monitoring of Reagents and Solvents	5/4/2017
GEN	012	7	Equipment/Instrument Preventative Maintenance and Troubleshooting	5/15/2015
GEN	013	2	Spill Cleanup	12/12/2013
GEN	015	2	Laboratory Contingencies	12/12/2013
GEN	016	3	Definitions	3/26/2013
GEN	018	10	Corrective and Preventative Action	7/1/2017
GEN	019	3	Project Specific Requirements	2/10/2014
GEN	021	1	Calibration Modules Used by Data Processing Software	1/9/2014
GEN	023	6	Laboratory Monitoring of Support Equipment	5/1/2017
GEN	024	0	Review of Requests, Tenders, and Contracts	10/31/2013
GEN	025	1	Purchasing Services and Supplies	7/1/2017
GEN	026	2	Radioactive Material License	1/26/2016
GEN	027	1	Management of Change	1/13/2016
LAD	004	7	Travel and Entertainment	4/1/2013
LAD	006	6	Bank Deposit Procedures	4/9/2013
LAD	007	3	Accounts Receivable Credit Policy and Procedure	4/1/2013

Date: 11/2/2017

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Area	Num.	Rev.	Title	Publish Date
LAD	001	4	Master Signature List	12/16/2013
LAD	002	6	GCAL Receptionist	4/1/2013
LAD	003	11	Report Generation	3/13/2017
LAD	014	11	Project Management	10/7/2013
LAD	019	3	Data Package Assembly	6/1/2017
LAD	020	0	Report Validation	8/5/2015

Date: 11/2/2017

Appendix-H

GLOSSARY

ACCEPTANCE LIMITS – data quality limits specified by the test method or generated by the laboratory. Specified limits placed on an item, process, or service defined in the requirement document.

ACCURACY – a measure of how close a measured value is to a known true value. Accuracy is assessed by means of reference samples and percent recoveries of spiked samples. The degree of agreement between an observed value and an accepted reference value. Accuracy includes combination of random error (precision) and systematic error (bias) components which are due to sampling and analytical operations; a data quality indicator.

ALIQUOT – a discrete, measure, or representative portion of a sample taken for analysis.

ANALYTE – the chemical element or compound an analyst seeks to determine; the chemical element of interest.

ANALYTICAL BATCH – the basic unit for analytical quality control, defined as samples that are analyzed together with the same method sequence and the same lots of reagents and with the manipulations common to each sample within the same time period or in continuous sequential time periods. Samples in each batch should be of similar composition (e.g., groundwater, sludge, ash).

ANALYTICAL SAMPLE – any solution or media introduced into an instrument on which an analysis is performed, excluding instrument calibration, initial calibration verification, initial calibration blank, continuing calibration verification, and continuing calibration blank. The following are all analytical samples: undiluted and diluted samples (EPA and non-EPA), predigestion spike samples, duplicate samples, serial dilution samples, analytical spike samples, post digestion spike samples, interference check samples (ICS), CRDL standard for AA(CRA), CRDL standard for ICP(CRI), laboratory control sample(LCS), preparation blank(PB), and linear range analysis sample(LRS).

ANALYST – the designated individual who performs the “hands on” analytical methods and associated techniques and who is the one responsible for applying required laboratory practices and other pertinent quality controls to meet the required level of quality.

AREA UNITS – a term used in gas chromatography that indicates the peak area of a compound exiting a chromatographic column. The size or area of the peak is proportional to the amount of analyte in the sample.

ATOMIC ABSORPTION (AA) – a technique for analyzing metal using an element-specific lamp that emits a characteristic light spectrum. A sample is heated in a flame or graphite furnace and the light beam is passed through it. When the sample absorbs light, an energy loss is detected and is translated into a concentration of metal in the sample. This technique detects one metal at a time.

AUDIT – a systematic check to determine the quality of some function or activity. Two basic types are performance audits and system audits. Perform audits involve a quantitative comparison of the laboratory’s results to those of a proficiency sample containing known concentration of analytes. A system audit is a qualitative evaluation that normally consists of an onsite review of a lab's quality assurance system and physical facilities.

BACKGROUND CORRECTION – a technique usually employed relative to metals analysis, which compensates for variable background contribution to the instrument signal in the determination of trace elements.

BATCH – environmental samples that are prepared and/or analyzed together with the same process and personnel, using the same lot(s) of reagents. A batch is composed of a maximum of twenty environmental samples. A preparation batch is composed of environmental sample of the same matrix, meeting the above-mentioned criteria and with a maximum time between the start of processing the first and last sample in the batch to be 24 hours. An analytical batch is composed of prepared environmental samples (extracts, digestates or concentrates) and/or those samples not requiring preparation, which are analyzed together as a group using the same calibration curve or factor. An analytical batch can include samples originating from various environmental matrices.

BIAS – the deviation of the mean of replicate analytical measurements from a reference analyte concentration. Relative bias is represented by analytical measurement mean minus the reference analyte concentration and the difference divided by the reference analyte concentration. See accuracy and precision.

4-BROMO-FLUOROBENZENE (BFB) – the compound used to check the tuning of the instrument, and is used as a surrogate compound spiked into every sample for volatile analysis. A compound utilized in EPA gas chromatography/mass spectrometry (GC/MS) volatile methods to establish mass spectral instrument performance.

BIOCHEMICAL OXYGEN DEMAND (BOD) – A measure of the amount of oxygen consumed in the biochemical processes that break down organic matter in water. A larger BOD value indicates a greater degree of organic pollution. A related term, BOD5, is the amount of dissolved oxygen consumed in five days.

BIOSEED – the bacterial culture used to inoculate a sample for testing.

BLANK – an artificial sample designed to monitor the introduction of artifacts into the measurement process. For aqueous samples, reagent water is used as a blank matrix. There are several types of blanks, which monitor a variety of processes:1.) *laboratory blank* is taken through sample preparation and analysis only. It is a test for contamination in sample preparation and analyses. 2.) *storage blank* is stored and analyzed with samples at the laboratory. It is a test for contamination in sample storage as well as sample preparation and analysis. 3.) *trip blank* is shipped to and from the field with the sample containers. It is not opened in the field and, therefore, provides a test for contamination from sample preservation, site conditions, and transport as well as sample storage, preparation, and analysis. It is most commonly used for volatile organics. 4.) *field blank* is opened in the field and tests for contamination from the atmosphere as well as those activities listed under the trip blank.

BNA – base, neutral and acid extractable compounds. The term base, neutral and acid refer to the pH condition of the sample undergoing extraction. Certain compounds extract more efficiently from water under acidic conditions. Such compounds are often referred to as "acid extractables."

CALIBRATE – to determine, by measurement or comparison with a standard, the correct value of each scale reading on a meter or other device, or the correct value for each setting of a control knob. The levels of the applied calibration standard should bracket the range of planned or expect sample measurements.

CALIBRATION – The systematic determination of the relationship of the response of the measurement system to the concentration of the analyte of interest. Instrument calibration performed before any samples are analyzed is called the initial calibration. Subsequent checks on the instrument calibration performed throughout analysis are called continuing calibration verification.

CALIBRATION BLANK (CB) – a volume of reagent water in the same matrix as the calibration standards but without the analyte.

CALIBRATION CURVE – the graphical relationship between the known values, such as concentrations, of a series of calibration standards and their analytical response.

CALIBRATION METHOD – a defined technical procedure for performing a calibration.

CALIBRATION STANDARD – a certified material used to calibrate an instrument.

CERTIFIED REFERENCE MATERIAL (CRM) – reference material, one or more of whose property values are certified by a technically valid procedure, accompanied by or traceable to a certificate or other documentation which is issued by a certifying body. (ISO Guide 30)

CONTINUING CALIBRATION VERIFICATION (CCV) – used to evaluate the performance of the instrument system with respect to a defined set of method criteria. The CCVs are used to verify instrument performance during analysis. The CCV shall be prepared from the same stock standard solution used to prepare the calibration curve.

CHAIN-OF-CUSTODY–Procedures and associated documents designed to trace the custody of a sample from the point of origin to final disposition, with the intent of legally demonstrating that custody remained intact and the tampering or substitutions were precluded.

CHEMICAL OXYGEN DEMAND (COD) – A measure of the oxygen required to oxidize all compounds in water, both organic and inorganic.

COMBINED STANDARD UNCERTAINTY – The standard uncertainty of the analytical measurement result that is the sum in quadrature (square-root-of-the-sum-of-the-squares) of the component standard uncertainties.

CORRECTIVE ACTION – the action taken to eliminate the causes of an existing non-conformity, defect, or other undesirable situation to prevent reoccurrence.

COVERAGE FACTOR – the numerical factor used as a multiplier of the combined standard uncertainty to expand the uncertainty corresponding to a specific level of confidence. The Student's *t*-distribution is used for determining the coverage factor.

DEMONSTRATION OF CAPABILITY (DOC) – a procedure used to establish the ability of the analyst to generate acceptable accuracy.

DEIONIZED WATER (DI) – water from which the majority of ions have been removed. Water that is contaminant free and used in the laboratory, the resistivity should be ≤ 18 megaohms.

DISSOLVED METALS –- metallic elements determined on a water sample that has been passed through a 0.45-um filter.

DISSOLVED OXYGEN (DO) – the oxygen freely available in water, an indicator of water quality.

DISSOLVED SOLIDS – disintegrated organic and inorganic material contained in water. Excessive amounts make water unfit to drink or use in industrial processes.

DRY WEIGHT – the weight of a sample based on percent solids. The weight of a sample after drying in an oven at a specified temperature.

DUPLICATE MEASUREMENT – a duplicate measurement is a second measurement made on the same or identical sample of material to assist in the evaluation of measurement of variance.

DUPLICATE SAMPLE – two samples taken from the same population and carried through certain stages of sampling and testing. Duplicate sample include field co-located duplicate samples, field-split duplicate samples, and laboratory duplicate subsamples.

EXPANDED UNCERTAINTY – the quantity defining an interval enveloping the analytical measurement that captures a large fraction of the distribution of analyte concentrations that could be attributable to the quantity measured. The combined standard uncertainty is multiplied by the coverage factor to calculate the expanded uncertainty.

EXTERNAL STANDARDS – a method of quantifying chromatographic data in which standards of known concentration are analyzed prior to unknown samples. The chromatographic peak area (or height) of a sample component is compared to a calibration curve of a peak area constructed from the standard data for that component. This comparison allows the concentration of the component in the sample to be determined.

FECAL COLIFORM BACTERIA – bacteria found in mammals' intestinal tracts. Their presence in water or sludge is an indicator of pollution and possible contamination by pathogens.

FLAME IONIZATION DETECTOR (FID) – a gas chromatography detector in which the column effluent gas is mixed with hydrogen and burned in air or oxygen. The ions and electrons produced in the flame generate an electric current proportional to the amount of materials in the detector. The FID responds to nearly all organic compounds, but it does not respond to air and water, which makes it exceptionally suited to environmental analysis.

FLASHPOINT – the lowest temperature at which a flammable liquid gives off sufficient vapor to form an ignitable mixture with air near its surface or within a vessel. Combustion does not continue.

GAS CHROMATOGRAPHY (GC) – a technique for detecting organic compounds by using their physical and chemical properties to separate a mixture. The compounds are identified and quantified with various types of detectors as they exit the chromatograph. Selection of detectors is dependent on the particular compounds of interest.

GAS CHROMATOGRAPHY MASS SPECTROMETRY (GCMS) – a technique in which sample analytes are bombarded with electrons as they exit a gas chromatography column and are fragmented into characteristics ion patterns. The mass spectrometer is the detector. It can determine which fragments are present and therefore the identity of the compounds.

GLUCOSE GLUTAMIC ACID (GGA) – used as a laboratory control standard in BOD procedures.

GRAPHITE FURNACE – a technique used for the analysis of metals. An atomic absorption spectrophotometer heats the sample within a graphite tube using an electrical current. It is also commonly called a flameless furnace and generally provides greater sensitivity for certain metals than flame or inductively coupled argon plasma techniques.

GRAVIMETRIC - analyses based on the direct or indirect weighing of the analyte in question. This technique usually requires the use of an analytical balance with a sensitivity of 0.1 mg or better.

HALL ELECTROLYTIC CONDUCTIVITY DETECTOR – an element-selective gas chromatography detector primarily intended for trace analysis of organic compounds containing chlorine, nitrogen or sulfur. In operation, this detector pyrolyzes the column effluent gas into soluble electrolytes that are dissolved in a stream of deionized liquid. The observed change in electrical conductivity, proportional to the amount of material present, is measured.

HAZARDOUS WASTE – waste regulated under RCRA that can pose a substantial or potential hazard to human health or the environment when improperly managed. Such wastes possess at least one of four characteristics (ignitability, corrosivity, reactivity, or toxicity) or appear on special EPA hazardous waste lists. The term is not interchangeable with hazardous substances or material.

HEADSPACE - Any area in a container not completely filled by the sample in which gases can collect.

HEAVY METALS – metallic elements with high atomic weights, i.e., mercury, chromium, cadmium, arsenic, and lead. They can damage the health of plants and animals at low concentrations and tend to accumulate in the food chain.

HOLDING TIME – the maximum times that samples may be held before analysis and still be considered valid or not compromised. The storage time allowed between sample collection and sample analysis when the designated preservation and storage techniques are employed.

HYDROCARBONS – chemical compounds that consist entirely of carbon and hydrogen.

ICP – Inductively coupled plasma is a type of instrument used for metals analysis. Because the temperature of the plasma is considerable higher (10,000^{o}K) than the temperature of a flame atomic absorption spectrophotometer, it is especially useful for refractory metals. Some instruments are also capable of performing simultaneous multielement analysis.

ICP-MS - Inductively coupled plasma mass spectrometry (ICP-MS) is a type of mass spectrometry highly sensitive and capable of the determination of a range of metals and several non-metals at concentrations below one part in 10^{12} (part per trillion). It is based on coupling together an inductively coupled plasma as a method of producing ions with a mass spectrometer as a method of separating and detecting the ions. In trace elemental analysis, the method has advantages of high speed, precision and sensitivity.

IGNITABLE – capable of burning or causing a fire.

INORGANIC CHEMICALS – chemical substances of mineral origin, unlike organic chemicals whose structure relies on carbon atoms.

INITIAL CALIBRATION VERIFICATION (ICV) - also referred to as the Independent Calibration Verification for this laboratory. A standard solution used to verify the calibration curve derived from a source independent of the instrument calibration standard. The ICV is use to quantify second source standard variance and bias.

INSTRUMENT CALIBRATION STANDARD - a reference material used to standardize an analytical instrument.

INSTRUMENT DETECTION LIMIT (IDL) - a term utilized in the EPA Inorganic Contract Laboratory Program. The IDL is three times the standard deviation obtained for the analysis of a standard solution (each analyte in reagent water) at a concentration of three to five times that of the IDL on three nonconsecutive days with seven consecutive measurements per day. The IDL is the concentration equivalent to a signal, due to the analyte of interest, which is the smallest signal that can be distinguished from background noise by a particular instrument. The IDL should always be below the method detection limit, and is not used for compliance data reporting, but may be used for statistical data analysis and comparing the attributes of different instruments.

INSTRUMENT PERFORMANCE CHECK - The analyses of one of the ICSs to verified initial and continuing calibration (CCV). The IPC is used to quantify the instrumental testing repeatability variance and bias.

INSTRUMENT TUNING - a technique used in gas chromatography/mass spectrometry procedures to verify that the instrument is properly calibrated to produce reliable mass spectral information. See 4-Bromofluorobenzene under "B".

INTERNAL STANDARDS - compounds added to every standard, blank, matrix spike, matrix spike duplicate, sample (for volatile organics), and sample extract (for semivolatiles) at a known concentration, prior to analysis. Internal standards are used as the basis for quantification of the target compound.

IONIZATION - Utilized in mass spectrometry to fragment analyte molecules into smaller segments. These smaller mass segments are then separated and plotted to form a "mass spectrum" which is used to identify the parent molecule. Electron impact is one example of ionization used in mass spectrometry. In more technical terms. Ionization is the process by which neutral atoms or groups of atoms become electrically charged, either positively or negatively, by the loss or gain of electrons.

ISOMERS - chemical compounds with the same molecular weight and atomic composition by differing molecular structure, e.g., n-pentane and 2-methylbutane.

LABORATORY CONTROL SAMPLE (LCS) - a clean-matrix reference sample spiked with a standard with an established analyte concentration. The LCS is carried through the entire chemical preparation and testing procedures. The LCS is used to quantify the variance and bias of the chemical preparation and instrumental testing stages without matrix interference. Also called a Laboratory fortified blank (LFB).

LABORATORY CONTROL SAMPLE DUPLICATE (LCSD) – a duplicate of the laboratory control sample in a clean matrix that is carried through the entire chemical preparation and testing procedures.

LABORATORY DUPLICATE SAMPLE (LAB DUPLICATE) - a portion of the collected sample that is carried through the chemical preparation and testing. The laboratory duplicate subsample is used to quantify the variance of the chemical preparation and instrumental testing stages with matrix interferences.

LEACHATE - a liquid that results from water collecting contaminants as it trickles through wastes, agricultural pesticides or fertilizers. Leaching may occur in farming areas, feedlots, and landfills, and may result in hazardous substances entering surface water, groundwater or soil.

LDEQ – Louisiana Department of Environmental Quality

LIBRARY SEARCH - a technique in which an unknown mass spectrum of a compound is compared to the mass spectra of compounds contained in a computer library in an effort to identify the compound. Compounds identified in this manner are referred to as tentatively identified compounds (TICs).

LIMIT OF DETECTION (LOD) – an estimate of the minimum amount of a substance that an analytical process can reliable detect. An LOD is analyte and matrix specific and may be laboratory dependent.

LIMIT OF QUANTIATION (LOQ) – the minimum levels, concentrations, or quantities of a target variable (e.g. target analyte) that can be reported with a specified degree of confidence..

LIMS – laboratory information management system. Horizons is the LIMS used by GCAL.

LINEAR CALIBRATION RANGE – the concentration range over which the instrument response is linear.

LOG-IN - the receipt and initial management of an environmental sample. It generally includes identifying who sent the sample; maintaining chain-of-custody; checking report and invoice information; recording analysis requested, including methodology and special instructions; and assigning a discreet in-lab identification, usually a number or bar code.

MASS SPECTRUM - a plot of ion mass/charge ratio versus intensity. A fragmentation pattern results from the particles whose mass distribution is characteristic of the parent molecule. Qualitative information is provided by a mass spectrum.

MATERIAL SAFETY DATA SHEET (MSDS) - a compilation of information required under the OSHA Communication Standard on the identity of hazardous chemicals and their associated health and physical hazards, exposure limits and precautions.

MATRIX - The physical characteristics or state of a sample – e.g., water, soil, sludge.

MATRIX INTERFERENCE - the influence of the sample matrix or sample components upon the ability of qualitatively identifies and quantitatively measures compounds in environmental samples.

MATRIX MODIFIERS - chemicals added to samples for metals analysis, which are used to lessen the effects of chemical interference, viscosity and surface tension.

MATRIX SPIKE (MS) – aliquot of a sample fortified (spiked) with known quantities of specific compounds and subjected to the entire analytical procedure in order to indicate the appropriateness of the method for the matrix by measuring recovery of the spike. Matrix spiked samples are used to quantify the variance and bias of the chemical preparation and testing stages with matrix interference.

MATRIX SPIKE DUPLICATE (MSD) - a second aliquot of the same matrix as the matrix spike that is spiked to determine the precision of the method.

METHOD DETECTION LIMIT (MDL) - the minimum concentration of compound that can be measured and reported within 99% confidence that the value is above zero and is determined from analysis of a sample in a given matrix containing the analyte.

MUST – denotes a mandatory requirement.

NARRATIVE - in an analytical report, a descriptive documentation of any problems encountered in processing the samples, along with corrective action taken and problem resolution.

NUTRIENT - any substance assimilated by living things that promote growth. The term is generally applied to nitrogen and phosphorus in wastewater, but is also applied to other essential and trace elements.

ORGANIC - generally, any compound that contains carbon bonded to a hydrogen or halogen atom.

OXIDATION - the process in chemistry whereby electrons are removed from a molecule.

PCBs - Polychlorinated biphenyl, a group of toxic persistent chemicals used in transformers and capacitors for insulating purposes and in gas pipeline systems as a lubricant. Sale of PCBs for new uses was banned by law in 1979.

PERCENT RECOVERY - a measure of accuracy that is calculated as the measured value relative to the true value expressed as a percent.

PERFORMANCE AUDIT - a quantitative evaluation of a measurement system that involves the analysis of standard reference samples or materials which are certified as to their chemical composition or physical characteristics.

PROFICIENCY TEST (PT) SAMPLE - a sample of known composition (unknown to the laboratory), provided by an external source, which is used to evaluate lab performance. For certification purposes the PT sample is purchased from an approved provider.

pH - a numerical designation of relative acidity and alkalinity. A pH of 7.0 indicates precise neutrality. Progressively higher values indicate increasing alkalinity and lower values increasing acidity.

POLLUTANT - generally, any substance introduced into the environment that adversely affects the usefulness of a resource.

PRACTICAL QUANTITATION LIMIT (PQL) - the lowest level that can be reliable achieved within specified limits of precision and accuracy routine laboratory operating conditions. The lowest concentration or amount of the target analyte that can be identified, measured, and reported with confidence that the analyte concentration is not a false positive value.

PRECISION - a measure of the ability to reproduce analytical results. It is generally determined through the analysis of duplicate samples. The degree to which a set of observations or measurements of the same property, obtained under similar conditions, conform to themselves; a data quality indicator. Precision is usually expressed as standard deviation, variance or range in either absolute or relative terms.

PRESERVATIVE - a chemical or reagent added to a sample to prevent or slow decomposition or degradation of a target analyte or a physical process. Physical and chemical preservation may be used in tandem to prevent sample deterioration.

PURGE AND TRAP - a technique used in the analysis of volatile organic where analytes are purged from a sample by means of an inert gas and trapped on a sorbent column. The sorbent is then flashheated and the analytes are transferred onto a gas chromatographic column for separation and identification.

PURGEABLE ORGANIC - an organic compound that is generally less than 20% soluble in water and has a boiling point at or below 200°C. A volatile organic. An organic compound is generally considered to be purgeable if it can be removed from water using the purging process.

QC BASED NESTED APPROACH - a procedure for estimating the uncertainty of measurement using quality control data. The procedure is described in SOP QA-013.

QUALITY ASSURANCE (QA) - all those planned and systematic actions necessary to provide adequate confidence in laboratory results. An integrated system of activities involving planning, quality control, quality assessment, reporting and quality improvement to ensure that a product or service meets the defined standards of quality with a stated level of confidence.

QUALITY ASSURANCE PROGRAM PLAN - a written assembly of management policies, objectives, principle and general procedures that outlines how the laboratory intends to generate data of known and accepted quality.

QUALITY CONTROL (QC) – the overall system of technical activities whose purpose to measure and control the quality of a product or service so that it meets the needs of the users.

QUALITY CONTROL CHART - a graph of analytical measurement results for a specific QC standard plotted sequentially with upper and lower control limits (±3SD). A central line that is the best estimate of the average variable plotted, and upper and lower marginal exceedence limits (±4SD) are usually included in the Quality Control Chart. The chart may also include upper and lower warning limits (±2SD).

QUALITY SYSTEM – a structured and documented management system describing the policies, objectives, principles, organizational authority, responsibilities, accountability, and implementation plan of an organization for ensuring quality in its work processes, products (items) and services. The quality system provides the framework for planning, implement and assessing work performed by the organization and for carrying out required QA and QC.

r^2 – Correlation Coefficient Squared – paramet6er used to evaluate the fit of linear or quadratic regression curve fit of initial calibration data.

RAW DATA – any original information from a measurement activity or study recorded in a laboratory note book, worksheets, records, memoranda, notes, or exact copies thereof that are necessary for the reconstruction and evaluation of the report of the activity or study. Raw data may include photography, microfilm or microfilm copies, computer printouts, magnetic media, including dictated observations, and recorded data from automated instruments.

REACTIVITY - the tendency of a chemical to explode under normal management conditions, to react violently when mixed with water, or to generate toxic gases.

REAGENT WATER - water in which an interference is not observed at or above the minimum quantitation limit of interest.

REFERENCE MATERIAL - a traceable standard with an established analyte concentration. Material or substance whose property values are sufficiently homogenous, stable and well established to be used for the calibration of an apparatus, the assessment of a measurement method or for assigning values to materials (ISO Guide 30)

REFERENCE METHOD – a method of known and documented accuracy and precision issued by an organization recognized as competent to do so.

RELATIVE RETENTION TIME – a measure of the shift in retention time of an analyte when referenced to an internal standard.

RELATIVE RESPONSE FACTOR (RRF) - a measure of the relative mass spectral response of an analyte compared to its internal standard. RRFs are determined by analysis of standards and are used in the calculation of concentrations of analytes in samples.

REPLICATE ANALYSES - two or more results representing the same sample parameter. Replicate analyses are used to quantify the analytical measurement repeatability precision.

RPD – Relative Percent Difference, a relative difference between two analyses calculated by dividing the absolute difference of thos two results by the average of therir two values, then multiplying by 100.

RESOLUTION - the degree of separation between peaks eluting from a chromatographic column. Sufficient resolution between peaks is required for proper quantitation of unknown analytes.

RETENTION TIME - a term used in gas and liquid chromatography describing the time elapsed from the sample injection until the specific compound elutes or exits the chromatographic column at the detector. Each compound has a characteristics retention time on a specific column; therefore, this information is used to qualitatively identify the compounds in the sample.

SAMPLE – portion of material collect for chemical analysuis, identified by a unique number assigned by the LIMS.

SHALL – denotes a requirement that is mandatory whenever the criterion for conformance with the specification requires that there be no deviation. This does not prohibit the use of alternative approaches or methods for implementing the specification so long as the requirement is fulfilled.

SHOULD – denotes a guideline or recommendation whenever noncompliance with the specification is permissible.

SOLID WASTE – non-liquid, non-soluble materials, ranging from municipal garbage to industrial waste, that contain complex, and sometimes hazardous, substances. Solid wastes include sewage sludge, agricultural refuse, demolition wastes, mining residues, and even liquids and gases in containers.

SOLVENT - a substance, usually liquid, capable of dissolving or dispersing one or more other substances.

SPIKE – a known mass of target analyte added to a blank sample or sub-sample; used to determine recovery efficiency or for other quality control purposes.

STANDARD CURVE - a curve that plots concentrations of known analyte standards versus the instrument response to the analyte. Calibration standards are prepared by diluting the stock analyte solution in graduated amounts that cover the expected range of the samples being analyzed. The calibration standards must be prepared by using the same type of acid or solvent at the same concentration as for the samples following sample preparation. This is applicable to organic and inorganic chemical analyses.

STANDARD OPERATING PROCEDURE - a detailed written description of how a laboratory executes a particular procedure or method intended to standardize its performance.

STANDARDIZED REFERENCE MATERIAL (SRM) – a certified reference material produced by the U.S. National Institute of Standards and Technology or other equivalent organization and characterized for absolute content, independent of analytical metho9d.

STANDARD UNCERTAINTY - the analytical measurement uncertainty expressed as a standard deviation. The relative standard deviation represents the relative standard uncertainty.

SURROGATE - an organic compound similar to the analyte of interest in chemical composition, extraction and chromatography, but not normally found in environmental samples. Primarily used in chromatography techniques, the surrogate is spiked into quality control blanks, calibration and check standards, samples (including duplicated and QC reference samples) and spiked samples before analysis. A percent recovery is calculated for each surrogate.

SUSPENDED SOLIDS - small pollutant particles that float on the surface of, or are suspended in, sewage or other liquids. They resist removal by conventional means.

TARGET COMPOUND - specific compounds that are to be quantified in a sample based on a standard list of potential compounds.

TENTATIVELY IDENTIFIED COMPOUNDS (TICs) - compounds detected in samples that are not target compounds, internal standards, system monitoring compounds or surrogates. TICs usually consist of up to 30 peaks that are greater than 10% of the peak areas, or heights, of the nearest internal standard. They are subjected to mass spectral library searches for tentative identification. A client may specify the number of unknown peaks in its samples it wishes the laboratory to tentatively identify.

TOTAL METALS - metallic elements that have been digested prior to analysis.

TYPE A EVALUATION UNCERTAINTY - the method of evaluation of uncertainty by the statistical analysis of a series of test results.

TYPE B EVALUATION OF UNCERTAINTY - the method of evaluation of uncertainty by means other than statistical analysis.

UNCERTAINTY - the parameter associated with the analytical measurement results that characterizes the dispersion of the values that could be reasonable attributed to the quantity measured.

UNCERTAINTY INTERVAL - the range of analyte concentrations that an analytical measurement could represent at a specified level of confidence. The relative standard deviation is used to represent the relative standard uncertainty in the QC-based Nested Approach.

VALIDATION –the process for evaluating the completeness, correctness, and conformance/compliance of a specific data set against the method, procedural, or contractual specifications. It essentially evaluates performance against predetermined specifications.

VOA - volatile organic analysis

VOA BOTTLE - a vial used to contain samples for volatile organic analysis.

VOLATILE COMPOUNDS - compounds amendable to analysis by purge and trap. Synonymous with purgeable compounds.

VOLATILE ORGANIC COMPOUND (VOC) - any organic compound that participates in atmospheric photochemical reactions, except for those designated by the EPA Administrator as having negligible photochemical reactivity.

WET CHEMISTRY - procedures that involve distillations, colorimetric determinations and titrimetric measurements. Examples are chloride, nitrates, sulfates and biochemical oxygen demand.

PERRY JOHNSON LABORATORY ACCREDITATION, INC.

Certificate of Accreditation

Perry Johnson Laboratory Accreditation, Inc. has assessed the Laboratory of:

Gulf Coast Analytical Laboratories, LLC

7979 Innovation Park Drive, Baton Rouge, LA 70820

(Hereinafter called the Organization) and hereby declares that Organization has met the requirements of ISO/IEC 17025:2005 "General Requirements for the competence of Testing and Calibration Laboratories" and the DoD Quality Systems Manual for Environmental Laboratories Version 5.1.1 February 2018 and is accredited is accordance with the:

United States Department of Defense Environmental Laboratory Accreditation Program (DoD-ELAP)

This accreditation demonstrates technical competence for the defined scope:

Environmental Testing

(As detailed in the supplement)

Accreditation claims for such testing and/or calibration services shall only be made from addresses referenced within this certificate. This Accreditation is granted subject to the system rules governing the Accreditation referred to above, and the Organization hereby covenants with the Accreditation body's duty to observe and comply with the said rules.

For PJLA:

Initial Accreditation Date:	*Issue Date:*	*Expiration Date:*
October 2, 2013	December 27, 2018	December 27, 2020

Accreditation No.:	*Certificate No.:*
74960	L18-597

Tracy Szerszen
President/Operations Manager

Perry Johnson Laboratory
Accreditation, Inc. (PJLA)
755 W. Big Beaver, Suite 1325
Troy, Michigan 48084

The validity of this certificate is maintained through ongoing assessments based on a continuous accreditation cycle. The validity of this certificate should be confirmed through the PJLA website: www.pjlabs.com

Certificate of Accreditation: Supplement

ISO/IEC 17025:2005 and DoD-ELAP

Gulf Coast Analytical Laboratories, LLC

7979 Innovation Park Drive, Baton Rouge, LA 70820
Contact Name: Randy Whittington   Phone: 225-769-4900

Accreditation is granted to the facility to perform the following testing:

Matrix	Standard/Method	Technology	Analyte
Aqueous	EPA 1664A	Gravimetric	Oil & Grease
Aqueous	EPA 200.8	ICP-MS	Aluminum
Aqueous	EPA 200.8	ICP-MS	Antimony
Aqueous	EPA 200.8	ICP-MS	Arsenic
Aqueous	EPA 200.8	ICP-MS	Barium
Aqueous	EPA 200.8	ICP-MS	Beryllium
Aqueous	EPA 200.8	ICP-MS	Cadmium
Aqueous	EPA 200.8	ICP-MS	Calcium
Aqueous	EPA 200.8	ICP-MS	Chromium
Aqueous	EPA 200.8	ICP-MS	Cobalt
Aqueous	EPA 200.8	ICP-MS	Copper
Aqueous	EPA 200.8	ICP-MS	Iron
Aqueous	EPA 200.8	ICP-MS	Lead
Aqueous	EPA 200.8	ICP-MS	Magnesium
Aqueous	EPA 200.8	ICP-MS	Manganese
Aqueous	EPA 200.8	ICP-MS	Molybdenum
Aqueous	EPA 200.8	ICP-MS	Nickel
Aqueous	EPA 200.8	ICP-MS	Potassium
Aqueous	EPA 200.8	ICP-MS	Selenium
Aqueous	EPA 200.8	ICP-MS	Silver
Aqueous	EPA 200.8	ICP-MS	Sodium
Aqueous	EPA 200.8	ICP-MS	Strontium
Aqueous	EPA 200.8	ICP-MS	Thallium
Aqueous	EPA 200.8	ICP-MS	Tin
Aqueous	EPA 200.8	ICP-MS	Titanium
Aqueous	EPA 200.8	ICP-MS	Total Hardness (as CaCO3)
Aqueous	EPA 200.8	ICP-MS	Vanadium
Aqueous	EPA 200.8	ICP-MS	Zinc
Aqueous	EPA 200.8	ICP-MS	Zirconium
Aqueous	EPA 245.2	CVAA	Mercury
Aqueous	EPA 300.0	IC	Bromide
Aqueous	EPA 300.0	IC	Chloride
Aqueous	EPA 300.0	IC	Fluoride
Aqueous	EPA 300.0	IC	Nitrate and Nitrite as N
Aqueous	EPA 300.0	IC	Nitrate as N
Aqueous	EPA 300.0	IC	Nitrite as N

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Matrix	Standard/Method	Technology	Analyte
Aqueous	EPA 300.0	IC	Sulfate
Aqueous	EPA 420.4	FIA	Total Phenolics (4AAP)
Aqueous	EPA 624	GC-MS	1,1,1,2-Tetrachloroethane
Aqueous	EPA 624	GC-MS	1,1,1-Trichloroethane
Aqueous	EPA 624	GC-MS	1,1,2,2-Tetrachloroethane
Aqueous	EPA 624	GC-MS	1,1,2-Trichloroethane
Aqueous	EPA 624	GC-MS	1,1-Dichloroethane
Aqueous	EPA 624	GC-MS	1,1-Dichloroethene
Aqueous	EPA 624	GC-MS	1,1-Dichloropropene
Aqueous	EPA 624	GC-MS	1,2 Dichlorobenzene
Aqueous	EPA 624	GC-MS	1,2 Dichloroethane
Aqueous	EPA 624	GC-MS	1,2,3-Trichlorobenzene
Aqueous	EPA 624	GC-MS	1,2,3-Trichloropropane
Aqueous	EPA 624	GC-MS	1,2,4-Trichlorobenzene
Aqueous	EPA 624	GC-MS	1,2,4-Trimethylbenzene
Aqueous	EPA 624	GC-MS	1,2-Dibromo-3-chloropropane (DBCP)
Aqueous	EPA 624	GC-MS	1,2-Dibromoethane (EDB)
Aqueous	EPA 624	GC-MS	1,2-Dichloropropane
Aqueous	EPA 624	GC-MS	1,3 Dichlorobenzene
Aqueous	EPA 624	GC-MS	1,3,5-Trimethylbenzene
Aqueous	EPA 624	GC-MS	1,3-Dichloropropane
Aqueous	EPA 624	GC-MS	1,4 Dichlorobenzene
Aqueous	EPA 624	GC-MS	2,2-Dichloropropane
Aqueous	EPA 624	GC-MS	2-Butanone (MEK)
Aqueous	EPA 624	GC-MS	2-Chloroethylvinylether
Aqueous	EPA 624	GC-MS	2-Chlorotoluene
Aqueous	EPA 624	GC-MS	2-Hexanone
Aqueous	EPA 624	GC-MS	4-Chlorotoluene
Aqueous	EPA 624	GC-MS	4-Methyl-2-pentanone (MIBK)
Aqueous	EPA 624	GC-MS	Acetone
Aqueous	EPA 624	GC-MS	Acetonitrile
Aqueous	EPA 624	GC-MS	Acrolein
Aqueous	EPA 624	GC-MS	Acrylonitrile
Aqueous	EPA 624	GC-MS	Benzene
Aqueous	EPA 624	GC-MS	Bromochloromethane
Aqueous	EPA 624	GC-MS	Bromodichloromethane

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Matrix	Standard/Method	Technology	Analyte
Aqueous	EPA 624	GC-MS	Bromoform
Aqueous	EPA 624	GC-MS	Bromomethane
Aqueous	EPA 624	GC-MS	Carbon disulfide
Aqueous	EPA 624	GC-MS	Carbon tetrachloride
Aqueous	EPA 624	GC-MS	Chlorobenzene
Aqueous	EPA 624	GC-MS	Chloroethane
Aqueous	EPA 624	GC-MS	Chloroform
Aqueous	EPA 624	GC-MS	Chloromethane
Aqueous	EPA 624	GC-MS	cis-1,2-Dichloroethene
Aqueous	EPA 624	GC-MS	cis-1,3-Dichloropropylene
Aqueous	EPA 624	GC-MS	Dibromochloromethane
Aqueous	EPA 624	GC-MS	Dibromomethane
Aqueous	EPA 624	GC-MS	Dichlorodifluoromethane
Aqueous	EPA 624	GC-MS	Ethylbenzene
Aqueous	EPA 624	GC-MS	Hexachlorobutadiene
Aqueous	EPA 624	GC-MS	Isopropylbenzene
Aqueous	EPA 624	GC-MS	m+p-Xylene
Aqueous	EPA 624	GC-MS	Methyl tert-butyl ether (MTBE)
Aqueous	EPA 624	GC-MS	Methylene Chloride
Aqueous	EPA 624	GC-MS	Naphthalene
Aqueous	EPA 624	GC-MS	n-Butylbenzene
Aqueous	EPA 624	GC-MS	n-Propylbenzene
Aqueous	EPA 624	GC-MS	o-Xylene
Aqueous	EPA 624	GC-MS	p-Isopropyltoluene
Aqueous	EPA 624	GC-MS	sec-Butylbenzene
Aqueous	EPA 624	GC-MS	Styrene
Aqueous	EPA 624	GC-MS	tert-Butylbenzene
Aqueous	EPA 624	GC-MS	Tetrachloroethene
Aqueous	EPA 624	GC-MS	Toluene
Aqueous	EPA 624	GC-MS	trans-1,2-Dichloroethene
Aqueous	EPA 624	GC-MS	trans-1,3-Dichloropropene
Aqueous	EPA 624	GC-MS	Trichloroethene
Aqueous	EPA 624	GC-MS	Trichlorofluoromethane
Aqueous	EPA 624	GC-MS	Vinyl acetate
Aqueous	EPA 624	GC-MS	Vinyl chloride
Aqueous	EPA 624	GC-MS	Xylenes, total

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Matrix	Standard/Method	Technology	Analyte
Aqueous	EPA 625	GC-MS	1,2,4,5-Tetrachlorobenzene
Aqueous	EPA 625	GC-MS	1,2,4-Trichlorobenzene
Aqueous	EPA 625	GC-MS	1-Methylnaphthalene
Aqueous	EPA 625	GC-MS	2,3,4,6-Tetrachlorophenol
Aqueous	EPA 625	GC-MS	2,4,5-Trichlorophenol
Aqueous	EPA 625	GC-MS	2,4,6-Trichlorophenol
Aqueous	EPA 625	GC-MS	2,4-Dichlorophenol
Aqueous	EPA 625	GC-MS	2,4-Dimethylphenol
Aqueous	EPA 625	GC-MS	2,4-Dinitrophenol
Aqueous	EPA 625	GC-MS	2,4-Dinitrotoluene
Aqueous	EPA 625	GC-MS	2,6-Dichlorophenol
Aqueous	EPA 625	GC-MS	2,6-Dinitrotoluene
Aqueous	EPA 625	GC-MS	2-Chloronaphthalene
Aqueous	EPA 625	GC-MS	2-Chlorophenol
Aqueous	EPA 625	GC-MS	2-Methyl-4,6-Dinitrophenol
Aqueous	EPA 625	GC-MS	2-Methylnaphthalene
Aqueous	EPA 625	GC-MS	2-Methylphenol
Aqueous	EPA 625	GC-MS	2-Nitroaniline
Aqueous	EPA 625	GC-MS	2-Nitrophenol
Aqueous	EPA 625	GC-MS	3,3'-Dichlorobenzidine
Aqueous	EPA 625	GC-MS	3-Nitroaniline
Aqueous	EPA 625	GC-MS	4-Bromophenyl-phenylether
Aqueous	EPA 625	GC-MS	4-Chloro-3-methylphenol
Aqueous	EPA 625	GC-MS	4-Chloroaniline
Aqueous	EPA 625	GC-MS	4-Chlorophenyl-phenylether
Aqueous	EPA 625	GC-MS	4-Methylphenol (and/or 3-Methylphenol)
Aqueous	EPA 625	GC-MS	4-Nitroaniline
Aqueous	EPA 625	GC-MS	4-Nitrophenol
Aqueous	EPA 625	GC-MS	Acenaphthene
Aqueous	EPA 625	GC-MS	Acenaphthylene
Aqueous	EPA 625	GC-MS	Aniline
Aqueous	EPA 625	GC-MS	Anthracene
Aqueous	EPA 625	GC-MS	Benzidine
Aqueous	EPA 625	GC-MS	Benzo(a)anthracene
Aqueous	EPA 625	GC-MS	Benzo(a)pyrene
Aqueous	EPA 625	GC-MS	Benzo(b)fluoranthene

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Contact Name: Randy Whittington   Phone: 225-769-4900

Accreditation is granted to the facility to perform the following testing:

Matrix	Standard/Method	Technology	Analyte
Aqueous	EPA 625	GC-MS	Benzo(g,h,i)perylene
Aqueous	EPA 625	GC-MS	Benzo(k)fluoranthene
Aqueous	EPA 625	GC-MS	Benzoic acid
Aqueous	EPA 625	GC-MS	Benzyl alcohol
Aqueous	EPA 625	GC-MS	bis(2-Chloroethoxy)methane
Aqueous	EPA 625	GC-MS	bis(2-Chloroethyl)ether
Aqueous	EPA 625	GC-MS	bis(2-Chloroiospropyl) ether
Aqueous	EPA 625	GC-MS	bis(2-ethylhexyl) phthalate
Aqueous	EPA 625	GC-MS	Butyl benzyl phthalate
Aqueous	EPA 625	GC-MS	Carbazole
Aqueous	EPA 625	GC-MS	Chrysene
Aqueous	EPA 625	GC-MS	Dibenzo(a,h)anthracene
Aqueous	EPA 625	GC-MS	Dibenzofuran
Aqueous	EPA 625	GC-MS	Diethyl phthalate
Aqueous	EPA 625	GC-MS	Dimethyl phthalate
Aqueous	EPA 625	GC-MS	Di-n-butylphthalate
Aqueous	EPA 625	GC-MS	Di-n-octylphthalate
Aqueous	EPA 625	GC-MS	Fluoranthene
Aqueous	EPA 625	GC-MS	Fluorene
Aqueous	EPA 625	GC-MS	Hexachlorobenzene
Aqueous	EPA 625	GC-MS	Hexachlorocyclopentadiene
Aqueous	EPA 625	GC-MS	Indeno(1,2,3, cd)pyrene
Aqueous	EPA 625	GC-MS	Isophorone
Aqueous	EPA 625	GC-MS	Naphthalene
Aqueous	EPA 625	GC-MS	Nitrobenzene
Aqueous	EPA 625	GC-MS	N-Nitrosodiethylamine
Aqueous	EPA 625	GC-MS	N-Nitrosodimethylamine
Aqueous	EPA 625	GC-MS	N-Nitroso-di-n-propylamine
Aqueous	EPA 625	GC-MS	N-Nitrosodiphenylamine
Aqueous	EPA 625	GC-MS	o-Toluidine
Aqueous	EPA 625	GC-MS	Pentachlorobenzene
Aqueous	EPA 625	GC-MS	Pentachlorophenol
Aqueous	EPA 625	GC-MS	Phenanthrene
Aqueous	EPA 625	GC-MS	Phenol
Aqueous	EPA 625	GC-MS	Pyrene
Aqueous	EPA 625	GC-MS	Pyridine

Certificate of Accreditation: Supplement

ISO/IEC 17025:2005 and DoD-ELAP

Gulf Coast Analytical Laboratories, LLC

7979 Innovation Park Drive, Baton Rouge, LA 70820
Contact Name: Randy Whittington Phone: 225-769-4900

Accreditation is granted to the facility to perform the following testing:

Matrix	Standard/Method	Technology	Analyte
Aqueous	EPA 7470A	CVAA	Mercury
Aqueous	EPA 8011	GC-ECD	1,2-Dibromo-3-chloropropane (DBCP)
Aqueous	EPA 8011	GC-ECD	1,2-Dibromoethane (EDB)
Aqueous	EPA 8081B	GC-ECD	Diallate
Aqueous	EPA 9040C	pH Meter	Corrosivity (pH)
Aqueous	HACH 8000	Spectrophotometer	COD
Aqueous	RSK175	GC-FID	Acetylene
Aqueous	RSK175	GC-FID	Butane
Aqueous	RSK175	GC-TCD	Carbon Dioxide
Aqueous	RSK175	GC-FID	Ethane
Aqueous	RSK175	GC-FID	Ethene
Aqueous	RSK175	GC-FID	Methane
Aqueous	RSK175	GC-FID	Propane
Aqueous	SM 2130B	Turbidimetric	Turbidity
Aqueous	HACH 10242	Spectrophotometer	Total Kieldahl Nitrogen
Aqueous	SM 2310B	Titration	Acidity(as CaCO3)
Aqueous	SM 2320B	Titration	Total Alkalinity(as CaCO3)
Aqueous	SM 2340 B	ICP-MS	Total Hardness (as CaCO3)
Aqueous	SM 2540B	Gravimetric	Total Solid
Aqueous	SM 2540C	Gravimetric	Total Dissolved Solid (TDS)
Aqueous	SM 2540D	Gravimetric	Non-Filterable Residue (TSS)
Aqueous	SM 3500-Fe B	Spectrophotometer	Ferrous Iron
Aqueous	SM 4500-Cl E	Autotitrator	Chloride
Aqueous	SM 4500-H+ B	pH Meter	Corrosivity (pH)
Aqueous	SM 4500-H+ B	pH Meter	pH
Aqueous	SM 4500-PE	Spectrophotometer	Orthophosphate as P
Aqueous	SM 4500-S2 D	Spectrophotometer	Sulfide
Aqueous	SM 4500-S2 F	Titration	Sulfide
Aqueous	SM 4500-SiO2 C	Spectrophotometer	Silica
Aqueous	SM 4500-SO4 E	IC	Sulfate
Aqueous	SM 5310B	TOC Analyzer	TOC
Aqueous	EPA 9020B	TOX Analyzer	Total Organic Halides
Drinking Water	EPA 537	LC/MS/MS	NMeFOSAA
Drinking Water	EPA 537	LC/MS/MS	NEtFOSAA
Drinking Water	EPA 537	LC/MS/MS	PFBS
Drinking Water	EPA 537	LC/MS/MS	PFDA

Accreditation is granted to the facility to perform the following testing:

Matrix	Standard/Method	Technology	Analyte
Drinking Water	EPA 537	LC/MS/MS	PFDoA
Drinking Water	EPA 537	LC/MS/MS	PFHpA
Drinking Water	EPA 537	LC/MS/MS	PFHxS
Drinking Water	EPA 537	LC/MS/MS	PFHxA
Drinking Water	EPA 537	LC/MS/MS	PFNA
Drinking Water	EPA 537	LC/MS/MS	PFOS
Drinking Water	EPA 537	LC/MS/MS	PFOA
Drinking Water	EPA 537	LC/MS/MS	PFTA
Drinking Water	EPA 537	LC/MS/MS	PFTrDA
Drinking Water	EPA 537	LC/MS/MS	PFUnA
Solid	EPA 1030	N/A	Ignitability
Solid	EPA 3060A	N/A	Hexavalent Chromium Preparation
Solid	EPA 7471B	CVAA	Mercury
Solid	EPA 9045D	pH Meter	Corrosivity (pH)
Solid	EPA 9095B	N/A	Paint Filter Test
Solid	SM 2540G	Gravimetric	Percent Moisture
Solid	SM 2540G	Gravimetric	Total Solid
Aqueous/Solid	EPA 1010A	Automated FP Analyzer	Ignitability
Aqueous/Solid	EPA 353.2	FIA	Nitrate and Nitrite as N
Aqueous/Solid	EPA 353.2	FIA	Nitrate as N
Aqueous/Solid	EPA 353.2	FIA	Nitrite as N
Aqueous/Solid	EPA 365.1	FIA	Total Phosphorous
Aqueous/Solid	EPA 6020A	ICP-MS	Aluminum
Aqueous/Solid	EPA 6020A	ICP-MS	Antimony
Aqueous/Solid	EPA 6020A	ICP-MS	Arsenic
Aqueous/Solid	EPA 6020A	ICP-MS	Barium
Aqueous/Solid	EPA 6020A	ICP-MS	Beryllium
Aqueous/Solid	EPA 6020A	ICP-MS	Cadmium
Aqueous/Solid	EPA 6020A	ICP-MS	Calcium
Aqueous/Solid	EPA 6020A	ICP-MS	Chromium
Aqueous/Solid	EPA 6020A	ICP-MS	Cobalt
Aqueous/Solid	EPA 6020A	ICP-MS	Copper
Aqueous/Solid	EPA 6020A	ICP-MS	Iron
Aqueous/Solid	EPA 6020A	ICP-MS	Lead
Aqueous/Solid	EPA 6020A	ICP-MS	Magnesium
Aqueous/Solid	EPA 6020A	ICP-MS	Manganese

Certificate of Accreditation: Supplement
ISO/IEC 17025:2005 and DoD-ELAP

Gulf Coast Analytical Laboratories, LLC
7979 Innovation Park Drive, Baton Rouge, LA 70820
Contact Name: Randy Whittington   Phone: 225-769-4900

Accreditation is granted to the facility to perform the following testing:

Matrix	Standard/Method	Technology	Analyte
Aqueous/Solid	EPA 6020A	ICP-MS	Molybdenum
Aqueous/Solid	EPA 6020A	ICP-MS	Nickel
Aqueous/Solid	EPA 6020A	ICP-MS	Potassium
Aqueous/Solid	EPA 6020A	ICP-MS	Selenium
Aqueous/Solid	EPA 6020A	ICP-MS	Silver
Aqueous/Solid	EPA 6020A	ICP-MS	Sodium
Aqueous/Solid	EPA 6020A	ICP-MS	Strontium
Aqueous/Solid	EPA 6020A	ICP-MS	Thallium
Aqueous/Solid	EPA 6020A	ICP-MS	Tin
Aqueous/Solid	EPA 6020A	ICP-MS	Titanium
Aqueous/Solid	EPA 6020A	ICP-MS	Vanadium
Aqueous/Solid	EPA 6020A	ICP-MS	Zinc
Aqueous/Solid	EPA 6020A	ICP-MS	Zirconium
Aqueous/Solid	EPA 6020B	ICP-MS	Aluminum
Aqueous/Solid	EPA 6020B	ICP-MS	Antimony
Aqueous/Solid	EPA 6020B	ICP-MS	Arsenic
Aqueous/Solid	EPA 6020B	ICP-MS	Barium
Aqueous/Solid	EPA 6020B	ICP-MS	Beryllium
Aqueous/Solid	EPA 6020B	ICP-MS	Cadmium
Aqueous/Solid	EPA 6020B	ICP-MS	Calcium
Aqueous/Solid	EPA 6020B	ICP-MS	Chromium
Aqueous/Solid	EPA 6020B	ICP-MS	Cobalt
Aqueous/Solid	EPA 6020B	ICP-MS	Copper
Aqueous/Solid	EPA 6020B	ICP-MS	Iron
Aqueous/Solid	EPA 6020B	ICP-MS	Lead
Aqueous/Solid	EPA 6020B	ICP-MS	Magnesium
Aqueous/Solid	EPA 6020B	ICP-MS	Manganese
Aqueous/Solid	EPA 6020B	ICP-MS	Molybdenum
Aqueous/Solid	EPA 6020B	ICP-MS	Nickel
Aqueous/Solid	EPA 6020B	ICP-MS	Potassium
Aqueous/Solid	EPA 6020B	ICP-MS	Selenium
Aqueous/Solid	EPA 6020B	ICP-MS	Silver
Aqueous/Solid	EPA 6020B	ICP-MS	Sodium
Aqueous/Solid	EPA 6020B	ICP-MS	Strontium
Aqueous/Solid	EPA 6020B	ICP-MS	Thallium
Aqueous/Solid	EPA 6020B	ICP-MS	Tin

Accreditation is granted to the facility to perform the following testing:

Matrix	Standard/Method	Technology	Analyte
Aqueous/Solid	EPA 6020B	ICP-MS	Titanium
Aqueous/Solid	EPA 6020B	ICP-MS	Vanadium
Aqueous/Solid	EPA 6020B	ICP-MS	Zinc
Aqueous/Solid	EPA 6020B	ICP-MS	Zirconium
Aqueous/Solid	EPA 7196A	Spectrophotometer	Chromium VI
Aqueous/Solid	EPA 8015C	GC-FID	Diesel
Aqueous/Solid	EPA 8015C	GC-FID	Diesel range organics (DRO)
Aqueous/Solid	EPA 8015C	GC-FID	Gasoline range organics (GRO)
Aqueous/Solid	EPA 8015C	GC-FID	Oil Range Organics (ORO)
Aqueous/Solid	EPA 8081B	GC-ECD	Aldrin
Aqueous/Solid	EPA 8081B	GC-ECD	alpha-BHC
Aqueous/Solid	EPA 8081B	GC-ECD	alpha-Chlordane
Aqueous/Solid	EPA 8081B	GC-ECD	beta-BHC
Aqueous/Solid	EPA 8081B	GC-ECD	Chlordane
Aqueous/Solid	EPA 8081B	GC-ECD	Chlordane (total)
Aqueous/Solid	EPA 8081B	GC-ECD	DDD (4,4’)
Aqueous/Solid	EPA 8081B	GC-ECD	DDE (4,4’)
Aqueous/Solid	EPA 8081B	GC-ECD	DDT (4,4’)
Aqueous/Solid	EPA 8081B	GC-ECD	delta-BHC
Aqueous/Solid	EPA 8081B	GC-ECD	Dieldrin
Aqueous/Solid	EPA 8081B	GC-ECD	Endosulfan I
Aqueous/Solid	EPA 8081B	GC-ECD	Endosulfan II
Aqueous/Solid	EPA 8081B	GC-ECD	Endosulfan sulfate
Aqueous/Solid	EPA 8081B	GC-ECD	Endrin
Aqueous/Solid	EPA 8081B	GC-ECD	Endrin aldehyde
Aqueous/Solid	EPA 8081B	GC-ECD	Endrin ketone
Aqueous/Solid	EPA 8081B	GC-ECD	gamma-BHC (Lindane)
Aqueous/Solid	EPA 8081B	GC-ECD	gamma-Chlordane
Aqueous/Solid	EPA 8081B	GC-ECD	Heptachlor
Aqueous/Solid	EPA 8081B	GC-ECD	Heptachlor Epoxide (beta)
Aqueous/Solid	EPA 8081B	GC-ECD	Methoxychlor
Aqueous/Solid	EPA 8081B	GC-ECD	Toxaphene
Aqueous/Solid	EPA 8081B	GC-ECD	Toxaphene (total)
Aqueous/Solid	EPA 8082A	GC-ECD	Aroclor 1016
Aqueous/Solid	EPA 8082A	GC-ECD	Aroclor 1221
Aqueous/Solid	EPA 8082A	GC-ECD	Aroclor 1232

Certificate of Accreditation: Supplement

ISO/IEC 17025:2005 and DoD-ELAP

Gulf Coast Analytical Laboratories, LLC

7979 Innovation Park Drive, Baton Rouge, LA 70820
Contact Name: Randy Whittington   Phone: 225-769-4900

Accreditation is granted to the facility to perform the following testing:

Matrix	Standard/Method	Technology	Analyte
Aqueous/Solid	EPA 8082A	GC-ECD	Aroclor 1242
Aqueous/Solid	EPA 8082A	GC-ECD	Aroclor 1248
Aqueous/Solid	EPA 8082A	GC-ECD	Aroclor 1254
Aqueous/Solid	EPA 8082A	GC-ECD	Aroclor 1260
Aqueous/Solid	EPA 8082A	GC-ECD	Aroclor 1262
Aqueous/Solid	EPA 8082A	GC-ECD	Aroclor 1268
Aqueous/Solid	EPA 8141B	GC-NPD	Azinphos-methyl (Guthion)
Aqueous/Solid	EPA 8141B	GC-NPD	Diazinon
Aqueous/Solid	EPA 8141B	GC-NPD	Disulfoton
Aqueous/Solid	EPA 8141B	GC-NPD	Malathion
Aqueous/Solid	EPA 8141B	GC-NPD	Parathion, ethyl
Aqueous/Solid	EPA 8141B	GC-NPD	Parathion, methyl
Aqueous/Solid	EPA 8141B	GC-NPD	Phorate
Aqueous/Solid	EPA 8141B	GC-NPD	Ronnel
Aqueous/Solid	EPA 8141B	GC-NPD	Stirophos
Aqueous/Solid	EPA 8151A	GC-ECD	2, 4, DB
Aqueous/Solid	EPA 8151A	GC-ECD	2, 4-D
Aqueous/Solid	EPA 8151A	GC-ECD	2,4,5-T
Aqueous/Solid	EPA 8151A	GC-ECD	2,4,5-TP (Silvex)
Aqueous/Solid	EPA 8151A	GC-ECD	2,4-DP (Dichlorprop)
Aqueous/Solid	EPA 8151A	GC-ECD	3,5-Dichlorobenzoic acid
Aqueous/Solid	EPA 8151A	GC-ECD	4-Nitrophenol
Aqueous/Solid	EPA 8151A	GC-ECD	Acifluorfen
Aqueous/Solid	EPA 8151A	GC-ECD	Bentazon
Aqueous/Solid	EPA 8151A	GC-ECD	Chloramben
Aqueous/Solid	EPA 8151A	GC-ECD	Dacthal (DCPA)
Aqueous/Solid	EPA 8151A	GC-ECD	Dalapon
Aqueous/Solid	EPA 8151A	GC-ECD	Dicamba
Aqueous/Solid	EPA 8151A	GC-ECD	Dinoseb
Aqueous/Solid	EPA 8151A	GC-ECD	MCPA
Aqueous/Solid	EPA 8151A	GC-ECD	MCPP
Aqueous/Solid	EPA 8151A	GC-ECD	Pentachlorophenol
Aqueous/Solid	EPA 8260B	GC-MS	1,1,1,2-Tetrachloroethane
Aqueous/Solid	EPA 8260B	GC-MS	1,1,1-Trichloroethane
Aqueous/Solid	EPA 8260B	GC-MS	1,1,2,2-Tetrachloroethane
Aqueous/Solid	EPA 8260B	GC-MS	1,1,2-trichloro-1,2,2-trifluoroethane

Accreditation is granted to the facility to perform the following testing:

Matrix	Standard/Method	Technology	Analyte
Aqueous/Solid	EPA 8260B	GC-MS	1,1,2-Trichloroethane
Aqueous/Solid	EPA 8260B	GC-MS	1,1-Dichloroethane
Aqueous/Solid	EPA 8260B	GC-MS	1,1-Dichloroethene
Aqueous/Solid	EPA 8260B	GC-MS	1,1-Dichloropropene
Aqueous/Solid	EPA 8260B	GC-MS	1,2 Dichlorobenzene
Aqueous/Solid	EPA 8260B	GC-MS	1,2 Dichloroethane
Aqueous/Solid	EPA 8260B	GC-MS	1,2,3-Trichlorobenzene
Aqueous/Solid	EPA 8260B	GC-MS	1,2,3-Trichloropropane
Aqueous/Solid	EPA 8260B	GC-MS	1,2,4,5-Tetrachlorobenzene
Aqueous/Solid	EPA 8260B	GC-MS	1,2,4-Trichlorobenzene
Aqueous/Solid	EPA 8260B	GC-MS	1,2,4-Trimethylbenzene
Aqueous/Solid	EPA 8260B	GC-MS	1,2-Dibromo-3-chloropropane (DBCP)
Aqueous/Solid	EPA 8260B	GC-MS	1,2-Dibromoethane (EDB)
Aqueous/Solid	EPA 8260B	GC-MS	1,2-Dichloropropane
Aqueous/Solid	EPA 8260B	GC-MS	1,3 Dichlorobenzene
Aqueous/Solid	EPA 8260B	GC-MS	1,3,5-Trimethylbenzene
Aqueous/Solid	EPA 8260B	GC-MS	1,3-Dichloropropane
Aqueous/Solid	EPA 8260B	GC-MS	1,4 Dichlorobenzene
Aqueous/Solid	EPA 8260B	GC-MS	1-Chlorohexane
Aqueous/Solid	EPA 8260B	GC-MS	2,2-Dichloropropane
Aqueous/Solid	EPA 8260B	GC-MS	2-Butanone (MEK)
Aqueous/Solid	EPA 8260B	GC-MS	2-Chloroethylvinylether
Aqueous/Solid	EPA 8260B	GC-MS	2-Chlorotoluene
Aqueous/Solid	EPA 8260B	GC-MS	2-Hexanone
Aqueous/Solid	EPA 8260B	GC-MS	4-Chlorotoluene
Aqueous/Solid	EPA 8260B	GC-MS	4-Methyl-2-pentanone (MIBK)
Aqueous/Solid	EPA 8260B	GC-MS	Acetone
Aqueous/Solid	EPA 8260B	GC-MS	Acetonitrile
Aqueous/Solid	EPA 8260B	GC-MS	Acrolein
Aqueous/Solid	EPA 8260B	GC-MS	Acrylonitrile
Aqueous/Solid	EPA 8260B	GC-MS	Benzene
Aqueous/Solid	EPA 8260B	GC-MS	Bromobenzene
Aqueous/Solid	EPA 8260B	GC-MS	Bromochloromethane
Aqueous/Solid	EPA 8260B	GC-MS	Bromodichloromethane
Aqueous/Solid	EPA 8260B	GC-MS	Bromoform
Aqueous/Solid	EPA 8260B	GC-MS	Bromomethane

Certificate of Accreditation: Supplement

ISO/IEC 17025:2005 and DoD-ELAP

Gulf Coast Analytical Laboratories, LLC

7979 Innovation Park Drive, Baton Rouge, LA 70820
Contact Name: Randy Whittington   Phone: 225-769-4900

Accreditation is granted to the facility to perform the following testing:

Matrix	Standard/Method	Technology	Analyte
Aqueous/Solid	EPA 8260B	GC-MS	Carbon disulfide
Aqueous/Solid	EPA 8260B	GC-MS	Carbon tetrachloride
Aqueous/Solid	EPA 8260B	GC-MS	Chlorobenzene
Aqueous/Solid	EPA 8260B	GC-MS	Chloroethane
Aqueous/Solid	EPA 8260B	GC-MS	Chloroform
Aqueous/Solid	EPA 8260B	GC-MS	Chloromethane
Aqueous/Solid	EPA 8260B	GC-MS	cis-1,2-Dichloroethene
Aqueous/Solid	EPA 8260B	GC-MS	cis-1,3-Dichloropropylene
Aqueous/Solid	EPA 8260B	GC-MS	Dibromochloromethane
Aqueous/Solid	EPA 8260B	GC-MS	Dibromomethane
Aqueous/Solid	EPA 8260B	GC-MS	Dichlorodifluoromethane
Aqueous/Solid	EPA 8260B	GC-MS	DIPE
Aqueous/Solid	EPA 8260B	GC-MS	ETBE
Aqueous/Solid	EPA 8260B	GC-MS	Ethylbenzene
Aqueous/Solid	EPA 8260B	GC-MS	Hexachlorobutadiene
Aqueous/Solid	EPA 8260B	GC-MS	Isopropylbenzene
Aqueous/Solid	EPA 8260B	GC-MS	m+p-Xylene
Aqueous/Solid	EPA 8260B	GC-MS	Methyl tert-butyl ether (MTBE)
Aqueous/Solid	EPA 8260B	GC-MS	Methylcyclohexane
Aqueous/Solid	EPA 8260B	GC-MS	Methylene Chloride
Aqueous/Solid	EPA 8260B	GC-MS	Methyl Acetate
Aqueous/Solid	EPA 8260B	GC-MS	MTBE
Aqueous/Solid	EPA 8260B	GC-MS	Naphthalene
Aqueous/Solid	EPA 8260B	GC-MS	n-Butylbenzene
Aqueous/Solid	EPA 8260B	GC-MS	n-Propylbenzene
Aqueous/Solid	EPA 8260B	GC-MS	o-Xylene
Aqueous/Solid	EPA 8260B	GC-MS	p-Isopropyltoluene
Aqueous/Solid	EPA 8260B	GC-MS	sec-Butylbenzene
Aqueous/Solid	EPA 8260B	GC-MS	Styrene
Aqueous/Solid	EPA 8260B	GC-MS	TAME
Aqueous/Solid	EPA 8260B	GC-MS	tert-Butyl alcohol
Aqueous/Solid	EPA 8260B	GC-MS	tert-Butylbenzene
Aqueous/Solid	EPA 8260B	GC-MS	Tetrachloroethene
Aqueous/Solid	EPA 8260B	GC-MS	Toluene
Aqueous/Solid	EPA 8260B	GC-MS	trans-1,2-Dichloroethene
Aqueous/Solid	EPA 8260B	GC-MS	trans-1,3-Dichloropropene

Accreditation is granted to the facility to perform the following testing:

Matrix	Standard/Method	Technology	Analyte
Aqueous/Solid	EPA 8260B	GC-MS	Trichloroethene
Aqueous/Solid	EPA 8260B	GC-MS	Trichlorofluoromethane
Aqueous/Solid	EPA 8260B	GC-MS	Vinyl acetate
Aqueous/Solid	EPA 8260B	GC-MS	Vinyl chloride
Aqueous/Solid	EPA 8260B	GC-MS	Xylenes, total
Aqueous/Solid	EPA 8260B	GC-MS VOC	Cyclohexane
Aqueous/Solid	EPA 8260B	GC-MS VOC	Ethyl Acetate
Aqueous/Solid	EPA 8260B	GC-MS VOC	n-Butanol
Aqueous/Solid	EPA 8260C	GC-MS	1,1,1,2-Tetrachloroethane
Aqueous/Solid	EPA 8260C	GC-MS	1,1,1-Trichloroethane
Aqueous/Solid	EPA 8260C	GC-MS	1,1,2,2-Tetrachloroethane
Aqueous/Solid	EPA 8260C	GC-MS	1,1,2-trichloro-1,2,2-trifluoroethane
Aqueous/Solid	EPA 8260C	GC-MS	1,1,2-Trichloroethane
Aqueous/Solid	EPA 8260C	GC-MS	1,1-Dichloroethane
Aqueous/Solid	EPA 8260C	GC-MS	1,1-Dichloroethene
Aqueous/Solid	EPA 8260C	GC-MS	1,1-Dichloropropene
Aqueous/Solid	EPA 8260C	GC-MS	1,2 Dichlorobenzene
Aqueous/Solid	EPA 8260C	GC-MS	1,2 Dichloroethane
Aqueous/Solid	EPA 8260C	GC-MS	1,2,3-Trichlorobenzene
Aqueous/Solid	EPA 8260C	GC-MS	1,2,3-Trichloropropane
Aqueous/Solid	EPA 8260C	GC-MS	1,2,4,5-Tetrachlorobenzene
Aqueous/Solid	EPA 8260C	GC-MS	1,2,4-Trichlorobenzene
Aqueous/Solid	EPA 8260C	GC-MS	1,2,4-Trimethylbenzene
Aqueous/Solid	EPA 8260C	GC-MS	1,2-Dibromo-3-chloropropane (DBCP)
Aqueous/Solid	EPA 8260C	GC-MS	1,2-Dibromoethane (EDB)
Aqueous/Solid	EPA 8260C	GC-MS	1,2-Dichloropropane
Aqueous/Solid	EPA 8260C	GC-MS	1,3 Dichlorobenzene
Aqueous/Solid	EPA 8260C	GC-MS	1,3,5-Trimethylbenzene
Aqueous/Solid	EPA 8260C	GC-MS	1,3-Dichloropropane
Aqueous/Solid	EPA 8260C	GC-MS	1,4 Dichlorobenzene
Aqueous/Solid	EPA 8260C	GC-MS	1-Chlorohexane
Aqueous/Solid	EPA 8260C	GC-MS	2,2-Dichloropropane
Aqueous/Solid	EPA 8260C	GC-MS	2-Butanone (MEK)
Aqueous/Solid	EPA 8260C	GC-MS	2-Chloroethylvinylether
Aqueous/Solid	EPA 8260C	GC-MS	2-Chlorotoluene
Aqueous/Solid	EPA 8260C	GC-MS	2-Hexanone

Accreditation is granted to the facility to perform the following testing:

Matrix	Standard/Method	Technology	Analyte
Aqueous/Solid	EPA 8260C	GC-MS	4-Chlorotoluene
Aqueous/Solid	EPA 8260C	GC-MS	4-Methyl-2-pentanone (MIBK)
Aqueous/Solid	EPA 8260C	GC-MS	Acetone
Aqueous/Solid	EPA 8260C	GC-MS	Acetonitrile
Aqueous/Solid	EPA 8260C	GC-MS	Acrolein
Aqueous/Solid	EPA 8260C	GC-MS	Acrylonitrile
Aqueous/Solid	EPA 8260C	GC-MS	Benzene
Aqueous/Solid	EPA 8260C	GC-MS	Bromobenzene
Aqueous/Solid	EPA 8260C	GC-MS	Bromochloromethane
Aqueous/Solid	EPA 8260C	GC-MS	Bromodichloromethane
Aqueous/Solid	EPA 8260C	GC-MS	Bromoform
Aqueous/Solid	EPA 8260C	GC-MS	Bromomethane
Aqueous/Solid	EPA 8260C	GC-MS	Carbon disulfide
Aqueous/Solid	EPA 8260C	GC-MS	Carbon tetrachloride
Aqueous/Solid	EPA 8260C	GC-MS	Chlorobenzene
Aqueous/Solid	EPA 8260C	GC-MS	Chloroethane
Aqueous/Solid	EPA 8260C	GC-MS	Chloroform
Aqueous/Solid	EPA 8260C	GC-MS	Chloromethane
Aqueous/Solid	EPA 8260C	GC-MS	cis-1,2-Dichloroethene
Aqueous/Solid	EPA 8260C	GC-MS	cis-1,3-Dichloropropylene
Aqueous/Solid	EPA 8260C	GC-MS	Dibromochloromethane
Aqueous/Solid	EPA 8260C	GC-MS	Dibromomethane
Aqueous/Solid	EPA 8260C	GC-MS	Dichlorodifluoromethane
Aqueous/Solid	EPA 8260C	GC-MS	DIPE
Aqueous/Solid	EPA 8260C	GC-MS	ETBE
Aqueous/Solid	EPA 8260C	GC-MS	Ethylbenzene
Aqueous/Solid	EPA 8260C	GC-MS	Hexachlorobutadiene
Aqueous/Solid	EPA 8260C	GC-MS	Isopropylbenzene
Aqueous/Solid	EPA 8260C	GC-MS	m+p-Xylene
Aqueous/Solid	EPA 8260C	GC-MS	Methyl tert-butyl ether (MTBE)
Aqueous/Solid	EPA 8260C	GC-MS	Methylcyclohexane
Aqueous/Solid	EPA 8260C	GC-MS	Methylene Chloride
Aqueous/Solid	EPA 8260C	GC-MS	Methyl Acetate
Aqueous/Solid	EPA 8260C	GC-MS	MTBE
Aqueous/Solid	EPA 8260C	GC-MS	Naphthalene
Aqueous/Solid	EPA 8260C	GC-MS	n-Butylbenzene

Matrix	Standard/Method	Technology	Analyte
Aqueous/Solid	EPA 8260C	GC-MS	n-Propylbenzene
Aqueous/Solid	EPA 8260C	GC-MS	o-Xylene
Aqueous/Solid	EPA 8260C	GC-MS	p-Isopropyltoluene
Aqueous/Solid	EPA 8260C	GC-MS	sec-Butylbenzene
Aqueous/Solid	EPA 8260C	GC-MS	Styrene
Aqueous/Solid	EPA 8260C	GC-MS	TAME
Aqueous/Solid	EPA 8260C	GC-MS	tert-Butyl alcohol
Aqueous/Solid	EPA 8260C	GC-MS	tert-Butylbenzene
Aqueous/Solid	EPA 8260C	GC-MS	Tetrachloroethene
Aqueous/Solid	EPA 8260C	GC-MS	Toluene
Aqueous/Solid	EPA 8260C	GC-MS	trans-1,2-Dichloroethene
Aqueous/Solid	EPA 8260C	GC-MS	trans-1,3-Dichloropropene
Aqueous/Solid	EPA 8260C	GC-MS	Trichloroethene
Aqueous/Solid	EPA 8260C	GC-MS	Trichlorofluoromethane
Aqueous/Solid	EPA 8260C	GC-MS	Vinyl acetate
Aqueous/Solid	EPA 8260C	GC-MS	Vinyl chloride
Aqueous/Solid	EPA 8260C	GC-MS	Xylenes, total
Aqueous/Solid	EPA 8260C	GC-MS VOC	Cyclohexane
Aqueous/Solid	EPA 8260C	GC-MS VOC	Ethyl Acetate
Aqueous/Solid	EPA 8260C	GC-MS VOC	n-Butanol
Aqueous/Solid	EPA 8270C	GC-MS	1,2 Dichlorobenzene
Aqueous/Solid	EPA 8270C	GC-MS	1,2,4,5-Tetrachlorobenzene
Aqueous/Solid	EPA 8270C	GC-MS	1,2,4-Trichlorobenzene
Aqueous/Solid	EPA 8270C	GC-MS	1,2-Diphenylhydrazine
Aqueous/Solid	EPA 8270C	GC-MS	1,3 Dichlorobenzene
Aqueous/Solid	EPA 8270C	GC-MS	1,4 Dichlorobenzene
Aqueous/Solid	EPA 8270C	GC-MS	1-Methylnaphthalene
Aqueous/Solid	EPA 8270C	GC-MS	2,3,4,6-Tetrachlorophenol
Aqueous/Solid	EPA 8270C	GC-MS	2,4,5-Trichlorophenol
Aqueous/Solid	EPA 8270C	GC-MS	2,4,6-Trichlorophenol
Aqueous/Solid	EPA 8270C	GC-MS	2,4-Dichlorophenol
Aqueous/Solid	EPA 8270C	GC-MS	2,4-Dimethylphenol
Aqueous/Solid	EPA 8270C	GC-MS	2,4-Dinitrophenol
Aqueous/Solid	EPA 8270C	GC-MS	2,4-Dinitrotoluene
Aqueous/Solid	EPA 8270C	GC-MS	2,6-Dichlorophenol
Aqueous/Solid	EPA 8270C	GC-MS	2,6-Dinitrotoluene

Matrix	Standard/Method	Technology	Analyte
Aqueous/Solid	EPA 8270C	GC-MS	2-Chloronaphthalene
Aqueous/Solid	EPA 8270C	GC-MS	2-Chlorophenol
Aqueous/Solid	EPA 8270C	GC-MS	2-Methyl-4,6-Dinitrophenol
Aqueous/Solid	EPA 8270C	GC-MS	2-Methylnaphthalene
Aqueous/Solid	EPA 8270C	GC-MS	2-Methylphenol
Aqueous/Solid	EPA 8270C	GC-MS	2-Nitroaniline
Aqueous/Solid	EPA 8270C	GC-MS	2-Nitrophenol
Aqueous/Solid	EPA 8270C	GC-MS	3,3'-Dichlorobenzidine
Aqueous/Solid	EPA 8270C	GC-MS	3-Nitroaniline
Aqueous/Solid	EPA 8270C	GC-MS	4-Bromophenyl-phenylether
Aqueous/Solid	EPA 8270C	GC-MS	4-Chloro-3-methylphenol
Aqueous/Solid	EPA 8270C	GC-MS	4-Chloroaniline
Aqueous/Solid	EPA 8270C	GC-MS	4-Chlorophenyl-phenylether
Aqueous/Solid	EPA 8270C	GC-MS	4-Methylphenol (and/or 3-Methylphenol)
Aqueous/Solid	EPA 8270C	GC-MS	4-Nitroaniline
Aqueous/Solid	EPA 8270C	GC-MS	4-Nitrophenol
Aqueous/Solid	EPA 8270C	GC-MS	Acenaphthene
Aqueous/Solid	EPA 8270C	GC-MS	Acenaphthylene
Aqueous/Solid	EPA 8270C	GC-MS	Acetophenone
Aqueous/Solid	EPA 8270C	GC-MS	Aniline
Aqueous/Solid	EPA 8270C	GC-MS	Anthracene
Aqueous/Solid	EPA 8270C	GC-MS	Atrazine
Aqueous/Solid	EPA 8270C	GC-MS	Benzaldehyde
Aqueous/Solid	EPA 8270C	GC-MS	Benzidine
Aqueous/Solid	EPA 8270C	GC-MS	Benzo(a)anthracene
Aqueous/Solid	EPA 8270C	GC-MS	Benzo(a)pyrene
Aqueous/Solid	EPA 8270C	GC-MS	Benzo(b)fluoranthene
Aqueous/Solid	EPA 8270C	GC-MS	Benzo(g,h,i)perylene
Aqueous/Solid	EPA 8270C	GC-MS	Benzo(k)fluoranthene
Aqueous/Solid	EPA 8270C	GC-MS	Benzoic acid
Aqueous/Solid	EPA 8270C	GC-MS	Benzyl alcohol
Aqueous/Solid	EPA 8270C	GC-MS	Biphenyl
Aqueous/Solid	EPA 8270C	GC-MS	bis(2-Chloroethoxy)methane
Aqueous/Solid	EPA 8270C	GC-MS	bis(2-Chloroethyl)ether
Aqueous/Solid	EPA 8270C	GC-MS	bis(2-Chloroiospropyl) ether
Aqueous/Solid	EPA 8270C	GC-MS	bis(2-ethylhexyl) phthalate

Certificate of Accreditation: Supplement

ISO/IEC 17025:2005 and DoD-ELAP

Gulf Coast Analytical Laboratories, LLC

7979 Innovation Park Drive, Baton Rouge, LA 70820
Contact Name: Randy Whittington   Phone: 225-769-4900

Accreditation is granted to the facility to perform the following testing:

Matrix	Standard/Method	Technology	Analyte
Aqueous/Solid	EPA 8270C	GC-MS	bis(2-ethylhexyl) phthalate
Aqueous/Solid	EPA 8270C	GC-MS	Butyl benzyl phthalate
Aqueous/Solid	EPA 8270C	GC-MS	Butyl benzyl phthalate
Aqueous/Solid	EPA 8270C	GC-MS	Caprolactom
Aqueous/Solid	EPA 8270C	GC-MS	Carbazole
Aqueous/Solid	EPA 8270C	GC-MS	Carbazole
Aqueous/Solid	EPA 8270C	GC-MS	Chrysene
Aqueous/Solid	EPA 8270C	GC-MS	Chrysene
Aqueous/Solid	EPA 8270C	GC-MS	Dibenzo(a,h)anthracene
Aqueous/Solid	EPA 8270C	GC-MS	Dibenzo(a,h)anthracene
Aqueous/Solid	EPA 8270C	GC-MS	Dibenzofuran
Aqueous/Solid	EPA 8270C	GC-MS	Dibenzofuran
Aqueous/Solid	EPA 8270C	GC-MS	Diethyl phthalate
Aqueous/Solid	EPA 8270C	GC-MS	Diethyl phthalate
Aqueous/Solid	EPA 8270C	GC-MS	Dimethyl phthalate
Aqueous/Solid	EPA 8270C	GC-MS	Dimethyl phthalate
Aqueous/Solid	EPA 8270C	GC-MS	Di-n-butylphthalate
Aqueous/Solid	EPA 8270C	GC-MS	Di-n-butylphthalate
Aqueous/Solid	EPA 8270C	GC-MS	Di-n-octylphthalate
Aqueous/Solid	EPA 8270C	GC-MS	Di-n-octylphthalate
Aqueous/Solid	EPA 8270C	GC-MS	Fluoranthene
Aqueous/Solid	EPA 8270C	GC-MS	Fluoranthene
Aqueous/Solid	EPA 8270C	GC-MS	Fluorene
Aqueous/Solid	EPA 8270C	GC-MS	Fluorene
Aqueous/Solid	EPA 8270C	GC-MS	Hexachlorobenzene
Aqueous/Solid	EPA 8270C	GC-MS	Hexachlorobenzene
Aqueous/Solid	EPA 8270C	GC-MS	Hexachlorobutadiene
Aqueous/Solid	EPA 8270C	GC-MS	Hexachlorobutadiene
Aqueous/Solid	EPA 8270C	GC-MS	Hexachlorocyclopentadiene
Aqueous/Solid	EPA 8270C	GC-MS	Hexachloroethane
Aqueous/Solid	EPA 8270C	GC-MS	Indeno(1,2,3, cd)pyrene
Aqueous/Solid	EPA 8270C	GC-MS	Isophorone
Aqueous/Solid	EPA 8270C	GC-MS	Naphthalene
Aqueous/Solid	EPA 8270C	GC-MS	Nitrobenzene
Aqueous/Solid	EPA 8270C	GC-MS	N-Nitrosodiethylamine
Aqueous/Solid	EPA 8270C	GC-MS	N-Nitrosodimethylamine

Accreditation is granted to the facility to perform the following testing:

Matrix	Standard/Method	Technology	Analyte
Aqueous/Solid	EPA 8270C	GC-MS	N-Nitroso-di-n-propylamine
Aqueous/Solid	EPA 8270C	GC-MS	N-Nitrosodiphenylamine
Aqueous/Solid	EPA 8270C	GC-MS	o-Toluidine
Aqueous/Solid	EPA 8270C	GC-MS	p-Dioxane
Aqueous/Solid	EPA 8270C	GC-MS	Pentachlorobenzene
Aqueous/Solid	EPA 8270C	GC-MS	Pentachlorophenol
Aqueous/Solid	EPA 8270C	GC-MS	Phenanthrene
Aqueous/Solid	EPA 8270C	GC-MS	Phenol
Aqueous/Solid	EPA 8270C	GC-MS	Pyrene
Aqueous/Solid	EPA 8270C	GC-MS	Pyridine
Aqueous/Solid	EPA 8270C SIM	GC-MS	1-Methylnaphthalene
Aqueous/Solid	EPA 8270C SIM	GC-MS	2-Methylnaphthalene
Aqueous/Solid	EPA 8270C SIM	GC-MS	Acenaphthene
Aqueous/Solid	EPA 8270C SIM	GC-MS	Acenaphthylene
Aqueous/Solid	EPA 8270C SIM	GC-MS	Anthracene
Aqueous/Solid	EPA 8270C SIM	GC-MS	Benzo(a)anthracene
Aqueous/Solid	EPA 8270C SIM	GC-MS	Benzo(a)pyrene
Aqueous/Solid	EPA 8270C SIM	GC-MS	Benzo(b)fluoranthene
Aqueous/Solid	EPA 8270C SIM	GC-MS	Benzo(g,h,i)perylene
Aqueous/Solid	EPA 8270C SIM	GC-MS	Benzo(k)fluoranthene
Aqueous/Solid	EPA 8270C SIM	GC-MS	Chrysene
Aqueous/Solid	EPA 8270C SIM	GC-MS	Dibenz(a,h) anthracene
Aqueous/Solid	EPA 8270C SIM	GC-MS	Fluoranthene
Aqueous/Solid	EPA 8270C SIM	GC-MS	Fluorene
Aqueous/Solid	EPA 8270C SIM	GC-MS	Indeno(1,2,3-cd) pyrene
Aqueous/Solid	EPA 8270C SIM	GC-MS	Naphthalene
Aqueous/Solid	EPA 8270C SIM	GC-MS	Phenanthrene
Aqueous/Solid	EPA 8270C SIM	GC-MS	Pyrene
Aqueous/Solid	EPA 8270D	GC-MS	1,2 Dichlorobenzene
Aqueous/Solid	EPA 8270D	GC-MS	1,2,4,5-Tetrachlorobenzene
Aqueous/Solid	EPA 8270D	GC-MS	1,2,4-Trichlorobenzene
Aqueous/Solid	EPA 8270D	GC-MS	1,2-Diphenylhydrazine
Aqueous/Solid	EPA 8270D	GC-MS	1,3 Dichlorobenzene
Aqueous/Solid	EPA 8270D	GC-MS	1,4 Dichlorobenzene
Aqueous/Solid	EPA 8270D	GC-MS	1-Methylnaphthalene
Aqueous/Solid	EPA 8270D	GC-MS	2,3,4,6-Tetrachlorophenol

Certificate of Accreditation: Supplement

ISO/IEC 17025:2005 and DoD-ELAP

Gulf Coast Analytical Laboratories, LLC

7979 Innovation Park Drive, Baton Rouge, LA 70820
Contact Name: Randy Whittington   Phone: 225-769-4900

Accreditation is granted to the facility to perform the following testing:

Matrix	Standard/Method	Technology	Analyte
Aqueous/Solid	EPA 8270D	GC-MS	2,4,5-Trichlorophenol
Aqueous/Solid	EPA 8270D	GC-MS	2,4,6-Trichlorophenol
Aqueous/Solid	EPA 8270D	GC-MS	2,4-Dichlorophenol
Aqueous/Solid	EPA 8270D	GC-MS	2,4-Dimethylphenol
Aqueous/Solid	EPA 8270D	GC-MS	2,4-Dinitrophenol
Aqueous/Solid	EPA 8270D	GC-MS	2,4-Dinitrotoluene
Aqueous/Solid	EPA 8270D	GC-MS	2,6-Dichlorophenol
Aqueous/Solid	EPA 8270D	GC-MS	2,6-Dinitrotoluene
Aqueous/Solid	EPA 8270D	GC-MS	2-Chloronaphthalene
Aqueous/Solid	EPA 8270D	GC-MS	2-Chlorophenol
Aqueous/Solid	EPA 8270D	GC-MS	2-Methyl-4,6-Dinitrophenol
Aqueous/Solid	EPA 8270D	GC-MS	2-Methylnaphthalene
Aqueous/Solid	EPA 8270D	GC-MS	2-Methylphenol
Aqueous/Solid	EPA 8270D	GC-MS	2-Nitroaniline
Aqueous/Solid	EPA 8270D	GC-MS	2-Nitrophenol
Aqueous/Solid	EPA 8270D	GC-MS	3,3'-Dichlorobenzidine
Aqueous/Solid	EPA 8270D	GC-MS	3-Nitroaniline
Aqueous/Solid	EPA 8270D	GC-MS	4-Bromophenyl-phenylether
Aqueous/Solid	EPA 8270D	GC-MS	4-Chloro-3-methylphenol
Aqueous/Solid	EPA 8270D	GC-MS	4-Chloroaniline
Aqueous/Solid	EPA 8270D	GC-MS	4-Chlorophenyl-phenylether
Aqueous/Solid	EPA 8270D	GC-MS	4-Methylphenol (and/or 3-Methylphenol)
Aqueous/Solid	EPA 8270D	GC-MS	4-Nitroaniline
Aqueous/Solid	EPA 8270D	GC-MS	4-Nitrophenol
Aqueous/Solid	EPA 8270D	GC-MS	Acenaphthene
Aqueous/Solid	EPA 8270D	GC-MS	Acenaphthylene
Aqueous/Solid	EPA 8270D	GC-MS	Aniline
Aqueous/Solid	EPA 8270D	GC-MS	Anthracene
Aqueous/Solid	EPA 8270D	GC-MS	Atrazine
Aqueous/Solid	EPA 8270D	GC-MS	Benzidine
Aqueous/Solid	EPA 8270D	GC-MS	Benzo(a)anthracene
Aqueous/Solid	EPA 8270D	GC-MS	Benzo(a)pyrene
Aqueous/Solid	EPA 8270D	GC-MS	Benzo(b)fluoranthene
Aqueous/Solid	EPA 8270D	GC-MS	Benzo(g,h,i)perylene
Aqueous/Solid	EPA 8270D	GC-MS	Benzo(k)fluoranthene
Aqueous/Solid	EPA 8270D	GC-MS	Benzoic acid

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Gulf Coast Analytical Laboratories, LLC

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Contact Name: Randy Whittington Phone: 225-769-4900

Accreditation is granted to the facility to perform the following testing:

Matrix	Standard/Method	Technology	Analyte
Aqueous/Solid	EPA 8270D	GC-MS	Benzyl alcohol
Aqueous/Solid	EPA 8270D	GC-MS	bis(2-Chloroethoxy)methane
Aqueous/Solid	EPA 8270D	GC-MS	bis(2-Chloroethyl)ether
Aqueous/Solid	EPA 8270D	GC-MS	bis(2-Chloroiospropyl) ether
Aqueous/Solid	EPA 8270D	GC-MS	bis(2-ethylhexyl) phthalate
Aqueous/Solid	EPA 8270D	GC-MS	Butyl benzyl phthalate
Aqueous/Solid	EPA 8270D	GC-MS	Caprolactom
Aqueous/Solid	EPA 8270D	GC-MS	Carbazole
Aqueous/Solid	EPA 8270D	GC-MS	Chrysene
Aqueous/Solid	EPA 8270D	GC-MS	Dibenzo(a,h)anthracene
Aqueous/Solid	EPA 8270D	GC-MS	Dibenzofuran
Aqueous/Solid	EPA 8270D	GC-MS	Diethyl phthalate
Aqueous/Solid	EPA 8270D	GC-MS	Dimethyl phthalate
Aqueous/Solid	EPA 8270D	GC-MS	Di-n-butylphthalate
Aqueous/Solid	EPA 8270D	GC-MS	Di-n-octylphthalate
Aqueous/Solid	EPA 8270D	GC-MS	Fluoranthene
Aqueous/Solid	EPA 8270D	GC-MS	Fluorene
Aqueous/Solid	EPA 8270D	GC-MS	Hexachlorobenzene
Aqueous/Solid	EPA 8270D	GC-MS	Hexachlorobutadiene
Aqueous/Solid	EPA 8270D	GC-MS	Hexachlorocyclopentadiene
Aqueous/Solid	EPA 8270D	GC-MS	Hexachloroethane
Aqueous/Solid	EPA 8270D	GC-MS	Indeno(1,2,3, cd)pyrene
Aqueous/Solid	EPA 8270D	GC-MS	Isophorone
Aqueous/Solid	EPA 8270D	GC-MS	Naphthalene
Aqueous/Solid	EPA 8270D	GC-MS	Nitrobenzene
Aqueous/Solid	EPA 8270D	GC-MS	N-Nitrosodiethylamine
Aqueous/Solid	EPA 8270D	GC-MS	N-Nitrosodimethylamine
Aqueous/Solid	EPA 8270D	GC-MS	N-Nitroso-di-n-propylamine
Aqueous/Solid	EPA 8270D	GC-MS	N-Nitrosodiphenylamine
Aqueous/Solid	EPA 8270D	GC-MS	o-Toluidine
Aqueous/Solid	EPA 8270D	GC-MS	Pentachlorobenzene
Aqueous/Solid	EPA 8270D	GC-MS	Pentachlorophenol
Aqueous/Solid	EPA 8270D	GC-MS	Phenanthrene
Aqueous/Solid	EPA 8270D	GC-MS	Phenol
Aqueous/Solid	EPA 8270D	GC-MS	Pyrene
Aqueous/Solid	EPA 8270D	GC-MS	Pyridine

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Accreditation is granted to the facility to perform the following testing:

Matrix	Standard/Method	Technology	Analyte
Aqueous/Solid	EPA 8270D SIM	GC-MS	1-Methylnaphthalene
Aqueous/Solid	EPA 8270D SIM	GC-MS	2-Methylnaphthalene
Aqueous/Solid	EPA 8270D SIM	GC-MS	Acenaphthene
Aqueous/Solid	EPA 8270D SIM	GC-MS	Acenaphthylene
Aqueous/Solid	EPA 8270D SIM	GC-MS	Anthracene
Aqueous/Solid	EPA 8270D SIM	GC-MS	Benzo(a)anthracene
Aqueous/Solid	EPA 8270D SIM	GC-MS	Benzo(a)pyrene
Aqueous/Solid	EPA 8270D SIM	GC-MS	Benzo(b)fluoranthene
Aqueous/Solid	EPA 8270D SIM	GC-MS	Benzo(g,h,i)perylene
Aqueous/Solid	EPA 8270D SIM	GC-MS	Benzo(k)fluoranthene
Aqueous/Solid	EPA 8270D SIM	GC-MS	Chrysene
Aqueous/Solid	EPA 8270D SIM	GC-MS	Dibenz(a,h) anthracene
Aqueous/Solid	EPA 8270D SIM	GC-MS	Fluoranthene
Aqueous/Solid	EPA 8270D SIM	GC-MS	Fluorene
Aqueous/Solid	EPA 8270D SIM	GC-MS	Indeno(1,2,3-cd) pyrene
Aqueous/Solid	EPA 8270D SIM	GC-MS	Naphthalene
Aqueous/Solid	EPA 8270D SIM	GC-MS	Phenanthrene
Aqueous/Solid	EPA 8270D SIM	GC-MS	Pyrene
Aqueous/Solid	EPA 8330A	HPLC	1,3,5-Trinitrobenzene
Aqueous/Solid	EPA 8330A	HPLC	1,3-Dinitrobenzene
Aqueous/Solid	EPA 8330A	HPLC	2,4,6-Trinitrotoluene
Aqueous/Solid	EPA 8330A	HPLC	2,4-Dinitrotoluene
Aqueous/Solid	EPA 8330A	HPLC	2,6-Dinitrotoluene
Aqueous/Solid	EPA 8330A	HPLC	2-Amino-4,6-dinitrotoluene
Aqueous/Solid	EPA 8330A	HPLC	2-Nitrotoluene
Aqueous/Solid	EPA 8330A	HPLC	3,5-Dinitroaniline
Aqueous/Solid	EPA 8330A	HPLC	3-Nitrotoluene
Aqueous/Solid	EPA 8330A	HPLC	4-Amino-2,6-dinitrotoluene
Aqueous/Solid	EPA 8330A	HPLC	4-Nitrotoluene
Aqueous/Solid	EPA 8330A	HPLC	HMX (Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine)
Aqueous/Solid	EPA 8330A	HPLC	Nitrobenzene
Aqueous/Solid	EPA 8330A	HPLC	Nitroglycerin
Aqueous/Solid	EPA 8330A	HPLC	Pentaerythritoltetranitrate
Aqueous/Solid	EPA 8330A	HPLC	RDX (Hexahydro-1,3,5-trinitro-1,3,5-triazine)

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Gulf Coast Analytical Laboratories, LLC

7979 Innovation Park Drive, Baton Rouge, LA 70820
Contact Name: Randy Whittington Phone: 225-769-4900

Accreditation is granted to the facility to perform the following testing:

Matrix	Standard/Method	Technology	Analyte
Aqueous/Solid	EPA 8330A	HPLC	Tetryl (Methyl-2,4,6-trinitrophenylnitramine)
Aqueous/Solid	EPA 8330B	HPLC	1,3,5-Trinitrobenzene
Aqueous/Solid	EPA 8330B	HPLC	1,3-Dinitrobenzene
Aqueous/Solid	EPA 8330B	HPLC	2,4,6-Trinitrotoluene
Aqueous/Solid	EPA 8330B	HPLC	2,4-Dinitrotoluene
Aqueous/Solid	EPA 8330B	HPLC	2,6-Dinitrotoluene
Aqueous/Solid	EPA 8330B	HPLC	2-amino-4,6-dinitrotoluene
Aqueous/Solid	EPA 8330B	HPLC	2-Nitrotoluene
Aqueous/Solid	EPA 8330B	HPLC	3,5-Dinitroaniline
Aqueous/Solid	EPA 8330B	HPLC	3-Nitrotoluene
Aqueous/Solid	EPA 8330B	HPLC	4-amino-2,6-dinitrotoluene
Aqueous/Solid	EPA 8330B	HPLC	4-Nitrotoluene
Aqueous/Solid	EPA 8330B	HPLC	HMX (Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine)
Aqueous/Solid	EPA 8330B	HPLC	Nitrobenzene
Aqueous/Solid	EPA 8330B	HPLC	Nitroglycerin
Aqueous/Solid	EPA 8330B	HPLC	Pentaerythritoltetranitrate
Aqueous/Solid	EPA 8330B	HPLC	RDX (Hexahydro-1,3,5-trinitro-1,3,5-triazine)
Aqueous/Solid	EPA 8330B	HPLC	Tetryl (Methyl-2,4,6-trinitrophenylnitramine)
Aqueous/Solid	EPA 9012B	FIA	Total Cyanide
Aqueous/Solid	EPA 9038	Spectrophotometer	Sulfate
Aqueous/Solid	EPA 9056A	IC	Bromide
Aqueous/Solid	EPA 9056A	IC	Chloride
Aqueous/Solid	EPA 9056A	IC	Fluoride
Aqueous/Solid	EPA 9056A	IC	Nitrate and Nitrite as N
Aqueous/Solid	EPA 9056A	IC	Nitrate as N
Aqueous/Solid	EPA 9056A	IC	Nitrite as N
Aqueous/Solid	EPA 9056A	IC	Sulfate
Aqueous/Solid	EPA 9060A	TOC Analyzer	TOC
Aqueous/Solid	EPA 9066	FIA	Total Phenolics (4AAP)
Aqueous/Solid	EPA 9251	FIA	Chloride
Aqueous/Solid	FL-PRO	GC-FID	Petroleum Hydrocarbons
Aqueous/Solid	GCAL SOP WL-070	IC	Acetic Acid
Aqueous/Solid	GCAL SOP WL-070	IC	Butyric Acid
Aqueous/Solid	GCAL SOP WL-070	IC	Formic Acid

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Gulf Coast Analytical Laboratories, LLC

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Contact Name: Randy Whittington   Phone: 225-769-4900

Accreditation is granted to the facility to perform the following testing:

Matrix	Standard/Method	Technology	Analyte
Aqueous/Solid	GCAL SOP WL-070	IC	Lactic Acid
Aqueous/Solid	GCAL SOP WL-070	IC	Propionic Acid
Aqueous/Solid	MADEP EPH	GC-FID	C11-C22 Aromatic Hydrocarbons
Aqueous/Solid	MADEP EPH	GC-FID	C19-C36 Aliphatic Hydrocarbons
Aqueous/Solid	MADEP EPH	GC-FID	C9-C18 Aliphatic Hydrocarbons
Aqueous/Solid	MADEP VPH	GC-FID	C5-C8 Aliphatic Hydrocarbons
Aqueous/Solid	MADEP VPH	GC-FID	C9-C10 Aromatic Hydrocarbons
Aqueous/Solid	MADEP VPH	GC-FID	C9-C12 Aliphatic Hydrocarbons
Aqueous/Solid	SM5210 B	Assay	BODs
Aqueous/Solid	SM4500-NH3 B & D	ISE	Ammonia as N
Aqueous/Solid	SW846 Sec 7.3	FIA	Reactive Cyanide
Aqueous/Solid	SW846 Sec 7.3	Titration	Reactive sulfide
Aqueous/Solid	TCEQ 1005	GC-FID	Total Petroleum Hydrocarbon
Aqueous/Solid	TNRCC 1006	GC-FID	DRO-aplhatic
Aqueous/Solid	TNRCC 1006	GC-FID	DRO-aromatic
Aqueous/Solid	TNRCC 1006	GC-FID	DRO-Total
Aqueous/Solid	TNRCC 1006	GC-FID	GRO-aliphatic
Aqueous/Solid	TNRCC 1006	GC-FID	GRO-aromatic
Aqueous/Solid	TNRCC 1006	GC-FID	GRO-Total
Aqueous/Solid	TNRCC 1006	GC-FID	ORO-aliphatic
Aqueous/Solid	TNRCC 1006	GC-FID	ORO-aromatic
Aqueous/Solid	TNRCC 1006	GC-FID	ORO-Total
Aqueous/Solid	TNRCC 1006	GC-FID	Total Petroleum Hydrocarbon
AFFF/Aqueous/Solid	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	LC/MS/MS	N-ethylperfluorooctanesulfonamidoacetic acid (NEtFOSAA)
AFFF/Aqueous/Solid	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	LC/MS/MS	Fluorotelomer sulfonate 8:2 (8:2 FTS)
AFFF/Aqueous/Solid	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	LC/MS/MS	Fluorotelomer sulfonate 4:2 (4:2 FTS)
AFFF/Aqueous/Solid	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	LC/MS/MS	Fluorotelomer sulfonate 6:2 (6:2 FTS)
AFFF/Aqueous/Solid	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	LC/MS/MS	N-methylperfluorooctanesulfonamidoacetic acid (NMeFOSAA)

Certificate of Accreditation: Supplement

ISO/IEC 17025:2005 and DoD-ELAP

Gulf Coast Analytical Laboratories, LLC

7979 Innovation Park Drive, Baton Rouge, LA 70820
Contact Name: Randy Whittington   Phone: 225-769-4900

Accreditation is granted to the facility to perform the following testing:

Matrix	Standard/Method	Technology	Analyte
AFFF/Aqueous/Solid	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	LC/MS/MS	Perfluorobutanesulfonate (PFBS)
AFFF/Aqueous/Solid	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	LC/MS/MS	Perfluorobutanoic acid (PFBA)
AFFF/Aqueous/Solid	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	LC/MS/MS	Perfluorodecanesulfonate (PFDS)
AFFF/Aqueous/Solid	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	LC/MS/MS	Perfluorodecanoic acid (PFDA)
AFFF/Aqueous/Solid	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	LC/MS/MS	Perfluorododecanoic acid (PFDoA)
AFFF/Aqueous/Solid	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	LC/MS/MS	Perfluoroheptanesulfonate (PFHpS)
AFFF/Aqueous/Solid	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	LC/MS/MS	Perfluoroheptanoic acid (PFHpA)
AFFF/Aqueous/Solid	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	LC/MS/MS	Perfluorohexanesulfonate (PFHxS)
AFFF/Aqueous/Solid	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	LC/MS/MS	Perfluorohexanoic acid (PFHxA)
AFFF/Aqueous/Solid	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	LC/MS/MS	Perfluorononanesulfonate (PFNS)
AFFF/Aqueous/Solid	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	LC/MS/MS	Perfluorononanoic acid (PFNA)
AFFF/Aqueous/Solid	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	LC/MS/MS	Perfluorooctane sulfonamide (FOSA)
AFFF/Aqueous/Solid	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	LC/MS/MS	Perfluorooctanesulfonate (PFOS)
AFFF/Aqueous/Solid	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	LC/MS/MS	Perfluorooctanoic acid (PFOA)
AFFF/Aqueous/Solid	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	LC/MS/MS	Perfluoropentanoic acid (PFPeA)
AFFF/Aqueous/Solid	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	LC/MS/MS	Perfluoropentansulfonate (PFPeS)
AFFF/Aqueous/Solid	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	LC/MS/MS	Perfluorotetradecanoic acid (PFTeDA)
AFFF/Aqueous/Solid	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	LC/MS/MS	Perfluorotridecanoic acid (PFTrDA)
AFFF/Aqueous/Solid	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	LC/MS/MS	Perfluoroundecanoic acid (PFUdA)

Certificate of Accreditation: Supplement

ISO/IEC 17025:2005 and DoD-ELAP

Gulf Coast Analytical Laboratories, LLC

7979 Innovation Park Drive, Baton Rouge, LA 70820
Contact Name: Randy Whittington Phone: 225-769-4900

Accreditation is granted to the facility to perform the following testing:

Matrix	Standard/Method	Technology	Analyte
Aqueous	EPA 3010A	Acid Digestion - Metals	Prep Method
Aqueous	EPA 3510C	Separatory Funnel	Prep Method
Aqueous	EPA 3520C	Continuous Liquid/Liquid Extraction	Prep Method
Aqueous	EPA 3535A	Solid Phase Extraction	Prep Method
Aqueous	EPA 5030B	Purge and Trap	Prep Method
Solid	EPA 1311	SPLC	Prep Method
Solid	EPA 1311	TCLP	Prep Method
Solid	EPA 3050B	Acid Digestion	Prep Method
Solid	EPA 3535A	Incremental Sampling Method	Prep Method
Solid	EPA 3550C	Extraction - Sonication	Prep Method
Solid	EPA 3540C	Extraction - Soxhlet	Prep Method
Solid	EPA 3546	Extraction - Microwave	Prep Method
Solid	EPA 5035	Purge and Trap	Prep Method

CERTIFICATE OF ACCREDITATION

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

This is to certify that

Shealy Environmental Services, Inc.
106 Vantage Point Drive
West Columbia, SC 29172

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

ISO/IEC 17025:2005

and DoD Quality Systems Manual for Environmental Laboratories (DoD QSM V 5.1.1)

while demonstrating technical competence in the fields of

TESTING

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

L2224
Certificate Number

ANAB Approval

Certificate Valid: 10/17/2018-11/18/2021
Version No. 007 Issued: 10/17/2018

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

ANSI-ASQ National Accreditation Board

SCOPE OF ACCREDITATION TO ISO/IEC 17025:2005 AND DOD QUALITY SYSTEMS MANUAL FOR ENVIRONMENTAL LABORATORIES (DOD QSM V 5.1.1)

Shealy Environmental Services, Inc

106 Vantage Point Drive
West Columbia, SC 29172
Wendy Plessinger
803-227-2705 x 104

TESTING

Valid to: **November 18, 2021**

Certificate Number: **L2224**

Environmental

Non-Potable Water

Technology	Method	Analyte
GC	EPA 8151A	2,4,5-T
GC	EPA 8151A	2,4D
GC	EPA 8151A	2,4DB
GC	EPA 8151A	Dalapon
GC	EPA 8151A	Dicamba
GC	EPA 8151A	Dichloroprop
GC	EPA 8151A	Dinoseb
GC	EPA 8151A	MCPA
GC	EPA 8151A	MCPP
GC	EPA 8151A	Silvex(2,4,5 TP)
GC/MS	EPA 8270D	0,0,0-Triethylphosphorothioate
GC/MS	EPA 8270D	1,2,4,5-Tetrachlorobenzene
GC/MS	EPA 8270D	1,2,4-Trichlorobenzene
GC/MS	EPA 8270D	1,2-Dichlorobenzene
GC/MS	EPA 8270D	1,3-Dichlorobenzene
GC/MS	EPA 8270D	1,3,5-Trinitrobenzene
GC/MS	EPA 8270D	1,4-Benzoquinone
GC/MS	EPA 8270D	1,4-Dichlorobenzene
GC/MS	EPA 8270D	1,4-Dinitrobenzene
GC/MS	EPA 8270D	1,4-Naphthoquinone

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/MS	EPA 8270D	1-Chloronaphthalene
GC/MS	EPA 8270D	1-Methylnaphthalene
GC/MS	EPA 8270D	1-Naphthylamine
GC/MS	EPA 8270D	2,3,4,6-Tetrachlorophenol
GC/MS	EPA 8270D	2,3,5,6-Tetrachlorophenol
GC/MS	EPA 8270D	2,4,5-Trichlorophenol
GC/MS	EPA 8270D	2,4,6-Trichlorophenol
GC/MS	EPA 8270D	2,4-Dichlorophenol
GC/MS	EPA 8270D	2,4-Dimethylphenol
GC/MS	EPA 8270D	2,4-Dinitrophenol
GC/MS	EPA 8270D	2,4-Dinitrotoluene
GC/MS	EPA 8270D	2,6-Dichlorophenol
GC/MS	EPA 8270D	2,6-Dinitrotoluene
GC/MS	EPA 8270D	2-Acetylaminofluorene
GC/MS	EPA 8270D	2-Chloronaphthalene
GC/MS	EPA 8270D	2-Chlorophenol
GC/MS	EPA 8270D	2-Methylnaphthalene
GC/MS	EPA 8270D	2-Methylphenol
GC/MS	EPA 8270D	2-Naphthylamine
GC/MS	EPA 8270D	2-Nitroaniline
GC/MS	EPA 8270D	2-Nitrophenol
GC/MS	EPA 8270D	2-Picoline
GC/MS	EPA 8270D	3,3’-Dichlorobenzidine
GC/MS	EPA 8270D	3,3’-Dimethylbenzidine
GC/MS	EPA 8270D	3-Methylcholanthrene
GC/MS	EPA 8270D	3-Nitroaniline
GC/MS	EPA 8270D	4,4’-Methylene-bis-chloroaniline
GC/MS	EPA 8270D	4,6-Dinitro-2-methylphenol
GC/MS	EPA 8270D	4-Aminobiphenyl
GC/MS	EPA 8270D	4-Bromophenylphenylether
GC/MS	EPA 8270D	4-Chloro-3-methylphenol
GC/MS	EPA 8270D	4-Chloroaniline
GC/MS	EPA 8270D	4-Chlorophenylphenylether
GC/MS	EPA 8270D	4-Nitroaniline
GC/MS	EPA 8270D	4-Nitrophenol
GC/MS	EPA 8270D	5-Nitro-o-toluidine

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/MS	EPA 8270D	7,12-Dimethylbenzo(a)anthracene
GC/MS	EPA 8270D	Acenaphthene
GC/MS	EPA 8270D	Acenaphthylene
GC/MS	EPA 8270D	Acetophenone
GC/MS	EPA 8270D	Aniline
GC/MS	EPA 8270D	Anthracene
GC/MS	EPA 8270D	Aramite
GC/MS	EPA 8270D	Atrazine
GC/MS	EPA 8270D	Azobenzene
GC/MS	EPA 8270D	Benzaldhyde
GC/MS	EPA 8270D	Benzidine
GC/MS	EPA 8270D	Benzo(a)Anthracene
GC/MS	EPA 8270D	Benzo(a)pyrene
GC/MS	EPA 8270D	Benzo(b)fluoranthene
GC/MS	EPA 8270D	Benzo(g,h,i)perylene
GC/MS	EPA 8270D	Benzo(k)fluoranthene
GC/MS	EPA 8270D	Benzoic acid
GC/MS	EPA 8270D	Benzyl alcohol
GC/MS	EPA 8270D	Biphenyl
GC/MS	EPA 8270D	bis(2-Chloroethoxy)methane
GC/MS	EPA 8270D	bis(2-Chloroethyl)ether
GCMS	EPA 8270D	Bis (2-Chloro-1-methylethyl) ether
GC/MS	EPA 8270D	bis(2-Ethylhexyl)phthalate
GC/MS	EPA 8270D	Butylbenzylphthalate
GC/MS	EPA 8270D	Caprolactam
GC/MS	EPA 8270D	Carbazole
GC/MS	EPA 8270D	Chrysene
GC/MS	EPA 8270D	Chlorobenzilate
GC/MS	EPA 8270D	DEET
GC/MS	EPA 8270D	Diallate
GC/MS	EPA 8270D	Dibenzo(a,h)acridine
GC/MS	EPA 8270D	Dibenzo(a,h)anthracene
GC/MS	EPA 8270D	Dibenzo(a,e)pyrene
GC/MS	EPA 8270D	Dibenzofuran
GC/MS	EPA 8270D	Diethylphthalate

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/MS	EPA 8270D	Dimethoate
GC/MS	EPA 8270D	Dimethylphthalate
GC/MS	EPA 8270D	Di-n-butylphthalate
GC/MS	EPA 8270D	Di-n-octylphthalate
GC/MS	EPA 8270D	Dinoseb
GC/MS	EPA 8270D	Disulfoton
GC/MS	EPA 8270D	Ethyl methacrylate
GC/MS	EPA 8270D	Ethyl methanesulfonate
GC/MS	EPA 8270D	Famphur
GC/MS	EPA 8270D	Fluoranthene
GC/MS	EPA 8270D	Fluorene
GC/MS	EPA 8270D	Hexachlorobenzene
GC/MS	EPA 8270D	Hexachlorobutadiene
GC/MS	EPA 8270D	Hexachlorocyclopentadiene
GC/MS	EPA 8270D	Hexachloroethane
GC/MS	EPA 8270D	Hexachloropropene
GC/MS	EPA 8270D	Indene
GC/MS	EPA 8270D	Indeno(1,2,3-c,d)pyrene
GC/MS	EPA 8270D	Isodrin
GC/MS	EPA 8270D	Isophorone
GC/MS	EPA 8270D	Isosafrole
GC/MS	EPA 8270D	Kepone
GC/MS	EPA 8270D	m+p-Cresol
GC/MS	EPA 8270D	m-Dinitrobenzene
GC/MS	EPA 8270D	Methyl methacrylate
GC/MS	EPA 8270D	Methyl methanesulfonate
GC/MS	EPA 8270D	Methyl parathion
GC/MS	EPA 8270D	Mirex
GC/MS	EPA 8270D	Naphthalene
GC/MS	EPA 8270D	Nitrobenzene
GC/MS	EPA 8270D	N-Nitrosodiethylamine
GC/MS	EPA 8270D	N-Nitrosodimethylamine
GC/MS	EPA 8270D	N-Nitrosodi-n-butylamine
GC/MS	EPA 8270D	n-Nitroso-di-n-propylamine
GC/MS	EPA 8270D	n-Nitrosodiphenylamine
GC/MS	EPA 8270D	N-Nitrosomethylethylamine

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/MS	EPA 8270D	N-Nitrosomorpholine
GC/MS	EPA 8270D	N-Nitrosopiperidine
GC/MS	EPA 8270D	N-Nitrosopyrrolidine
GC/MS	EPA 8270D	o-Cresol
GC/MS	EPA 8270D	o-Toluidine
GC/MS	EPA 8270D	p-(Dimethylamino)azobenzene
GC/MS	EPA 8270D	Parathion
GC/MS	EPA 8270D	Pentachlorobenzene
GC/MS	EPA 8270D	Pentachloroethane
GC/MS	EPA 8270D	Pentachloronitrobenzene
GC/MS	EPA 8270D	Pentachlorophenol
GC/MS	EPA 8270D	Phenacetin
GC/MS	EPA 8270D	Phenanthrene
GC/MS	EPA 8270D	Phenol
GC/MS	EPA 8270D	Phorate
GC/MS	EPA 8270D	Pronamide
GC/MS	EPA 8270D	Pyrene
GC/MS	EPA 8270D	Pyridine
GC/MS	EPA 8270D	Quinoline
GC/MS	EPA 8270D	Safrole
GC/MS	EPA 8270D	Tetraethyl dithiopyrophosphate
GC/MS	EPA 8270D	Thionazine
GC/MS	EPA 8270D	Tributyl phosphate
GC/MS	EPA 8270D SIM	Acenaphthene
GC/MS	EPA 8270D SIM	Acenaphthylene
GC/MS	EPA 8270D SIM	Anthracene
GC/MS	EPA 8270D SIM	Benzo(a)anthracene
GC/MS	EPA 8270D SIM	Benzo(a)pyrene
GC/MS	EPA 8270D SIM	Benzo(b)fluoranthene
GC/MS	EPA 8270D SIM	Benzo(g,h,i)perylene
GC/MS	EPA 8270D SIM	Benzo(k)fluoranthene
GC/MS	EPA 8270D SIM	Chrysene
GC/MS	EPA 8270D SIM	Dibenz(a,h)anthracene
GC/MS	EPA 8270D SIM	1,4-Dioxane
GC/MS	EPA 8270D SIM	Fluoranthene
GC/MS	EPA 8270D SIM	Fluorene

Non-Potable Water

Technology	Method	Analyte
GC/MS	EPA 8270D SIM	Indeno(1,2,3-cd)pyrene
GC/MS	EPA 8270D SIM	1-Methylphenol
GC/MS	EPA 8270D SIM	2-Methylphenol
GC/MS	EPA 8270D SIM	Naphthalene
GC/MS	EPA 8270D SIM	Pentachlorophenol
GC/MS	EPA 8270D SIM	Phenanthrene
GC/MS	EPA 8270D SIM	Pyrene
GC/MS	EPA 625.1	Acenaphthene
GC/MS	EPA 625.1	Acenaphthylene
GC/MS	EPA 625.1	Aniline
GC/MS	EPA 625.1	Anthracene
GC/MS	EPA 625.1	Benzidine
GC/MS	EPA 625.1	Benzo(a)anthracene
GC/MS	EPA 625.1	Benzo(a)pyrene
GC/MS	EPA 625.1	Benzo(b)fluoranthene
GC/MS	EPA 625.1	Benzo(g,h,i)perylene
GC/MS	EPA 625.1	Benzo(k)fluoranthene
GC/MS	EPA 625.1	Benzoic acid
GC/MS	EPA 625.1	Benzyl alcohol
GC/MS	EPA 625.1	4-Bromophenyl phenyl ether
GC/MS	EPA 625.1	Butyl benzyl phthalate
GC/MS	EPA 625.1	Carbazole
GC/MS	EPA 625.1	bis (2-Chloro-1-methylethyl) ether
GC/MS	EPA 625.1	4-Chloro-3-methyl phenol
GC/MS	EPA 625.1	4-Chloroaniline
GC/MS	EPA 625.1	bis(2-Chloroethoxy)methane
GC/MS	EPA 625.1	bis(2-Chloroethyl)ether
GC/MS	EPA 625.1	2-Chloronaphthalene
GC/MS	EPA 625.1	2-Chlorophenol
GC/MS	EPA 625.1	4-Chlorophenyl phenyl ether
GC/MS	EPA 625.1	Chrysene
GC/MS	EPA 625.1	n-Decane
GC/MS	EPA 625.1	Dibenzo(a,h)anthracene
GC/MS	EPA 625.1	Dibenzofuran
GC/MS	EPA 625.1	2,3-Dichloroaniline
GC/MS	EPA 625.1	1,2-Dichlorobenzene

Non-Potable Water

Technology	Method	Analyte
GC/MS	EPA 625.1	1,3-Dichlorobenzene
GC/MS	EPA 625.1	1,4-Dichlorobenzene
GC/MS	EPA 625.1	3,3'-Dichlorobenzidine
GC/MS	EPA 625.1	2,4-Dichlorophenol
GC/MS	EPA 625.1	2,6-Dichlorophenol
GC/MS	EPA 625.1	Diethylphthalate
GC/MS	EPA 625.1	Dimethyl phthalate
GC/MS	EPA 625.1	3,3'-Dimethylbenzidine
GC/MS	EPA 625.1	2,4-Dimethylphenol
GC/MS	EPA 625.1	Di-n-butyl phthalate
GC/MS	EPA 625.1	4,6-Dinitro-2-methylphenol
GC/MS	EPA 625.1	2,4-Dinitrophenol
GC/MS	EPA 625.1	2,4-Dinitrotoluene
GC/MS	EPA 625.1	2,6-Dinitrotoluene
GC/MS	EPA 625.1	Di-n-octylphthalate
GC/MS	EPA 625.1	1,2-Diphenylhydrazine(as azobenzene)
GC/MS	EPA 625.1	bis(2-Ethylhexyl)phthalate
GC/MS	EPA 625.1	Fluoranthene
GC/MS	EPA 625.1	Fluorene
GC/MS	EPA 625.1	Hexachlorobenzene
GC/MS	EPA 625.1	Hexachlorobutadiene
GC/MS	EPA 625.1	Hexachlorocyclopentadiene
GC/MS	EPA 625.1	Hexachloroethane
GC/MS	EPA 625.1	Indeno(1,2,3-c,d)pyrene
GC/MS	EPA 625.1	Isophorone
GC/MS	EPA 625.1	1-Methylnaphthalene
GC/MS	EPA 625.1	2-Methylnaphthalene
GC/MS	EPA 625.1	2-Methylphenol
GC/MS	EPA 625.1	3+4-Methylphenol
GC/MS	EPA 625.1	N,N-Diethyl-m-toluamide (DEET)
GC/MS	EPA 625.1	Naphthalene
GC/MS	EPA 625.1	Nitrobenzene
GC/MS	EPA 625.1	2-Nitrophenol
GC/MS	EPA 625.1	4-Nitrophenol
GC/MS	EPA 625.1	N-Nitrosodimethylamine
GC/MS	EPA 625.1	N-Nitrosodi-n-propylamine

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/MS	EPA 625.1	N-Nitrosodiphenylamine (Diphenylamine)
GC/MS	EPA 625.1	n-Octadecane
GC/MS	EPA 625.1	Pentachlorophenol
GC/MS	EPA 625.1	Phenanthrene
GC/MS	EPA 625.1	Phenol
GC/MS	EPA 625.1	Piperonyl butoxide (PIP)
GC/MS	EPA 625.1	Pyrene
GC/MS	EPA 625.1	alpha-Terpineol
GC/MS	EPA 625.1	1,2,4-Trichlorobenzene
GC/MS	EPA 625.1	2,4,6-Trichlorophenol
GC/MS	EPA 8260B	1,1,1,2-Tetrachloroethane
GC/MS	EPA 8260B	1,1,1-Trichloroethane
GC/MS	EPA 8260B	1,1,2,2-Tetrachloroethene
GC/MS	EPA 8260B	1,1,2-Trichloroethane
GC/MS	EPA 8260B	1,1-Dichloroethane
GC/MS	EPA 8260B	1,1-Dichloroethene
GC/MS	EPA 8260B	1,1-Dichloropropene
GC/MS	EPA 8260B	1,2,3-Trichlorobenzene
GC/MS	EPA 8260B	1,2,3-Trichloropropane
GC/MS	EPA 8260B	1,2,4-Trichlorobenzene
GC/MS	EPA 8260B	1,2,4-Trimethylbenzene
GC/MS	EPA 8260B	1,2-Dibromo-3-chloropropane
GC/MS	EPA 8260B	1,2-Dibromoethane (EDB)
GC/MS	EPA 8260B	1,2-Dichlorobenzene
GC/MS	EPA 8260B	1,2-Dichloroethane
GC/MS	EPA 8260B	1,2-Dichloropropane
GC/MS	EPA 8260B	1,3,5-Trimethylbenzene
GC/MS	EPA 8260B	1,3-Dichlorobenzene
GC/MS	EPA 8260B	1,3-Dichloropropane
GC/MS	EPA 8260B	1,4-Dichlorobenzene
GC/MS	EPA 8260B	1,4-Dioxane
GC/MS	EPA 8260B	2,2-Dichloropropane
GC/MS	EPA 8260B	2-Butanone (MEK)
GC/MS	EPA 8260B	2-Chloroethylvinyl ether
GC/MS	EPA 8260B	2-Chlorotoluene
GC/MS	EPA 8260B	2-Hexanone

Non-Potable Water

Technology	Method	Analyte
GC/MS	EPA 8260B	3,3-Dimethyl-1-butanol
GC/MS	EPA 8260B	4-Chlorotoluene
GC/MS	EPA 8260B	4-Methyl-2-pentanone
GC/MS	EPA 8260B	Acetone
GC/MS	EPA 8260B	Acetonitrile
GC/MS	EPA 8260B	Acrolein
GC/MS	EPA 8260B	Acrylonitrile
GC/MS	EPA 8260B	Allyl chloride
GC/MS	EPA 8260B	Benzene
GC/MS	EPA 8260B	Benzyl chloride
GC/MS	EPA 8260B	Bromobenzene
GC/MS	EPA 8260B	Bromochloromethane
GC/MS	EPA 8260B	Bromodichloromethane
GC/MS	EPA 8260B	Bromoform
GC/MS	EPA 8260B	Bromomethane
GC/MS	EPA 8260B	Carbon disulfide
GC/MS	EPA 8260B	Carbon tetrachloride
GC/MS	EPA 8260B	Chlorobenzene
GC/MS	EPA 8260B	Chloroethane
GC/MS	EPA 8260B	Chloroform
GC/MS	EPA 8260B	Chloromethane
GC/MS	EPA 8260B	Chloroprene
GC/MS	EPA 8260B	cis-1,2-Dichloroethene
GC/MS	EPA 8260B	cis-1,3-Dichloropropene
GC/MS	EPA 8260B	Cyclohexane
GC/MS	EPA 8260B	Cyclohexanone
GC/MS	EPA 8260B	Dibromochloromethane
GC/MS	EPA 8260B	Dibromomethane
GC/MS	EPA 8260B	Dichlorodifluoromethane
GC/MS	EPA 8260B	Diisopropyl ether (IPE)
GC/MS	EPA 8260B	Ethanol
GC/MS	EPA 8260B	Ethyl ether
GC/MS	EPA 8260B	Ethyl methacrylate
GC/MS	EPA 8260B	Ethylbenzene
GC/MS	EPA 8260B	Ethyl-Tert-Butyl Ether
GC/MS	EPA 8260B	Freon 113

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/MS	EPA 8260B	Hexachlorobutadiene
GC/MS	EPA 8260B	Isobutyl alcohol
GC/MS	EPA 8260B	Isopropylbenzene
GC/MS	EPA 8260B	m+p-Xylenes
GC/MS	EPA 8260B	Methacrylonitrile
GC/MS	EPA 8260B	Methyl Acetate
GC/MS	EPA 8260B	Methyl iodide
GC/MS	EPA 8260B	Methyl methacrylate
GC/MS	EPA 8260B	Methyl tertiary butyl ether (MTBE)
GC/MS	EPA 8260B	Methylcyclohexane
GC/MS	EPA 8260B	Methylene chloride
GC/MS	EPA 8260B	Naphthalene
GC/MS	EPA 8260B	n-Butylbenzene
GC/MS	EPA 8260B	n-Propylbenzene
GC/MS	EPA 8260B	o-Xylene
GC/MS	EPA 8260B	Pentachloroethane
GC/MS	EPA 8260B	p-Isopropyltoluene
GC/MS	EPA 8260B	Propionitrile
GC/MS	EPA 8260B	sec-Butylbenzene
GC/MS	EPA 8260B	Styrene
GC/MS	EPA 8260B	Tert-Amyl Alcohol (TAA)
GC/MS	EPA 8260B	Tert-Amyl Methyl Ether (TAME)
GC/MS	EPA 8260B	Tert-Butyl Alcohol (TBA)
GC/MS	EPA 8260B	Tert-Butyl Formate (TBF)
GC/MS	EPA 8260B	tert-Butylbenzene
GC/MS	EPA 8260B	Tetrachloroethene
GC/MS	EPA 8260B	Tetrahydrofuran
GC/MS	EPA 8260B	Toluene
GC/MS	EPA 8260B	Total Xylenes
GC/MS	EPA 8260B	trans-1,2-Dichloroethene
GC/MS	EPA 8260B	trans-1,3-Dichloropropene
GC/MS	EPA 8260B	trans-1,4-Dichloro-2-butene
GC/MS	EPA 8260B	Trichloroethene
GC/MS	EPA 8260B	Trichlorofluoromethane
GC/MS	EPA 8260B	Vinyl acetate
GC/MS	EPA 8260B	Vinyl chloride

Non-Potable Water

Technology	Method	Analyte
GC/MS	EPA 8260B SIM	1,4-Dioxane
GC/MS	EPA 624.1	Acetone
GC/MS	EPA 624.1	Acetonitrile
GC/MS	EPA 624.1	Acrolein
GC/MS	EPA 624.1	Acrylonitrile
GC/MS	EPA 624.1	Benzene
GC/MS	EPA 624.1	Bromochloromethane
GC/MS	EPA 624.1	Bromodichloromethane
GC/MS	EPA 624.1	Bromoform
GC/MS	EPA 624.1	Bromomethane (Methyl bromide)
GC/MS	EPA 624.1	2-Butanone (MEK)
GC/MS	EPA 624.1	Carbon disulfide
GC/MS	EPA 624.1	Carbon tetrachloride
GC/MS	EPA 624.1	Chlorobenzene
GC/MS	EPA 624.1	Chloroethane
GC/MS	EPA 624.1	2-Chloroethylvinylether
GC/MS	EPA 624.1	Chloroform
GC/MS	EPA 624.1	Chloromethane (Methyl chloride)
GC/MS	EPA 624.1	Dibromochloromethane
GC/MS	EPA 624.1	1,2-Dibromoethane (EDB)
GC/MS	EPA 624.1	1,2-Dichlorobenzene
GC/MS	EPA 624.1	1,3-Dichlorobenzene
GC/MS	EPA 624.1	1,4-Dichlorobenzene
GC/MS	EPA 624.1	Dichlorodifluoromethane
GC/MS	EPA 624.1	1,1-Dichloroethane
GC/MS	EPA 624.1	1,2-Dichloroethane
GC/MS	EPA 624.1	1,1-Dichloroethene
GC/MS	EPA 624.1	cis-1,2-Dichloroethene
GC/MS	EPA 624.1	trans-1,2-Dichloroethene
GC/MS	EPA 624.1	1,2-Dichloropropane
GC/MS	EPA 624.1	cis-1,3-Dichloropropene
GC/MS	EPA 624.1	trans-1,3-Dichloropropene
GC/MS	EPA 624.1	Diisopropyl ether (IPE)
GC/MS	EPA 624.1	1,4-Dioxane
GC/MS	EPA 624.1	Ethylbenzene
GC/MS	EPA 624.1	Methyl methacrylate

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/MS	EPA 624.1	Methyl tertiary butyl ether (MTBE)
GC/MS	EPA 624.1	Methylene chloride
GC/MS	EPA 624.1	Naphthalene
GC/MS	EPA 624.1	Styrene
GC/MS	EPA 624.1	1,1,2,2-Tetrachloroethane
GC/MS	EPA 624.1	Tetrachloroethene
GC/MS	EPA 624.1	Toluene
GC/MS	EPA 624.1	1,2,4-Trichlorobenzene
GC/MS	EPA 624.1	1,1,1-Trichloroethane
GC/MS	EPA 624.1	1,1,2-Trichloroethane
GC/MS	EPA 624.1	Trichloroethene
GC/MS	EPA 624.1	Trichlorofluoromethane
GC/MS	EPA 624.1	1,2,4-Trimethylbenzene
GC/MS	EPA 624.1	1,3,5-Trimethylbenzene
GC/MS	EPA 624.1	Vinyl acetate
GC/MS	EPA 624.1	Vinyl chloride
GC/MS	EPA 624.1	Xylenes (total)
GC/MS	SM 6200B-2011	Benzene
GC/MS	SM 6200B-2011	Bromobenzene
GC/MS	SM 6200B-2011	Bromochloromethane
GC/MS	SM 6200B-2011	Bromodichloromethane
GC/MS	SM 6200B-2011	Bromoform
GC/MS	SM 6200B-2011	Bromomethane (Methyl bromide)
GC/MS	SM 6200B-2011	n-Butylbenzene
GC/MS	SM 6200B-2011	sec-Butylbenzene
GC/MS	SM 6200B-2011	tert-Butylbenzene
GC/MS	SM 6200B-2011	Carbon tetrachloride
GC/MS	SM 6200B-2011	Chlorobenzene
GC/MS	SM 6200B-2011	Chloroethane
GC/MS	SM 6200B-2011	Chloroform
GC/MS	SM 6200B-2011	Chloromethane (Methyl chloride)
GC/MS	SM 6200B-2011	2-Chlorotoluene
GC/MS	SM 6200B-2011	4-Chlorotoluene
GC/MS	SM 6200B-2011	Dibromochloromethane
GC/MS	SM 6200B-2011	1,2-Dibromoethane (EDB)
GC/MS	SM 6200B-2011	Dibromomethane (Methylene bromide)

Non-Potable Water

Technology	Method	Analyte
GC/MS	SM 6200B-2011	1,2-Dichlorobenzene
GC/MS	SM 6200B-2011	1,3-Dichlorobenzene
GC/MS	SM 6200B-2011	1,4-Dichlorobenzene
GC/MS	SM 6200B-2011	Dichlorodifluoromethane
GC/MS	SM 6200B-2011	1,1-Dichloroethane
GC/MS	SM 6200B-2011	1,2-Dichloroethane
GC/MS	SM 6200B-2011	1,1-Dichloroethene
GC/MS	SM 6200B-2011	cis-1,2-Dichloroethene
GC/MS	SM 6200B-2011	trans-1,2-Dichloroethene
GC/MS	SM 6200B-2011	1,2-Dichloropropane
GC/MS	SM 6200B-2011	1,3-Dichloropropane
GC/MS	SM 6200B-2011	2,2-Dichloropropane
GC/MS	SM 6200B-2011	1,1-Dichloropropene
GC/MS	SM 6200B-2011	cis-1,3-Dichloropropene
GC/MS	SM 6200B-2011	trans-1,3-Dichloropropene
GC/MS	SM 6200B-2011	Diisopropyl ether (IPE)
GC/MS	SM 6200B-2011	Ethylbenzene
GC/MS	SM 6200B-2011	Hexachlorobutadiene
GC/MS	SM 6200B-2011	Isopropylbenzene (Cumene)
GC/MS	SM 6200B-2011	p-Isopropyltoluene (p-Cymene)
GC/MS	SM 6200B-2011	Methyl tertiary butyl ether (MTBE)
GC/MS	SM 6200B-2011	4-Methyl-2-pentanone
GC/MS	SM 6200B-2011	Methylene chloride
GC/MS	SM 6200B-2011	Naphthalene
GC/MS	SM 6200B-2011	n-Propylbenzene
GC/MS	SM 6200B-2011	Styrene
GC/MS	SM 6200B-2011	1,1,1,2-Tetrachloroethane
GC/MS	SM 6200B-2011	1,1,2,2-Tetrachloroethane
GC/MS	SM 6200B-2011	Tetrachloroethene
GC/MS	SM 6200B-2011	Toluene
GC/MS	SM 6200B-2011	1,1,2-Trichloro-1,2,2-Trifluoroethane
GC/MS	SM 6200B-2011	1,2,3-Trichlorobenzene
GC/MS	SM 6200B-2011	1,2,4-Trichlorobenzene
GC/MS	SM 6200B-2011	1,1,1-Trichloroethane
GC/MS	SM 6200B-2011	1,1,2-Trichloroethane
GC/MS	SM 6200B-2011	Trichloroethene

Non-Potable Water

Technology	Method	Analyte
GC/MS	SM 6200B-2011	Trichlorofluoromethane
GC/MS	SM 6200B-2011	1,2,3-Trichloropropane
GC/MS	SM 6200B-2011	1,3,5-Trimethylbenzene (Mesitylene)
GC/MS	SM 6200B-2011	1,2,4-Trimethylbenzene
GC/MS	SM 6200B-2011	Vinyl chloride
GC/MS	SM 6200B-2011	m+p - Xylenes
GC/MS	SM 6200B-2011	o-Xylene
GC	EPA 8081B	4,4'-DDD
GC	EPA 8081B	4,4'-DDE
GC	EPA 8081B	4,4'-DDT
GC	EPA 8081B	Aldrin
GC	EPA 8081B	alpha-BHC
GC	EPA 8081B	alpha-Chlordane
GC	EPA 8081B	beta-BHC
GC	EPA 8081B	Chlordane
GC	EPA 8081B	delta-BHC
GC	EPA 8081B	Dieldrin
GC	EPA 8081B	Endosulfan I
GC	EPA 8081B	Endosulfan II
GC	EPA 8081B	Endosulfan sulfate
GC	EPA 8081B	Endrin
GC	EPA 8081B	Endrin Aldehyde
GC	EPA 8081B	Endrin Ketone
GC	EPA 8081B	gamma-BHC (Lindane)
GC	EPA 8081B	gamma-Chlordane
GC	EPA 8081B	Heptachlor
GC	EPA 8081B	Heptachlor Epoxide
GC	EPA 8081B	Methoxychlor
GC	EPA 8081B	Mirex
GC	EPA 8081B	Toxaphene
GC	EPA 8082A	Aroclor 1016
GC	EPA 8082A	Aroclor 1221
GC	EPA 8082A	Aroclor 1232
GC	EPA 8082A	Aroclor 1242
GC	EPA 8082A	Aroclor 1248
GC	EPA 8082A	Aroclor 1254

Non-Potable Water

Technology	Method	Analyte
GC	EPA 8082A	Aroclor 1260
GC	EPA 8082A	Aroclor 1262
GC	EPA 8082A	Aroclor 1268
GC	EPA 608.3	Aldrin
GC	EPA 608.3	gamma-BHC (Lindane)
GC	EPA 608.3	alpha-BHC
GC	EPA 608.3	beta-BHC
GC	EPA 608.3	delta-BHC
GC	EPA 608.3	Chlordane
GC	EPA 608.3	cis-Chlordane
GC	EPA 608.3	trans-Chlordane
GC	EPA 608.3	4,4'-DDD
GC	EPA 608.3	4,4'-DDE
GC	EPA 608.3	4,4'-DDT
GC	EPA 608.3	Dieldrin
GC	EPA 608.3	Endosulfan I
GC	EPA 608.3	Endosulfan II
GC	EPA 608.3	Endosulfan sulfate
GC	EPA 608.3	Endrin
GC	EPA 608.3	Endrin aldehyde
GC	EPA 608.3	Endrin ketone
GC	EPA 608.3	Heptachlor
GC	EPA 608.3	Heptachlor epoxide
GC	EPA 608.3	Methoxychlor
GC	EPA 608.3	Toxaphene
GC	EPA 608.3	Aroclor 1016
GC	EPA 608.3	Aroclor 1221
GC	EPA 608.3	Aroclor 1232
GC	EPA 608.3	Aroclor 1242
GC	EPA 608.3	Aroclor 1248
GC	EPA 608.3	Aroclor 1254
GC	EPA 608.3	Aroclor 1260
HPLC	EPA 8330A	2-Amino-4,6-dinitrotoluene
HPLC	EPA 8330A	4-Amino-2,6-dinitrotoluene
HPLC	EPA 8330A	1,3-Dinitrobenzene
HPLC	EPA 8330A	2,4-Dinitrotoluene

Non-Potable Water		
Technology	**Method**	**Analyte**
HPLC	EPA 8330A	2,6-Dinitrotoluene
HPLC	EPA 8330A	HMX
HPLC	EPA 8330A	Nitrobenzene
HPLC	EPA 8330A	2-Nitrotoluene
HPLC	EPA 8330A	3-Nitrotoluene
HPLC	EPA 8330A	4-Nitrotoluene
HPLC	EPA 8330A	RDX
HPLC	EPA 8330A	Tetryl
HPLC	EPA 8330A	1,3,5-Trinitrobenzene
HPLC	EPA 8330A	2,4,6-Trinitrotoluene
HPLC	EPA 8330B	2-Amino-4,6-dinitrotoluene
HPLC	EPA 8330B	4-Amino-2,6-dinitrotoluene
HPLC	EPA 8330B	1,3-Dinitrobenzene
HPLC	EPA 8330B	2,4-Dinitrotoluene
HPLC	EPA 8330B	2,6-Dinitrotoluene
HPLC	EPA 8330B	HMX
HPLC	EPA 8330B	Nitrobenzene
HPLC	EPA 8330B	Nitroglycerin (NG)
HPLC	EPA 8330B	2-Nitrotoluene
HPLC	EPA 8330B	3-Nitrotoluene
HPLC	EPA 8330B	4-Nitrotoluene
HPLC	EPA 8330B	RDX
HPLC	EPA 8330B	Tetryl
HPLC	EPA 8330B	1,3,5-Trinitrobenzene
HPLC	EPA 8330B	2,4,6-Trinitrotoluene
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	N-ethylperfluoro-1-octanesulfonamidoacetic acid (EtFOSAA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Fluorotelomer sulfonate 8:2 [1H,1H,2H,2H-perfluorodecane sulfonate] (8:2 FTS)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Fluorotelomer sulfonate 4:2 [1H,1H,2H,2H-perfluorohexane sulfonate] (4:2 FTS)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Fluorotelomer sulfonate 6:2 [1H,1H,2H,2H-perfluorooctane sulfonate] (6:2 FTS

Non-Potable Water		
Technology	**Method**	**Analyte**
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	GenX (HFPO-DA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	N-methylperfluoro-1-octanesulfonamidoacetic acid (MeFOSAA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluoro-1-butanesulfonate (PFBS)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluoro-n-butanoic acid (PFBA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluoro-1-decanesulfonate (PFDS)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluoro-n-decanoic acid (PFDA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluoro-n-dodecanoic acid (PFDoA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluoro-1-heptanesulfonate (PFHpS)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluoro-n-heptanoic acid (PFHpA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluoro-1-hexanesulfonate (PFHxS)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluoro-n-hexanoic acid (PFHxA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluoro-1-nonanesulfonate (PFNS)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluoro-n-nonanoic acid (PFNA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluorooctanesulfonate (PFOS)

Non-Potable Water		
Technology	**Method**	**Analyte**
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluoro-1-octanesulfonamide (PFOSA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluoro-n-octanoic acid (PFOA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluoro-n-pentanoic acid (PFPeA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluoro-1-pentansulfonate (PFPeS)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluoro-n-tetradecanoic acid (PFTeDA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluoro-n-tridecanoic acid (PFTrDA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluoro-n-undecanoic acid (PFUDA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	N-methylperfluoro-1-octanesulfonamide (MeFOSA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	N-ethylperfluoro-1-octanesulfonamide (EtFOSA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	1H,1H,2H,2H-perfluorododecane sulfonate (10:2FTS)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluoro-n-butanoic acid (PFBA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluoro-n-pentanoic acid (PFPeA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluoro-n-heptanoic acid (PFHpA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluorohexanesulfonate (PFHxS)

Non-Potable Water		
Technology	**Method**	**Analyte**
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluoro-n-octanoic acid (PFOA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluoro-n-nonanoic acid (PFNA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluorooctanesulfonate (PFOS)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluoro-n-decanoic acid (PFDA)
GC	EPA 8015C	Diesel Range Organics
GC	EPA 8015C	WI-Diesel Range Organics
GC	EPA 8015C	Gasoline Range Organics
GC	EPA 8015C	WI-Gasoline Range Organics
GC	RSK - 175	Methane, Ethane, Ethene
GC	EPA 8011	1,2-Dibromoethane (EDB)
GC	EPA 8011	1,2-Dibromo-3-chloropropane (DBCP)
GC	FL-PRO	FL-PRO
ICP	EPA 6010D	Aluminum
ICP	EPA 6010D	Antimony
ICP	EPA 6010D	Arsenic
ICP	EPA 6010D	Barium
ICP	EPA 6010D	Beryllium
ICP	EPA 6010D	Cadmium
ICP	EPA 6010D	Calcium
ICP	EPA 6010D	Chromium
ICP	EPA 6010D	Cobalt
ICP	EPA 6010D	Copper
ICP	EPA 6010D	Iron
ICP	EPA 6010D	Lead
ICP	EPA 6010D	Magnesium
ICP	EPA 6010D	Manganese
ICP	EPA 6010D	Molybdenum
ICP	EPA 6010D	Nickel
ICP	EPA 6010D	Potassium
ICP	EPA 6010D	Selenium

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

Non-Potable Water

Technology	Method	Analyte
ICP/MS	EPA 6020B	Barium
ICP/MS	EPA 6020B	Beryllium
ICP/MS	EPA 6020B	Cadmium
ICP/MS	EPA 6020B	Calcium
ICP/MS	EPA 6020B	Chromium
ICP/MS	EPA 6020B	Cobalt
ICP/MS	EPA 6020B	Copper
ICP/MS	EPA 6020B	Iron
ICP/MS	EPA 6020B	Lead
ICP/MS	EPA 6020B	Magnesium
ICP/MS	EPA 6020B	Manganese
ICP/MS	EPA 6020B	Nickel
ICP/MS	EPA 6020B	Potassium
ICP/MS	EPA 6020B	Selenium
ICP/MS	EPA 6020B	Silver
ICP/MS	EPA 6020B	Sodium
ICP/MS	EPA 6020B	Thallium
ICP/MS	EPA 6020B	Tin
ICP/MS	EPA 6020B	Vanadium
ICP/MS	EPA 6020B	Zinc
CVAA	EPA 1631E	Low Level Mercury
CVAA	EPA 7470A / EPA 245.1	Mercury
Gravimetric	EPA 1664B	Oil & Grease
Titration	SM 2320B-2011	Alkalinity
Calculation	SM 2320B-2011	Bicarbonate Alkalinity
Calculation	SM 2320B-2011	Carbonate Alkalinity
Calculation	SM 2320B-2011	Hydroxide Alkalinity
Calculation	SM 4500-CO2 D	Carbon Dioxide (CO2)
Photometric	SM 2120F-2011	Color
Photometric	SM 2120B-2011	Platinum Cobalt Color
UV/VIS	SM 3500-Fe B-2011	Ferrous Iron
Titration	SM 4500-S2 F-2011	Sulfide
Wet Oxidation	EPA 9060A	TOC
Wet Oxidation	SM 5310C-2011	TOC
Titration	SM 2340C-2011	Total Hardness

Non-Potable Water

Technology	Method	Analyte
Filtration	SM 2540C-2011	Total Dissolved Solids (TDS)
Filtration	SM 2540D-2011	Total Suspended Solids (TSS)
UV/VIS	SM 4500-CN E-2011	Total Cyanide
UV/VIS	EPA 9012B	Total Cyanide
UV/VIS	EPA 9065	Phenolics
UV/VIS	EPA 9066	Phenolics
IC	EPA 9056A	Fluoride
IC	EPA 9056A	Chloride
IC	EPA 9056A	Sulfate
IC	EPA 9056A	Bromide
IC	EPA 9056A	Nitrate
IC	EPA 9056A	Nitrite
IC	EPA 300.0	Fluoride
IC	EPA 300.0	Chloride
IC	EPA 300.0	Sulfate
IC	EPA 300.0	Bromide
IC	EPA 300.0	Nitrate
IC	EPA 300.0	Nitrite
IC	EPA 218.6	Hexavalent chromium
IC	EPA 7199	Hexavalent chromium
UV/VIS	EPA 7196A	Hexavalent chromium
Discrete Analyzer	SM 3500-Cr B-2011	Hexavalent chromium
Pensky-Martens	EPA 1010A	Ignitability
Electrode	EPA 9040C	Corrosivity
Electrode	SM 4500-H B-2011	Corrosivity
Electrode	EPA 120.1	Specific Conductance
Electrode	EPA 180.1	Turbidity
Titration	Sec. 7.3.3 SW-846	Reactive Cyanide
Photometric	Sec. 7.3.4 SW-846	Reactive Sulfide
UV/VIS	EPA 353.2	Nitrate
UV/VIS	EPA 353.2	Nitrite
UV/VIS	EPA 353.2	Nitrate-Nitrite
UV/VIS	EPA 365.1	Phosphorus/ Orthophosphate

Non-Potable Water		
Technology	**Method**	**Analyte**
UV/VIS	EPA 350.1	Ammonia
Gas Diffusion / UV/VIS	EPA 350.1	Ammonia - N
UV/VIS	EPA 351.2	TKN
UV/VIS	SM 5220D-2011	COD
GC	MADEP-EPH-MOD	Extractable Petroleum Hydrocarbons (EPH) Modified
GC	MADEP-VPH-MOD	Volatile Petroleum Hydrocarbons (VPH) Modified
Preparation	**Method**	**Type**
Organic Preparation	EPA 3520C	Organic Prep. of Water by Continuous Liquid-Liquid
Organic Preparation	EPA 3535A	Solid-Phase Extraction (SPE)
Organic Cleanup	EPA 3620B	Florisil Cleanup Procedure
Organic Cleanup	EPA 3660B	Sulfur Cleanup Procedure
Organic Cleanup	EPA 3665A	Sulfuric Acid Cleanup Procedure
Waste Dilution	EPA 3580A	Waste Dilution
Volatile Organic Preparation	EPA 5030B	Purge-and-Trap for Aqueous Samples
Volatile Organic Preparation	EPA 5035	Closed-System Purge-and-Trap and extraction for Volatile Organics in Soil and Waste Samples
Volatile Organic Preparation	EPA 3585	Waste Dilution for Volatile Organics
Inorganic Preparation	EPA 3005A	Preparation of Waters by Hotblock
Inorganic Preparation	EPA 1311	Toxicity Characteristic Leaching Procedure (TCLP)
Inorganic Metals Preparation	EPA 3010A	Acid Digestion of Aqueous Samples and TCLP/SPLP Extracts for ICP analysis
Inorganic Metals Preparation	EPA 3030C	Acid Digestion of Aqueous Samples for ICP Spectroscopy
Organic Cleanup	EPA 3640	GPC Cleanup Procedure

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC	EPA 8151A	Dalapon
GC	EPA 8151A	Dicamba
GC	EPA 8151A	Dichloroprop
GC	EPA 8151A	MCPP
GC	EPA 8151A	MCPA
GC	EPA 8151A	2,4D

Solid and Chemical Materials

Technology	Method	Analyte
GC	EPA 8151A	Silvex(2,4,5 TP)
GC	EPA 8151A	2,4,5-T
GC	EPA 8151A	2,4DB
GC	EPA 8151A	Dinoseb
GC/MS	EPA 8270D	1,2,4,5-Tetrachlorobenzene
GC/MS	EPA 8270D	1,2,4-Trichlorobenzene
GC/MS	EPA 8270D	1,2-Dichlorobenzene
GC/MS	EPA 8270D	1,3-Dichlorobenzene
GC/MS	EPA 8270D	1,4-Dichlorobenzene
GC/MS	EPA 8270D	1-Methylnaphthalene
GC/MS	EPA 8270D	2,3,4,6-Tetrachlorophenol
GC/MS	EPA 8270D	2,4,5-Trichlorophenol
GC/MS	EPA 8270D	2,4,6-Trichlorophenol
GC/MS	EPA 8270D	2,4-Dichlorophenol
GC/MS	EPA 8270D	2,4-Dimethylphenol
GC/MS	EPA 8270D	2,4-Dinitrophenol
GC/MS	EPA 8270D	2,4-Dinitrotoluene
GC/MS	EPA 8270D	2,6-Dichlorophenol
GC/MS	EPA 8270D	2,6-Dinitrotoluene
GC/MS	EPA 8270D	2-Chloronaphthalene
GC/MS	EPA 8270D	2-Chlorophenol
GC/MS	EPA 8270D	2-Methylnaphthalene
GC/MS	EPA 8270D	2-Methylphenol
GC/MS	EPA 8270D	2-Nitroaniline
GC/MS	EPA 8270D	2-Nitrophenol
GC/MS	EPA 8270D	3,3'-Dichlorobenzidine
GC/MS	EPA 8270D	3,3'-Dimethylbenzidine
GC/MS	EPA 8270D	3-Nitroaniline
GC/MS	EPA 8270D	4,6-Dinitro-2-methylphenol
GC/MS	EPA 8270D	4-Bromophenylphenylether
GC/MS	EPA 8270D	4-Chloro-3-methylphenol
GC/MS	EPA 8270D	4-Chloroaniline
GC/MS	EPA 8270D	4-Chlorophenylphenylether
GC/MS	EPA 8270D	4-Nitroaniline
GC/MS	EPA 8270D	4-Nitrophenol
GC/MS	EPA 8270D	Acenaphthene

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC/MS	EPA 8270D	Acenaphthylene
GC/MS	EPA 8270D	Acetophenone
GC/MS	EPA 8270D	Anthracene
GC/MS	EPA 8270D	Atrazine
GC/MS	EPA 8270D	Azobenzene
GC/MS	EPA 8270D	Benzaldhyde
GC/MS	EPA 8270D	Benzidine
GC/MS	EPA 8270D	Benzo(a)Anthracene
GC/MS	EPA 8270D	Benzo(a)pyrene
GC/MS	EPA 8270D	Benzo(b)fluoranthene
GC/MS	EPA 8270D	Benzo(g,h,i)perylene
GC/MS	EPA 8270D	Benzo(k)fluoranthene
GC/MS	EPA 8270D	Benzoic acid
GC/MS	EPA 8270D	Benzyl alcohol
GC/MS	EPA 8270D	Biphenyl
GC/MS	EPA 8270D	bis(2-Chloroethoxy)methane
GC/MS	EPA 8270D	bis(2-Chloroethyl)ether
GCMS	EPA 8270D	Bis (2-Chloro-1-methylethyl) ether
GC/MS	EPA 8270D	bis(2-Ethylhexyl)phthalate
GC/MS	EPA 8270D	Butylbenzylphthalate
GC/MS	EPA 8270D	Caprolactam
GC/MS	EPA 8270D	Carbazole
GC/MS	EPA 8270D	Chrysene
GC/MS	EPA 8270D	DEET
GC/MS	EPA 8270D	Dibenzo(a,h)anthracene
GC/MS	EPA 8270D	Dibenzofuran
GC/MS	EPA 8270D	Diethylphthalate
GC/MS	EPA 8270D	Dimethylphthalate
GC/MS	EPA 8270D	Di-n-butylphthalate
GC/MS	EPA 8270D	Di-n-octylphthalate
GC/MS	EPA 8270D	Fluoranthene
GC/MS	EPA 8270D	Fluorene
GC/MS	EPA 8270D	Hexachlorobenzene
GC/MS	EPA 8270D	Hexachlorobutadiene
GC/MS	EPA 8270D	Hexachlorocyclopentadiene
GC/MS	EPA 8270D	Hexachloroethane

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC/MS	EPA 8270D	Indeno(1,2,3-c,d)pyrene
GC/MS	EPA 8270D	Isophorone
GC/MS	EPA 8270D	m+p-Cresol
GC/MS	EPA 8270D	Naphthalene
GC/MS	EPA 8270D	Nitrobenzene
GC/MS	EPA 8270D	N-Nitrosodimethylamine
GC/MS	EPA 8270D	n-Nitroso-di-n-propylamine
GC/MS	EPA 8270D	n-Nitrosodiphenylamine
GC/MS	EPA 8270D	N-Nitrosopyrrolidine
GC/MS	EPA 8270D	o-Cresol
GC/MS	EPA 8270D	Pentachlorophenol
GC/MS	EPA 8270D	Phenanthrene
GC/MS	EPA 8270D	Phenol
GC/MS	EPA 8270D	Pyrene
GC/MS	EPA 8270D	Pyridine
GC/MS	EPA 8270D SIM	Acenaphthene
GC/MS	EPA 8270D SIM	Acenaphthylene
GC/MS	EPA 8270D SIM	Anthracene
GC/MS	EPA 8270D SIM	Benzo(a)anthracene
GC/MS	EPA 8270D SIM	Benzo(a)pyrene
GC/MS	EPA 8270D SIM	Benzo(b)fluoranthene
GC/MS	EPA 8270D SIM	Benzo(g,h,i)perylene
GC/MS	EPA 8270D SIM	Benzo(k)fluoranthene
GC/MS	EPA 8270D SIM	Chrysene
GC/MS	EPA 8270D SIM	Dibenz(a,h)anthracene
GC/MS	EPA 8270D SIM	1,4-Dioxane
GC/MS	EPA 8270D SIM	Fluoranthene
GC/MS	EPA 8270D SIM	Fluorene
GC/MS	EPA 8270D SIM	Indeno(1,2,3-cd)pyrene
GC/MS	EPA 8270D SIM	1-Methylphenol
GC/MS	EPA 8270D SIM	2-Methylphenol
GC/MS	EPA 8270D SIM	Naphthalene
GC/MS	EPA 8270D SIM	Pentachlorophenol
GC/MS	EPA 8270D SIM	Phenanthrene
GC/MS	EPA 8270D SIM	Pyrene
GC/MS	EPA 8260B	1,1,1,2-Tetrachloroethane

Solid and Chemical Materials

Technology	Method	Analyte
GC/MS	EPA 8260B	1,1,1-Trichloroethane
GC/MS	EPA 8260B	1,1,2,2-Tetrachloroethene
GC/MS	EPA 8260B	1,1,2-Trichloroethane
GC/MS	EPA 8260B	1,1-Dichloroethane
GC/MS	EPA 8260B	1,1-Dichloroethene
GC/MS	EPA 8260B	1,1-Dichloropropene
GC/MS	EPA 8260B	1,2,3-Trichlorobenzene
GC/MS	EPA 8260B	1,2,3-Trichloropropane
GC/MS	EPA 8260B	1,2,4-Trichlorobenzene
GC/MS	EPA 8260B	1,2,4-Trimethylbenzene
GC/MS	EPA 8260B	1,2-Dibromo-3-chloropropane
GC/MS	EPA 8260B	1,2-Dibromoethane (EDB)
GC/MS	EPA 8260B	1,2-Dichlorobenzene
GC/MS	EPA 8260B	1,2-Dichloroethane
GC/MS	EPA 8260B	1,2-Dichloropropane
GC/MS	EPA 8260B	1,3,5-Trimethylbenzene
GC/MS	EPA 8260B	1,3-Dichlorobenzene
GC/MS	EPA 8260B	1,3-Dichloropropane
GC/MS	EPA 8260B	1,4-Dichlorobenzene
GC/MS	EPA 8260B	1,4-Dioxane
GC/MS	EPA 8260B	2,2-Dichloropropane
GC/MS	EPA 8260B	2-Butanone (MEK)
GC/MS	EPA 8260B	2-Chloroethylvinyl ether
GC/MS	EPA 8260B	2-Chlorotoluene
GC/MS	EPA 8260B	2-Hexanone
GC/MS	EPA 8260B	4-Chlorotoluene
GC/MS	EPA 8260B	4-Methyl-2-pentanone
GC/MS	EPA 8260B	Acetone
GC/MS	EPA 8260B	Acetonitrile
GC/MS	EPA 8260B	Acrolein
GC/MS	EPA 8260B	Acrylonitrile
GC/MS	EPA 8260B	Allyl chloride
GC/MS	EPA 8260B	Benzene
GC/MS	EPA 8260B	Benzyl chloride
GC/MS	EPA 8260B	Bromobenzene
GC/MS	EPA 8260B	Bromochloromethane

Solid and Chemical Materials

Technology	Method	Analyte
GC/MS	EPA 8260B	Bromodichloromethane
GC/MS	EPA 8260B	Bromoform
GC/MS	EPA 8260B	Bromomethane
GC/MS	EPA 8260B	Carbon disulfide
GC/MS	EPA 8260B	Carbon tetrachloride
GC/MS	EPA 8260B	Chlorobenzene
GC/MS	EPA 8260B	Chloroethane
GC/MS	EPA 8260B	Chloroform
GC/MS	EPA 8260B	Chloromethane
GC/MS	EPA 8260B	Chloroprene
GC/MS	EPA 8260B	cis-1,2-Dichloroethene
GC/MS	EPA 8260B	cis-1,3-Dichloropropene
GC/MS	EPA 8260B	Cyclohexane
GC/MS	EPA 8260B	Cyclohexanone
GC/MS	EPA 8260B	Dibromochloromethane
GC/MS	EPA 8260B	Dibromomethane
GC/MS	EPA 8260B	Dichlorodifluoromethane
GC/MS	EPA 8260B	Diisopropyl ether (IPE)
GC/MS	EPA 8260B	Ethyl ether
GC/MS	EPA 8260B	Ethyl methacrylate
GC/MS	EPA 8260B	Ethylbenzene
GC/MS	EPA 8260B	Freon 113
GC/MS	EPA 8260B	Hexachlorobutadiene
GC/MS	EPA 8260B	Isobutyl alcohol
GC/MS	EPA 8260B	Isopropylbenzene
GC/MS	EPA 8260B	m+p-Xylenes
GC/MS	EPA 8260B	Methacrylonitrile
GC/MS	EPA 8260B	Methyl Acetate
GC/MS	EPA 8260B	Methyl iodide
GC/MS	EPA 8260B	Methyl methacrylate
GC/MS	EPA 8260B	Methyl tertiary butyl ether (MTBE)
GC/MS	EPA 8260B	Methylcyclohexane
GC/MS	EPA 8260B	Methylene chloride
GC/MS	EPA 8260B	Naphthalene
GC/MS	EPA 8260B	n-Butylbenzene
GC/MS	EPA 8260B	n-Propylbenzene

Solid and Chemical Materials

Technology	Method	Analyte
GC/MS	EPA 8260B	o-Xylene
GC/MS	EPA 8260B	Pentachloroethane
GC/MS	EPA 8260B	p-Isopropyltoluene
GC/MS	EPA 8260B	Propionitrile
GC/MS	EPA 8260B	sec-Butylbenzene
GC/MS	EPA 8260B	Styrene
GC/MS	EPA 8260B	tert-Butylbenzene
GC/MS	EPA 8260B	Tetrachloroethene
GC/MS	EPA 8260B	Tetrahydrofuran
GC/MS	EPA 8260B	Toluene
GC/MS	EPA 8260B	Total Xylenes
GC/MS	EPA 8260B	trans-1,2-Dichloroethene
GC/MS	EPA 8260B	trans-1,3-Dichloropropene
GC/MS	EPA 8260B	trans-1,4-Dichloro-2-butene
GC/MS	EPA 8260B	Trichloroethene
GC/MS	EPA 8260B	Trichlorofluoromethane
GC/MS	EPA 8260B	Vinyl acetate
GC/MS	EPA 8260B	Vinyl chloride
GC/MS	EPA 8260B SIM	1,4-Dioxane
GC	EPA 8081B	4,4'-DDD
GC	EPA 8081B	4,4'-DDE
GC	EPA 8081B	4,4'-DDT
GC	EPA 8081B	Aldrin
GC	EPA 8081B	alpha-BHC
GC	EPA 8081B	alpha-Chlordane
GC	EPA 8081B	beta-BHC
GC	EPA 8081B	Chlordane
GC	EPA 8081B	delta-BHC
GC	EPA 8081B	Dieldrin
GC	EPA 8081B	Endosulfan I
GC	EPA 8081B	Endosulfan II
GC	EPA 8081B	Endosulfan sulfate
GC	EPA 8081B	Endrin
GC	EPA 8081B	Endrin Aldehyde
GC	EPA 8081B	Endrin Ketone
GC	EPA 8081B	gamma-BHC (Lindane)

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC	EPA 8081B	gamma-Chlordane
GC	EPA 8081B	Heptachlor
GC	EPA 8081B	Heptachlor Epoxide
GC	EPA 8081B	Methoxychlor
GC	EPA 8081B	Mirex
GC	EPA 8081B	Toxaphene
GC	EPA 8082A	Aroclor 1016
GC	EPA 8082A	Aroclor 1221
GC	EPA 8082A	Aroclor 1232
GC	EPA 8082A	Aroclor 1242
GC	EPA 8082A	Aroclor 1248
GC	EPA 8082A	Aroclor 1254
GC	EPA 8082A	Aroclor 1260
GC	EPA 8082A	Aroclor 1262
GC	EPA 8082A	Aroclor 1268
HPLC	EPA 8330A	2-Amino-4,6-dinitrotoluene
HPLC	EPA 8330A	4-Amino-2,6-dinitrotoluene
HPLC	EPA 8330A	1,3-Dinitrobenzene
HPLC	EPA 8330A	2,4-Dinitrotoluene
HPLC	EPA 8330A	2,6-Dinitrotoluene
HPLC	EPA 8330A	HMX
HPLC	EPA 8330A	Nitrobenzene
HPLC	EPA 8330A	2-Nitrotoluene
HPLC	EPA 8330A	3-Nitrotoluene
HPLC	EPA 8330A	4-Nitrotoluene
HPLC	EPA 8330A	RDX
HPLC	EPA 8330A	Tetryl
HPLC	EPA 8330A	1,3,5-Trinitrobenzene
HPLC	EPA 8330A	2,4,6-Trinitrotoluene
GC	EPA 8015C	Diesel Range Organics
GC	EPA 8015C	WI-Diesel Range Organics
GC	EPA 8015C	Gasoline Range Organics
GC	EPA 8015C	WI-Gasoline Range Organics
GC	FL-PRO	FL-PRO

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	N-ethylperfluoro-1-octanesulfonamidoacetic acid (EtFOSAA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Fluorotelomer sulfonate 8:2 [1H,1H,2H,2H-perfluorodecane sulfonate] (8:2 FTS)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Fluorotelomer sulfonate 4:2 [1H,1H,2H,2H-perfluorohexane sulfonate] (4:2 FTS)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Fluorotelomer sulfonate 6:2 [1H,1H,2H,2H-perfluorooctane sulfonate] (6:2 FTS)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	GenX (HFPO-DA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	N-methylperfluoro-1-octanesulfonamidoacetic acid (MeFOSAA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluoro-1-butanesulfonate (PFBS)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluoro-n-butanoic acid (PFBA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluoro-1-decanesulfonate (PFDS)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluoro-n-decanoic acid (PFDA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluoro-n-dodecanoic acid (PFDoA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluoro-1-heptanesulfonate (PFHpS)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluoro-n-heptanoic acid (PFHpA)

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluoro-1-hexanesulfonate (PFHxS)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluoro-n-hexanoic acid (PFHxA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluoro-1-nonanesulfonate (PFNS)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluoro-n-nonanoic acid (PFNA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluorooctanesulfonate (PFOS)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluoro-1-octanesulfonamide (PFOSA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluoro-n-octanoic acid (PFOA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluoro-n-pentanoic acid (PFPeA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluoro-1-pentansulfonate (PFPeS)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluoro-n-tetradecanoic acid (PFTeDA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluoro-n-tridecanoic acid (PFTrDA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	Perfluoro-n-undecanoic acid (PFUDA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	N-methylperfluoro-1-octanesulfonamide (MeFOSA)

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	N-ethylperfluoro-1-octanesulfonamide (EtFOSA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.1 Table B-15	1H,1H,2H,2H-perfluorododecane sulfonate (10:2FTS)
HPLC	EPA 8330B MOD	2-Amino-4,6-dinitrotoluene
HPLC	EPA 8330B MOD	4-Amino-2,6-dinitrotoluene
HPLC	EPA 8330B MOD	1,3-Dinitrobenzene
HPLC	EPA 8330B MOD	2,4-Dinitrotoluene
HPLC	EPA 8330B MOD	2,6-Dinitrotoluene
HPLC	EPA 8330B MOD	HMX
HPLC	EPA 8330B MOD	Nitrobenzene
HPLC	EPA 8330B MOD	Nitroglycerin (NG)
HPLC	EPA 8330B MOD	2-Nitrotoluene
HPLC	EPA 8330B MOD	3-Nitrotoluene
HPLC	EPA 8330B MOD	4-Nitrotoluene
HPLC	EPA 8330B MOD	RDX
HPLC	EPA 8330B MOD	Tetryl
HPLC	EPA 8330B MOD	1,3,5-Trinitrobenzene
HPLC	EPA 8330B MOD	2,4,6-Trinitrotoluene
ICP	EPA 6010D	Copper
ICP	EPA 6010D	Iron
ICP	EPA 6010D	Lead
ICP	EPA 6010D	Magnesium
ICP	EPA 6010D	Manganese
ICP	EPA 6010D	Molybdenum
ICP	EPA 6010D	Nickel
ICP	EPA 6010D	Potassium
ICP	EPA 6010D	Selenium
ICP	EPA 6010D	Silver
ICP	EPA 6010D	Sodium
ICP	EPA 6010D	Thallium
ICP	EPA 6010D	Tin
ICP	EPA 6010D	Vanadium
ICP	EPA 6010D	Zinc
ICP/MS	EPA 6020B	Aluminum

Solid and Chemical Materials

Technology	Method	Analyte
ICP/MS	EPA 6020B	Antimony
ICP/MS	EPA 6020B	Arsenic
ICP/MS	EPA 6020B	Barium
ICP/MS	EPA 6020B	Beryllium
ICP/MS	EPA 6020B	Cadmium
ICP/MS	EPA 6020B	Calcium
ICP/MS	EPA 6020B	Chromium
ICP/MS	EPA 6020B	Cobalt
ICP/MS	EPA 6020B	Copper
ICP/MS	EPA 6020B	Iron
ICP/MS	EPA 6020B	Lead
ICP/MS	EPA 6020B	Magnesium
ICP/MS	EPA 6020B	Manganese
ICP/MS	EPA 6020B	Nickel
ICP/MS	EPA 6020B	Potassium
ICP/MS	EPA 6020B	Selenium
ICP/MS	EPA 6020B	Silver
ICP/MS	EPA 6020B	Sodium
ICP/MS	EPA 6020B	Thallium
ICP/MS	EPA 6020B	Vanadium
ICP/MS	EPA 6020B	Zinc
CVAA	EPA 7471B	Mercury
Titration	Walkley-Black	TOC
UV/VIS	EPA 9012B	Total Cyanide
UV/VIS	EPA 9065	Phenolics
UV/VIS	EPA 9066	Phenolics
IC	EPA 9056A	Bromide
IC	EPA 9056A	Chloride
IC	EPA 9056A	Fluoride
IC	EPA 9056A	Sulfate
IC	EPA 9056A	Nitrate
IC	EPA 9056A	Nitrite
IC	EPA 300.0	Fluoride
IC	EPA 300.0	Chloride
IC	EPA 300.0	Sulfate
IC	EPA 300.0	Bromide

Solid and Chemical Materials

Technology	Method	Analyte
IC	EPA 300.0	Nitrate
IC	EPA 300.0	Nitrite
IC	EPA 7199 / EPA 3060A	Hexavalent chromium
UV/VIS	EPA 7196A EPA 3060A	Hexavalent chromium
Pensky-Martens	EPA 1010A	Ignitability
Electrode	EPA 9045D	Corrosivity
Titration	Sec. 7.3.3 SW-846	Reactive Cyanide
Photometric	Sec. 7.3.4 SW-846	Reactive Sulfide
Filtration	EPA 9095B	Paint Filter Test
UV/VIS	EPA 365.1 MOD	Phosphorus
UV/VIS	EPA 353.2 MOD	Nitrate
UV/VIS	EPA 353.2 MOD	Nitrite
UV/VIS	EPA 353.2 MOD	Nitrate-Nitrite
UV/VIS	EPA 350.1	Ammonia
Gas Diffusion / UV/VIS	EPA 350.1	Ammonia - N
UV/VIS	EPA 351.2 MOD	TKN
GC	MADEP-EPH MOD	Extractable Petroleum Hydrocarbons (EPH) Modified
GC	MADEP-VPH-MOD	Volatile Petroleum Hydrocarbons (VPH) Modified
Preparation	**Method**	**Type**
Organic Preparation	EPA 3550C	Preparation of Soil by Sonication
Organic Preparation	EPA 3546	Microwave Extraction
Organic Cleanup	EPA 3620B	Florisil Cleanup Procedure
Organic Cleanup	EPA 3660B	Sulfur Cleanup Procedure
Organic Cleanup	EPA 3665A	Sulfuric Acid Cleanup Procedure
Organic Cleanup	EPA 3640C	GPC Cleanup Procedure
Volatile Organic Preparation	EPA 5035	Closed-System Purge-and-Trap and extraction for Volatile Organics in Soil and Waste Samples
Volatile Organic Preparation	EPA 3585	Waste Dilution for Volatile Organics
Waste Dilution	EPA 3580A	Waste Dilution
Inorganic Preparation	EPA 3050B	Preparation of Soils by Hotblock
Inorganic Preparation	EPA 1311	Toxicity Characteristic Leaching Procedure (TCLP)
Inorganic Preparation	EPA 1312	Synthetic Precipitation Leaching Procedure (SPLP)
Inorganic Metals Preparation	EPA 3010A	Acid Digestion of Aqueous Samples and TCLP/SPLP Extracts

Biological Tissue

Technology	Method	Analyte
GC	EPA 8081B	4,4'-DDE
GC	EPA 8081B	4,4'-DDT
GC	EPA 8081B	Aldrin
GC	EPA 8081B	alpha-BHC
GC	EPA 8081B	alpha-Chlordane
GC	EPA 8081B	beta-BHC
GC	EPA 8081B	Chlordane
GC	EPA 8081B	delta-BHC
GC	EPA 8081B	Dieldrin
GC	EPA 8081B	Endosulfan I
GC	EPA 8081B	Endosulfan II
GC	EPA 8081B	Endosulfan sulfate
GC	EPA 8081B	Endrin
GC	EPA 8081B	Endrin Aldehyde
GC	EPA 8081B	Endrin Ketone
GC	EPA 8081B	gamma-BHC (Lindane)
GC	EPA 8081B	gamma-Chlordane
GC	EPA 8081B	Heptachlor
GC	EPA 8081B	Heptachlor Epoxide
GC	EPA 8081B	Methoxychlor
GC	EPA 8081B	Toxaphene
GC	EPA 8082A	Aroclor 1016
GC	EPA 8082A	Aroclor 1221
GC	EPA 8082A	Aroclor 1232
GC	EPA 8082A	Aroclor 1242
GC	EPA 8082A	Aroclor 1248
GC	EPA 8082A	Aroclor 1254
GC	EPA 8082A	Aroclor 1260
GC	EPA 8082A	Aroclor 1262
GC	EPA 8082A	Aroclor 1268
GC/MS	EPA 8270D	1,1’-Biphenyl
GC/MS	EPA 8270D	1-Methylnaphthalene
GC/MS	EPA 8270D	2-Methylnaphthalene
GC/MS	EPA 8270D	Acenaphthene
GC/MS	EPA 8270D	Acenaphthylene
GC/MS	EPA 8270D	Anthracene
GC/MS	EPA 8270D	Atrazine

Biological Tissue

Technology	Method	Analyte
GC/MS	EPA 8270D	Bronzo(a)anthracene
GC/MS	EPA 8270D	Benzo(b)fluoranthene
GC/MS	EPA 8270D	Benzo(g,h,i)perylene
GC/MS	EPA 8270D	Benzo(k)fluoranthene
GC/MS	EPA 8270D	Chrysene
GC/MS	EPA 8270D	Dibenzo(a,h)anthracene
GC/MS	EPA 8270D	Dibenzofuran
GC/MS	EPA 8270D	Dimethoate
GC/MS	EPA 8270D	Disulfoton
GC/MS	EPA 8270D	Fluoranthene
GC/MS	EPA 8270D	Fluorene
GC/MS	EPA 8270D	Hexachlorobenzene
GC/MS	EPA 8270D	Indeno(1,2,3-c,d)pyrene
GC/MS	EPA 8270D	Methyl parathion
GC/MS	EPA 8270D	Naphthalene
GC/MS	EPA 8270D	Phenanthrene
GC/MS	EPA 8270D	Phorate
GC/MS	EPA 8270D	Pronamide
GC/MS	EPA 8270D	Pyrene
Preparation	**Method**	**Type**
Organic Preparation	EPA 3540C	Soxhlet Extraction

Drinking water

Technology	Method	Analyte
GC/MS	EPA 524.2	1,1,1,2-Tetrachloroethane
GC/MS	EPA 524.2	1,1,1-Trichloroethane
GC/MS	EPA 524.2	1,1,2,2-Tetrachloroethane
GC/MS	EPA 524.2	1,1,2-Trichloroethane
GC/MS	EPA 524.2	1,1-Dichloroethane
GC/MS	EPA 524.2	1,1-Dichloroethene
GC/MS	EPA 524.2	1,1-Dichloropropene
GC/MS	EPA 524.2	1,2,3-Trichlorobenzene
GC/MS	EPA 524.2	1,2,3-Trichloropropane
GC/MS	EPA 524.2	1,2,4-Trichlorobenzene
GC/MS	EPA 524.2	1,2,4-Trimethylbenzene

Drinking water		
Technology	**Method**	**Analyte**
GC/MS	EPA 524.2	1,2-Dibromo-3-chloropropane (DBCP)
GC/MS	EPA 524.2	1,2-Dibromoethane (EDB)
GC/MS	EPA 524.2	1,2-Dichlorobenzene
GC/MS	EPA 524.2	1,2-Dichloroethane
GC/MS	EPA 524.2	1,2-Dichloropropane
GC/MS	EPA 524.2	1,3,5-Trimethylbenzene
GC/MS	EPA 524.2	1,3-Dichlorobenzene
GC/MS	EPA 524.2	1,3-Dichloropropane
GC/MS	EPA 524.2	1,4-Dichlorobenzene
GC/MS	EPA 524.2	2,2-Dichloropropane
GC/MS	EPA 524.2	2-Butanone (MEK)
GC/MS	EPA 524.2	2-Chlorotoluene
GC/MS	EPA 524.2	2-Hexanone
GC/MS	EPA 524.2	2-Nitropropane
GC/MS	EPA 524.2	3-Chloropropene (Allyl chloride)
GC/MS	EPA 524.2	4-Chlorotoluene
GC/MS	EPA 524.2	4-Methyl-2-pentanone
GC/MS	EPA 524.2	Acetone
GC/MS	EPA 524.2	Acrylonitrile
GC/MS	EPA 524.2	Benzene
GC/MS	EPA 524.2	Bromobenzene
GC/MS	EPA 524.2	Bromochloromethane
GC/MS	EPA 524.2	Bromodichloromethane
GC/MS	EPA 524.2	Bromoform
GC/MS	EPA 524.2	Bromomethane (Methyl bromide)
GC/MS	EPA 524.2	Carbon disulfide
GC/MS	EPA 524.2	Carbon tetrachloride
GC/MS	EPA 524.2	Chlorobenzene
GC/MS	EPA 524.2	Chloroethane
GC/MS	EPA 524.2	Chloroform
GC/MS	EPA 524.2	Chloromethane (Methyl chloride)
GC/MS	EPA 524.2	cis-1,2-Dichloroethene
GC/MS	EPA 524.2	cis-1,3-Dichloropropene
GC/MS	EPA 524.2	Cyclohexane
GC/MS	EPA 524.2	Dibromochloromethane
GC/MS	EPA 524.2	Dibromomethane (Methylene bromide)

Drinking water		
Technology	**Method**	**Analyte**
GC/MS	EPA 524.2	Dichlorodifluoromethane
GC/MS	EPA 524.2	Ethyl ether
GC/MS	EPA 524.2	Ethyl methacrylate
GC/MS	EPA 524.2	Ethylbenzene
GC/MS	EPA 524.2	Hexachlorobutadiene
GC/MS	EPA 524.2	Isopropylbenzene
GC/MS	EPA 524.2	m+p - Xylenes
GC/MS	EPA 524.2	Methacrylonitrile
GC/MS	EPA 524.2	Methyl iodide (Iodomethane)
GC/MS	EPA 524.2	Methyl methacrylate
GC/MS	EPA 524.2	Methyl tertiary butyl ether (MTBE)
GC/MS	EPA 524.2	Methylene chloride
GC/MS	EPA 524.2	Naphthalene
GC/MS	EPA 524.2	n-Butylbenzene
GC/MS	EPA 524.2	n-Propylbenzene
GC/MS	EPA 524.2	o - Xylenes
GC/MS	EPA 524.2	Pentachloroethane
GC/MS	EPA 524.2	p-Isopropyltoluene
GC/MS	EPA 524.2	Propionitrile (Ethyl cyanide)
GC/MS	EPA 524.2	sec-Butylbenzene
GC/MS	EPA 524.2	Styrene
GC/MS	EPA 524.2	tert-Butylbenzene
GC/MS	EPA 524.2	Tetrachloroethene
GC/MS	EPA 524.2	Toluene
GC/MS	EPA 524.2	trans-1,2-Dichloroethene
GC/MS	EPA 524.2	trans-1,3-Dichloropropene
GC/MS	EPA 524.2	trans-1,4-Dichloro-2-butene
GC/MS	EPA 524.2	Trichloroethene
GC/MS	EPA 524.2	Trichlorofluoromethane
GC/MS	EPA 524.2	Vinyl chloride
GC/MS	EPA 524.2	Xylenes (total)
LC/MS/MS	EPA 537	N-ethylperfluoro-1-octanesulfonamidoacetic acid (EtFOSAA)
LC/MS/MS	EPA 537	N-methylperfluoro-1-octanesulfonamidoacetic acid (MeFOSAA)
LC/MS/MS	EPA 537	Perfluoro-1-butanesulfonate (PFBS)

Drinking water		
Technology	**Method**	**Analyte**
LC/MS/MS	EPA 537	Perfluoro-n-decanoic acid (PFDA)
LC/MS/MS	EPA 537	Perfluoro-n-dodecanoic acid (PFDoA)
LC/MS/MS	EPA 537	Perfluoro-n-heptanoic acid (PFHpA)
LC/MS/MS	EPA 537	Perfluoro-1-hexanesulfonate (PFHxS)
LC/MS/MS	EPA 537	Perfluoro-n-hexanoic acid (PFHxA)
LC/MS/MS	EPA 537	Perfluoro-n-nonanoic acid (PFNA)
LC/MS/MS	EPA 537	Perfluorooctanesulfonate (PFOS)
LC/MS/MS	EPA 537	Perfluoro-n-octanoic acid (PFOA)
LC/MS/MS	EPA 537	Perfluoro-n-tetradecanoic acid (PFTeDA)
LC/MS/MS	EPA 537	Perfluoro-n-tridecanoic acid (PFTrDA)
LC/MS/MS	EPA 537	Perfluoro-n-undecanoic acid (PFUDA)

Note:

1. This scope is formatted as part of a single document including Certificate of Accreditation No. L2224.

R.D.

Vice President

SHEALY ENVIRONMENTAL SERVICES, INC.

STANDARD OPERATING PROCEDURE

Quality Assurance Management Plan
(QAMP)

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1. Introduction

The Environmental Quantitation Incorporated ("EQI") Quality Assurance Management Plan (QAMP) has been written to provide guidance and direction to all EQI employees regarding quality assurance. The QAMP defines and documents all quality related activities, policies, programs, responsibilities, and controls required to provide legally defensible data.

This QAMP refers to other EQI documents, including those that describe general policy, give guidance and instruction, and the standard operating procedures (SOPs). Together, all these documents comprise the written basis of the EQI Quality Management System (QMS).

Our clients and various regulatory/certification agencies require documentation of our QMS. This QAMP fulfills a large part, but not all of this requirement. The project-specific requirements delineated in project plans may supersede the general quality requirements described in this document.

Additionally, this document addresses the basic information required for a quality management plan as described by the ISO:17025 accreditation, the United States Environmental Protection Agency (USEPA), the National Environmental Laboratory Accreditation Program (NELAP), and the Department of Defense (DoD) and Department of Energy (DOE) Quality Systems Manual (QSM).

1.1. Overview, Mission, Vision, Values

1.1.1. Overview

EQI is classified as a small business, incorporated in the State of South Carolina, providing services covered under NAICS code 541380. A *Certification and Permits Summary* [ME001PL], reflecting current accreditation status, is located in the addendum to this document.

EQI was founded in 1982 (as Shealy Environmental Services, Incorporated) with the vision of establishing a full-service environmental laboratory. With the aid of a small mobile laboratory, our initial services were primarily biological in nature. Since that beginning, EQI has prudently expanded its operation to provide unequaled services to a steadily growing clientele in the private and governmental business sectors. In 1985, a permanent laboratory was established in Columbia, South Carolina, to meet expanded service needs. In 1987, an analytical laboratory was added providing organic, inorganic, and microbiological analyses. In 1994, the entire business was moved to a facility that was custom- designed and constructed specifically as an environmental laboratory.

EQI management has consistently utilized responsible business practices, allowing the company to experience healthy growth while many other environmental testing laboratories were collapsing. We continuously invest in new instrumentation, software, computer systems, and experienced scientists to remain current with the latest technology and maintain the ability to provide the best service and highest quality data possible to our clients.

In 2001, EQI was among the first round of laboratories to earn accreditation by The National Environmental Laboratory Accreditation Conference Institute (NELAC or TNI). TNI's vision is to foster a national accreditation program, where environmental laboratories within the United States are accredited to one uniform, rigorous, and robust program (National Environmental Laboratory Accreditation Program (NELAP). In 2012, the company was purchased by the current owners and in 2017, the name was changed to Environmental Quantitation Incorporated.

EQI has been in the US EPA Contract Laboratory Program (CLP) since 2001. We have active CLP contracts for the analysis of multi-media, multi-concentration organic, metals, and inorganic non-metals compounds in water and solid samples by SOM02.4 and ISM02.4 methodologies. To become part of the CLP, laboratories must meet stringent requirements and standards for equipment, personnel, laboratory practices, and analytical and quality control (QC) operations.

The Department of Defense (DoD) Environmental Data Quality Workgroup (EDQW) and the Department of Energy (DOE) Consolidated Audit Program (DOECAP) Operations Team developed the DoD/DOE Quality Systems Manual (QSM) for Environmental Laboratories. The QSM is a set of requirements based upon the TNI requirements and ISO:17025 for establishing and managing quality systems for laboratories performing analytical testing services for the DoD and the DOE. Conformance to the requirements is mandatory for any laboratory that is maintaining accreditation in accordance with the DoD Environmental Laboratory Accreditation Program (ELAP) or maintaining qualification in accordance with the DOECAP and DOE related contract awards. As a result of all these efforts and accomplishments, EQI has achieved its vision of becoming a reliable, full-service, and high-quality environmental laboratory. EQI is recognized as a responsive and credible environmental laboratory focused on creating cost- effective and workable solutions to meet individual client needs.

1.1.2. Mission

EQI exists to provide accurate, legally defensible data in the requested deliverables to industries, municipalities, consulting/engineering firms, and government agencies within the timeframes required.

1.1.3. Statement of Vision

EQI's vision is to be recognized regionally and nationally as an innovative, client-focused, high quality, on time, environmental laboratory that supports diverse regulatory programs. EQI's focus is client satisfaction, quality, and sound science.

1.1.4. Values

Scientific knowledge, experience, integrity, trust, teamwork, and dedication to strong client relationships are the hallmarks of how EQI builds and maintains its reputation in the industry. By ensuring high professional standards and an open and responsive culture, we strive to provide the following to our staff and clients:

- Our staff deserve a safe workplace, fairness, respect, clear expectations, training, tools for high caliber performance, clear opportunities for career development and an environment that embraces teamwork, communication, & empowerment.

- Our clients deserve frequent and effective communication, high quality work compliant to our SOPs, QAMP, and applicable QAPP/SAPs, on-time deliverables, the highest integrity, and an excellent value.

2. Management and Organization

2.1. Statement of Management Commitment to Quality

EQI management is committed to providing services of unmatched quality that meet the technical and management objectives of our clients, while satisfying all applicable regulatory requirements. We strive to provide a working environment in our well-equipped state-of-the-art laboratory that encourages safety and excellence in all our activities, requires the participation of all employees in our quality efforts, and demands integrity from all employees. Providing on-going documented training both internally and externally facilitates this commitment.
The EQI QAMP provides the foundation for the overall quality level of our operation. It provides guidance to all employees in order for them to fulfill their job responsibilities, while serving as a statement of quality commitment to our clients and regulatory agencies.

EQI management is committed to compliance with the TNI standard, the Department of Defense Department of Energy (DOE) Consolidated Quality Systems Management Plan (DoD/DOE QSM), the USEPA Contract Laboratory Program (CLP) Statement of Work (SOW) and all applicable state and regulatory requirements. In addition, top management ensures that the integrity of the QMS is maintained when changes are made.

2.2. Approved Signatories

The following positions have the authority to sign off (give approval) on all documents used for business purposes or the operation of the laboratory:

- Laboratory Director
- Technical Director

The following positions have the authority to sign off (give approval) of any documents used for training and/or for the generation of data within their areas of expertise:

- Laboratory Director
- Technical Director
- Operations Director
- Quality Assurance Officer
- Environmental Health and Safety Officer
- Waste Manager
- Radiation Safety Officer
- Analytical Manager
- Project Manager
- Group Leaders
- Sample Custodian
- Analyst
- IT Specialist

The following positions have the authority to include an electronic signature on either client reports, SOPs/Policies/QAMP and/or any other applicable documents within their areas of expertise:

- Laboratory Director
- Technical Director
- Operations Director
- Quality Assurance Officer
- Analytical Manager
- Quality Assurance Specialist
- Quality Assurance Associate
- Project Manager
- Group Leaders

Electronic signatures are stored in LIMS and in EQLIMS and are populated in client reports, SOPs, Policies and the QAMP automatically upon approval.

2.3. Quality Organizational Structure

The achievement of the EQI vision is only possible through the implementation and on-going utilization of the EQI QAMP. The responsibility for this vision resides in the efforts of all employees as led by the management team. The following section describes the quality activities for various positions within the EQI organization.

The responsibilities and authority of the personnel holding these positions, as related to quality and the implementation of this QAMP, are described the sections below. The management structure and the overall organizational structure are presented in an addendum to this document which is subject to change *[Key Managerial Personnel Organizational Chart* (ME00185); *Organizational Chart* (ME0013A)].

2.3.1. President/CEO/Laboratory Director

- Responsible for the overall corporate philosophy and policy for quality
- Responsible for ensuring the implementation of an effective quality system
- Provides support and resources to implement all quality efforts and the EQI QAMP
- Responsible for overall approval of the EQI QAMP
- Responsible for management assessments
- Responsible for the financial oversight and management of the company
- Responsible for the overall quality and production activities of the analytical laboratory
- Responsible for the oversight of health and safety, facility, and human resources related matters
- Ensures that an effective Comprehensive Chemical Hygiene, Safety, and Hazard Communication Plan and associated, documented training processes are in place
- Approves the QAMP, SOPs, and other quality system documents
- Assists with and supports all QA activities
- Directs the overall laboratory operations to meet current and future client needs
- Contributes to, develops, and focuses the quality assurance department on targeted market segments
- Provides technical support on method development, automation, instrument performance, and production efficiency
- Prioritizes IT projects to ensure that EQI has the necessary infrastructure to maintain a competitive advantage with respect to efficiency, reporting, and quality
- Initiates improvements in operations and quality programs
- Assigns specific personnel responsibilities and provides the overall direction to the Group Leaders and the Technical Director to improve quality and production related matters
- Ensures that adequate staffing is available to perform the sample workload within the QMS framework
- Ensures compliance with the TNI standard and the DoD QSM

2.3.2. Technical Director

- Reports directly to the Laboratory Director on all quality and operational matters
- Approves the QAMP, SOPs, and other quality system documents
- Responsible for the overall current use of technology in the laboratory including instruments, computers, and LIMS
- Evaluates available technology which will make operations more efficient and meet current and future client needs. Directs the efforts to implement this technology
- Supports the QA department with respect to SOPs, MDLs, acceptance limits/control charts, internal audits, and LIMS interaction
- Contributes to the continuous improvement of all operations
- Provides technical and operational guidance to analysts and Group Leaders
- Reviews quality activities performed as part of the analytical operation
- Trains analysts and ensures performance standards are achieved and documented
- Provides technical support and instrument troubleshooting
- Implements and oversees data review procedures
- Supervises the preparation and maintenance of laboratory records
- Ensures compliance with the TNI standard and the DoD QSM

- Oversees EPA CLP contracts
- Deputy to the Laboratory Director
- Data Integrity Officer
- Facilitates anonymous reporting of data integrity issues / ethical violations
- Maintains confidentiality for employees who wish to remain anonymous
- Alternate Radiation Safety Officer (Alternate RSO)
- Assists Radiation Safety Officer will all duties
- Acts as the Radiation Safety Officer in the event the RSO is not available

2.3.3. Quality Assurance Officer (QAO)

- The QAO reports directly and independently to the Laboratory Director on all quality-related matters
- Approves the QAMP, SOPs, and other quality system documents
- Interacts with the Laboratory Director, Technical Director, Operations Director, Analytical Manager, and department Group Leaders regarding quality related matters
- Responsible for assessing the adequacy, utilization, and implementation of the QMS
- Supervises the preparation, maintenance, and storage of laboratory records
- Responsible for ensuring and improving overall quality within the laboratory operation
- Has authority to suspend sample processing activities when QA requirements are not met
- Assists clients concerning data quality issues
- Investigates and approves laboratory NCMs
- Monitors data quality objectives (DQOs) to verify the laboratory meets stated levels of performance
- Oversees corrective and preventive actions (CAPAs) and tracks them to closure
- Oversees procurement from the quality perspective
- Administers Proficiency Testing (PT) program in accordance with the TNI standard, DoD, and state reporting requirements
- Interacts with regulatory bodies in matters of certification and accreditation
- Performs quality audits and reports results to the Laboratory Director and laboratory management
- Maintains all controlled quality related documents
- Assists in employee training
- Tracks and coordinates responses to external audit findings
- Responsible for approval of the EQI QAMP
- Monitors customer feedback and/or data quality via the report revision form, client complaint form, and annual customer survey
- Performs annual management review
- Approves and tracks employee demonstrations of capability (DOC)
- Ensures compliance with the TNI standard and the DoD QSM
- Tracks and manages the QAMP, contingency plan, SOP, and policy updates

2.3.4. Operations Director

- Reports to the Laboratory Director on all quality and operational matters
- Approves the QAMP, SOPs, and other quality system documents
- Responsible for the daily operation of all organics and inorganics departments
- Directly supervises all analysts in the technical, quality, and operational aspects of their positions

- Ensures that analysts are following the Comprehensive Chemical Hygiene, Safety, and Hazard Communication Plan
- Ensures that each department has the technical and human resources to perform documented, quality-oriented preparation, analysis, and review in accordance with EQI SOPs, QAMP, policies, and client requirements
- Oversees the cross-training of analysts and shares resources where appropriate
- Solves problems and takes corrective action or preventive action to prevent recurrence
- Provides guidance on instrument troubleshooting
- Seeks general continuous improvement and implementation of technology
- Oversees the scheduling of weekday and weekend shifts, rotational schedules, etc. to maximize equipment and facilities
- Ensures chemicals and supplies are ordered appropriately
- Ensures performance standards are achieved and documented
- Implements and oversees data review procedures
- Supervises the preparation and maintenance of laboratory records
- Evaluates instrument performance and supervises the calibration, preventative maintenance, and scheduling of repairs
- Ensures compliance with the TNI standard and the DoD DOE QSM
- Evaluates organic methods for quality and productivity and recommends and implements improvements
- Evaluates organic extraction procedures and recommends and implements improvements
- Evaluates the use of Target Thru-Put and recommends improvements
- Works with vendors to improve products purchased
- Spearheads training and mentoring lab analysts and managers
- Collaborates with QA department to improve SOPs, improve execution of the TNI standard and the DoD DOE QSM, and complete Corrective and Preventive Actions
- Drives the improvement of and manages CLP, Level 3 and Level 4 packaging group
- Works with laboratory director and IT to continuously improve LIMS
- Reviews data, performs analysis, and plugs in as necessary in response to client workload
- Deputy to the Technical Director

2.3.5. Environmental Health and Safety Officer (EHSO)

- Reports to the Laboratory Director
- Performs health and safety audits as required
- Coordinates refresher health and safety training
- Maintains OSHA “Work-Related Injuries and Illnesses Log”
- Posts annual OSHA Summaries (Form 300A)
- Ensures proper placement, function, and accessibility of all safety equipment
- Ensures compliance with all state and federal regulations, as outlined in the 29 CFR or as required by SC DHEC
- Assists the Waste Manager in maintaining the EQI (Shealy) *Environmental Integrated Contingency Plan* [HS SOP ME0012C]
- Serves as the Chemical Hygiene Officer
- Responsible for maintenance of the Lockout/Tagout program, foreign soils program, and respiratory protection plan.
- Serves as the Emergency Response Coordinator.

2.3.6. Hazardous Waste Manager

- Maintains the *Hazardous and Non-Hazardous Laboratory Waste Management Plan* [HS SOP ME0012A]
- Sends quarterly reports to Department of Health and Environmental Control for Large Quantity Generator (Forms DHEC 1962, 1963, and 1965.)

- Issues Notification Form 2701 to DHEC as required
- Oversees the purging of drums for waste disposal to the appropriate waste disposal facility
- Maintains waste profiles and waste manifests
- Oversees weekly hazardous waste audits of the hazardous waste central accumulation area
- Oversees the proper disposal of all lab-generated wastes
- Ensures that EQI is compliant with all regulations, state and federal, as outlined in the 40 CFR or as required by SCDHEC

2.3.7. Radiation Safety Officer (RSO)

- Establishes, maintains, enforces and controls Shealy's radiation safety program
- Acts as the contact person for all regulatory agencies
- Ensures that all conditions of the radioactive material license are met
- Responsible for making necessary amendments and notifying the regulatory agency of these amendments
- Updates the safety program per changes in the regulations
- Responsible for maintaining the radioactive material inventory program
- Acts as the primary respondent during emergency situations involving radioactive materials

2.3.8. Project Manager (PM)

- Reports to the Laboratory Director
- Acts as liaison between the client and the laboratory.
- Monitors all client analytical and quality requirements.
- Reviews project data packages for completeness and compliance.
- Reviews laboratory project status and works with laboratory personnel to ensure due dates are met.
- Coordinates overall project needs with the laboratory staff to ensure adequate equipment, methods, materials and analysts are available before a project is quoted or accepted.
- Contributes to pre-project planning meetings.
- Ascertains and assures laboratory implementation of project DQOs.
- Assists with regulatory-specific methods and special project requirements.
- Provides price quotations and enters all project specifications into LIMS.
- Coordinates field sampling and sample container shipping.
- Reviews Chain of Custody (COC) information against information entered into LIMS.
- Communicates any COC discrepancies and sample analysis anomalies to client.
- Monitors client-specified turnaround time (TAT).
- Assures deliverable requirements are met.
- Provides updates on project status.
- Reviews, releases, and signs final reports.

2.3.9. Human Resources Director

- Responsible for talent acquisition and staffing
- Employment processing including compensation and health and welfare benefits
- Assists in employee onboarding
- Maintains employee records
- Assists with employee relations and retention

2.3.10. IT Specialist/IT Programmer

- Reports to the Laboratory Director
- Responsible for the overall maintenance and development of the LIMS and EQLIMS
- Provides support to all LIMS users

- Performs database maintenance and backup
- Monitors and implements all network security
- Generates all client specific electronic deliverables
- Maintains EQI website

2.3.11. QA Specialist

- Reports to the QAO
- Supports QAO in all QA activities
- Assists QAO with initiatives for ensuring and improving quality within the operation
- Monitors and maintains quarterly LOD/LOQ verifications
- Monitors and maintains annual MDL verifications
- Assists QAO in investigating and approving laboratory Corrective and Preventive Actions (CAPAs)
- Assists QAO in administering Proficiency Testing (PT) program in accordance with the TNI standard, DoD and DOE requirements, and individual state requirements
- Interfaces with regulatory bodies in matters of certification
- Assists QAO in performing quality internal audits
- Assists QAO prior to and during external audits
- Assists QAO in tracking and coordinating responses to external audit findings
- Tracks external quality related documents
- Maintains vendor registration and approval
- Assists in generating and updating controlled documents (forms and spreadsheets)
- Tracks, manages and reviews quality documents
- Responsible for DL, acceptance criteria, LOD and LOQ updates to LIMs, as needed
- Deputy to the QAO

2.3.12. QA Associate

- Reports to the QAO
- Supports QAO in all QA activities
- Supervises the preparation, maintenance, and storage of laboratory records
- Assists QAO with initiatives for ensuring and improving quality within the operation
- Assists QAO in investigating laboratory NCMs
- Assists QAO in administering Proficiency Testing (PT) program in accordance with TNI standards, DoD and DOE requirements, and individual state requirements
- Assists QAO in performing quality internal audits
- Responsible for generating and updating controlled documents (forms, spreadsheets)
- Responsible for validation of spreadsheets
- Responsible for generation of logbooks per the laboratory’s requirements
- Assists in tracking and managing the QAMP, contingency plan, SOPs, and policy updates
- Tracks employee IDOCs and CDOCs
- Monitors receipt of certificates of analysis
- Maintains support equipment temperature logs
- Monitors the review of laboratory logbooks
- Manages or performs calibration of laboratory balances and thermometers
- Responsible for DI water and storage blank testing
- Responsible for generating quarterly control charts
- Manages employee-training records

2.3.13. Analytical Manager

- Reports to the Operations Director
- Spearheads method optimization and development
- Performs instrument maintenance and trains analysts in instrument maintenance
- Trains analysts
- Serves as floating senior analyst
- Performs Level I and Level II data review
- Drives continuous improvement efforts
- Responsible for cost-reduction & ordering of supplies
- Serves as a technical advisor
- Involved with the testing and development of LIMS enhancements

2.3.14. Senior Data Package Specialist

- Generation and assembly of all ISM and Level 3 / Level 4 data packages
- Testing and development of MARRS
- Testing and development of LIMS enhancements
- Primary contact to metals analysis Level 3 / Level 4 data package inquiries
- Provide feedback to management where CAPAs are required
- ISM CCS report review and response
- Training all analysts on applicable features of MARRS and any updates/revisions
- Level I and Level II data review as needed
- Respond to PMs with regards to adding tests, removing tests, un-batching samples
- Serve as a backup ICP-AES and ICP-MS analyst as needed

2.3.15. Data Package Specialist

- Generation and assembly of all SOM and Level 3 / Level 4 data packages
- Assists with assembly of ISM data packages
- Generation and assembly of PT data packages
- Primary contact for organic Level 3 / Level 4 data package inquires
- Communicates with Project Managers regarding data package deliverables
- Level III review of data packages

2.3.16. Field Services Group Leader

- Reports directly to the Laboratory Director on all quality and operational related matters
- Supervises, guides, and trains field service technicians
- Ensures field sampling SOPs are followed for all field parameters and activities
- Maintains proper calibration logs and reviews all field data logs and summaries
- Coordinates field service scheduling

2.3.17. Organic Extractions Group Leader

- Reports directly to the Operations Director on all quality and operational matters
- Supervises all organic extractions analysts in all technical and operational aspects
- Ensures organic extractions department meets all quality requirements and initiatives
- Manages on time delivery
- Serves as primary contact for rush projects
- Proactively informs Project Managers of late data and instruments down
- Trains analysts and ensures performance standards are achieved
- Implements and oversees data review procedures

- Evaluates instrument performance
- Ensures that instrument and equipment maintenance is performed and is properly documented
- Oversees calibration where required
- Ensures standards, chemicals and supplies are ordered appropriately
- Seeks continuous improvement and implements new technology
- Performs annual review of organic extractions department SOPs

2.3.18. Volatiles Group Leader

- Reports directly to the Operations Director on all quality and operational matters
- Supervises all volatiles analysts in all technical and operational aspects
- Ensures volatile department meets all quality requirements and initiatives
- Manages on time delivery
- Serves as primary contact for rush projects
- Proactively informs Project Managers of late data and instruments down
- Trains analysts and ensures performance standards are achieved
- Implements and oversees data review procedures
- Evaluates instrument performance
- Ensures that instrument and equipment maintenance is performed and is properly documented
- Oversees calibration where required
- Ensures standards, chemicals and supplies are ordered appropriately
- Seeks continuous improvement and implements new technology
- Performs annual review of volatile department SOPs

2.3.19. Semi-Volatiles Group Leader

- Reports directly to the Operations Director on all quality and operational matters
- Supervises all semi-volatiles analysts in all technical and operational aspects
- Ensures semi-volatile department meets all quality requirements and initiatives
- Manages on time delivery
- Serves as primary contact for rush projects
- Proactively informs Project Managers of late data and instruments down
- Trains analysts and ensures performance standards are achieved
- Implements and oversees data review procedures
- Evaluates instrument performance
- Ensures that instrument and equipment maintenance is performed and is properly documented
- Oversees calibration where required
- Ensures standards, chemicals and supplies are ordered appropriately
- Seeks continuous improvement and implements new technology
- Performs annual review of semi-volatile department SOPs

2.3.20. Inorganic Metals Group Leader

- Reports directly to the Operations Director on all quality and operational matters
- Supervises all inorganic metal analysts in all technical and operational aspects
- Ensures inorganic metals department meets all quality requirements and initiatives
- Manages on time delivery
- Serves as primary contact for rush projects
- Proactively informs Project Managers of late data and instruments down
- Trains analysts and ensures performance standards are achieved
- Implements and oversees data review procedures

- Evaluates instrument performance
- Ensures that instrument and equipment maintenance is performed and is properly documented
- Oversees calibration where required
- Ensures standards, chemicals and supplies are ordered appropriately
- Seeks continuous improvement and implements new technology
- Performs annual review of inorganic metal department SOPs

2.3.21. Inorganic Non-Metals Group Leader

- Reports directly to the Operations Director on all quality and operational matters
- Supervises all inorganic non-metals analysts in all technical and operational aspects
- Ensures inorganic non-metals department meets all quality requirements and initiatives
- Manages on time delivery
- Serves as primary contact for rush projects
- Proactively informs Project Managers of late data and instruments down
- Trains analysts and ensures performance standards are achieved
- Implements and oversees data review procedures
- Evaluates instrument performance
- Ensures that instrument and equipment maintenance is performed and is properly documented
- Oversees calibration where required
- Ensures standards, chemicals and supplies are ordered appropriately
- Seeks continuous improvement and implements new technology
- Performs annual review of inorganic non-metal department SOPs

2.3.22. Sample Receiving Group Leader

- Reports to the Operations Director on all quality and operational matters
- Supervises all sample receiving custodians in all technical and operational aspects
- Ensures sample receiving and shipping department meets all quality requirements and initiatives
- Reviews LIMS sample receiving logins
- Trains custodians and shipping personnel and ensures performance standards are achieved
- Supports sample receiving and shipping as necessary in response to client workload
- Performs annual review of sample receiving and shipping department SOPs

2.3.23. Sample Custodian

- Reports directly to the Sample Receiving Group Leader on all quality and operational matters
- Implements proper sample receiving procedures in accordance with the Sample Receiving SOP
- Documents anomalies related to samples as received
- Enters all sample information into the LIMS
- Monitors that internal chain-of-custody procedures are followed for all samples leaving the sample receiving area
- Ensures proper sample storage conditions are maintained
- Assists the Waste Manager to ensure that disposed samples are properly documented

2.3.24. Analyst/Senior Analyst

- Reports directly to the appropriate Group Leader on all quality and operational matters
- Follows all health and safety policies and procedures
- Performs analysis, documentation procedures, and review in accordance with appropriate SOPs, policies, and the QAMP
- Performs and documents all calibrations and standards preparation

- Performs and documents equipment maintenance
- Reports NCMs to the appropriate Group Leader
- Reviews SOPs under the supervision of the Group Leader

2.4. Quality Management System

The purpose of the EQI Quality Management System (QMS) is to ensure the production of legally defensible data of known quality. The QMS encompasses the necessary documents, policies, instructions, controls, and operating procedures needed to meet client and regulatory requirements relating to the work performed and the data produced. The QAMP is a document which describes the EQI QMS in a clearly written format for use by both our personnel and by our clients.

2.4.1. Quality Responsibility

All EQI employees are accountable for performing their job duties in compliance with applicable laws, regulations, methods, SOPs, policies, consensus standards, and the EQI QAMP. Each employee is directly responsible for ensuring the highest quality of his/her work performance. All analysts are required to perform documented initial and continuing demonstrations of capability (IDOC/CDOC) with respect to the analysis and preparation procedures they perform. All EQI employees concerned with environmental testing activities are required to familiarize themselves with the QAMP and with the policies and procedures required for their work.

2.4.2. Quality Assurance/Quality Control

Quality Assurance (QA) is defined as set of activities used to ensure the quality in the processes by which laboratory data is generated. For an environmental laboratory, QA provides assurance that established procedures and policies are effective in producing precise and accurate data so that customer requirements are satisfied in a systematic and reliable fashion. Some examples of QA elements are:

- Document control
- Training (demonstration of capability, ethics, etc.)
- Procurement control (vendor approval, subcontract lab approval, certificates of analysis, etc.)
- Internal audits
- Corrective and preventive action (CAPA)
- SOPs that are utilized to ensure uniformity in procedure and parent method compliance.

Quality Control (QC) is defined as a set of activities for ensuring that established procedures are effective and successful in producing precise and accurate data. Some examples of QC elements are:

- Measurement of all aspects of instrument performance to ensure instruments are operating within established statistical control limits
- Monitoring analysis proficiency through single-blind or duplicate analysis and providing corrective action if necessary
- Utilization of acceptance limits for QC parameters such as method blanks (MB), laboratory control samples (LCS), and matrix spike/matrix spike duplicate (MS/MSD) samples to determine the validity and quality of sample results

Together, all QA activities and all QC activities combine to form the basis of our QMS. The QAMP is the controlling document that is central to our QMS. It describes our QA/QC efforts and ties in other regulatory documents that are the framework of our QMS.

2.5. Quality System Components

2.5.1. Quality Documents and Records

***Quality Documents* -** Quality documents are those documents that establish and control the production of data of known quality and legal defensibility. They define not only quality objectives but also the policies and procedures required to affect high quality. Quality documents are developed, reviewed, approved and controlled as per section 5.1. EQI quality documents include the following:

- EQI QAMP
- SOPs
- Policies

***Quality Records* -** Quality records are those that provide evidence of overall proficient laboratory operation. EQI quality records include but are not limited to the following:

- Logbooks (instrument maintenance, standard preparation, etc.)
- Forms and spreadsheets
- Support equipment calibration records
- Instrument calibration data
- QC sample data
- Certificates of analysis
- Laboratory accreditations/certifications
- Proficiency testing results
- Audit reports
- Nonconformance memos (NCMs)
- Corrective and Preventive Actions (CAPAs)

***Project Records* -** Project Records are those that provide evidence of overall proficient laboratory operation for a specific project. EQI project records include but are not limited to the following:

- Chain-of-Custody forms
- Raw data
- Field data
- Final data reports including case narrative
- QC and calibration results

2.6. Implementation

In order to implement the QMS and ensure that the applicable elements of the quality system are understood, the following items must be in place:

- Appropriate, well-written standard operating procedures (SOPs), policies and QAMP
- Document control system
- Properly qualified employees
- Effective training program
- Ongoing quality improvement initiatives
- Internal auditing program
- Corrective and preventive action program
- Procurement control system
- Effective communication – internal and external
- Data verification and validation

3. Personnel Qualifications and Training

3.1. Personnel Qualifications

The laboratory recruits personnel from the university campuses located throughout South Carolina, from other respected environmental laboratories across the country and from other similar industries. Many applied science graduates join EQI as entry-level analysts, and progress, through training and experience, into senior analysts, data reviewers, project managers, and QA personnel. Currently, over 90 percent of our laboratory personnel have degrees in applied science. The average years of experience for most employees is six years with many employees having over ten years of experience in the environmental laboratory business. Detailed synopses of key employees, as noted on the management organizational chart in Figure 2.3-1 and on the Organizational Chart in the addendum, are included in Appendix A.

Prior to hiring, each potential employee must meet certain minimum requirements. These requirements are covered in section 3.1.2 below, which specify the minimum education and experience requirements. The necessary duties of the positions listed below can be found in section 2.2. Experience can be substituted for education at a two to one ratio. For example, eight years of experience is equivalent to four years of schooling. Potential employees must produce proof of academic training, give permission to EQI to verify information via contact with references, and successfully pass a pre-employment drug screen. The final decision to hire is made by the Laboratory Director and the applicable member(s) of management based upon the applicant's qualifications.

After hiring, personnel in most analytical positions receive training for a period that lasts from six months to two years, depending upon the level of experience required to competently perform the duties of the position.

3.1.1. Human Resources

In order to ensure that EQI hires and maintains only qualified employees, it has established policies, guidelines, and procedures governing the hiring process. These policies, guidelines, and procedures are elaborated in the EQI (Shealy) *Employee Handbook* [ME002CW]. A few key areas that apply to quality and the QAMP are as follows:

- Classification of Employees - Prerequisites used during hiring process.
- Confidentiality - Protection to satisfy the requirements of clients.
- Disciplinary Guidelines - Addresses the quality of an individual's work as well as other aspects that affect performance.
- Substance Abuse - Outlines the pre-employment and random drug screening requirements EQI has established.

3.1.2. Experience Requirements

3.1.2.1. Organics

- GC and GC/MS analysts must have at least one year of experience in the operation of GC and/or GC/MS instrumentation analyzing environmental samples. Gas chromatographic and/or mass spectral interpretation analysts must have at least one year of experience in the interpretation of data gathered in GC and/or GC/MS analysis. Two years of college or equivalent is required.

- Extractions analysts must have at least one year of experience in the preparation of extracts. Two-year degree in science or equivalent is required.

3.1.2.2. Inorganic Metals

- ICP, ICP/MS and CVAA/CVAF analysts must have at least one year of experience in the operation of ICP, ICP/MS and/or CVAA/CVAF instrumentation analyzing environmental samples. ICP, ICP/MS and CVAA/CVAF spectral interpretation analysts must have at least one-year experience in the operation and interpretation of ICP, ICP/MS and/or CVAA/CVAF data. Two years of college or equivalent is required.

- Preparation analysts must have a least one year of experience in the preparation of digests. A two-year degree in science or equivalent is required.

3.1.2.3. Inorganic Non-Metals and Microbiology

- Inorganic and micro analysis and preparation analysts must have a least one year of experience performing inorganic and/or micro prep and analysis. Two-year degree in science or equivalent is required.

3.1.2.4. Sample Custodian

- Sample custodians must have a least one year of experience in a similar work environment. Two-year degree in science or equivalent is preferred.

3.1.2.5. Shipping Custodian

- Shipping custodians must have at least two years of experience in a similar work environment.

3.1.2.6. Field Service Technician

- Field service technicians must have at least two years of experience in a similar work environment.

3.1.2.7. Group Leader, QA Specialist and QA Associate

- Group Leaders, QA Specialists and QA Associates must have a minimum of a four-year science degree or equivalent as well as three years of laboratory experience.

3.1.2.8. Project Manager

- Project Managers must have a minimum of a four-year science degree or equivalent and two years of laboratory experience.

3.1.2.9. Health and Safety Officer / Hazardous Waste Manager / Hazardous Waste Assistant and Radiation Safety Officer

- The Health and Safety Officer must have a four-year science degree or equivalent, be first aid/CPR certified, a working knowledge of all state and federal regulations governing laboratory health and safety and two years of experience.

- The Hazardous Waste Manager must have a four-year science degree, 40-hour HAZWOPER training (with yearly 8-hour refresher training), first aid/CPR certified, and have two years of hazardous waste handling, labeling, and shipping experience.

- The Hazardous Waste Assistant must have a four-year science degree and 40-hour HAZWOPER training (with yearly 8-hour refresher training).

- The Radiation Safety Officer must have a four-year science degree and a working knowledge of the types and quantities of licensed materials found at EQI. A 40-hour radiation safety course presented by an academic institution, a commercial radiation safety consulting company, or a professional organization of radiation protection experts is required. Two years of experience is required.

3.1.2.10. IT Programmer / IT Systems Administrator

– The IT Programmer and the IT Systems Administrator must have a four-year computer science degree or equivalent, knowledge of Delphi, SQL, and network management. Two years of experience is required.

3.1.2.11. Senior Management - Laboratory Director, Quality Assurance Officer, Operations Director, Analytical Manager and Technical Director

– Senior management must have a minimum of a four-year science degree or equivalent as well as five years laboratory management experience.

NOTE: The laboratory must have a designated full-time staff member meeting the same requirements as the technical director if the technical director is absent for a period of 15 consecutive calendar days. The operations director is the deputy for the technical director in the event of the technical director's absence. In the event that the technical director is absent for 35 or more consecutive days, the DoD and NELAP accreditation authorities must be notified. The technical director cannot be the technical director of more than one accredited environmental laboratory without authorization from the accrediting body.

3.2. Personnel Training (New Hire Orientation)

All new hires to the EQI operation receive appropriate levels of training commensurate with their experience, job duties and positions. Our training program is divided into four categories including:

- New Hire Orientation Training
- Health and Safety / Hazardous Waste Orientation Training
- QA Orientation Training
- General Laboratory Training (Laboratory Techniques)
- Specific Laboratory Training

All new employees, including technical, clerical, and management participate in New Hire Orientation Training. This training occurs typically during the first two to three days after a new hire reports to work and is conducted by the Human Resources Director, Health and Safety Officer, Waste Manager, Operations Director, Quality Assurance Officer, and/or other members of the management team. When appropriate, additional assistance can be provided by other qualified employees.

Items covered in the new hire orientation training are stated in the *New Hire Orientation Training Checklist* [ME001A9] and includes but is not limited to: health and safety, confidentiality, ethics, conflict of interest, computer security awareness, sexual harassment, and substance abuse. The newly hired employee signs the checklist to show that he/she understands the information presented. A copy of the completed checklist is included in each employee's training file.

3.2.1. Ethical Practices / Data Integrity Training

EQI management is aware that both internal and external pressures can adversely affect an employee's judgment and the quality of the work they perform. As part of our hiring process, all new employees are required to read and sign an *Ethics Policy Agreement* [AD Policy ME0012V] that forbids inappropriate, unacceptable, or unethical behavior in the performance of their job duties. At least annually, mandatory ethics training for all employees is conducted by the QAO, the Laboratory Director, or the Operations Director. As part of this ethics training, the ethics policy is reviewed and each employee is required to sign the policy. Signatures may be captured manually or via EQLIMS. This signed policy is filed with each employee's training records.

In addition, other safeguards against inappropriate behavior and fraud are in place. These include a low employee/group leader ratio, a quality-based performance review system, disciplinary policies and procedures, internal proficiency testing, mandatory multiple-level data reviews, in-depth internal audits, and on-going training in proper and ethical laboratory practices. The laboratory also maintains a mechanism for confidential reporting of data integrity issues by naming a data integrity officer.

As a DoD ELAP laboratory, Shealy must report instances of inappropriate and prohibited laboratory practices, as detailed in the DoD QSM, to our accrediting body within 15 business days of discovery. Discovery includes findings of such inappropriate practices by laboratory staff or customer stakeholders. DoD ELAP laboratories must submit records of associated corrections taken or proposed corrective actions to their accrediting body within 30 business days of discovery.

3.2.2. Computer Security Awareness Training

Computer Security Awareness training is conducted during new employee orientation and is reviewed on an annual basis. This training covers password handling and security measures taken to ensure protection against unauthorized use of EQI computer systems. Further information concerning computer security is found in the *Laboratory Information Management System* SOP [ME00161].

3.2.3. Confidentiality Agreement

Confidentiality agreement training is conducted during new employee training. All EQI employees are bound by a confidentiality agreement not to divulge client information to other parties to protect client confidentiality, national security, and proprietary rights. See section 5.6 for further information.

3.2.4. Health & Safety / Hazardous Waste Orientation Training

All laboratory new hires are given the health & safety / hazardous waste orientation training. This training is conducted by the Health & Safety Manager or the Hazardous Waste Assistant. The training includes an overview of the *Integrated Contingency Plan* [ME0012C], evacuation and emergency preparedness, chemical hygiene, chemical safety, radiation awareness and hazardous waste management. The purpose of this training is to familiarize the new hire with EQI's health & safety and hazardous waste policies and practices.

3.2.5. QA Orientation Training

All new hires, including technical, clerical, and management personnel are given the QA orientation training. This training is conducted by the QAO or a member of the management team. This is a training session covering all sections of the QAMP. The trainer also emphasizes those sections of the QAMP that apply to the new hire's position. The purpose of this training is to familiarize the new hire with EQI's quality policies and practices.

3.2.6. General Laboratory Training

All new hires that will be working within the EQI laboratory receive general laboratory training following their New Hire Orientation Training. If a non-laboratory employee changes positions to a laboratory position, he/she also receives general laboratory training.

General laboratory training is conducted during the first few weeks after new hire orientation, and must occur before the individual is deemed qualified to perform sample preparation or analysis. This training is administered by a number of qualified EQI employees including senior analysts, group leaders, the QA department and senior management.

3.2.7. Specific Laboratory Training

Once orientation and general laboratory training are complete, specific laboratory training begins. Specific laboratory training is given to those individuals in order to impart the skills needed for most positions in the laboratory. Specific training is given for each preparation and/or analysis performed at EQI. The purpose of specific laboratory training is to ensure understanding and proficiency of all aspects of the method being performed. Demonstration of understanding and proficiency includes the completion of the following:

- Documentation indicating the review and understanding of the EQI SOP covering the items and topics relevant to the training subject.
- Successful completion of an Initial Demonstration of Capability (IDOC) to perform a given preparation and/or analysis via the independent execution of that preparation and/or analysis on four consecutive laboratory control samples (LCS; a spiked, clean matrix sample) and obtaining acceptable levels of precision and accuracy.
- The Training application in EQLIMS is used to systematically document all SOP training as well as ongoing training (section 3.3) and DOCs. The LIMS system is capable of generating a batch of IDOC samples including recoveries and is also capable of searching for LCS samples and creating a batch in order to document Continuing Demonstration of Capability (CDOCs) which is required annually.
- Further information concerning IDOCs and CDOCs is found in the *Demonstration of Capability* SOP [ME001F2].

3.3. Personnel Training (Ongoing Training)

EQI performs ongoing training for employees on a regular basis. This training includes but is not limited to QA, health and safety, SOP/Policy and departmental specific training. The trainer can be any qualified member of the EQI team. Reviewers and approvers of SOPs and policies are considered trained upon publishing of the document. If no significant changes are made to an SOP or policy then no training is necessary.

Group training is held throughout the year to cover various topics, and may be given by outside companies. Training topics are selected by the trainer, are determined as needed and may be due to changing requirements. If applicable, the trainer fills out the *Training Materials Presented Form* [ME0024P] or the *Employee Specific Training Checklist* [ME001LZ] detailing the contents of the training session. The trainees' sign the *Training Attendance Record* [ME001PJ] or the Employee Specific Training Checklist. A copy of the completed training form is filed in each employee's training folder.

The following training is performed on an annual basis: Integrated Contingency Plan [ME0012C], the QAMP, Ethics Policy [ME0012V] and Computer Security Awareness.

3.4. Quality Assurance Officer Training

The QAO must have experience with and/or training in QA/QC procedures, quality systems and auditing. As needed, the QAO will attend appropriate training events or conferences in order to keep the QAO's expertise current.

3.5. Training Files

The quality department tracks training events and retains training documentation. All laboratory training records including the New Hire Orientation Training Checklist and Demonstration of Capability records are kept in training files maintained by the Quality Assurance Associate.

4. Procurement of Laboratory Materials and Services

Procurement control of laboratory materials and services is paramount in the establishment and maintenance of data quality. Laboratory materials and services used must meet specified criteria that fulfill all quality needs and requirements if they are to be used to generate legally defensible data.

Another aspect of the establishment of legally defensible data is proper documentation and traceability, which indicates that laboratory materials or services of adequate quality were used in the production of specific data. This task is accomplished with the use of a systematic procedure that establishes guidelines for the procurement of laboratory materials and services which meet or exceed specified requirements. This procedure includes guidelines for vendor approval, sub-contract lab approval and the steps taken in order to procure laboratory materials and services.
Purchased laboratory materials generally consist of consumable supplies, equipment and instruments. Consumable supplies include items such as standards, chemicals, solvents, preservatives, and reagents. Equipment includes items such as glassware, sample containers, gloves, personal protective equipment, and test equipment. Purchased services consist primarily of calibration services for instrumentation and equipment, repair and maintenance of equipment and instrumentation and the subcontracting of analytical services.

EQI's procurement system is outlined in the Procurement of Laboratory Supplies, Services and Equipment SOP (ME0015U). The system includes procedures for vendor selection and approval, purchasing, ordering, receipt and acceptance of laboratory materials and services.

5. Documents and Records

Many of the documents and records listed in section 2.5 require a systematic and controlled approach to creation, approval, distribution, implementation and use. Others are created during the process of laboratory analysis and must be controlled, used and stored appropriately. Records requiring a systematic approach are the QAMP, SOPs, policies, forms and spreadsheets and all logbooks generated as part of the analytical process. The process for managing all records can be found in the *Document and Record Control* SOP [ME001HS]. Specific elements associated with internal document development and control is described in the *Document and Record Control* SOP [ME001HS]. EQI's document control software application, EQLIMS Media, is used to edit, review, approve and publish quality documents. The *Spreadsheet Validation* SOP [ME001IJ] describes the specific elements needed to develop and validate a spreadsheet.

5.1. Establishment, Approval, and Review of QAMP, SOPs, and Policies

5.1.1. QAMP

The EQI QAMP meets all quality systems requirements as stipulated by the NELAP, DoD DOE QSM, ISO 17025 and USEPA CLP.

5.1.2. SOPs and Policies

EQI has established and maintains a comprehensive set of SOPs and Policies that govern all laboratory activities including sample collection, laboratory receipt of samples, preparation, analysis, quality assurance, quality control, data reporting, final sample disposition and health and safety. SOPs contain method procedures as well as instrument and equipment calibration procedures and QA/QC requirements. SOPs and Policies are based upon approved United States Environmental Protection Agency (USEPA) Methods, Standard Methods for the Examination of Water and Wastewater, the American Society for Testing and Materials (ASTM) or other approved procedures with specifications indicating specific laboratory instrumentation, corrective action procedures, calibration procedures, reportable analytes, LOQs, health and safety information and etc. Policies may also be based upon regulatory documents such as the DoD DOE QSM, TNI 2009, ISO 17025, NELAC 2003, USEPA CLP, etc. Refer to the addendum for a comprehensive list of currently approved SOPs and Policies.

5.1.3. Review Frequency

The EQI QAMP and all SOPs are reviewed, at a minimum, on an annual basis (± one month) for accuracy and adequacy. Changes are approved by the signatories after a thorough review. Policies are reviewed every 3 years for accuracy and adequacy. SOPs and policies must also be revised whenever procedural method changes or changes to regulations occur. The review is completed to ensure that only current and correct methodology and regulatory guidance is employed by the laboratory and that the SOPs and policies are followed as written.

For the purposes of the EPA CLP Statement of Work (SOW), the QAMP is revised within 14 days anytime any of the conditions listed below exist:

- USEPA modifies the technical requirements of the SOW or the contract;
- USEPA notifies EQI of deficiencies in the QAP document;
- USEPA notifies EQI of deficiencies resulting from USEPA’ s review of EQI’s performance;
- EQI’s organization, personnel, facility, equipment, policy, or procedures change;
- EQI identifies deficiencies resulting from the internal review of changes in their organization, personnel, facility, equipment, policy, or procedures.

In addition, for the EPA CLP, changes made to the QAMP that affect policy, reporting, documentation, and quality are clearly marked in the document, the pages dated as to when the changes were implemented, and the amended copies sent to the Regional CLP PO and QATS.

SOPs or policies for processes that have any sort of impact on CLP samples will be amended anytime any of the situations below arise:

- USEPA modifies the technical requirements of the SOW or the contract;
- USEPA notifies the Contractor of deficiencies in their SOP documentation;
- USEPA notifies the Contractor of deficiencies resulting from USEPA‘s review of the Contractor’s performance.

CLP SOPs and policies will be amended or new SOPs and policies must be written within 14 days of when the circumstances listed above result in a discrepancy between what was previously described in the SOPs and policies and what is presently occurring at EQI. All changes in the SOPs and policies are clearly marked and a copy is to be sent to the Regional CLP PO and QATS. When new or revised SOPs and policies are prepared, the reason(s) for the change are documented and the new or amended SOPs and policies are maintained on-file at EQI.

5.2. Establishment, Approval, and Review of Forms and Spreadsheets

5.2.1. Establishment and Approval

EQI utilizes forms for logbook creation and spreadsheets for many of the analytical activities and QA processes performed. Forms and spreadsheets are based upon the QAMP, SOPs, policies, parent methods and other regulatory documents.

5.2.2. Review Frequency

Forms and spreadsheets are reviewed every 5 years for accuracy and adequacy. Forms and spreadsheets must also be revised whenever procedural method changes or changes to regulations occur. The review is completed to ensure that only current and correct methodology and regulatory guidance is employed by the laboratory and that the forms and spreadsheets function as intended.

5.3. Control and Distribution of QAMP, SOPs, Policies, Forms, and Spreadsheets

The QAMP and each SOP, policy, form and spreadsheet is assigned a unique tracking number as documented in our *Document and Record Control* SOP [ME001HX]. This number is used to track the documents from creation through archival. Each document contains a header on every page which contains specific information as per our *Document and Record Control* SOP [ME001HX]. A master list of all SOPs, policies, forms and spreadsheets is maintained by QA.

Certain departments may receive controlled paper copies of these documents. The distribution of all paper copies is recorded in a distribution log to ensure that the current copy is being used. For employees with computer access, current documents can be viewed via EQLIMS Media.

5.4. Analytical Logbooks

An inventory system is maintained for all analytical logbooks. Each logbook is uniquely identified and controlled using a non-removable numbered tag. The logbook inventory database is maintained by QA. Analytical logbooks are kept for a period of not less than five (5) years following completion. Analytical logbooks can be kept for an extended period if a project specific retention period exceeds this requirement. The procedure for generation, control and use of logbooks is found in the *Logbook and Data* Recording SOP [ME0012T].

5.5. Quality and Project Records Management

5.5.1. Analytical Data & LIMS Backup

All hard copy and/or electronic data is retained for a period of at least five (5) years after the year of reporting. All analytical data from LIMS is stored electronically on the server. All data is backed up daily on an on-site backup server and is replicated to remote cloud servers. To ensure ongoing computer operation, maintain data storage capability, and to allow time to shut down the system in an orderly manner, the LIMS server is protected by the facility-wide UPS. Refer to the *LIMs* SOP [ME00161] for additional information regarding the archival of electronic data.

5.5.2. Supporting Data

All hard copy supporting data including that previously listed under Quality Records and Project Records is sorted by type or project and filed in storage boxes. The storage boxes are kept at an off-site storage facility for a period no less than five (5) years after generation, or three (3) years for CLP Contract data after submission of the reconciled complete SDG file (CSF), unless an extended period is requested. Additional information concerning hard copy data storage can be found in the *Document and Record Control* SOP [ME001HS].. All electronic supporting data is stored as stated in section 5.5.1.

5.5.3. Data Maintenance Plan

In the event that EQI transfers ownership of the business, or goes out of business, all clients for whom analytical work has been performed for the past 5 years (records retention period) would be contacted to ascertain the desired disposition of their records. Environmental Quantitation Incorporated will ensure the desired disposition is affected.

5.6. Data Confidentiality

EQI considers all project information and generated data as confidential and the property of the client. Client specific information is released to third parties only after consultation with and written approval from the client. If so directed by courts of law or regulatory agencies, EQI will provide required project information and data and will notify the affected client as to the requesting body and the information surrendered.

In addition, all EQI employees are required to sign a *Confidentiality Agreement* [ME0022R] not to divulge client information to other parties to protect client confidentiality, national security, and proprietary rights.

6. Computer Hardware and Software

EQI utilizes computers in a variety of ways including:

- In-house designed and programmed Laboratory Information Management System (LIMS & EQLIMS).

- The capture and processing of data from instrumentation.
- The transfer of data from instrumentation to the LIMS.
- Spreadsheet databases for storage and calculation of data.
- Quality Assurance functions such as document control and training.

The procedures for ensuring and protecting the integrity of data processed in each of these computer systems is discussed below and is based upon the EPA document "2185 – Good Automated Laboratory Practices". The *LIMS* SOP [ME00161] contains more specific information related to responsibilities, personnel, quality assurance, LIMS raw data, software, security, hardware, testing and record retention. The *LIMS User Guide* SOP [ME001IS] describes the basic steps for using LIMS.

6.1. Laboratory Information Management System (LIMS / EQLIMS)

The legacy LIMS utilizes a state-of-the-art, open architecture, object oriented relational database developed by the EQI information technology department. The LIMS has been designed and developed to address the current and future needs of the operation's data handling and reporting requirements. LIMS utilizes Microsoft server products which ensures compatibility, stability, and security through standardization and integration.

EQLIMS is a LIMS designed and developed to address the current and future needs of the operation's data handling and reporting requirements written in C#.net. C#.net is a multi-paradigm programming language encompassing strong typing, imperative, declarative, functional, generic, object-oriented (class-based), and component-oriented programming. The code leverages the .NET Framework Class Library (FCL). Microsoft SQL Server, a relational database management system, is used for storing and retrieving data as requested by EQLIMS.

The system is designed so that each module is fully independent of the other modules running within the current session. This allows for proper testing of new modules in a real time environment without compromising existing modules or data, as well as allowing the system security to operate on a module-by-module basis, preventing unauthorized access to critical portions of the system.

The LIMS is based on the following high-level functions: Quoting, Sample Receiving, Sample Management, Electronic Data Handling and Reporting. Currently EQLIMS is used to support Quality Assurance (Document Control, CAPA and Training modules).

6.1.1. Quoting

The LIMS Quoting system allows our project managers to do all client project quoting electronically. This module obtains the client code from the user to provide automatic custom pricing, turnaround time requirements, analytical methodology, specific compound requirements, LOQs, deliverable requirements, and sample scheduling. This captures the project specifications, which forms the front-end module for Sample Receiving.

6.1.2. Sample Receiving

The Sample Receiving module provides an efficient and reliable method of accurately entering sample parameters into the LIMS. Using the appropriate quote number, the Sample Receiving module automatically obtains the client project specifications. The client's sample identification, the date and time of collection, the number and type of containers received, and other sample specific information are entered into this module. A unique laboratory ID is assigned and holding time and turnaround time management systems are activated.

6.1.3. Sample Management

The LIMS employs a Sample Management module that tracks samples throughout the laboratory (Internal Chain-of-Custody or ICOC), from sample receipt to sample disposal. This module allows the user to rapidly locate samples within the laboratory. This module requires all users to scan each sample's barcode each time the sample moves from one location to another or from one analyst to another. This module also handles sample batching. This procedure allows the user to group like samples together for analysis. This group (Sample Batch) stores the QC information for all samples within that batch.

6.1.4. Electronic Data Handling

The LIMS retrieves data from many data sources throughout the laboratory. Each data source has a custom LIMS batching module for data transfer designed for that particular analysis method. Each of these transfer modules operates independently of each other, yet all of them transfer the data to LIMS in a standard format. This allows the quality control routines to be standardized for all analyses, while providing the flexibility to run specialized routines against the raw data before transfer. The data is transferred to LIMS in preliminary form. Before the data can be reported as final, an analytical group leader or senior level analyst reviews the information for final release. This module also handles manual data entry for methods that have no electronic data capturing means. Data that is manually entered from logbooks or bench sheets is entered twice. If the second entry matches the first entry, the result is final and the next sample result can be entered. If the second entry does not match the first entry, both entries must be repeated until they match. Data is not rounded or adjusted for dry weight prior to manual data entry.

6.1.5. Non-Conformance Memo (NCM)

The LIMS includes an application in which analysts can efficiently create nonconformance memos. The application allows the analyst to choose the specific batch and samples associated with the nonconformance, to choose the type of nonconformance and to add any additional information required. The NCM application forwards the nonconformance via email to the appropriate group leader, project manager, QA and the Operations Director for review. See section 10.1 for further information outlining the documentation of non-conformances.

6.1.6. Data Reporting

The LIMS utilizes a Delphi reporting engine for reporting. This allows for unlimited report formats. LIMS also has electronic reporting capabilities allowing our data to be delivered or transmitted to the client in all of the popular industry standard formats. LIMS also publishes enrolled client’s data to our secure web site, allowing our clients to review the data as soon as it becomes available. The EQLIMS Client Report Management application is a client data repository module which is used for editing report narratives, storage and retrieval of reports.

6.1.7. Document Control

The EQLIMS Document Control application allows for complete electronic document management. It ensures that all quality documents are reviewed and approved and that changes are restricted to authorized personnel and tracked for future referral. Quality documents are securely stored to ensure only authorized access and protection against disaster. EQLIMS Document Control is able to maintain the current document’s availability, while simultaneously managing review and changes that will result in the next revision of that same document.

6.1.8. Corrective and Preventative Actions (CAPA)

EQLIMS is also used to initiate, write, review and approve corrective actions and preventive actions (CAPA) via the CAPA application. The CAPA application has many of the same features as the Document Control application but for the specific purpose of providing an electronic platform for the CAPA process.

6.1.9. Training

EQLIMS Training is an application which allows for automated management of all training tasks, from routing, tracking and maintaining records. This training system offers the capability to provide online exams, sign off for group trainings, and creation of training matrices. The types of training included in this module encompasses SOPs, Policies, Demonstration of Capability, and onsite / offsite training.

6.1.10. Continuing Demonstrations of Capability (CDOC)

The LIMS CDOC application allows for the automatic retrieval of previously analyzed standards to be used in generating the necessary CDOC documentation required annually for all analysts.

6.2. Target, AIM, and MARRS

6.2.1. Target Thru-Put

Target Thru-Put is a chromatographic data processing and reporting software package available on Windows and HP-UX. Target reads raw data files and processed results from chromatographic systems, and provides these tools for GC, LC, MS, and MS/MS techniques. Raw data from EQI's GC and GC/MS instruments are processed using Target Thru-Put before being transferred to an analysis batch in LIMS.

6.2.2. AIM

AIM is a reporting software which works in tandem with Target Thru-Put. AIM is used to generate all chromatographs, quantitation reports and calibration reports. Analysts use Target Thru-Put in conjunction with the reports generated by AIM to review data.

6.2.3. MARRS

The Metals Analytical Review & Reporting System (MARRS) provides a seamless, universal connectivity platform that assimilates and summarizes dynamic analytical instrument data into comprehensive analytical information. Essentially, MARRS bridges the functionality gap between instrument raw data and information delivery. MARRS software integrates inorganic instrumentation to a single point for data handling, automates quality assurance and then assimilates and transfers the data to LIMS. Raw data from ICP-AES, ICP-MS, and mercury instruments are reviewed using MARRS software.

6.3. Industry Standard Software

Industry standard software programs are defined as those which are purchased and widely used without modification to the program itself. This type of software is normally purchased previously tested and verified by the manufacturer. However, once purchased and installed, the program is initially verified for use by using test problems (or reference materials for instrument software) with known solutions (known values) to demonstrate that the program is operational for the desired application. This may be performed by the manufacturer onsite in the laboratory. New instrument software is verified in one of three ways: by analyzing a standard curve, by performing a method detection limit or by performing a demonstration of capability each of which must meet the requirements of the method. All purchased software must be used in accordance with the terms of its software license. Any use of software contrary to its license terms is expressly prohibited by EQI. Wherever audit trail functionality is available as a part of instrumentation software, this function is enabled.

Whenever a program is changed, the change is evaluated to determine if revalidation is necessary. If the software has had features added, test problems or reference materials should be run to demonstrate that the software functions as expected. If software revision changes the basic operation of the program, complete revalidation of the program may be required. The technical director and appropriate group leader are responsible for the generation of the verification data for instrument software as outlined above for new software. Quality assurance maintains the necessary documentation.

Spreadsheets used to acquire and process client data must be documented and re-verified when changes that may affect data quality are made. A test problem, is processed and the results compared to demonstrate that performance of the software is unchanged. Spreadsheets are controlled through locking of cells and assigning passwords to every sheet. They are verified as described in the *Spreadsheet Validation* SOP [ME001IJ].

6.4. Hardware

The LIMS is a client/server-based system, utilizing industry standard SQL for data manipulation. The LIMS currently runs on a Windows 2008 server, with Microsoft SQL Server 2014 as the database. The LIMS application and database servers are virtual servers and are being hosted on Dual PowerEdge R620 servers with Intel Xeon E5-2630 2.3 GHz processor, 96 GB memory, 2 x 300 GB 6 Gbps SAS Hot-plug hard drives. The physical storage box is an EMC VNXE 3200, ISCSI, 25 900 GB hot- plug hard drives.

6.5. Training

All LIMS users are trained on the menu option/modules that they will be using prior to being given access to that menu option. Training is provided by an experienced person in that module. Because LIMS is windows based and intuitive, training typically will be hands on and relatively short.

All other software users are trained either when new software is installed by the manufacturer or by an experienced software user as a part of job training.

7. Project Planning and Control

Quality analytical data generation and reporting is the end product of a complex process dependent upon detailed planning and control efforts. EQI expends extraordinary effort on “project management” from the initial client inquiry, through delivery of the final analytical data, to follow up inquiries after the data is delivered. The process of project management is shown in Figure 7.0-1.

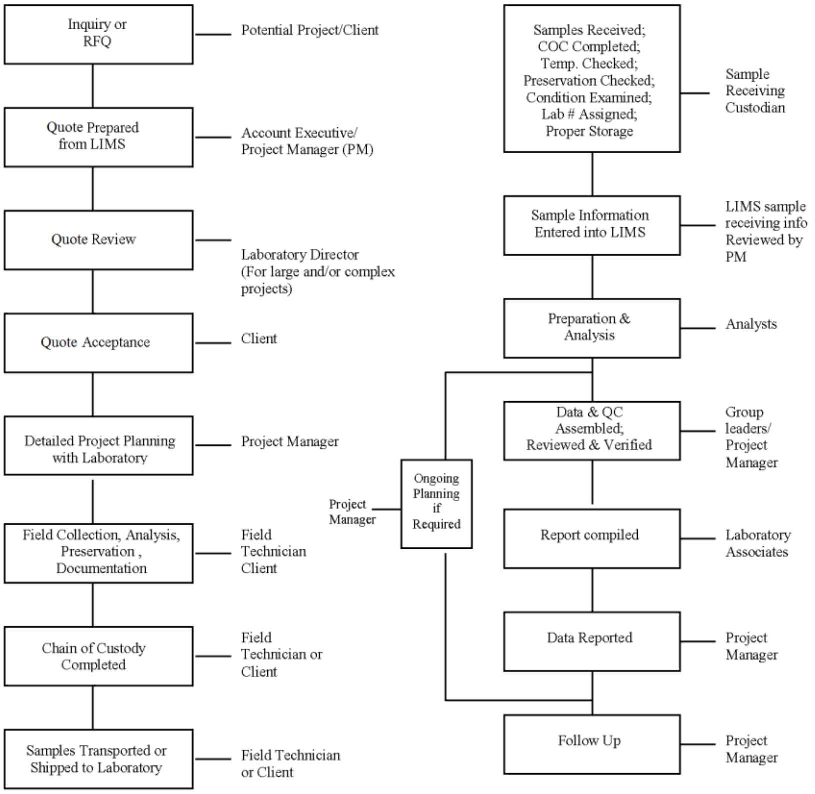


Figure 7.0-1: Process of Project Management

7.1. Assignment of a Project Manager

Once a proposal has been accepted, the client is assigned a project manager to control the project from cradle to grave. The project manager is normally the individual who created the quote.

7.2. Quote/Proposal Generation

Project planning begins at the initial client inquiry. This inquiry may range from a verbal request to a very formal and detailed request for quotation. Regardless of the format of the inquiry, a quote / proposal is generated by the quote module in LIMS. The quote module takes into account, at minimum, the following:

- Analyses required
- Regulatory program and certifications required
- Methods required for both preparation and analysis
- Analyses and compounds required
- LOQs required
- “J-values” needed
- Project schedule-duration and time frame
- Deliverable format-EDD, paper, special
- Deliverable requirements-Level 2, 3, 4, other
- Report contact
- Invoicing information
- Comments or special client needs

Most quotes/proposals are generated by either the Project Manager or the Laboratory Director. Very large or complex proposals or ones involving lengthy contractual language may be prepared by the Laboratory Director.

7.3. Quote/Proposal Review

All large quotes are reviewed by the Laboratory Director who determines the impact each project will have on the laboratory. It is at this review step that an assessment is made to determine the laboratory’s capacity to perform the quoted work from a standpoint of personnel, materials, analytical instrumentation, etc.

For large or complex projects, this assessment is made with the concurrence of the technical director and laboratory operations. Only after the proposal is thoroughly discussed and deemed within the capacity and technical capability of the laboratory is a quotation submitted to the potential client.

7.4. Detailed Project Planning

The most important aspect of project management is the communication of specific client needs and requirements to the laboratory organization. Methods utilized in sample analyses are usually dictated by client and/or permit requirement. Where no method is indicated by the client or permit, the most appropriate method based on the program area (such as drinking water, wastewater, solid and hazardous waste) is selected.
The applicable QC requirements as outlined in the QAMP are dictated by the program area chosen in LIMS. A comprehensive list of the methods routinely performed is detailed in the addendum to this document.

For large or complex projects; those requiring elevated levels of deliverables; those requiring quick turnaround of analysis and data; and those where experience indicates there may be potential analytical problems due to source / sample matrix / etc.; a project review meeting is held by the project manager with the analysts, group leaders, and data package specialists if needed. Project details are discussed and understanding of project particulars is gained. This process is timed to occur before samples arrive at the facility, but not so soon as to lose impact and knowledge gained.

For projects that continue over time, the project manager may conduct on going or refresher meeting to discuss progress and assess that all requirements are being met. The project manager takes the lead role in communicating and affecting changes, when and where needed.

7.5. Contingency Planning

Any effective organization must plan for the "unexpected", and be able to react in an expeditious manner. The EQI management team constantly reviews the following to ensure uninterrupted and successful project completion.

7.5.1. Equipment Capacity / Redundant Instrumentation

EQI reviews work load and equipment capacity on an ongoing basis to determine instrument utilization time. Instruments are not normally utilized at 100% of their theoretical capacity, allowing time for both planned and unplanned maintenance.

EQI also has redundant equipment, in both the inorganic metals analysis and the organic analysis areas, to permit on going processing/analysis even if an instrument is out of service for any prolonged length of time.

In circumstances where a catastrophic outage or instrument failure occurs, customers are contacted promptly to determine if alternate methodology may be appropriate or if out sourcing of analysis is desired.

7.5.2. Staffing

As is true with equipment capacity, the EQI laboratory staffing level is closely watched to ensure that the proper number of qualified employees are available to perform the work on hand and the work planned for the future.

7.5.3. Subcontract Laboratories

Subcontract laboratories are only utilized if the laboratory is not capable of or certified for a required analysis as part of a complex project (i.e. dioxins/furans, fixed gases, etc.), or if an instrument is inoperable for any extended length of time jeopardizing holding times or client schedules.

For parameters that are regulated or require state and/or federal certification, subcontract laboratories are required to maintain such certification. In any event, we do not subcontract analyses without the client's approval. The subcontract laboratory must be on the approved laboratory list as described in the *Procurement of Laboratory Supplies, Services and Equipment* SOP [ME0015U].

7.5.4. System Safeguard during Power Failure

All instrument and computer critical circuits within the laboratory are protected with an uninterruptible power supply (UPS) system. Therefore, the LIMS server and all workstations in the building are protected by this system. The system consists of a Mitsubishi Electric 9700 Series 225 kVA UPS is equipped with two battery packs. The UPS ensures ongoing computer operation to maintain data storage capability, and time to shut down all computer systems in an orderly manner if required. Additionally, it filters the local current to supply conditioned power to all instrumentation and computer systems. Refer to the *LIMS* SOP [ME00161] regarding analytical data and LIMS backup procedures.

8. EQI Operations

8.1. Physical Facility

The analytical laboratory and corporate offices of EQI are located in West Columbia, South Carolina at 106 Vantage Point Drive which is near the intersection of Interstates 26 and 77 in the Overlook Business Park. EQI's client service centers are located in the Raleigh, North Carolina, Charlotte, North Carolina, Greenville, South Carolina, and Charleston, South Carolina areas.

The 15,000 square foot building was designed and constructed in 1992, and offers many state-of-the-art technological features.
The building's unique computer controlled closed system (chiller/boiler) seven-module cooling and heating system maintains negative, atmospheric, or positive pressure in seven general work areas. This system has been balanced with the laboratory's 14 fume hoods and outside air to provide the appropriate pressure to each work area.

The facility includes seven different laboratory areas: Sample Receiving, Organic Extractions, Inorganic Non-metals / Microbiology, Inorganic Metals, Semi-volatiles, Volatiles and Chemical Storage / Waste Staging. A summary of each area is provided in section 8.2.

Other facility features include data review/processing areas separate from the preparation and analysis laboratories, an efficient sample receiving area, three walk-in coolers for proper sample storage, and a centralized and secure LIMS server area.

An extremely important part of the operation of the EQI laboratories is the assurance and maintenance of a safe and clean facility. This extends to proper lighting, ventilation, fume control, temperature control, and a supply of stable power. We maintain contract services for general building cleaning as well as equipment and instrument repair. Our analysts are also trained to repair the equipment they operate.

The Laboratory Director and the Technical Director, working together with group leaders and analysts have the responsibility to ensure that samples are stored to eliminate, as much as possible, the chance of contamination, that work areas are equipped with adequate counter, hood, and operational space, and that work areas are free from contamination which might impact analysis.

A current layout of the facility is included in Figure 8.1-1.

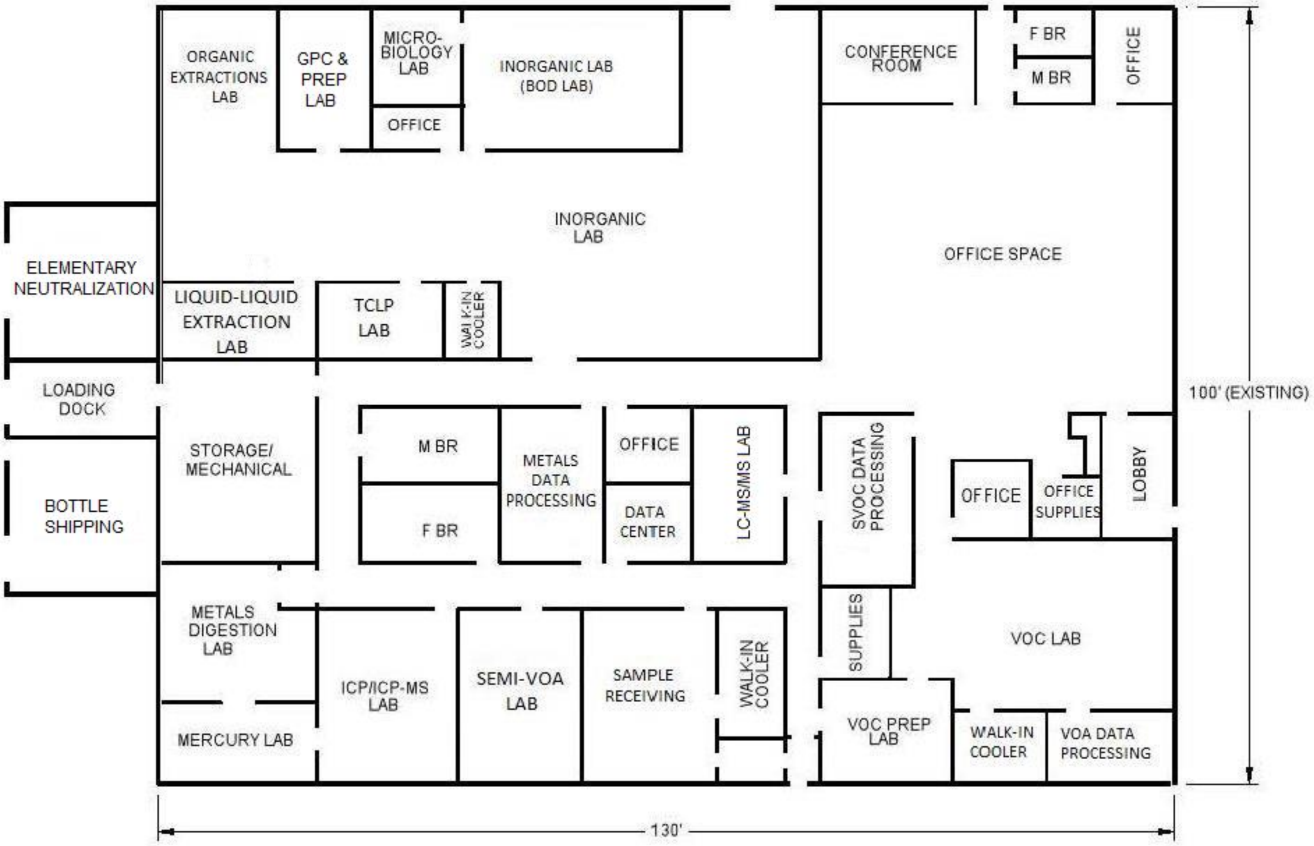


Figure 8.1-1: EQI Facility Layout

8.2. Laboratory Areas

8.2.1. Sample Receiving

All samples received at the laboratory originate in the sample receiving department. Samples received are inspected for proper preservation, physical problems, etc., and are bar coded for sample tracking and disposition. After samples are received and inspected, they are entered into LIMS as discussed in Section 8.4. All samples except volatiles are stored in a large walk-in cooler in the sample receiving area. Volatile samples are stored in either the volatiles walk-in cooler or in various matrix segregated coolers in the volatiles laboratory.

All samples are released to analysts via bar code scanning and internal chain of custody (ICOC) procedures. A fume hood is used in sample receiving for ventilation while opening sample coolers as well as for samples that require ventilation.

8.2.2. Organic Extractions

The organic extractions area operates under negative pressure to prevent the migration of airborne contamination into other areas. Organic extractions and leaching procedures are completed in four separate but contiguous rooms each equipped with fume hoods and airflow technology designed to quickly remove solvent fumes. The four areas are as follows:

- Microwave Reaction System & TCLP/SPLP Room - This room is dedicated to microwave extraction and leaching procedures. The room includes one Microwave Extraction System for organic soil extractions and two independent 12-station rotators that are used to perform leaching procedures. This room is maintained at 23 +/- 2 °C.

- Continuous Liquid-Liquid Extractions (CLLE) Room **-** This is a dedicated room equipped to perform 76 separate CLLE simultaneously. A point of use solvent delivery system provides methylene chloride dispensing. This system eliminates the disposal of over 700 glass bottles and packaging materials per year, reduces labor costs, and significantly reduces our analysts' exposure to methylene chloride vapors. This room is maintained on a negative air pressure basis, preventing solvent migration to other laboratory areas.

- Main Extraction Area – This area is equipped with five 8-foot high efficiency fume hoods.

- Each fume hood is utilized for a dedicated process as follows: dual-horn sonicator used for soil sample extraction, TurboVap concentrators, water bath and concentration station, and separatory funnel extraction of aqueous samples. Four muffle furnaces are used to decontaminate glassware after each use. This area is maintained on a negative air pressure basis, preventing solvent migration to other laboratory areas.

- GPC Area – This area contains two gel permeation chromatography (GPC) instruments and a 4-foot fume hood.

8.2.3. Volatiles Laboratory

The volatile organic analysis area operates under positive pressure to prevent the influx of airborne contamination. This spacious laboratory is located on the opposite corner of the facility from the extractions laboratory. Volatile analysis is conducted in a spacious room located in the opposite corner of the facility from the organic extraction area (also in order to prevent the influx of airborne contamination). A walk-in cooler is located inside this laboratory is dedicated to the storage of volatile aqueous samples. The temperature of the walk-in cooler is monitored and if found out of spec, management is contacted automatically. Major instrumentation includes eight GC/MS instruments with purge & trap concentrators and various auto-samplers, a dual GC/FID system configured for dissolved gases and Direct Aqueous Injection (DAI), and one GC/PID/FID system with a purge & trap concentrator and autosampler. Additionally, GC/PID/FID interfaced with a headspace analyzer is used for screening samples prior to analysis as deemed necessary. Trip blanks, field QC, and samples with known historical results may not be screened.

The volatile organic analysis laboratory has a dedicated computer-controlled heating/cooling system. Room pressure is maintained positive at all times to prevent the influx of airborne contamination. The GC and GC/MS instrumentation, purge and trap concentrators, and auto-samplers are supplied with high-purity helium using a stainless-steel gas delivery system equipped with an automatic switching manifold. The helium cylinders reside in a secure storage bay located near the loading dock in the back of the facility. This system ensures an uninterrupted supply of reagent grade helium and eliminates the need for analysts to transport cylinders. Hydrogen and zero-air generators are located in this laboratory supplying an uninterrupted source of high-purity gases to the instruments.

Additionally, all analytical instruments are networked to the LIMS via Target software, permitting uploading of data into the LIMS for review and report preparation.

8.2.4. Semi-Volatiles Laboratory

The semi-volatile organics analysis area operates under negative pressure. A hydrogen and zero-air generator supply uninterrupted high purity gases to the GCs. Semi-volatile analysis, consisting of BNAs, pesticides, PCB, herbicides, explosives, TPH-DRO, EDB/DBCP analysis is conducted in this laboratory. The semi-volatile laboratory contains four GC/MS instruments with auto-samplers, five dual GC/ECD instruments and two dual GC/FID instruments.

The semi-volatile area has a dedicated computer-controlled heating/cooling system. This room is maintained on a negative air pressure basis, preventing solvent migration to other laboratory areas. The GC/MS instruments are supplied with high-purity helium using a stainless-steel gas delivery system equipped with an automatic switching manifold. The helium cylinders reside in a secure storage bay located near the loading dock in the back of the facility. This system ensures an uninterrupted supply of purified helium and eliminates the need for analysts to transport cylinders. Hydrogen and zero-air generators supply uninterrupted high purity gases to the GCs. A micro-bulk liquid nitrogen tank provides an uninterrupted supply of nitrogen to the appropriate instrumentation.

Additionally, all analytical instruments are networked to the LIMS via Target software, permitting uploading of data to the LIMS for review and report preparation.

8.2.5. HPLC & LC/MS/MS Laboratory

This laboratory has a dedicated eight-foot fume hood for performing perfluoroalkyl substance and polyfluoroalkyl substance (PFAS) sample preparation. A micro-bulk liquid nitrogen tank provides an uninterrupted supply of nitrogen to the HPLC-MS/MS instrument. Explosive and PFAS analysis is conducted in this laboratory. The laboratory contains two HPLC instruments (VWD and DAD detectors) and one HPLC-MS/MS instrument. The laboratory has a dedicated computer-controlled heating and cooling system. The system maintains atmospheric to negative pressures depending on the fume hood use.

8.2.6. Inorganic Metals Preparation & Instrumentation Laboratory

The metals preparation and instrumentation laboratory consist of three rooms, one for sample digestion, digestate staging and storage, the second for low-level mercury and mercury analysis, and the third for ICP and ICP-MS analyses.

The metals preparation area is equipped with polypropylene casework, two eight-foot polypropylene hoods, one six-foot polypropylene hood for low level mercury, acid-resistant counter tops and sink, and vented sample storage cabinets. The entire exhaust pathway for the polypropylene hoods is PVC including the stacks. Because digestions are performed in a plastic, completely metals-free environment, contamination is minimized. Digestions are performed in hot blocks using disposable digestion tubes. The digestion room has a dedicated computer-controlled heating/cooling system that maintains a negative laboratory pressure to ensure acid fumes do not migrate into other laboratory areas. Also, the digestion room has a clean room ceiling.

The metals instrumentation laboratories include two Thermo Scientific Inductively Coupled Plasma (ICP) trace instruments (iCAP 6500, iCAP 7600), two Thermo Scientific ICP-MS instruments (X Series 2, iCAP Q), a Teledyne Technologies automated Quick Trace M8000 Mercury Analyzer (CVAF), and two Leeman automated CVAA mercury analyzers. The instrument rooms have a dedicated computer-controlled heating/cooling system. The pressure of both rooms is maintained positive at all times to prevent the influx of acid fumes and reduce airborne particulate contamination. A 900-gallon bulk liquid argon tank provides an uninterrupted supply of argon to all the appropriate instrumentation. The metals analysis labs have clean room ceilings.

8.2.7. Inorganic Non-Metals and Microbiology Laboratory

The inorganic non-metals and microbiology laboratory consist of four contiguous rooms. This laboratory is equipped with three fume hoods, multiple faucets providing tap and de-ionized water, multiple sinks, a walk-in sample cooler, and multiple LIMS workstations. Major instrumentation includes two Aquakem 200 discrete analyzers, three Dionex / Thermo Scientific ion chromatography (IC) systems, an autotitrator, one OI TOC analyzer, two OI auto chemistry analyzers, one Lachat auto analyzer, two analytical balances, one Hach spectrophotometer, several incubators, an autoclave, four midi-distillation blocks, three cyanide midi-digestion blocks, two cyanide micro- distillation blocks, and various other instruments and other scientific equipment.

The inorganic non-metals laboratory has a dedicated computer-controlled heating and cooling system. The system maintains atmospheric to negative pressures depending on the fume hood use.

8.2.8. Waste Accumulation and Chemical Storage

EQI is classified as a Large Quantity Generator (LQG) of hazardous waste as defined under 40 CFR Part 261. As a LQG, EQI follows all generation, management, security, emergency preparedness, and pre-transport requirements as set required by 40 CFR Part 262. Additionally, EQI ensures compliance with all state and local requirements administered by the South Carolina Department of Health and Environmental Control (SC DHEC).

A 600 square foot building, detached from the main building, is utilized as a central accumulation area. Hazardous wastes may be staged and accumulated in this area for up to 90 days prior to pick-up by a licensed waste transporter. EQI also utilizes satellite accumulation areas, located throughout the laboratory, to accumulate wastes at the point of generation. The *Hazardous and Non-Hazardous Waste Management Plan* [ME0012A] includes specific information regarding EQI's waste management practices and policies.

To maintain customer confidentiality, all sample container labels are rendered illegible prior to container disposal. These procedures are outlined in the *Destruction and Disposal of Empty Sample Containers* SOP [ME001H7].

Bulk chemicals are stored in appropriately labeled storage or safety cabinets located throughout laboratory areas. Overflow solvent storage is located in the loading dock area. If chemicals are received when all cabinets are full, bottles are kept in the packaged boxes they were received in until space becomes available. Chemical storage policies are located in the *Comprehensive Chemical Hygiene, Safety, and Hazard Communication Plan* [ME0012D].

8.3. Equipment and Services

8.3.1. Equipment Control

All major equipment and instruments are assigned a unique identifying number and are tracked via the *Major Operational Equipment List* [ME001PM] which is maintained by QA. The Major Operational Equipment List can be found in the addendum to this document. This list establishes a baseline of our operational capability.

8.3.2. Equipment Maintenance

The maintenance of the operational equipment and instruments EQI employs is performed through a combination of contract maintenance services and the skills of our well-trained analytical employees. Preventative maintenance as well as most major repair occurs on site. Frequency of maintenance and the types of maintenance performed is determined by both the manufacturer's recommendations and professional experience. The Group Leader evaluates if the problem with the subject equipment may have affected previously analyzed samples. If such a problem is identified, the Group Leader must report this to the technical director for further action. A passing calibration is performed post repair/maintenance as required and no samples are analyzed until such a calibration is generated. The Group Leader is responsible for ensuring that regular maintenance is performed in a timely manner. Maintenance logbooks are utilized to record such maintenance as well as repairs. Maintenance performed on support equipment is documented in the *Support Equipment Repair and Maintenance Log* [ME001PC].

8.3.3. Deionized Water System

Many analyses require the use of high purity water. EQI employs a series of deionized (DI) water tanks to purify the incoming water to ASTM Type I specifications for use by the laboratory. The resistivity of the water is read on a daily basis via an in-line resistivity meter.

The resistivity is also constantly monitored by an indicator light, which is located on the first resin tank. When the light changes color, this indicates that the system needs to be serviced. In order to further eliminate problem volatile organic contaminants, the in-house DI water is purified via an activated carbon filter and ultra-filtration at the point of use in the Volatiles laboratory. This water is used for the preparation of standards, blanks, and dilutions associated with volatile organic analysis. Lastly, the DI water is tested on a regular basis for TOC, metals, volatile organic compounds, ammonia, TRC and HPC.

EQI also provides evidence of contaminant free water through the use of method and instrument blanks for all analytical methods. The blank data is stored with the sample raw data as QC.

The *Deionized Water System and Storage Blank Testing* SOP [ME0012S] contains more detailed information concerning EQI's in-house DIW.

8.3.4. Gases and Solvents

In applications where instrumentation is not supplied gas from an in-house generator, only high-purity grade gases from approved suppliers are utilized. These gases are typically furthered purified using appropriate in-house purification systems, which remove moisture, oxygen, hydrocarbons, and other contaminants.

Nitrogen and Argon gas are piped into the appropriate laboratory from outside bulk tanks. Helium gas is delivered in cylinders which are stored accessible to the appropriate instruments within the laboratory. Hydrogen and zero-air generators supply uninterrupted high purity gases to the appropriate instruments.

Solvents are of appropriate grade for the application (at least ACS grade up to high-purity grade) and are purchased from approved suppliers. Methylene chloride is utilized as a solvent in the extractions lab and is piped in from outside tanks. All other solvents are purchased in smaller amounts and stored in proper enclosures meeting code requirements.

8.3.5. Glassware Cleaning

All vessels or containers used in analytical or preparation procedures are purchased and certified clean if disposable or washed in accordance with the *Glassware Washing* SOP [ME001IV] to ensure no contaminants are introduced into the process.

8.3.6. Chemical Storage

Chemicals are purchased from approved suppliers and inventoried in minimum amounts to prevent waste due to non-usage. All chemicals are inventoried on a monthly basis for shelf life and those approaching expiration are properly disposed of. Acids and bases are stored separately in marked cabinets. Flammable solvents are stored in proper enclosures meeting code requirements.

8.3.7. Security and Loss Control

The laboratory has a number of security features to prevent unauthorized access or loss of property.

- The entire sample receiving area and all analytical areas of the laboratory are secured 24 hours a day, every day, with a secure keypad key fob entry system.
- The entry can only be accessed using an electronic key fob system during business and non-business hours.
- During business hours, the front entry is accessible to the public. Beyond the front entry is a fully enclosed lobby. Entry into the interior of the building from the lobby can only be accessed using an electronic key fob system during business and non-business hours.
- After hours, the building is secured by barrier alarms and motion detectors connected to a central, off-site security organization.
- The local police department makes several inspections of the building perimeter each night.
- Hard copy records are securely stored off-site for a period of no less than five years.
- Smoke detection devices are installed in all seven heating and cooling systems and connected to a central off-site security organization.

- Bulk storage of chemicals and accumulation of waste is separate from the main laboratory building preventing loss or downtime if a fire or a spill should occur.
- Adequate fire extinguisher and coverage is maintained.

8.4. Sample Processing

The sample processing operation includes the following:

- Sample collection supplies
- Field collection operation
- Laboratory sample handling process

8.4.1. Sample Collection Supplies

8.4.1.1. Sample Containers

Control of the quality of laboratory analyses begins with the selection of the proper sampling container and preservative for the sample to be collected. EQI supplies new pre-cleaned, pre-labeled, certified and traceable, pre-preserved sample containers for all sampling events. Additional field quality control sample materials and supplies are included as required. The documentation certifying container cleanliness is available as supplied by the container vendor. Proper sample containers by analysis type are listed in the addendum to this document.

8.4.1.2. Sample Preservation

The stability of most analytes decreases as a function of time. Sample preservation aids in stabilizing samples, allowing for adequate analysis time in the laboratory.

Sample preservation is normally achieved by adding a chemical stabilizer and/or through a physical means such as lowering the temperature of the sample. EQI provides chemically pre-preserved sample containers for certain analyses to all clients. Analyses that require refrigeration require ice. Proper sample preservatives by analyte are listed in the addendum to this document.

8.4.1.3. Shipping Containers

Shipping containers are sealed enclosures in which sample containers are securely stored when in transit from the collection site to the laboratory. The most prevalent type of shipping container used is an insulated cooler which is durable, resists crushing and provides a measure of temperature insulation. EQI supplies shipping containers of various sizes and in sufficient numbers in order to allow samples to be packed in an upright position. Bubble wrap packing material is also supplied in order to provide shock absorbency so as to prevent sample container breakage during transit. In addition, absorbent padding is used when sending bottles that contain preservatives. All EQI coolers are cleaned to prevent contamination before they are supplied to customers.

During a collection operation, the sample collector must ensure that the cooler is clean and that samples are placed upright in the cooler with adequate shock protection. The samples must be packed with adequate ice to allow a laboratory receipt temperature of 4ºC ± 2ºC. If samples are shipped by commercial courier, the ice must be contained in leak resistant, sealable bags.

EQI provides sampling kits with chain of custody (COC) records as well as new, pre-labeled, certified and traceable, pre-preserved sample containers and temperature blanks. Other project specific requirements such as cooler custody seals, trip blanks, and etc. are provided upon request. When sampling kits are shipped to a client, applicable Department of Transportation or International Air Transport Association regulations are followed.

The *Sample Container Shipping* SOP [ME001DS] outlines the sample container shipping procedures in more detail.

8.4.2. Field Collection Operations & Sample Transfer

EQI employs a team of field sampling technicians whose efforts are directed by comprehensive field sampling and analysis SOPs. Whether EQI performs field collection or analysis for a given project, or the client employs its own field sampling personnel, each must adhere to regulatory established procedures to provide samples and/or data that accurately represent the relevant matrix.

All project sampling requirements must be planned and communicated in advance of activating a sampling event. Assurance of sample integrity throughout the entire process includes the use of proper:

- Containers of adequate volume with the appropriate preservatives
- Sampling equipment
- Sampling techniques
- Field cleaning techniques
- QC sample collection techniques and frequency
- Measurement of field parameters such as dissolved oxygen, pH, total residual chlorine, conductivity, and temperature
- Data documentation

EQI's Field Technicians maintain proper field collection data sheets that record ambient conditions and abnormalities encountered during the collection process. They document all aspects of the field collection process including visual observations, sampling equipment information, field analytical information, and any other data related to the sampling event. All measurement results and calibration data for field measurement equipment are recorded.

A self-adhesive, water resistant label is attached to each sample container and the following information is recorded using indelible ink:

- Client name
- Field identification or sample station identification
- Sample collection date and time
- Sample preservation
- Analyses required
- Field technician initials

A COC form documents each sampling event. It is evidence of the proper collection, shipment, laboratory receipt, and custody of samples. The COC is an accurate, written record which documents the possession of samples from the moment of collection through laboratory receipt, analysis, and disposition. In general, the chain of custody provides the following documentation:

- Client name, address, telephone number, contact person, and if applicable the purchase order number
- The sample ID such as location or station number, the date and time of collection, and the type of sample, either grab or composite
- The total number of sample containers
- The preservation type
- The analysis required
- Other pertinent data or instructions
- The samplers signature and signatures of any other persons to which samples have been relinquished

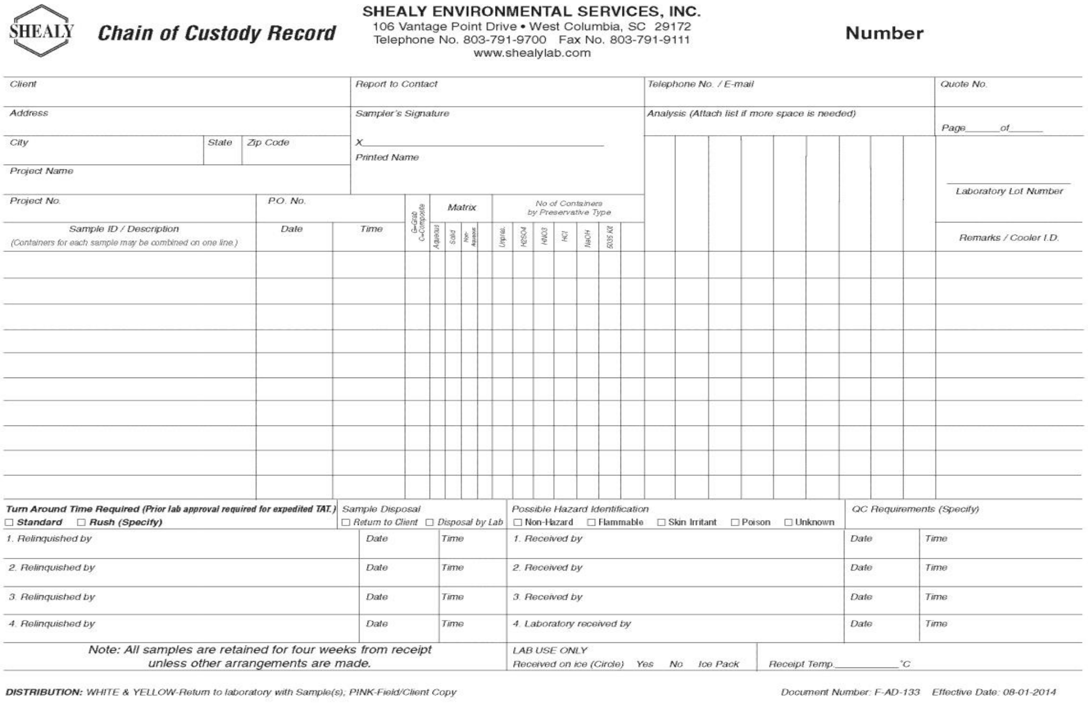
A copy of the EQI COC is included as Figure 8.4-1 and a copy of the CWA / NPDES COC is included as Figure 8.4-2. EQI field collection personnel ensure that the COC is completed fully, including the information bulleted above.

Finally, it is imperative that samples be shipped and received in the laboratory in an expeditious manner. Whether EQI personnel or others collect the samples, they should be hand delivered or transported to ensure timely laboratory receipt.

It must be noted that proper "custody" of samples must be maintained throughout the collection, transfer, receipt, and analysis process. A sample is in one's possession or is in custody if:

- It is in a person's possession; or
- It is in view after being in possession; or
- It is locked in a secure area after being in possession; or
- It is in a designated secure area, accessible only to authorized personnel.

In the event that packages are transferred by a common carrier, the receipts verifying custody by the common carrier are retained and are attached to the permanent COC document.



SHEALY **Chain of Custody Record**

SHEALY ENVIRONMENTAL SERVICES, INC.
106 Vantage Point Drive • West Columbia, SC 29172
Telephone No. 803-791-9700 Fax No. 803-791-9111
www.shealylab.com

Number

Client
Report to Contact
Telephone No. / E-mail
Quote No.
Address
Sampler's Signature
Analysis (Attach list if more space is needed)
Page______of______
City
State
Zip Code
X________________________________
Printed Name
Project Name
Laboratory Lot Number
Project No.
P.O. No.

Sample ID / Description (Containers for each sample may be combined on one line.)	Date	Time	G=Grab C=Composite	Matrix: Aqueous	Matrix: Solid	Matrix: Non-Aqueous	No of Containers by Preservative Type: Unpres.	H2SO4	HNO3	HCl	NaOH	5035 Kit	Remarks / Cooler I.D.

Turn Around Time Required (Prior lab approval required for expedited TAT.)
☐ Standard ☐ Rush (Specify)
Sample Disposal
☐ Return to Client ☐ Disposal by Lab
Possible Hazard Identification
☐ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison ☐ Unknown
QC Requirements (Specify)

1. Relinquished by	Date	Time	1. Received by	Date	Time
2. Relinquished by	Date	Time	2. Received by	Date	Time
3. Relinquished by	Date	Time	3. Received by	Date	Time
4. Relinquished by	Date	Time	4. Laboratory received by	Date	Time

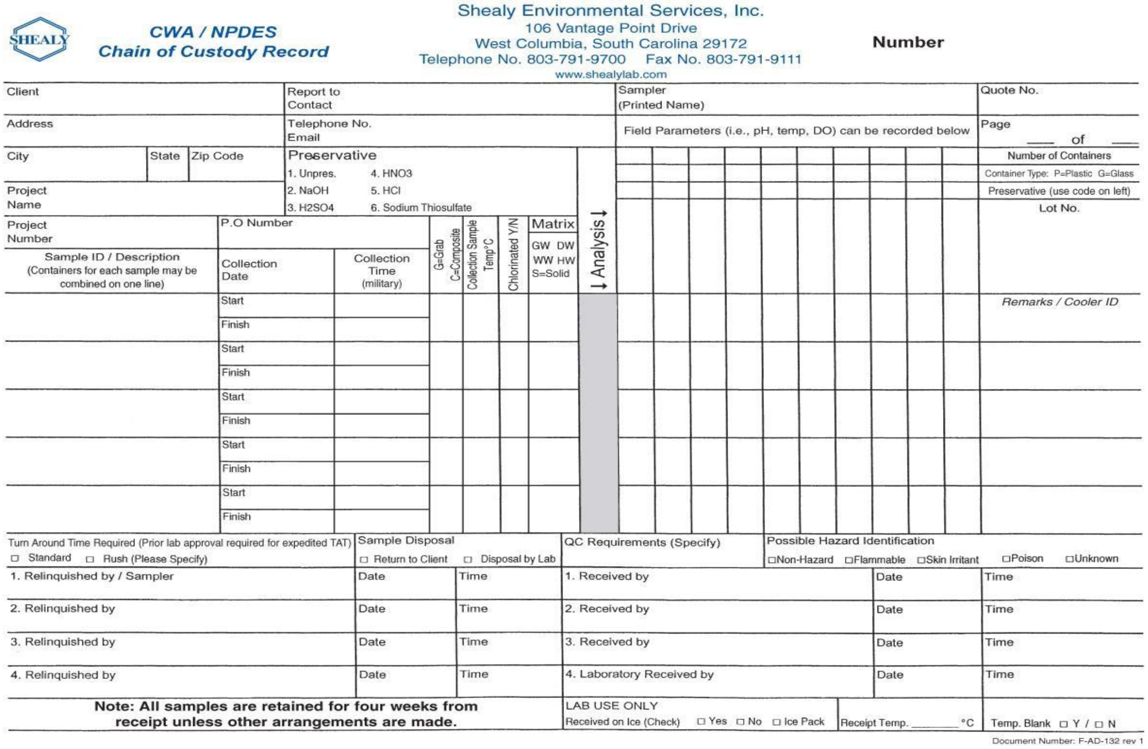
Note: All samples are retained for four weeks from receipt unless other arrangements are made.

LAB USE ONLY
Received on ice (Circle) Yes No Ice Pack
Receipt Temp.__________°C

DISTRIBUTION: WHITE & YELLOW-Return to laboratory with Sample(s); PINK-Field/Client Copy

Document Number: F-AD-133 Effective Date: 08-01-2014

Figure 8.4-1: Chain-of-Custody Form



CWA / NPDES
Chain of Custody Record

Shealy Environmental Services, Inc.
106 Vantage Point Drive
West Columbia, South Carolina 29172
Telephone No. 803-791-9700 Fax No. 803-791-9111
www.shealylab.com

Number

Client	Report to Contact	Sampler (Printed Name)	Quote No.
Address	Telephone No. Email	Field Parameters (i.e., pH, temp, DO) can be recorded below	Page ___ of ___
City / State / Zip Code	Preservative 1. Unpres. 4. HNO3 2. NaOH 5. HCl 3. H2SO4 6. Sodium Thiosulfate	↓ Analysis ↓	Number of Containers Container Type: P=Plastic G=Glass Preservative (use code on left) Lot No.
Project Name			
Project Number	P.O Number		

Sample ID / Description (Containers for each sample may be combined on one line)	Collection Date	Collection Time (military)	G=Grab C=Composite	Collection Sample Temp°C	Chlorinated Y/N	Matrix GW DW WW HW S=Solid	Remarks / Cooler ID
	Start						
	Finish						
	Start						
	Finish						
	Start						
	Finish						
	Start						
	Finish						
	Start						
	Finish						

Turn Around Time Required (Prior lab approval required for expedited TAT) ☐ Standard ☐ Rush (Please Specify)
Sample Disposal ☐ Return to Client ☐ Disposal by Lab
QC Requirements (Specify)
Possible Hazard Identification ☐Non-Hazard ☐Flammable ☐Skin Irritant ☐Poison ☐Unknown

1. Relinquished by / Sampler	Date	Time	1. Received by	Date	Time
2. Relinquished by	Date	Time	2. Received by	Date	Time
3. Relinquished by	Date	Time	3. Received by	Date	Time
4. Relinquished by	Date	Time	4. Laboratory Received by	Date	Time

Note: All samples are retained for four weeks from receipt unless other arrangements are made.

LAB USE ONLY
Received on Ice (Check) ☐ Yes ☐ No ☐ Ice Pack
Receipt Temp. ________ °C
Temp. Blank ☐ Y / ☐ N

Document Number: F-AD-132 rev 1

Figure 8.4-2: CWA/NPDES Chain-of-Custody Form

8.4.3. Laboratory Sample Handling Process (Sample Receiving)

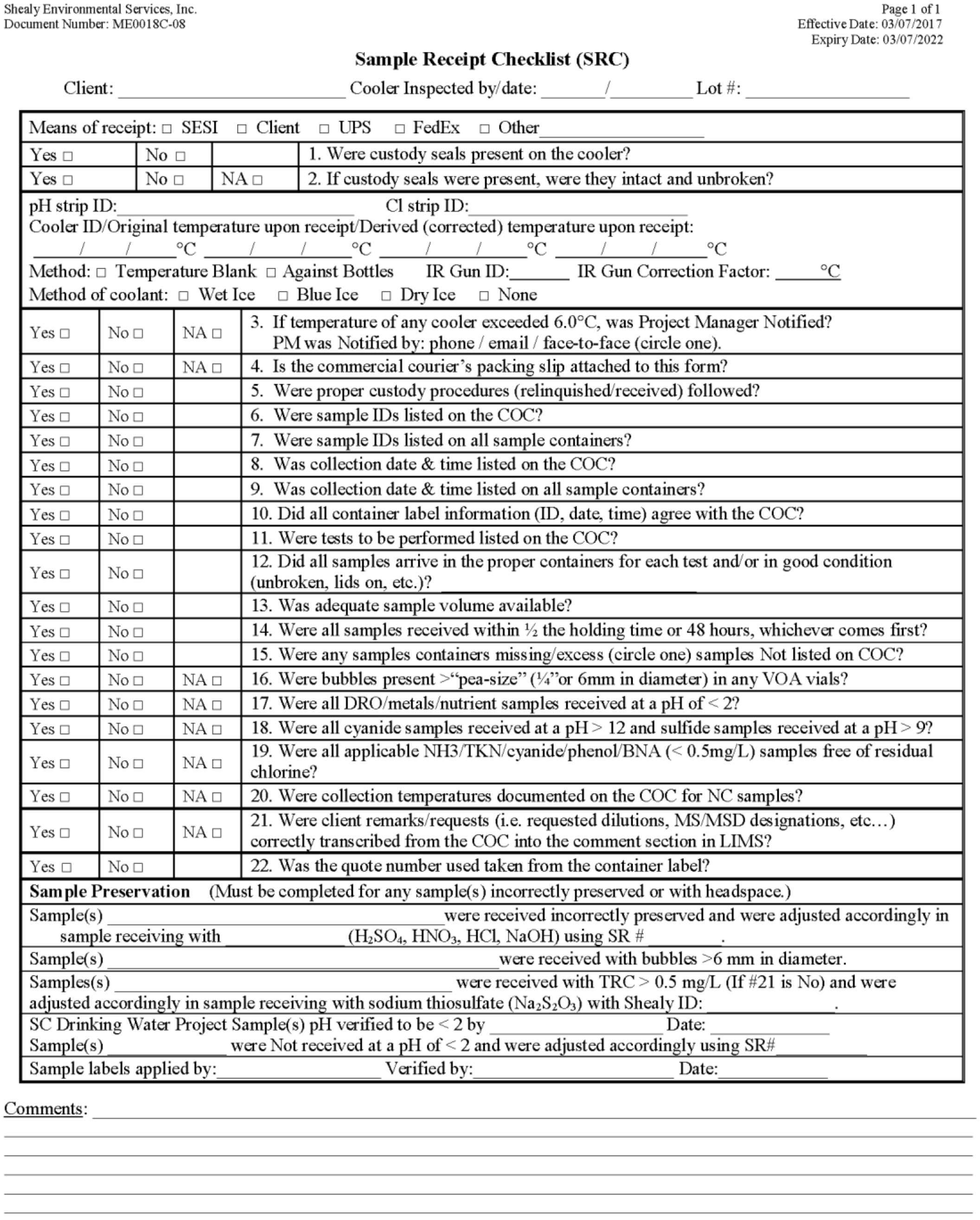
EQI utilizes a comprehensive SOP (*Sample Receiving*; ME0013H) detailing the prerequisites for proper sample receipt and the sample receiving operation. The general process is described below.

Full time sample receiving custodians receive all samples. At receipt, the custodians perform the following:

- Examines the shipping container for security/damage
- Opens the shipping container and examines the contents for security/damage
- Documents the temperature of samples as received
- Checks chemical preservation of samples
- Compares samples received (quantity & type) against the COC information
- Verifies that sample holding times are not expired
- Signs and dates the COC after shipment is accepted
- Completes a Sample Receipt Checklist (SRC) form (Figure 8.4-3) for each shipment received. If anomalies are noted, the Sample Receiving Technician or the project manager must resolve the deviation internally and/or notify the client to resolve the anomaly.
- The SRC and COC are scanned to be included in the client report. The SRC form is affixed to a hard copy of the chain of custody and stored appropriately.
- Assigns a unique laboratory control number and attaches a bar coded identification sticker to each sample container.
- Places all samples into the appropriate secure storage cooler and/or alerts analysts to short holding time samples.
- For samples that are received under the laboratory's CLP contract additional procedures are performed as outlined in the sample receiving SOP and the SOM02.4 and ISM02.4 SOWs.

After samples are received, the sample receiving custodian enters all appropriate chain of custody data into the LIMS. Further assessments are made regarding method holding times, as it is imperative that samples are analyzed within the stipulated holding time. Analyses with the holding time “analyze immediately” are normally field parameters to be measured at the time of collection. If these field parameters are performed in the laboratory, proper data qualifiers are indicated on the report.

EQI is responsible for meeting all holding times for properly preserved samples received within 48 hours of collection, or within one-half the holding time, whichever is shortest. Short holding time samples such as those for BOD, fecal coliform, hexavalent chromium, etc., require project manager or client notice to the laboratory to ensure analysis within the holding time.



Shealy Environmental Services, Inc.
Document Number: ME0018C-08

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Effective Date: 03/07/2017
Expiry Date: 03/07/2022

Sample Receipt Checklist (SRC)

Client: ________________________ Cooler Inspected by/date: _______/_________ Lot #: _________________

Means of receipt: ☐ SESI ☐ Client ☐ UPS ☐ FedEx ☐ Other__________________

Yes ☐	No ☐		1. Were custody seals present on the cooler?
Yes ☐	No ☐	NA ☐	2. If custody seals were present, were they intact and unbroken?

pH strip ID:_________________________ Cl strip ID:______________________
Cooler ID/Original temperature upon receipt/Derived (corrected) temperature upon receipt:
_____/_____/_____°C _____/_____/_____°C _____/_____/_____°C _____/_____/_____°C
Method: ☐ Temperature Blank ☐ Against Bottles IR Gun ID:_______ IR Gun Correction Factor: _____°C
Method of coolant: ☐ Wet Ice ☐ Blue Ice ☐ Dry Ice ☐ None

Yes ☐	No ☐	NA ☐	3. If temperature of any cooler exceeded 6.0°C, was Project Manager Notified? PM was Notified by: phone / email / face-to-face (circle one).
Yes ☐	No ☐	NA ☐	4. Is the commercial courier’s packing slip attached to this form?
Yes ☐	No ☐		5. Were proper custody procedures (relinquished/received) followed?
Yes ☐	No ☐		6. Were sample IDs listed on the COC?
Yes ☐	No ☐		7. Were sample IDs listed on all sample containers?
Yes ☐	No ☐		8. Was collection date & time listed on the COC?
Yes ☐	No ☐		9. Was collection date & time listed on all sample containers?
Yes ☐	No ☐		10. Did all container label information (ID, date, time) agree with the COC?
Yes ☐	No ☐		11. Were tests to be performed listed on the COC?
Yes ☐	No ☐		12. Did all samples arrive in the proper containers for each test and/or in good condition (unbroken, lids on, etc.)? ____________________
Yes ☐	No ☐		13. Was adequate sample volume available?
Yes ☐	No ☐		14. Were all samples received within ½ the holding time or 48 hours, whichever comes first?
Yes ☐	No ☐		15. Were any samples containers missing/excess (circle one) samples Not listed on COC?
Yes ☐	No ☐	NA ☐	16. Were bubbles present >“pea-size” (¼”or 6mm in diameter) in any VOA vials?
Yes ☐	No ☐	NA ☐	17. Were all DRO/metals/nutrient samples received at a pH of < 2?
Yes ☐	No ☐	NA ☐	18. Were all cyanide samples received at a pH > 12 and sulfide samples received at a pH > 9?
Yes ☐	No ☐	NA ☐	19. Were all applicable NH3/TKN/cyanide/phenol/BNA (< 0.5mg/L) samples free of residual chlorine?
Yes ☐	No ☐	NA ☐	20. Were collection temperatures documented on the COC for NC samples?
Yes ☐	No ☐	NA ☐	21. Were client remarks/requests (i.e. requested dilutions, MS/MSD designations, etc…) correctly transcribed from the COC into the comment section in LIMS?
Yes ☐	No ☐		22. Was the quote number used taken from the container label?

Sample Preservation (Must be completed for any sample(s) incorrectly preserved or with headspace.)

Sample(s) ____________________________________were received incorrectly preserved and were adjusted accordingly in sample receiving with ______________ (H_2SO_4, HNO_3, HCl, NaOH) using SR # ________.

Sample(s) ____were received with bubbles >6 mm in diameter.

Samples(s) ___________________________________ were received with TRC > 0.5 mg/L (If #21 is No) and were adjusted accordingly in sample receiving with sodium thiosulfate ($Na_2S_2O_3$) with Shealy ID:______________.

SC Drinking Water Project Sample(s) pH verified to be < 2 by __________________ Date: _____________
Sample(s) _____________ were Not received at a pH of < 2 and were adjusted accordingly using SR#__________

Sample labels applied by:_________________ Verified by:____________________ Date:___________

Comments: ____

Figure 8.4-3: Sample Receiving Checklist (SRC)

8.4.4. Sample Storage

Samples must be stored appropriately to offer maximum preservation, to minimize contamination, and to maintain sample security within the laboratory.

All samples are stored in clean refrigeration units monitored and maintained at 4 ± 2°C. Volatile organic samples are stored separately from all other samples in matrix specific coolers and freezers. Inorganic non-metal samples are transferred from the sample receiving walk-in cooler to the inorganic non-metal laboratory walk-in cooler.

In the event of a catastrophic failure of our refrigerated storage facilities or an area-wide natural disaster that results in the loss of power, local truck rental companies will be contacted and a refrigerated truck will be rented to temporarily store samples until our internal system is functional.

8.4.4.1. Storage Blanks

To monitor potential volatile organic compound contamination of VOA samples, storage unit blanks are placed in dedicated refrigerators, sample storage freezers, and in the walk-in cooler every two weeks. One vial from each respective storage unit are analyzed for the TCL and UST list of compounds on the 13th or 14th day following storage. All storage unit blanks are logged into LIMS; the report is generated and reviewed by QA. Refer to the *Deionized Water System and Storage Blank Testing* SOP [ME0012S] for further details.

8.4.5. CLP Sample Storage

Samples that are received under the laboratory's CLP contract are stored in lockable refrigerated areas. All CLP Trace/SIM VOA (SOM) and low-level water samples are stored together in a lockable dedicated refrigerator in the VOA department. CLP low-medium solid samples are stored in a solid sample only refrigerator. All CLP semi-volatile, pesticide, PCB, metals, and cyanide samples are stored in the walk-in cooler in the sample receiving department.

8.4.5.1. CLP Storage Blanks (Holding Blanks)

A storage blank associated with volatile organic samples is logged into the LIMS and prepared for each SDG. The *Sample Receiving* SOP [ME0013H] contains more details about the CLP Storage Blank procedure.

8.4.6. Internal Chain-of-Custody System (ICOC)

Security of samples and sample tracking is accomplished by an automated internal chain of custody program. When removing a sample from the sample receiving area, the bar code label attached to each sample container during the login process is scanned. The scanning process allows a record to be kept of the person who is taking the sample, the date taken, the analytical laboratory to which the sample is to be taken, and all other LIMS information previously entered for this sample.

Samples are required to be scanned from the sample receiving area to the department they are being transferred to. Samples are required to be scanned when being transferred between departments, and when and how they are disposed of.

8.4.7. Subcontracted Sample Transfer

EQI does not subcontract analytical work without written notification to our clients. When samples are subcontracted, a new chain of custody is issued to the subcontract laboratory with all pertinent information. EQI retains the original chain of custody and includes the new chain of custody with the project file.

8.4.8. Sample Return / Disposal

After preparation and analysis has been completed on a sample, it is returned to storage. Most samples are kept for a minimum duration of four (4) weeks before disposal. Others are kept longer due to client request. Sample extracts are retained for at least 40 days. Inorganic metal sample digestates are retained for 30 days. Exceptions to this include samples whose holding times are short and those that are consumed during analysis.

Regardless of the method of disposal or final disposition, EQI records the event through the internal chain of custody “bar code” system.

Sample containers are retained for SOM and ISM samples for 60 days following delivery of a complete, reconciled L4 data package. Extracts for SOM samples are kept for 365 days. TCLP/SPLP leachate and ISM digestates are kept for 180 days.

Samples are either returned to customers via the chain of custody system or disposed as either hazardous or non-hazardous waste. The *Sample Receiving* SOP [ME0013H] and the *Hazardous and Non-hazardous Waste Management Plan* [ME0012A] govern these activities. In the event samples are part of a litigation process, disposal of the samples shall only occur with the written approval of the legal authority, sample submitter, or sample data user.

8.5. Sustainability

Shealy Environmental Services, Inc. (“Shealy”) is continuously evaluating methods and ways to become more sustainable. The following practices are in place at Shealy:

- Shealy purchases methylene chloride in bulk 200 liter containers which supply our solvent delivery system. Shealy has been using these bulk containers since 2002. Since the laboratory consumes approximately 18 bulk containers per year this saves 900 four liter glass containers, 225 cardboard shipping boxes, 450 foam box inserts, and reduces our overall carbon footprint as less deliveries are needed.

- The laboratory has implemented organic extraction procedures that utilizes approximately six times less methylene chloride which further reduces our carbon footprint related to this solvent.

- Shealy participates in a chemical recycle/reuse program offered by our contracted waste disposal facility. Under this program, spent solvents are recycled into reusable products which are in turn utilized in industrial applications that do not require virgin products. This alternative to traditional solvent waste disposal minimizes the energy and resources spent making new chemicals and reduces the carbon footprint associated with traditional solvent waste treatment.

- Shealy continuously looks for ways to reduce hazardous waste generation through source reduction. This includes prudent management of chemical procurement to avoid over-ordering of chemicals and the use of micro-scale processes to reduce the volume of reagents used. These practices minimize the generation of hazardous wastes that may adversely affect the environment.

- The laboratory has been using gas generators since 2003 to produce zero air and hydrogen which reduces our carbon footprint since the delivery of compressed gas cylinders has been drastically reduced.

- Shealy installed a 3000-liter argon tank in 2001 which has eliminated the weekly delivery of argon dewars reducing our carbon footprint.

- Shealy installed a 700-liter nitrogen tank in 2015 which has eliminated the bi-weekly delivery of nitrogen cylinders and dewars reducing our carbon footprint.

- Shealy installed a white reflective membrane on the building roof in 2013. This highly reflective material has reduced our thermal heat load in the building resulting in a lower load on the air conditioning system. This has yielded optimal facility environmental conditions, and has resulted in less energy consumption by the chiller.

- Shealy installed a high-efficiency 80 ton chiller in 2014. This replaced the original chiller which was installed when the building was constructed in 1994. We have seen a 15% reduction in our kWh used since this unit was installed. This installation also qualified us for SCE&G's EnergyWise for Your Business Program.

- Shealy's field services department uses Toyota Tacoma trucks and Nissan NV200 mini cargo vans with 4-cylinder engines to perform sample courier services. These trucks are relatively environmental friendly with respect to emissions and fuel consumption.

- Shealy has been recycling office paper since 2000 and corrugated cardboard since 2011.

- Shealy has been systematically replacing fluorescent lights with LED lights and standard light switches with motion sensor switches.

- Shealy continuously evolves our documentation processes from paper to electronic which has drastically reduced our paper usage. This is primarily driven through ongoing development of our laboratory information management system (LIMS) electronic notebooks.

9. Quality Systems

All laboratory activities must be closely planned, implemented, and controlled in order to meet both client and regulatory requirements. These activities are governed by the standard processes, practices, and procedures either detailed in or referenced by this QAMP. This section describes the processes, practices, and procedures that EQI utilizes to meet both client and regulatory requirements concerning environmental sample analysis.

9.1. Data Quality Objectives

Data Quality Objectives (DQOs) are used to ensure the quality of data produced when analyzing samples by established and practiced analytical methodologies. The EPA has established the following DQOs concerning environmental analyses:

9.1.1. Precision

Precision is a measure of the statistical variability of individual measurements of the same parameter under similar measurement conditions. The variability is caused by random or unpredictable error. Precision is expressed in terms of either relative standard deviation (RSD) for replicates involving more than two measurements, or relative percent difference (RPD) for duplicate measurements.

9.1.2. Accuracy

Accuracy is a measure of the agreement between a measured value and its true or expected value. The degree of accuracy reflects the presence and magnitude of systematic errors, or those errors of a consistent nature. Accuracy is expressed as percent recovery (% R).

9.1.3. Representativeness

Representativeness is the extent or degree to which a sample, or analytical data generated from a sample, represents a larger population. Representativeness relies on appropriate and precise sampling activities, as well as sample preparation that include the selection of a homogeneous aliquot of the sample.

9.1.4. Completeness

Completeness describes the amount of valid data obtained from a measurement system compared to the amount that was expected to be obtained under correct, normal conditions. EQI utilizes, at a minimum, a completeness goal for data of 90 percent based on a total of all constituents analyzed.

9.1.5. Comparability

Comparability is a measure of the confidence with which one data set can be compared to another data set. To ensure comparability, uniform procedures (SOPs) and practices must be used, as well as a uniform set of calculations and reporting units for analytical data.

9.1.6. Detectability

Detectability encompasses the establishment of instrument detection limits (IDLs), method detection limits (MDLs), the limit of detection (LOD), and the limit of quantitation (LOQ) for analysis methods.

9.1.6.1. Instrument Detection Limit (IDL)

EQI performs instrument detection limit studies (IDL Studies) studies for metals constituents on an annual basis. The IDL measurement is a direct measurement of instrument sensitivity. The IDL establishes the detection limit of the measurement instrument or measurement system under ideal conditions.

9.1.6.2. Detection Limit (DL)

The DL is the laboratory reporting limit, which must be greater than or equal to the MDL and below the LOQ and LOD. The DL is determined by the MDL. The DL must be equal to or higher than the calculated MDL and lower than the LOQ. The MDL is carefully evaluated to determine the DL. The DL must meet the following: LOQ > LOD > DL ≥ MDL. The DL must be approved by the technical director, operations director, department group leader, and QA before being used for client reporting. The DL takes the place of the MDL in LIMs. Data reported below the LOQ, also known as a J value or estimated result, is reported to the DL.

9.1.6.3. Method Detection Limit (MDL)

The MDL is the minimum concentration of an analyte that, when a sample is processed through the complete method, produces a signal or result with a 99% probability that it is different from a blank. MDLs are determined by replicate analysis of prepared low-level standards. An MDL study is the process through which the laboratory determines a detection limit (DL) for a particular analytical method in adherence to requirements established in 40 CFR Part 136, Appendix B, Definition and Procedure for the Determination of the Method Detection Limit Revision 2.

MDL Policy **-** EQI determines MDLs for all new methods or new compounds of interest for both aqueous and solid matrices. After the initial MDL is determined, verifications are performed quarterly, at the frequency specified by the method, or at the frequency specified by a program or contract (i.e. whenever a new instrument is brought on-line for CLP) whichever is more frequent. MDLs are generated for all individual analytes that can be spiked into a clean matrix. EQI performs an MDL study for a target analyte using each preparation method that will be used for client samples. MDL determinations are matrix-specific and level-specific (i.e., the MDL is determined for trace and trace SIM levels). MDLs must be less than any LOQ, RL, or CRQL (USEPA CLP) that may be reported to the client. Program and client specific MDL studies are performed as required. The *Method Validation Policy* [ME003BF] outlines the procedures used in the determination of MDLs.

9.1.6.4. Limit of Detection (LoD)

The LOD is an estimate of the minimum amount of a substance that an analytical process can reliably detect. It is also defined as the smallest amount or concentration of a substance that must be present in a sample in order to be detected at a high level of confidence (99%). At the LOD, the false negative rate (Type II error) is 1%. The LOD is analyte and matrix specific and may be laboratory dependent.

LOD Policy **-** EQI establishes limits of detection (LODs) for each analyte listed on the DOD Scope of Accreditation reported below the LOQ and are used to verify MDLs under the TNI standard, where applicable. All LODs are supported by technical data such as MDL studies (see section 9.3.6.2.1.) and/or through the analysis of a standard at a concentration below the LOQ. EQI's LODs are based on an evaluation of the laboratory's expected analytical performance. LODs are greater than the MDLs and in no case are LODs lower than established method detection limits. The *Method Validation Policy* [ME003BF]) outlines LOD determination and verification policies and procedures.

9.1.6.5. Limit of Quantitation (LoQ)

The LOQ is the minimum level, concentration, or quantity of a target analyte that can be reported with a specified degree of confidence. It is also defined as the lowest concentration that produces a quantitative result within specified limits of precision and bias. The LOQ shall be set at or above the concentration of the lowest initial calibration standard.

LOQ Policy **-** EQI establishes LOQs for all reported analytes for which spiking solutions can be prepared. The LOQ is established as the concentration at or above the lowest initial calibration standard. All LOQs are supported by technical data such as MDL studies (see section 9.3.6.2.1.) or may be based on an evaluation of the laboratory's expected analytical performance. At the discretion of the technical director and the QAO, other technical data may be used such as a detection limit from a published method or a regulatory limit. LOQs are greater than the MDLs and in no case are LOQs lower than the established method detection limits. The *Method Validation Policy* [ME003BF] outlines the LOQ determination and verification policies and procedures.

9.2. Quality Control

EQI uses various types of QC samples to generate data which confirms that the analysis is in control. QC sample data generated during analysis is used to satisfy the DQOs in section 9.3. QC samples include the following types:

9.2.1. Field QC Samples

This section describes the QC samples that EQI utilizes in both its field collection activities and its laboratory work. Field QC samples are collected during a field sampling event and are used to assess precision, accuracy and any possible contamination during collection, equipment cleaning and transfer of samples to the laboratory. EQI's Field Services Group Leader ensures that the proper type and number of field QC samples are collected during any field sampling activity performed. The laboratory considers field QC samples to be "routine" samples for the purposes of batching, sample preparation, analysis, and reporting of data. Analytical data is not adjusted based on the results of field QC samples.

9.2.1.1. Field Blank

A Field Blank (FB) is used to demonstrate the absence of contamination during sampling activities. It is normally comprised of contaminant free water or soil brought by the sampling crew to the site, and transferred to the proper sample container for shipment along with other collected samples. Field Blank sampling frequency is one sample per site per sampling day.

9.2.1.2. Rinsate Blank

A Rinsate Blank (RB), commonly called an “equipment blank”, is used to demonstrate the effectiveness of field cleaning procedures for sampling equipment. A volume of rinse solution, usually contaminant free water, is sent through the cleaned sampling equipment in the same manner as a sample and collected for analysis. Rinsate Blank sampling frequency is generally one sample per site per sampling day when equipment is cleaned in the field.

9.2.1.3. Trip Blank

Volatile organic samples are susceptible to contamination by introduction or migration of contaminants through the volatile vial septum. A Trip Blank (TB) is utilized to detect possible volatile organic contamination of samples to be analyzed for volatile compounds. Trip Blanks are prepared by filling volatile sampling vials with deionized water. Trip Blanks accompany volatile sample collection vials to the sampling site, back to the laboratory, and are stored with the collected samples before analysis. Trip Blanks are supplied when requested for each cooler transported to a client or field site at the rate of 1 per shipping container.

9.2.1.4. Field Duplicate

A Field Duplicate (FD) is utilized to assess sampling precision. They are replicate samples taken for the same sampling event from a given sampling point or source. Frequency of the Field Duplicate collection is at the direction of the client.

9.2.1.5. Split Samples

A Split Sample (SS) is a sample that is collected and immediately divided into two parts. One portion is returned to the laboratory for analysis while the other is shipped to a second laboratory for identical analysis. Split Samples are used to gauge accuracy. Split Sample frequency is dependent upon a client’s requirement.

9.2.2. Laboratory QC Samples

Laboratory QC samples are utilized to gauge the precision and accuracy of the analytical processes as well as to determine the effect of matrix or site/field conditions on the analytical data.

To ensure that the analytical process from sample preparation through data generation and evaluation is operating within acceptable QC guidelines, the laboratory performs a variety of QC checks. It must be noted that not all methods employ the use of all of the following QC elements. Detailed analytical SOPs contain the specific QC requirement. The following is a description of QC sample types and techniques.

9.2.2.1. Preparation Batch

A preparation batch is composed of 1 to 20 environmental samples of the same matrix which are prepped together as a group. The maximum time between the start of processing the first and last sample in the batch is 24 hours. The samples must be processed by the same analyst(s) using the same lot(s) of reagents.

In general, the minimum QC requirements for each preparation batch are:

- One (1) method blank (MB)
- One (1) laboratory control sample (LCS)
- One (1) matrix spike (MS)

- One (1) matrix spike duplicate (MSD)

Field QC samples, such as trip blanks, equipment blanks, and duplicate samples are considered individual samples and are included in the preparation batch size of no more than 20. Samples that require re-extraction or re-digestion and analysis are considered additional samples and must be included as part of a new batch. Dilutions are not to be considered as part of the maximum 20 samples in a QC batch

Batch precision can be demonstrated through the analysis of a matrix spike and a matrix spike duplicate. Batch precision can also be demonstrated through the analysis of samples in duplicate. It should be noted that sample duplicates may not provide usable precision data if concentrations are below LOQs. A Laboratory Control Sample Duplicate (LCSD) may also be used as a measure of batch precision when insufficient sample exists to prepare a matrix spike, matrix spike duplicate, or a sample duplicate.

Precision over time is monitored via control charting of Laboratory Control Sample (LCS) values. A control chart is a graphical representation of analytical accuracy. It displays the arithmetic mean of a data set, the upper and lower warning limits, and the upper and lower control limits.

9.2.2.2. Analytical Batch

An analytical batch is composed of prepared environmental samples (extracts, digestates, or concentrates) which are analyzed together as a group (i.e. metals and SVOCs). An analytical batch may include prepared samples originating from various matrices.

Analytical methods that do not require an extraction or a digestion process, such as volatile organic analysis by purge and trap, require that the analytical batch is analyzed sequentially using the same instrument. The same calibration curve and calibration factors must be maintained for the entire batch.

9.2.2.3. Batch Identification

The identity of each sample batch is unique, documented and traceable.

9.2.2.4. Method Blank

A Method Blank (MB) normally consists of a volume of reagent water, Ottawa sand, sodium sulfate, glass beads or other preparation matrix that is processed as a normal sample. The MB must be carried through all the steps of the analysis being performed, such as cleanup, extraction, reagent addition, filtering, and analysis. A MB is used to detect interferences or contamination that may produce high or false positive data. One MB is prepared for each analytical batch.

9.2.2.5. Initial Calibration Verification

The Initial Calibration Verification (ICV) is a standard prepared from a different source than the initial calibration standards. The ICV is analyzed after the initial calibration and is used to verify the accuracy of the calibration.

9.2.2.6. Initial Calibration Blank

An Initial Calibration Blank (ICB) is analyzed after the calibration in order to check system cleanliness before sample analysis. The ICB consists of reagent water (or other appropriate matrix) containing all reagents specific to the method which is carried through the entire analytical procedure.

9.2.2.7. Instrument Blank / Continuing Calibration Blank

An Instrument Blank (IB) consists of an aliquot of reagent, usually the same as used for sample dilution, processed through an instrument. An Instrument Blank measures the presence of possible contamination that may produce high or false positive data. An IB is also referred to as a Continuing Calibration Blank (CCB).

9.2.2.8. Continuing Calibration Verification

The Continuing Calibration Verification (CCV) is a standard that is prepared from the same source as the ICAL, usually at a concentration approximately at the mid-point of the ICAL. It is run at the beginning of the analytical day, at the end, and at intervals throughout the sequence to verify that the system is in control. The CCV is used as a continuing verification of the accuracy of the calibration.

9.2.2.9. Laboratory Control Sample / Laboratory Control Sample Duplicate

A Laboratory Control Sample (LCS) is a clean matrix sample to which known concentrations of target analytes are added (i.e. “spiked”). One laboratory control sample is analyzed with each analytical batch and is used to monitor the accuracy of the analytical process. Long term collection of LCS data is also used to gauge precision. A Laboratory Control Sample Duplicate (LCSD) may also be used as a measure of batch precision when insufficient sample exists to prepare a matrix spike, matrix spike duplicate or a sample duplicate.

9.2.2.10. Sample Duplicate

A Sample Duplicate (SD) is a second aliquot of a sample that is processed along with the sample. An SD is processed identically as independent samples within the same batch. SD results indicate the precision of the analytical process and may indicate a sample is homogenous in nature. An SD is randomly selected, pending sufficient sample volume or by client request.

9.2.2.11. Matrix Spike

A Matrix Spike (MS) is a second aliquot of a sample to which known concentrations of target analytes are added. The addition of the analytes is performed prior to sample preparation or extraction. An MS is randomly selected, pending sufficient sample volume or by client request. The MS result, as compared to the unspiked sample, is used to evaluate the effect of the sample matrix on the analytical process, or the accuracy of analysis. Due to the variability of sample matrices, it is not typically indicative of other samples in the batch. In general, an MS is added to each batch, with the exception of some inorganic analyses.

9.2.2.12. Matrix Spike Duplicate

A Matrix Spike Duplicate (MSD) is a third aliquot of the same sample used for an MS, to which the same known concentrations of target analytes are added. The MSD is processed in the same batch as the original sample and the MS sample. The MS and the MSD results are used to determine the effect of the sample matrix on the precision and accuracy of the analytical process.

9.2.2.13. Post-Digestion Spike

A Post Digestion Spike (PDS) is prepared by taking a digested sample aliquot and adding target analytes before analysis. It is useful in providing information on matrix interferences during analysis as compared to a predigested spiked sample. A PDS is most often employed in metals analysis.

9.2.2.14. Internal Standard

An Internal Standard (IS) is a chemical compound(s) or element(s) with properties that are similar in character and behavior to analytes of concern in an environmental sample. Internal standards are normally added after sample preparation and are used to quantify the effectiveness of the measuring system, or gauge its accuracy. The IS can also be used to gauge short-term system performance or precision.

Two different types of internal standard are used in the preparation and analysis of PFAS. The Injection Internal Standard is an internal standard which is added to samples, QC, blank and standards just prior to analysis. The Extracted Internal Standard is an internal standard which is added to samples, QC, blank and standards prior to extraction.

9.2.2.15. Surrogate Standard

A Surrogate Standard is an organic compound(s) that behaves like the target analyte compounds, but is not normally investigated through analysis. Surrogates are added to all appropriate environmental samples and QC samples prior to preparation or analysis to determine matrix effects, preparation efficiencies, and the accuracy of the measurement system.

9.2.2.16. Interference Check Samples

An Interference Check Sample (ICS) is a sample that contains known amounts of analytes that may cause interference during metals analysis. The ICS is useful in verifying background and inter-element correction factors.

9.2.2.17. Post Serial Dilution Spike / Post Spike Sample

A Post Serial Dilution Spike or Post Spike Sample is a sample which is spiked at the LOQ in the final dilution reported. This only applies to aqueous PFAS samples prepared by serial dilution instead of SPE that have reported value of < LOQ for analytes.

9.3. Calibration of Equipment

9.3.1. Calibration Procedures

Equipment and instruments that are used for quantitative measurements are calibrated in accordance with established SOP procedures. The procedures provide the following information:

- Instrument(s) to be calibrated
- Standards to be used in calibration
- Calibration technique such as linear, response factor, etc.
- Calibration tolerances
- Corrective action if calibration tolerances are not met
- Frequency of calibration
- Documentation requirements

9.3.2. Periodic Verification of Support Equipment

Certain pieces of laboratory equipment require periodic verification at intervals as prescribed in the corresponding SOPs and/or Policies. Periodic verification generally applies to equipment having a singular purpose, and which is stable in performance. Equipment requiring periodic verification includes: analytical balances, top-loading balances, bottle-top dispensers, micro-pipettes, IR thermometers used in sample receiving, fume hoods, Geiger counters and the thermometers used in freezers, coolers, water baths, timers and other similar equipment. This is not an all-inclusive list. Standards used for periodic verifications include NIST-certified weights for balance verification and NIST-certified thermometers for the verification of working thermometers. Some periodic verifications are performed by outside vendors such as balance verifications and the verification of Geiger counters.

9.3.3. Operational Calibration

Operational calibration is performed on a routine basis while using a measurement instrument or system. The calibration is directed by detailed requirements in method specific SOPs. Measurement instruments or systems which cannot pass initial calibration or fail ongoing calibration checks are taken out of service until they are repaired and a successful calibration is achieved.

9.3.4. Operational Calibration Verification

For all applicable analyses, an independent second source standard is used to verify instrument calibration. This second source standard is obtained or prepared from a source independent of that of the standards used for the initial calibration. That is, two standards either supplied by two different vendors or of differing lots from the same vendor, composed of the same target constituents, are used in order to ensure proper initial calibration. This second source is referred to as the initial calibration verification (ICV). Detailed requirements for initial calibration and ICV criteria are contained in method specific SOPs.

9.3.5. Calibration Records

All calibrations, whether periodic or operational, are documented and are retained per the quality record procedures outlined in the SOPs and/or Policies corresponding to the equipment.

9.4. Uncertainty Measurements for Results

All results have an inherent risk of uncertainty. When this uncertainty is due to measurable factors such as allowable variances due to prep (QC limits), allowable calibration variances (CCV limits), and/or equipment capabilities (smallest measurable increment), a statement can be made about the uncertainty of the result. Any tolerances should be applied to the results when assessing accuracy of data.

Each analytical SOP contains sections that list, wherever applicable, the established range of acceptable limits for QC such as the LCS and the MS. The LCS has in-house limits; these limits can be applied to the uncertainty of the result. The same is true for the calibration. If the calibration is allowed to drift 10%, the result could also reflect the same amount of drift.

Example: The LCS limits are established at 73-132% and the CCV is allowed a 90-110% window. The results could have a negative bias of 37% (27% + 10%) or a positive bias of 42% (32% + 10%) in the worst case scenario. Thus, a known standard of 100 mg/L could read in the range of 63 mg/L – 142 mg/L. This same amount of uncertainty could apply to all samples in the batch.

Example: An MS can be biased due to the matrix of the sample. If an MS recovery is 99%, and the CCV was allowed 90-110%, the results could have a negative bias of 11% (1% + 10%) or a positive bias of 9% (10% - 1%). A very low recovery would show a major bias and the data associated should be scrutinized by the end user. This type of bias applies only to the sample associated with the MS.

For tests that do not use conventional QC limits, other factors may apply. Many tests calculate the uncertainty from the smallest increment that is measurable. A titration can be calculated with an uncertainty that is equal to the smallest increment on the burette times the calculation used for that particular method. The burette for manual sulfide titration has 0.1 mL increments. This calculates to be 0.2 mg/L of sulfide. Therefore, any measurement has an uncertainty of 0.2 mg/L.

9.5. Standards and Reagents

9.5.1. Standards

Standards are materials containing a precisely known concentration of a substance for use in quantitative analysis. All standards used at EQI are supplied by approved vendors who can supply a certificate of analysis. All standards must be traceable to NIST, ASTM, ISO Guide 34 or equivalent where applicable. A more detailed procedure for the purchasing of standards can be found in the *Procurement of Laboratory Supplies, Services and Equipment* SOP [ME0015U].

All chemical reference standards used in calibration or in the preparation of spiked samples are prepared, documented, labeled and stored according to the analytical SOP and the *Preparation and Documentation of Laboratory Standards and Reagents* SOP [ME001HG].

9.5.2. Reagents

Reagents used in the preparation and/or analysis of samples are also required to be supplied by approved vendors who can certify the purity. Many analyses are performed at trace levels, therefore only reagents of the appropriate purity level are purchased. A more detailed procedure for the purchasing of reagents can be found in the *Procurement of Laboratory Supplies, Services and Equipment* SOP [ME0015U].

All reagents are prepared, documented, labeled and stored according to the analytical SOP and the *Preparation and Documentation of Laboratory Standards and Reagents* SOP [ME001HG].

9.5.3. Traceability

All standards are purchased from vendors who must document the quality of the materials they sell through certificates verifying NIST traceability, when available.

At receipt, all standards are given a unique identifying number (i.e. “EQI (Shealy) ID”) and the following is documented at a minimum:

- Lot number
- Receipt date
- Manufacturer
- Catalogue (part) number
- Expiration date

A more detailed procedure for ensuring traceability of standards can be found in the *Procurement of Laboratory Supplies, Services and Equipment* SOP [ME0015U]. Refer to the *Preparation and Documentation of Laboratory Standards and Reagents* SOP [ME001HG] for specific procedural guidance on standard preparation and documentation.

9.6. Data Recording

9.6.1. Recording Policies

To ensure data completeness and integrity, EQI adheres to data recording policies which govern the requirements for proper documentation of data and records. These policies are found in the *Logbook and Data Recording* SOP [ME0012T].

9.6.2. Rounding and Significant Figures

All analytical data must be reported in a consistent manner that reflects a standard method for rounding and establishing significant figures. The following policies have been established to ensure the proper handling and reporting of data with respect to rounding and the use of significant figures.

- LOQs must be expressed with the identical number of significant figures as the data to be reported.
- LOQs that are altered by calculation (dry weight or dilution factors) are rounded per the same rules as apply to analytical data, to yield the identical number of significant figures as the final data reported.
- Data must be rounded before comparison to the LOQ to determine if the result is a reportable number or should be reported as less than the LOQ or non-detect (ND).
- Data must be rounded before comparison to a control limit to determine acceptability.
- Software used to perform calculations must comply with the rounding rules of this policy.

- Data entry into the LIMS, where calculations may be made, requires the input of the maximum number of digits available from the analysis.

9.6.2.1. Rounding Rules

When the digit that immediately follows the one to be retained is less than five (5), the one to be retained stays the same (round down).

Example 1	8.54 = 8.5	round down
Example 2	3.8499 = 3.8	round down

When the digit that immediately follows the one to be retained is greater than or equal to five (5), the one to be retained is increased by one (1).

Example 1	7.76 = 7.8	round up
Example 2	4.6877 = 4.7	round up
Example 3	4.85 = 4.9	round up
Example 4	6.75 = 6.8	round up
Example 5	2.5501 = 2.6	round up

Microbiology results are rounded up to the nearest whole number.

9.6.2.2. Significant Figure Rules

Data Type	**Organic**	**Organic QC % Recovery**	**Inorganic**	**Inorganic QC % Recovery**	**RPD**
Method Blank	2	NA	2[B]	NA	NA
LCS/LCSD	3	A	3	A	A
MS/MSD	3	A	3	A	A
Duplicates	2	NA	2	NA	A
Surrogates	3	A	NA	NA	NA
Sample Results	2	NA	2[B]	NA	NA

[A] 2 Significant figures if value is < 100
3 Significant figures if value is ≥ 100

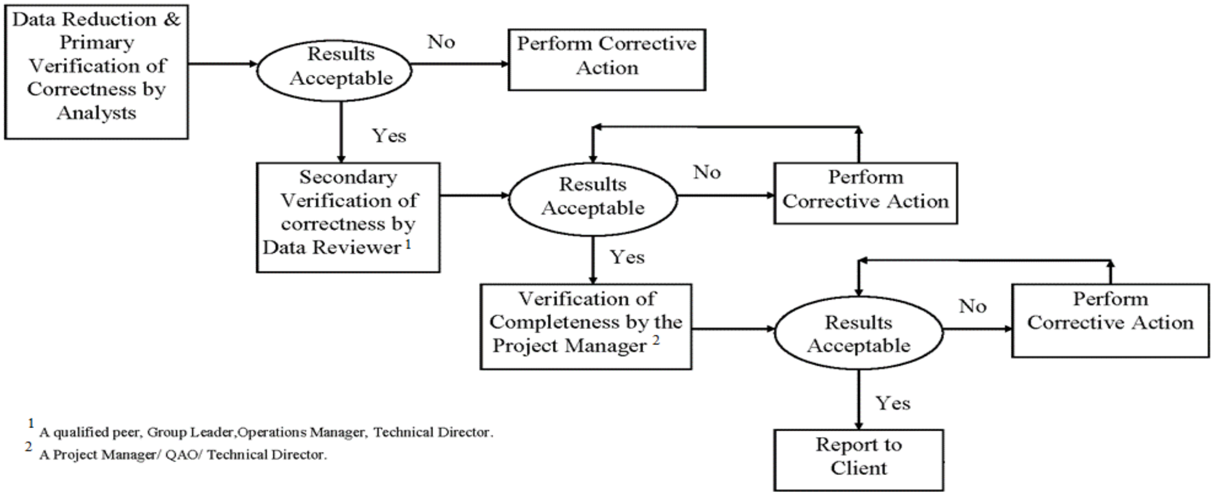
[B] For inorganic non-metals, significant figures will vary from method to method.

9.7. Data Review

All data generated by the EQI laboratory receives three (3) independent levels of review, each of varying comprehension and intensity. The three levels are:

- Data Reduction and Primary Verification (Level I)
- Secondary Verification (Level II)
- Verification of Completeness (Level III)

The review process is flow charted below.



[1] A qualified peer, Group Leader,Operations Manager, Technical Director.

[2] A Project Manager/ QAO/ Technical Director.

Figure 9.7-1: Data Review Process

Data is normally processed by an analyst in one of three ways:

- Manual computation of data/results in a logbook or on a batch sheet which is then entered into LIMS.
- Automatic transfer of data to LIMS via instrument or interim software. Data processing may occur prior to or completed in LIMs following transfer.
- Data entry into a spreadsheet where it is processed followed by entry into LIMS.

If data is processed by manual computation via the use of a spreadsheet, the analyst must provide all computation information including, but not limited to, the source of input parameters such as response factors, dilution factors, and calibration constants. If data is entered by an analyst and processed by a computer in a spreadsheet, the input must be saved and identified. If data is subsequently transferred to LIMS, the analyst must verify that all necessary information is entered correctly.

9.7.1. Data Reduction and Primary Verification (Level I Review)

Data reduction and primary verification of the data is executed by the analysts' performing the preparation and analysis. The data reduction and primary verification must ensure the following:

- Sample preparation information is complete and accurate and includes documentation of standards, solvent lot numbers, sample volume, and other key data as required by SOPs / Policies.
- Analytical information is complete and accurate including the proper identification of the analytical output such as chromatograms, charts, printouts and etc.
- Analytical results are complete and accurate including instrument calibration, verification, batch and / or instrument QC data and etc.
- The appropriate methods / SOPs have been used.
- Proper documentation procedures have been used.
- All non-conformances have been documented, with a properly completed NCM.
- The data generated has been recorded with the appropriate number of significant figures.

Initial data reduction and primary verification is documented in at least one of three ways:

- On a data review checklist, which is initialed and dated by the analyst.

- In LIMS with the analyst initials.
- In a logbook, spreadsheet, or on a batch sheet with the analyst initials and date.

9.7.2. Secondary Verification (Level II Review)

Upon the completion of data reduction and primary verification by the analyst, a second level of verification is performed. This secondary verification is performed by a peer, a Group Leader, a Data Specialist, the Operations Director, or the Technical Director.

This secondary verification includes the re-examination of all data reviewed and signed by the analyst, with emphasis on exceptions noted. Included in this review is an assessment as to the acceptability of data as per the following:

- Analytical procedure performed is the procedure requested.
- Adherence to the required SOPs.
- Correct interpretation of outputs such as chromatograms.
- Correctness of data before it is transferred into LIMS.
- Correct identification of constituents.
- Correct quantification of constituents
- Random check of 10% of all calculations for non-automated analyses.
- Review of data to ensure acceptability of calibrations, performance checks and etc.
- Acceptability of QC data.
- Review of data concerning standard concentrations and dilution factors.
- Sample holding time compliance.
- Nonconformance events have been addressed and corrective action, if appropriate, has been taken and documented on a properly completed NCM.
- Interpretations by the analyst are correct, as are any data review comments.

Secondary verification is documented in at least one of four ways:

- Reviewer’s initials and date on the data review checklist as secondary reviewer
- Reviewer’s initials in LIMS as secondary reviewer.
- Reviewer’s initials and date in spreadsheet as secondary reviewer.
- Inorganic Non-metals manual entry: double entry analyst’s initials in LIMS as secondary reviewer.

9.7.3. Verification of Completeness (Level III Review)

A third level review to verify the completeness of the data reported and the L3/L4 data package (if applicable) is required before results are submitted to clients. This final review is conducted by the project manager.

The items reviewed during this third and final verification are as follows:

- Analytical results are included for all samples analyzed.
- Every parameter or requested analyte is reported with a value or a limit.
- The proper reporting format is used.
- All appropriate preparation and analysis dates are identified as are the initials of the analyst.
- All non-conformances such as holding time violations and data evaluation qualifiers are clearly expressed.
- The final report package is per the EQI or the client specified format and contains all the required supporting documentation. The final review is documented by the reviewer by signing the final printed report.

9.7.4. Data Package Review (Level IV Review – Where Applicable)

A fourth level of review to verify that the L3/L4 data package contains all of the appropriate forms, summaries and data required and that all items are in the correct order is required before submitting a L3/L4 data package to the client. This review is conducted by a data package specialist. See the *Data Package Generation, Assembly and Review Policy* [ME001QX] or the *CLP Data Package Generation, Assembly and Review Policy* [ME0013C] for further details.

9.8. Data Evaluation and Corrective Action

The following sections detail the guidelines used for evaluation of QC samples and corrective action. QC acceptance criteria are outlined in section 9.8.9.

9.8.1. General Policy

Any measure of QC that fails to fall within established limits is considered a QC failure. QC failures must be documented and all associated data evaluated to determine an appropriate plan of correction. As it is impossible to address all data evaluation circumstances, EQI's guiding principal is to use established policies and procedures, along with good scientific evidence and judgment, to make sound data evaluations. When a QC failure occurs and a reanalysis and/or re-preparation indicates that the cause is not within the laboratory's control, no additional corrective action is required. The issue must be documented in the final report. When a QC failure occurs, it must be recorded as a nonconformance event. Sample matrix interferences are normally outside of the laboratory's control as they are a function of the method utilized. Therefore, failures due to matrix affect are documented in the final report. When systematic failures are identified, all analysis must cease until the problem is identified and control is restored. System non-conformances are addressed in section 10.1.4.

9.8.2. Method Blank (MB) Evaluation

A flowchart, which diagrams the evaluation of the MB, is located in Figure 9.8-1.

9.8.2.1. MB Acceptance Criteria for Data Reported to the LoQ

All analyte concentrations in the MB must be less than the LOQ or project specific reporting limits with the following exceptions:

- Samples in the batch show no detection of a contaminant found in the MB.
- The contaminant is not a target compound for samples in the batch.
- The analyte concentration in the samples is greater than 10 times the MB concentration (may be greater than 20 times the MB as per analytical SOP).
- If a MB contamination occurs and insufficient sample exists for re-extraction or re-analysis, any contaminant detections in the associated samples are flagged with a "B" on the final report.

9.8.2.1.1. MB Corrective Action (Data Reported to the LoQ)

The general corrective action requirement is to first reanalyze the MB, if the analytical SOP allows. If MB contamination is confirmed then the entire batch must be reprepared / reanalyzed.

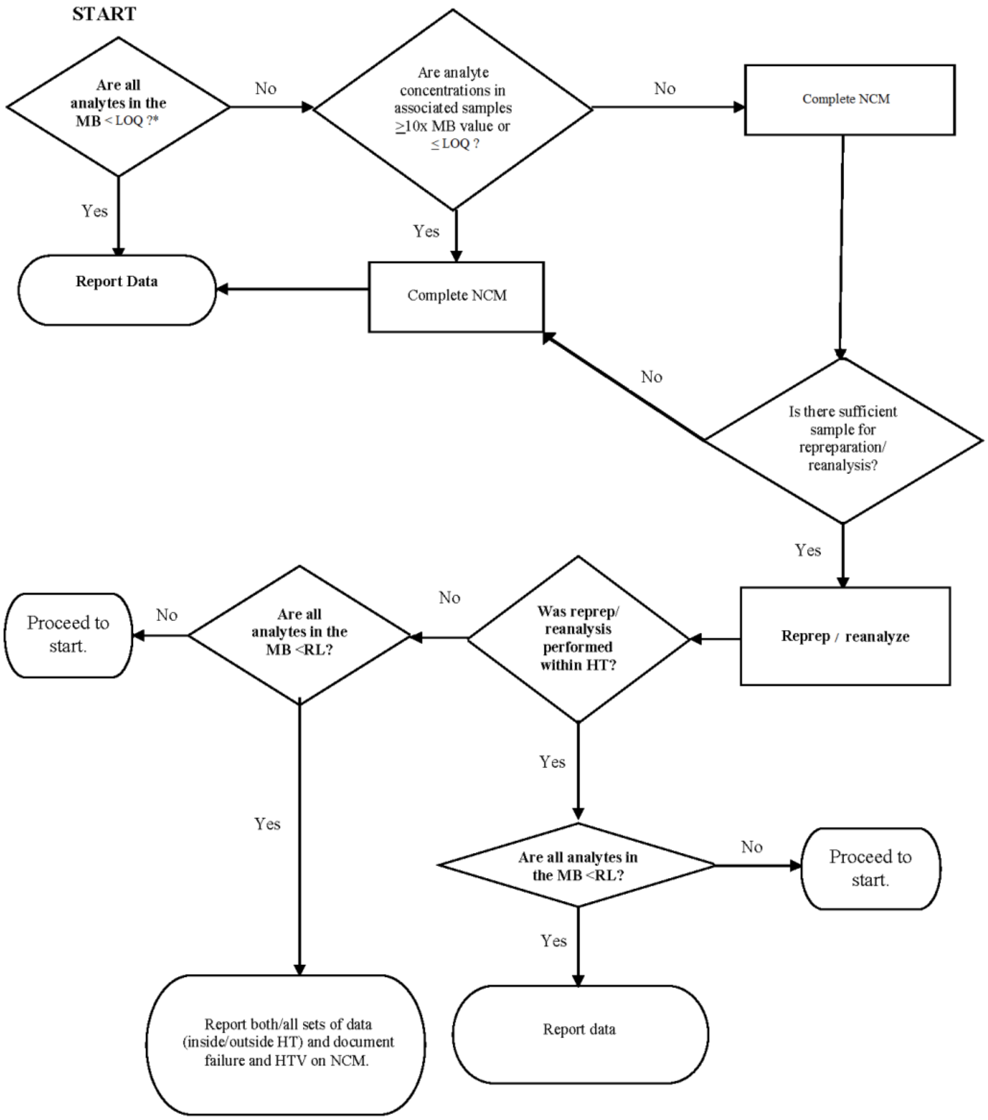
9.8.2.2. MB Acceptance Criteria for Data Reported to the MDL / LoD

For a method blank to be acceptable for use with the associated samples, the concentration of analytes detected in the blank must be ≤ LOQ or project specific reporting limits, unless specified by the method. The following exceptions apply:

- For DoD and NC samples, analytes in method blanks must be < 1/2 LOQ.

9.8.2.2.1. MB Corrective Action for Data Reported to the MDL / LoD

If the MB does not meet the criteria above, the source of the contamination must be investigated and measures taken to minimize or eliminate the problem. The affected samples must be reprepared / reanalyzed or the data must be appropriately qualified. All steps taken to return the system to control must be fully documented. If re-prep / re-analysis is not possible due to limited sample volume or holding time, then the samples associated with the contaminated blank must be appropriately qualified.



*Unless otherwise specified by the method. For DoD and NC samples, analytes in Method Blanks must be <1/2 LOQ.

Figure 9.8-1: MB Evaluation

9.8.3. Laboratory Control Sample (LCS) Evaluation

A flowchart, which diagrams the evaluation of the LCS/LCSD, is located in Figure 9.8-2.

9.8.3.1. Accuracy Expressed as LCS (or LCSD) % Recovery

$$\% \text{ Recovery} = \frac{X}{t} \text{x } 100$$

Where: X = observed concentration of spiked sample
t = actual concentration of spike added

9.8.3.2. LCS Acceptance Criteria

Laboratory Control Sample percent recovery must be within established limits. The following is an exception to LCS/LCSD acceptance criteria:

If the LCS recovery is greater than control limits and the sample results are < LOQ, the batch may be accepted for some but not all regulatory agencies. Specific regulatory agency or program requirements are found in the analytical SOPs.

9.8.3.3. LCS Corrective Action

The general corrective action requirement is to check all calculations, check the instrument performance, and reanalyze the LCS when the method/SOP allows. Where subsequent samples are associated with the failed LCS, or if the reanalyzed LCS recovery limits are still outside of control limits then the entire batch must be reprepared and reanalyzed.

9.8.4. Laboratory Control Sample Duplicate (LCSD) Evaluation

A flowchart, which diagrams the evaluation of the LCS/LCSD, is located in Figure 9.8-2.

9.8.4.1. Precision Expressed as LCS / LCSD RSD/RPD

9.8.4.1.1. Relative Standard Deviation (RSD)

$$\% \text{ RSD} = \frac{SD}{X} \text{ x } 100$$

Where: X = Mean of all measurements
SD = Standard deviation of all measurements

$$SD = \sqrt{\sum_{i=1}^{N} \frac{(x_i - \bar{x})^2}{N-1}}$$

Where: Xi = Individual measurement
N = Number measurements

9.8.4.1.2. Relative Percent Difference (RPD)

$$RPD = \frac{|X1 - X2|}{\frac{(X1 + X2)}{2}} \text{x } 100$$

Where: X1 = first observed concentration
X2 = second observed concentration

9.8.4.2. LCSD Acceptance Criteria

The Laboratory Control Sample Duplicate percent recovery must be within established limits. In order to maintain consistency for batches containing samples from more than one client, where one requires a single LCS and a second requires an LCSD, the first spike of the pair must be reported as the LCS. The precision for the pair must be within established limits.

9.8.4.3. LCSD Corrective Action

Check all calculations and instrument performance. If necessary, reanalyze the control sample and if it is still out of limits, re-prepare and reanalyze all samples in the QC batch. If either the LCS or the LCSD fails and the batch cannot be reanalyzed, the failure is noted and documented.

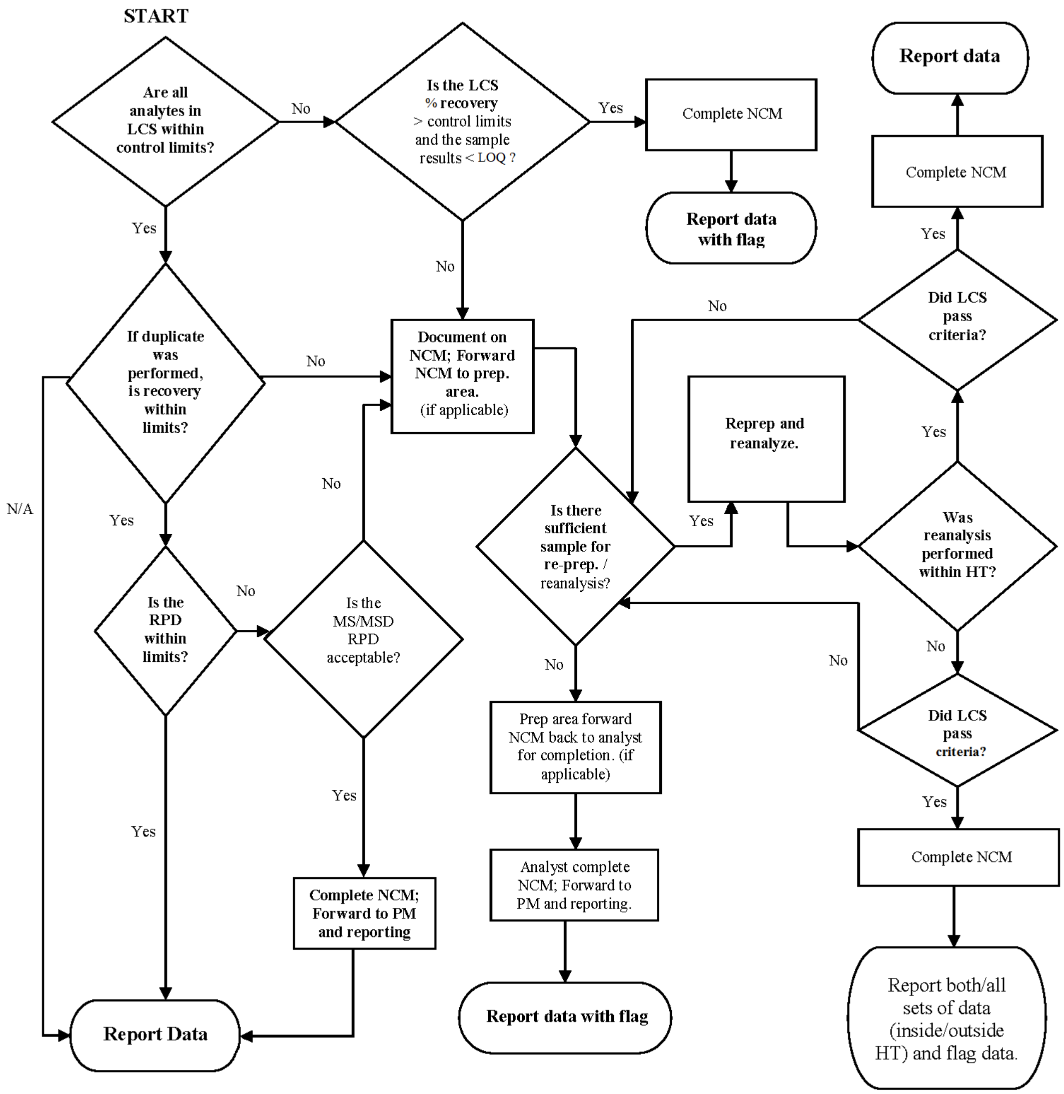


Figure 9.8-2: LCS / LCSD Evaluation

9.8.5. Surrogate Evaluation

A flowchart, which diagrams surrogate evaluation, is located in Figure 9.8-3.

9.8.5.1. Surrogate Acceptance Criteria

All batch QC such as the MB, LCS, and LCSD must have acceptable surrogate % recoveries. If any batch QC does not have acceptable surrogate recoveries, the same corrective action described for each QC sample must be followed. If field samples or MS/MSD samples require dilutions greater than or equal to 5X due to elevated target and/or non-target analytes, the surrogate acceptance limits do not apply with the exception of aqueous and non-aqueous liquid VOC analysis. Additionally, if objective evidence of matrix interference exists re-analysis and/or re-extraction may not be required. An NCM must be completed documenting this situation.

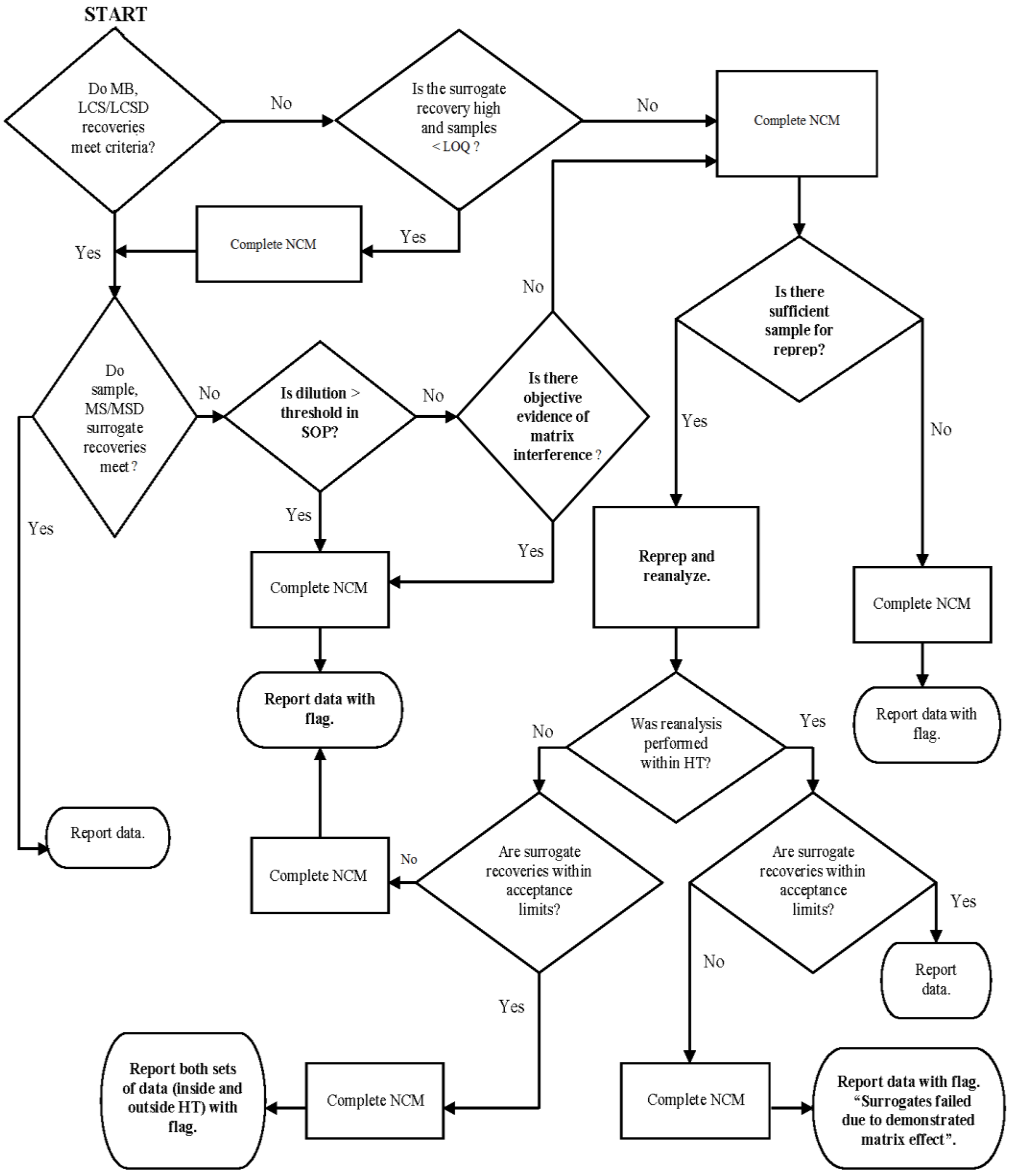


Figure 9.8-3: Surrogate Evaluation

9.8.6. Matrix Spike and Matrix Spike Duplicate (MS/MSD) Evaluation

A flowchart, which diagrams the evaluation of the MS/MSD, is located in Figure 9.8-4.

9.8.6.1. Accuracy Expressed as MS % Recovery

$$\%\ \text{Recovery} = \frac{Xs - X}{t} \text{x } 100$$

Where: Xs = observed concentration in spiked sample (MS)
X = observed concentration in unspiked sample
t = actual concentration of spike added

9.8.6.2. Precision Expressed as MS/MSD RSD/RPD

Refer to section 9.8.4.1 for RSD and RPD calculations.

9.8.6.3. MS/MSD Acceptance Criteria

MS and MSD percent recoveries and relative percent differences between MS and MSD recoveries must be within established limits. If MS and MSD samples require dilutions above the limits stated in analytical SOPs, control limits do not apply.

9.8.6.4. MS/MSD Corrective Action

If the LCS is in control, check all calculations and instrument performance. Determine if objective evidence of matrix interference is present such as non-homogeneous sample or interfering compounds as seen on chromatograms. The failure must be documented and noted on the final report.

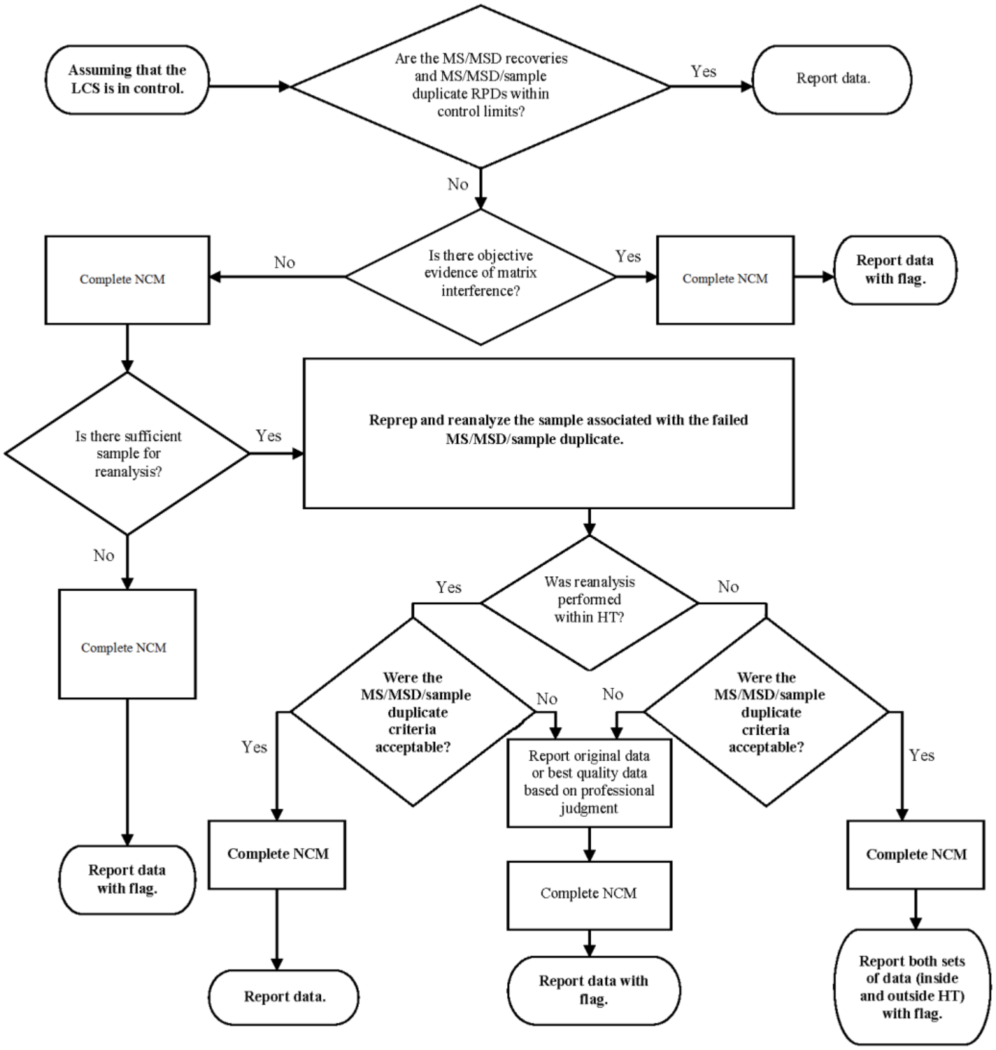


Figure 9.8-4: MS/MSD Evaluation

9.8.7. Sample Duplicate Evaluation

9.8.7.1. Precision Expressed as Sample Duplicate RPD

Refer to section 9.8.4.1 for RSD and RPD calculations.

9.8.7.2. Sample Duplicate Acceptance Criteria

The RPD for the sample and its duplicate must be within established limits.

9.8.7.3. Corrective Action

Check all calculations and instrument performance. The failure must be documented and noted on the final report.

9.8.8. Internal Standards

9.8.8.1. Internal Standard Acceptance Criteria

As defined in appropriate analytical SOP

9.8.8.2. Internal Standard Corrective Action

Re-analysis of sample or extract

9.8.9. QC Acceptance Criteria

For all analyses, QC acceptance criteria are found in the analytical SOPs and have been derived either from the published method, regulatory agencies or programs or from laboratory derived limits. For all organic analyses, where allowed by regulators, QC acceptance criteria may be statistically derived using a minimum of 20 data points.

Regulatory agency, program or client specific acceptance limits are often used rather than in-house and/or method derived limits. These specific limits are contained in the LIMS database. Program specific acceptance limits such as the DoD QSM may also be contained in analytical SOPs as appendices. Analysis QC acceptance criteria are determined by calculating mean and standard deviation values for the subject data per the following conventions (where s = standard deviation):

Organics LCS or LCSD Accuracy	All methods	Mean recovery ± 3s
Organics Surrogate Accuracy	All methods	Mean recovery ± 3s
Organics MS/MSD Accuracy	8000 series methods	Mean recovery ± 3s
Organics MS/MSD and DU Precision	8000 series methods	Zero to (mean RPD ± 3s)
Organics MS/MSD and DU Precision	Other methods	Zero to (mean RPD ± 3s)
Organics LCS/LCSD Precision	All methods	Zero to (mean RPD ± 3s)
Inorganic Parameters	All methods	Mean recovery ± 3s

If there is insufficient MS/MSD data available to calculate limits, LCS/LCSD limits may be used. If there is insufficient sample surrogate recovery data available to calculate limits, method limits may be used.

Control limits are set after the laboratory statistical performance is calculated and compared to limits published in reference methods. Evaluation of the statistical calculations versus the published limits is accomplished by the following tables.

9.8.9.1. Accuracy Evaluation

Lower Limit Evaluation	Upper Limit Evaluation	Accuracy Decision
lab generated lower limit > guidance limit	lab generated upper limit > guidance limit	use lab generated lower limit and guidance upper limit
lab generated lower limit > guidance limit	lab generated upper limit < guidance limit	use lab generated lower limit and lab generated upper limit
lab generated lower limit < guidance limit	lab generated upper limit > guidance limit	Use guidance lower limit and guidance upper limit
lab generated lower limit < guidance limit	lab generated upper limit < guidance limit	Use guidance lower limit and lab generated upper limit

9.8.9.2. Precision Evaluation

Range Evaluation	Precision Decision
Lab generated precision > guidance precision value	Use guidance precision
Lab generated precision < guidance precision	Use lab generated precision

Notes:

- Laboratory-generated range = calculated statistical range
- Published guidance range = (upper control limit – lower control limit)
- If the decision leads to limits that are significantly tighter than both the guidance limits and the calibration acceptance criteria for the method, the laboratory can default to using the laboratory-generated mean + calibration acceptance limit. Unreasonably tight statistical limits can result from exclusion of outliers from the database.
- If the decision is to use guidance limits from the method, the laboratory should investigate procedural improvements leading to better performance.

9.8.10. CLP QC Acceptance Criteria

For analyses performed under the EPA CLP SOW, all acceptance criteria and corrective actions are found in the individual SOPs for the SOM analysis of organics and the ISM analysis of inorganics.

9.9. Reporting of Data

9.9.1. Analytical Results

Analytical results are reported per analytical SOP or the client’s specifications. Results that are less than the LOQ are reported as a non-detect (ND) with the LOQ noted. Customized reporting formats are also available. A few examples are:

- If the lab is asked to report analytes of interest that are less than the LOQ but greater than the MDL, the data will be reported and flagged with an appropriate qualifier (J).
- If the lab is asked to report tentatively identified compounds (TICs) this data will be flagged with an appropriate qualifier.
- If a client specifies an LOQ in excess of the EQI limit, only those analytes found in excess of the client specified limit would be reported as positive values. All analytes of interest below the client specified limit would be reported as ND.

9.9.2. Verbal Results

EQI discourages the verbal release of both reviewed and un-reviewed analytical data. If a client requests verbal or hard copy results before final review, the results must be clearly identified as preliminary and are subject to change.

9.9.3. Report Format

EQI is capable of providing many report formats from relatively simple reports to “CLP like” L3/L4 data packages. We also offer other deliverables including electronic data transfer and a wide variety of electronic data deliverable (EDD) formats. EDDs can be customized based on client requirements.

9.9.4. Revisions to Reports

Any revision to a final report is documented via a *Revision Notice* form [ME001W6]. This notice is sent to the client, along with the revised report. In addition, a copy of the revised report and the revision notice is filed with QA. Any revisions must be verified for completeness before re-sending.

9.9.5. USEPA CLP Report Organization, Preparation, and Review

Forms for reporting data for the USEPA CLP contract are generated via LIMS. Package assembly and final review are performed by data specialists and encompasses the use of multiple software platforms. The laboratory produces a contract compliant L4 data package that meets all specifications of the SOM and the ISM SOW. CLP package assembly and final review is more specifically outlined in the *CLP Data Package Generation, Assembly and Review* policy [ME0013C].

10. Quality Assessment and Improvement

Quality assessment and improvement tasks are consistently and programmatically performed throughout each year. Examples of these activities include nonconformance memo monitoring, corrective action / preventive action investigations, nonconforming item reports, internal and external audits, management review, client complaint investigations and client survey evaluation.

Quality improvement projects may be launched anytime there is a perceived need to make a change or modify conditions that may affect quality. Examples of quality improvement projects are quality or service improvement, customer satisfaction enhancement, productivity improvement, waste reduction, removal of obsolete documentation, safety enhancement, cost saving, cycle time reduction, and work flow streamlining. Management must play an important part in steering and supporting the effort to ensure that conditions adverse to quality are prevented, identified promptly, corrected promptly and that actions are taken toward prevention, documented and actions tracked to closure. EQI employees are encouraged to initiate the quality improvement process by submitting their ideas to his/her Group Leader or any member of management.

10.1. Non-Conformance Events

Deviations from SOPs and Policies are documented in a nonconformance memo (NCM). Problems of various types and degrees of complexity are inherent in any analytical process. It is a major goal of the entire EQI organization to minimize the occurrence and potential severity of problems within our control, especially those that pose a threat to the generation of quality data. Resolutions to problem events or “nonconformance events” must be commensurate with the severity of the problem. In cases where a nonconformance event occurs, the problem and the solution are documented. EQI categorizes nonconformance events into the following four categories:

- Sample Receipt Nonconformance
- Quality Control Nonconformance
- Laboratory Nonconformance
- System Nonconformance

All types of nonconformance memos can and are used to identify trends in the analytical systems of the laboratory. When a trend is identified, a Corrective Action Preventive Action (CAPA) which includes an investigation into the root cause is initiated and solutions to the problem are implemented as needed. The NCM, CAPA and NIS procedures are outlined in the *NCM, CAPA, Client Complaints and Nonconforming Items and Services* SOP [ME001BO].

10.1.1. Sample Receipt Non-Conformance

As discussed previously in this document, all samples and documentation received with samples are rigorously reviewed during the sample receiving process to ensure and document the integrity of the sample collection, documentation, preservation, and shipping process. Sample receiving personnel document non-conformances at sample receipt on the *Sample Receipt Checklist* [SRC; ME0018C]. Examples of this type may include such things as temperature exceedances, container breakage upon receipt, samples requiring further preservation, and/or chain of custody versus client label discrepancies.

10.1.2. Quality Control Non-Conformance

Quality control non-conformances are documented through the generation of a properly completed nonconformance memo (NCM) during the first or second level of data review. A QC NCM is generated for any data reported outside method or SOP criteria but may still be of value to the end user. An example may include QC acceptance limits outside method criteria due to sample matrix. QC NCMs may also be reported on the final analytical report in the case narrative. The NCM application in the LIMS is used to generate NCMs which are automatically emailed to the appropriate employees as needed.

10.1.3. Laboratory Non-Conformance

A laboratory nonconformance may result from an isolated incident or from any instance where the laboratory cannot follow documented policies, procedures, and/or standard specifications. Examples may include such things as insufficient sample volume or improper preservation, dilutions due to difficult sample matrices, or container breakage with subsequent sample loss.

It should also be noted that an NCM is also completed prior to the rare case where the laboratory cannot follow documented policies, procedures, and standard specifications. An example would include a client request for a deviation from the standard method procedure. The proper level of laboratory management will review any departure from documented policies and procedures. These departures will be permitted only with the approval of the Laboratory Director, Technical Director and/or the QAO. The NCM application in LIMS is also used to generate laboratory non-conformances.

10.1.4. System Non-Conformance

A system nonconformance is a large and “non-isolated” deviation from stated policies, practices, and procedures. If uncorrected, a system nonconformance may result in a serious question as to the validity of a broad pool of data. A system nonconformance includes problems where stated practices are not followed and the ongoing malfunction of a measurement system without resolution. System non-conformances are documented with a corrective action and preventive action (CAPA).

10.2. Corrective and Preventative Action (CAPA)

The Corrective and Preventative Action (CAPA) application in EQLIMS issued to document compliance issues associated with Internal and External Audits (where required), Proficiency Test failures, NCM trend investigations, system non-conformances or other quality-related issues. Corrective action investigations help to eliminate the root cause of nonconforming events in order to prevent recurrence. Preventive actions help to determine and eliminate the root cause of potential non-conformances in order to prevent occurrence. The EQLIMS CAPA app is also used to track all corrective and preventive actions to completion.

10.3. Non-Conforming Items and Services (NIS)

A *Nonconforming Items and Services Report* [ME0024Q] documents items or services purchased by EQI that do not meet EQI’s quality requirements. For example, a standard purchased by EQI that does not meet the criteria stated on the Certificate of Analysis. Although this is a rare nonconformance, the potential for high impact to the quality of data is significant. An investigation is performed and the impact on data quality is evaluated. A corrective action is formulated and implemented.

10.4. Quality Assessment Audits

10.4.1. Audit Types

Audits of the laboratory are performed to assess the degree of compliance to stated policies, practices, and procedures. These audits are conducted by external agencies such as certifying bodies and clients, as well as internally by EQI personnel. The following is a list of audits routinely performed, along with a brief description of purpose and frequency. See the *Internal Audits and Data Report Review* SOP [ME0015T] and the *Performance Evaluation / Proficiency Testing* SOP [ME001IG] for more details.

Audit	Type	Description/Purpose	Frequency
Proficiency Testing (PT)	Internal & External	To verify the laboratory's ability to correctly identify and quantify compounds.	2 complete studies per year per program area
Data	External	Random selection of a final report in order to trace the overall process from sample receiving through data verification. Each step in the process is evaluated for proper documentation, evaluation, and verification of data.	Varies per assessing body
Field	Internal	Random selection of a field sampling event to assess the overall process from equipment preparation through collection technique and sample delivery to the lab	Internal – Annually External – Varies per assessing body
Procedural/ Technical	Internal & External	Internal audits are performed by the QAO, QA Specialist, QA Associate and/or Operations Director. Checklists such as the DOECAP checklist may be utilized.	Internal - Annually all areas of the lab must be audited. External - Varies per assessing body.
Quality Systems	Internal & External	A comprehensive review of the overall quality system.	Internal - Annually External - Varies per assessing body.

10.4.2. Audit Responses

Audit deficiencies, whether identified by external or internal auditors, warrant an expeditious response and correction timetable. Response to external audits must adhere to the time frame specified by the auditor if possible/practical. If not possible/practical, negotiated time frames must be agreed upon. A plan of action to correct audit deficiencies, as well as corrective action taken, must be documented.

The QAO has the responsibility to coordinate all external audit responses. The development of corrective action for both external and internal audits and implementation of corrective action is the responsibility of the Operations Director, the Technical Director, the Group Leaders and their staff. It is the responsibility of the QAO to monitor the progress of the implementation of the corrective action and inform the Operations Director, the Technical Director and the Group Leaders of perceived and actual implementation problems. If external or internal audit resolution cannot be achieved in a timely manner, the Laboratory Director must be made aware of the problem and its consequences. When any audit finding would have a significant impact on the validity of a result, notice of the finding is given to any client whose work may have been affected.

10.5. Management Review

A management review is conducted on an annual basis in order to evaluate the organization's quality and management systems, in order to ensure their continuing suitability and effectiveness, and to introduce any necessary changes or improvements. Further information concerning the annual management review is found in the *Management Review* policy [ME001HH]. The management review is prepared by the QAO on an annual basis.

10.6. Client Complaints

Client complaints are generally received from the Project Managers. Client complaints are recorded, on the *Client Complaint* form [ME001W8]. The form is completed and either a written or a verbal response is issued to the client by either a Project Manager, the QAO, the Operations Director, the Technical Director or the Laboratory Director. Completed complaint forms and responses are filed with QA. For a more detailed treatment of the client complaint process, see *NCM, CAPA, Client Complaint and NIS* SOP [ME001BO].

10.7. Client Surveys

In order to pro-actively take steps to monitor performance and service, EQI sends out *Client Survey* forms [ME001X0], to all clients once per year. Completed Client Surveys are submitted to the QAO. The surveys are reviewed and the results are presented to the management team. The completed surveys are filed with QA. After discussion and investigation, procedures or actions that can be improved upon based on client feed-back is evaluated for feasibility and initiated if no negative impact can be determined.

11. References

Source	**Source Reference**
DoD DOE QSM 5.3	Department of Defense Department of Energy Consolidated Quality Systems Manual (QSM) for Environmental Laboratories, Version 5.3, 2019
TNI 2009	The NELAC Institute Environmental Laboratory Sector. TNI Standard, 2009.
TNI 2016	The NELAC Institute Environmental Laboratory Sector. TNI Standard, 2016.
ISO 17025	ASTM International. International ANS / ISO / IEC Standard 17025, Second Edition, 2005.
ISO 17025	ASTM International. International ANS/ISO/IEC Standard 17025, Third Edition, 2017.
40CFR Part 136 - Appendix B	40CFR Part 136 - “Guidelines Establishing Test Procedures for the Analysis of Pollutants, Appendix B: “Definition and Procedure for the Determination of the Method Detection Limit”, Code of Federal Regulations, Revised July 1, 1995.
ASTM	1993 Annual Book of ASTM Standards, Section 11, Water and Environmental Technology, Volume 11.02, Water (II).
EPA QA / R-2	United States Environmental Protection Agency. EPA Requirements for Quality Management Plans, EPA QA / R-2, March 2001.
Standard Methods	Standard Methods for the Examination of Water and Wastewater, 21st Edition, 2011. Prepared and published jointly by: APHA, AWWA, and WEF.
SW-846	"The SW-846 Compendium." EPA. Environmental Protection Agency, 22 Feb. 2017. Web. 11 July 2017.
CLP (SOM)	US EPA CLP SOW SOM02.4 Organic Superfund Methods, Multi- Media, Multi-Concentration, October 2016.
CLP (ISM)	US EPA CLP SOW ISM02.4 Inorganic Superfund Methods, Multi- Media, Multi-Concentration, October 2016.

Appendix A: Synopses of Key Technical Staff

Daniel J. Wright – Laboratory Director & President/CEO

Mr. Wright provides the overall direction of the company and is responsible for laboratory operations. He is accountable for building a winning environmental lab team, posturing the laboratory to be recognized as the best single site facility in the country as measured by providing on-time defensible data in diverse markets (CWA though CLP) and organizational excellence. He directs the efforts of the operations group, the information technology group, the project management group, and the sales and marketing group. He initiates all major capital expenditures. He executes facility design to accommodate growth in targeted business sectors, systematically and continuously adding state-of-the-art instrumentation, automation, LIMS technology, and top-talent; all of which will drive revenue, profitability, and allow for the rapid expansion of our facility. Mr. Wright is an essential contributor to our quality and safety programs, and is intimately familiar with ISO17025 and GLP. He provides technical support on method development, automation, instrument performance, and production efficiency. He has over 29 years of experience in environmental chemistry, QA/QC, and project management in environmental laboratory settings.

B.S. Biology, 1986, Manchester College, North Manchester, IN
17 years with EQI

Dr. Robert Zhu – Technical Director

Dr. Zhu provides technical direction to all laboratory areas. He is directly responsible for managing our contract with the USEPA Contract Laboratory Program. Dr. Zhu is a contributor to our quality assurance program, and is intimately familiar with ISO17025 and GLP. He also drives LIMS initiatives and IT efforts. He provides technical support on method development, automation, instrument performance, and production efficiency. He has over 22 years of experience in environmental chemistry, QA/QC, and project management in environmental laboratory settings. Dr. Zhu is the company’s data integrity officer. As Alternate Radiation Safety Officer, he assists in the maintenance and compliance with EQI Radioactive Materials License program, policies, and procedures.

Ph.D. Physical Chemistry, 1994, University of South Carolina, Columbia, SC
19 years with EQI

Mike McFadden - National Sales Director

Mr. McFadden is the National Sales Director for Environmental Quantitation Incorporated. He is the primary contact for Federal Programs and the majority of the national contracts that EQI services. Mr. McFadden is responsible for the soliciting and procuring analytical work, contract negotiations and overall program management. Mr. McFadden has 26 years' experience in the Environmental industry.

B.S. Biology/Zoology 1986, North Carolina State University, Raleigh, NC
B.S. Biochemistry 1987, North Carolina State University, Raleigh, NC
12 years with EQI

Bradley E. Belding – Operations Director

Mr. Belding is responsible for overall laboratory quality, and timely delivery of data to our clients. He is responsible for laboratory group leaders including volatiles, semi-volatiles, extractions, metals, inorganics, data review, and expanded deliverable data packaging. Mr. Belding drives process improvement initiates, provides solutions to operational challenges, and conducts training events. Mr. Belding has 25 years of experience from one of Test America's (TA) flagship laboratories, located in North Canton, OH. While at TA, Brad managed extractions, semi-volatiles, and expanded deliverables reporting. He has extensive knowledge of the demands of this industry, and utilizes this knowledge to optimize processes, improve data quality, and increase employee engagement. Mr. Belding has over 28 years of experience in the environmental industry.

B.S. Chemistry, 1987 University of Akron, OH
6 years with EQI

Neil Magee – Analytical Manager

Mr. Magee is responsible for technical support of the laboratory including method optimization and development, instrument maintenance, analyst training, Level II data review, cost-reduction and ordering of supplies. Mr. Magee has over 15 years of experience in the environmental industry. His other duties include serving as a floating senior analyst, testing and development of LIMS enhancements and driving continuous improvement efforts.

B.S. 1994 Environmental Management, Louisiana State University, Baton Rouge, Louisiana
13 years with EQI

Stephanie Atkins – Quality Assurance Officer/ Environmental Health and Safety Officer/ Waste Manager/ Radiation Safety Officer

Mrs. Atkins functions as the Quality Assurance Officer, Environmental Health and Safety Officer, Hazardous Waste Manager, and Radiation Safety Officer for the analytical laboratory. As Quality Assurance Officer, Ms. Atkins is responsible for ensuring and improving overall quality within laboratory operations. She is responsible for providing initial safety and waste training to new personnel and all subsequent refresher trainings. Her duties also include performing laboratory safety audits and maintaining internal health and safety plans to ensure compliance with all state and federal regulations. Mrs. Atkins is also responsible for maintaining compliance with all state and federal waste and hazardous materials regulations. As Hazardous Waste Manager, she maintains EQI's compliance with all state and federal regulations. As Radiation Safety Officer, she maintains and enforces compliance with EQI Radioactive Materials License program, policies, and procedures.

M.S. 2018 Environmental Management, Webster University, St Louis, Missouri
B.S. 2007 Biology, University of South Carolina, Columbia, South Carolina
13 years with EQI

Eleanor C. Cuaresma – Project Manager/Sample Receiving & Shipping Group Leader

Mrs. Cuaresma is the sample receiving/shipping group leader for the company. She has over 24 years of environmental laboratory experience. Her primary duties include supervising the receipt of all samples in accordance with our quality assurance management plan and SOPs. This includes: verifying preservation of each sample, performing chain of custody receipt, completing the sample receiving checklist, and entering all the sample identification and analyses requested into the LIMS. Mrs. Cuaresma is responsible for ensuring cradle-to-grave internal chain of custody procedures are followed for all samples.

B.S. 1978 Chemical Engineering, University of St. Tomas, Manila, Philippines
15 years with EQI

Cheryl R. Melton - Information Technology

Ms. Baker performs network administration and is actively involved in LIMS programming and development. She previously served as our quality assurance officer, inorganics group leader, and was a bench analyst. Additionally, Ms. Baker has vast experience with metals data evaluation and reporting. She has assembled CLP and CLP like deliverables utilizing the LIMS and EISC MARRS. Her knowledge of the inner working of the laboratory, coupled with her computer skills, allows her to be a very effective programmer.

M.E. 2002 Computer Engineering, University of South Carolina, Columbia, SC
25 years with EQI

Fran Stone –Senior Data Specialist

Ms. Stone has over 20 years' experience in metals analysis. This includes sample digestion, mercury analysis, ICP-AES analysis (200.7, 6010, CLP ISM), ICP-MS analysis (200.8, 6020, CLP ISM), and data regression and review. She is responsible for the generation and assembly of all CLP ISM and expanded deliverable data packages. She serves an integral role in the testing and development of software systems including MARRS and LIMS and provides feedback on enhancements. She serves as a trainer for all analysts on applicable features of MARRS and any updates/revisions. Ms. Stone also performs Level I and Level II review of data and serves as a backup ICP-AES and ICP-MS analyst as needed. Ms. Stone has had a leadership role at the laboratory since her early days and continues that today in her current position

B.S. 1987 Biology, St. Augustine's College, Raleigh, NC
28 years with EQI

Stephen Somerville – PFAS Analyst

Mr. Somerville has over 2 years' experience with semi-volatiles and volatiles analysis. In the last year, he has developed our in-house PFAS methods which includes a modified 537 method including SPE preparation and isotope dilution analysis and a quick and dirty "dilute and shoot" method for screening. He has also been integral in setting up and validating our drinking water PFAS method (EPA 537).

B.S. 2010 Chemistry, Warren Wilson College, Swannanoa, NC
4 years with EQ

James Feldhaus – Metals Group Leader

Mr. Feldhaus has over 15 years' experience in metals analysis. He is responsible for metals analysis by 200.7/6010D and performs instrument maintenance. Mr. Feldhaus is the Inorganic Metals Group Leader and is responsible for scheduling and processing samples through the metals department, ensuring appropriate turnaround times are met, training new employees, ensuring QA objectives are met and reviewing SOPs for use and content. He performs and provides technical support on method development, method validation, automation and instrument performance. Mr. Feldhaus is the primary level 2 reviewer for all metals data when he is not the analyst.

B.S. 2000 Chemistry, North Carolina State University
2 year with EQI

Brittany Williams – Metals Analyst

Ms. Williams has over 8 years' experience in metals analysis. This includes sample digestion, mercury analysis, ICP-AES analysis (200.7, 6010, CLP ISM), ICP-MS analysis (200.8, 6020, CLP ISM), and data regression and review. She is a metals analyst and primarily analyzes samples by ICP-MS and ICP-AES. Ms. Williams performs data review, instrument maintenance and troubleshooting.

B.S. 2007 Biology, University of South Carolina, Columbia, SC
11 years with EQI

Tracy Fowler – Inorganics Group Leader

Mrs. Fowler is responsible for the overall supervision of the inorganics department and has 28 years of experience in the environmental laboratory industry. She manages the daily departmental workload of the laboratory's largest department ensuring that sample holding times and analysis due dates are met. Mrs. Fowler has experience in the analysis of volatiles and semi-volatiles by GC/MS. She also has deep experience in the analysis of anions by ion chromatography (300/9056). Her key responsibilities include the training of analysts, method development and optimization, data review, and SOP review. She also services as an analyst as needed.

B.S. 1983 Physics, University of Waterloo, Waterloo Ontario, Canada
8 years with EQI

James Geiger –Semi-Volatiles Group Leader

Mr. Geiger is responsible for the overall supervision of the GC/MS semi-volatiles department with over 6 years of experience in the industry. His duties include method development, training of analysts, analyzing samples, data review, SOP review and managing the daily departmental workload to meet deadlines. Mr. Geiger also assists in the daily organics supervision.

B.S. 2006 Biology, University of South Carolina, Columbia, SC
13 years with EQI

David Lucas –Extractions Group Leader

Mr. Lucas is responsible for the daily operation of the organic extractions department. He has been performing organic extractions and GPC on water, soils, sludge, and sediment samples in accordance with EPA methods for over two years.

B.S. 2007 Biology, University of South Carolina, Columbia, South Carolina
9 years with EQI

Erin Boyd – Volatiles Group Leader

Mrs. Boyd has over 16 years' experience in volatiles analysis. This includes sample preparation and GC/MS analysis for various EPA methods (i.e. 8260, 624, RSK-175). She is a volatiles analyst and primarily analyzes samples by GC/MS. Mrs. Boyd performs data review, instrument maintenance and troubleshooting.

B.S. 2000 Chemistry, Dickinson College, Carlisle, PA
3 year with EQI

Grant R. Wilton – Project Manager

Mr. Wilton has over 25 years of experience in the environmental industry and over 15 years' experience as a project manager. Mr. Wilton's Project Manager duties include management of client project activities from sample receipt through data review and report generation.

B.S. 1981 Water Science, Northern Michigan University, Marquette, Michigan
12 years with EQI

Lucas J. Odom – Project Manager / Laboratory Director - Greenville

Mr. Odom is the Project Manager for many of our South Carolina and North Carolina NPDES clients as well as our SCDHEC drinking water program. Mr. Odom has past experience as our field service assistant group leader where he gained valuable knowledge of many sampling techniques including: composite sampling, well sampling, soil sampling, and LL-Hg sampling. As a Project Manager, his duties include management of client project activities from sample generation through data review and report generation.

M.S. 2008 Environmental Health Sciences, University of South Carolina
11 years with EQI

Nisreen M. Saikaly –Project Manager

Mrs. Saikaly functions as the project manager for our government, and government like deliverable client base. As the primary point of contact for these clients, she provides cradle-to-grave project management for continuing projects as well new projects. Her duties include planning kick-off meetings, providing price quotations, coordinating sample kit shipping, reviewing Chain of Custody (COC) information against information entered into LIMS, communicating any COC discrepancies and sample analysis anomalies to client, providing updates on project status, monitoring client-specified TAT, assuring deliverable requirements are met, and final review and release of reports. Mrs. Saikaly's experience includes being an analyst in the laboratory as well as QA. Her QA experience allows her to assist with regulatory-specific methods and special project requirements and QAP review.

B.S. 2002 Chemistry, University of Toronto, Toronto Canada
13 years with EQI

Kelly M. Nance –Project Manager

Ms. Nance functions as the project manager for our NPDES projects in NC and SC as well as project specific accounts. She will also be managing all new accounts from TN, GA, AL and MS. Ms. Maberry has over 7 years' experience as a PM as well as being an analyst in the Sample Receiving Dept. for 3 years. Her experience with the Laboratory Information Management System (LIMS) and logging in analytical assignments from Chain of Custody forms allows her to accurately assess correct method assignment and project specific requirements. She is highly knowledgeable regarding method specific parameters that require special attention from lab personnel (short hold times, preservation requirements, etc.).

B.S. 1995 Biology, University of South Carolina, Columbia, South Carolina
9 years with EQI

Cathy Dover – Project Manger

Ms. Dover has over 32 years of experience in the environmental laboratory with over 16 years as a project manager. Ms. Dover manages commercial clients as well as USEPA Contract Laboratory Program. As the primary point of contact for these clients, she provides cradle-to-grave project management for continuing projects as well new projects. Her duties include planning kick-off meetings, providing price quotations, coordinating sample kit shipping, reviewing Chain of Custody (COC) information against information entered into LIMS, communicating any COC discrepancies and sample analysis anomalies to client, providing updates on project status, monitoring client-specified TAT, assuring deliverable requirements are met, and final review and release of reports. Ms. Dover has a wide range of experience that includes being an analyst to working sample receiving/shipping as well as QA. All of this experience allows her to assist with regulatory-specific methods and special project requirements.

1980 - 1983 Chemical Engineering / Chemistry / Science Education, North Carolina State University, Raleigh, NC
3 years with EQI

REVISION HISTORY

Revision #	Revision Date	Section Modified	Modification	Reason for Modification
-08	10/24/2018	Title Page	Quality Assurance Officer updated from Wendy Plessinger to Stephanie Atkins	Personnel change
		Title Page	Lucas Odom added as Laboratory Director - Greenville	New position added
		Appendix A	Removed Cal Easter	Personnel change
		Appendix A	Removed Wendy Plessinger	Personnel change

Revision #	Revision Date	Section Modified	Modification	Reason for Modification
-09	06/25/2019	2.4.2	Updated to specify applicability of DOCs to both analysis and preparation procedures	Clarity
		1.1	Added reference to Certification and Permits Summary	Clarity
		11	Updated QSM reference to reflect currently adopted standard; added reference to TNI 2016 and ISO 17025:2017	Maintain reference to currently adopted standards/reference documents

Addendum to the Quality Assurance Management Plan

This addendum contains the following documents:

- Management and Organizational Chart [ME0018S]
- Organizational Chart [ME0013A]
- Major Operational Equipment List [ME001PM]
- Certification List [ME001PL]
- EQI Analytical Methods [ME002BS]
  - Sample containers, preservatives, and holding times
  - Analytical SOP list
  - Parent method list
- SOP and Policy List [Generated via EQLIMs]

These documents are not contained in the pagination of the QAMP and may change without revision to the QAMP.

FINAL

August 2020

FINAL UNIFORM FEDERAL POLICY-QUALITY ASSURANCE PROJECT PLAN ADDENDUM

Yakima Training Center

Yakima, Washington

Joint Base Lewis-McChord Public Works – Environmental Division

IMLM-PWE

MS 17 Box 339500
Joint Base Lewis-McChord, Washington 98433

Uniform Federal Policy-Quality Assurance Project Plan Addendum

USAEC PFAS PA/SI
Yakima Training Center, WA

Prepared for:

U.S. Army Corps of Engineers
Contract: W912DR-18-D-0004
Delivery Order: W912DR18F0685

Prepared by:

Arcadis, U.S., Inc.
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Our Ref.:

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Date:

August 2020

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Site Inspection Project Manager

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Rhonda Stone, PMP
Project Manager

Joseph Quinnan, PG/PE
Technical Lead

CONTENTS

Table

Figures

Attachments

List of Acronyms and Abbreviations

%	percent
ºF	degree Fahrenheit
AFFF	aqueous film-forming foam
AOPI	area of potential interest
Arcadis	Arcadis U.S., Inc.
Army	United States Army
bgs	below ground surface
B.S.	Bachelor of Science
CAS	Chemical Abstracts Service
CERCLA	Comprehensive Environmental Responsibility and Compensation Liability Act
CFR	Code of Federal Regulations
CPR	cardiopulmonary resuscitation
CSM	conceptual site model
DoD	Department of Defense
DQO	data quality objective
EB	equipment blank
FB	field blank
FD	field duplicate
GW	groundwater
HAZWOPER	Hazardous Waste Operations and Emergency Response
IDW	investigation-derived waste
installation	United States Army and Reserve installation
LHA	lifetime health advisory
LOD	limit of detection
LOQ	limit of quantitation
M.S.	Master of Science
mg/kg	milligram per kilogram
MS	matrix spike
MSD	matrix spike duplicate
N	normal (parent sample)
N/A	not applicable
ng/L	nanogram per liter
OSD	Office of the Secretary of Defense
OSHA	Occupational Safety and Health Administration
PA	preliminary assessment
PFAS	per- and polyfluoroalkyl substances
PFBS	perfluorobutanesulfonic acid
PFOA	perfluorooctanoic acid
PFOS	perfluorooctane sulfonate
POC	point of contact
ppm	part per million
PQAPP	Programmatic Uniform Federal Policy-Quality Assurance Project Plan
PSL	project screening level
QA	quality assurance
QAPP	Quality Assurance Project Plan

List of Acronyms and Abbreviations

QC	quality control
QSM	Quality Systems Manual
RCRA	Resource Conservation Recovery Act
SAIC	Science Applications International Corporation
SB	source blank
Shealy	Shealy Environmental Services, Inc.
SI	site inspection
SO	soil
SOP	standard operating procedure
SSHP	Site Safety and Health Plan
SW	surface water
TGI	technical guidance instructions
TOC	total organic carbon
U.S.	United States
UFP-QAPP	Uniform Federal Policy-Quality Assurance Project Plan
USACE	United States Army Corps of Engineers
USAEC	United States Army Environmental Command
USEPA	United States Environmental Protection Agency
YTC	Yakima Training Center

INTRODUCTION

A Programmatic Uniform Federal Policy-Quality Assurance Project Plan (PQAPP; Arcadis U.S., Inc. [Arcadis] 2019) was developed and submitted as final in October 2019. The PQAPP addresses the per- and polyfluoroalkyl substances (PFAS) preliminary assessment (PA) and site inspection (SI)-phase sampling at active United States (U.S.) Army (Army) installations (installations) within the U.S. Perfluorooctane sulfonate (PFOS), perfluorooctanoic acid (PFOA), and perfluorobutanesulfonic acid (PFBS) are three of the most abundant PFAS and are recognized by the U.S. Environmental Protection Agency (USEPA) as chemicals of emerging concern that present potentially unacceptable human health and environmental impacts. The purpose of this site-specific Quality Assurance Project Plan (QAPP) Addendum is to supplement the PQAPP, detail the planning processes for collecting data, and describe the implementation of the quality assurance (QA) and quality control (QC) activities developed for the PA/SI sampling proposed at Yakima Training Center (YTC) in Yakima, Washington. The objectives of the PQAPP and this QAPP Addendum are to generate project data that are technically defensible and useful in meeting the Army's PFAS PA/SI project goals. Project goals include identifying the presence or absence of PFOS, PFOA, and PFBS at areas of potential interest (AOPIs), identifying the presence or absence and the nature of other PFAS, and updating AOPI conceptual site models (CSMs), which will be detailed in a PA/SI Report.

This QAPP Addendum addresses three primary elements:

- Project management
- General CSM description
- Site-specific investigation design and data acquisition

The site-specific worksheets in this QAPP Addendum for YTC supplement the general programmatic information provided in the PQAPP. **Table 1** presents a crosswalk between the PQAPP and the YTC QAPP Addendum. Site-specific details provided in this QAPP Addendum include sampling locations, media, methodologies, and procedures. Should site conditions warrant deviation from the prescribed procedures in this QAPP Addendum, the stakeholders defined in **Worksheet #4** of this QAPP Addendum will be consulted following the specific communication pathways described in Worksheet #6 of the PQAPP before changes to the sampling plan are made. Additionally, a non-conformance report summarizing the sampling deviations will be issued and attached as an appendix to the PA/SI Report, if necessary (i.e., if data quality objectives [DQOs] are affected and corrective action is needed).

Table 1. Crosswalk: PQAPP to YTC QAPP Addendum

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

QAPP ADDENDUM WORKSHEET #1 & #2: TITLE AND APPROVAL PAGE

(Uniform Federal Policy-Quality Assurance Project Plan [UFP-QAPP] Manual Section 2.1)
(USEPA 2106-G-05 Section 2.2.1)

1. Project Identifying Information:
    a. Site name/project name: U.S. Army Environmental Command (USAEC) PFAS PA/SI
    b. Site location/number: Yakima Training Center, Yakima, Washington
    c. Contract/work assignment number: W912DR-18-D-0004 / W912DR18F0685
2. Lead Organizations: U.S. Army Corps of Engineers (USACE), USAEC, and YTC
    a. USACE Regional Point of Contact (POC), Kansas City District

    ____

    Ms. Amanda Chirpich Date

    b. YTC USAEC Environmental Support Manager

    ____

    Mr. Martin Roberts Date

    c. YTC Directorate of Public Works Installation Restoration Program Manager

    ____

    Ms. Meseret Ghebresllassie Date
3. List plans and reports from previous investigations relevant to this project:

Author/Title	Date
Arcadis. Final Programmatic Uniform Federal Policy-Quality Assurance Project Plan, USAEC PFAS PA/SI, Active Army Installations, Nationwide, USA.	October 2019

QAPP ADDENDUM WORKSHEET #4, #7, & #8: PERSONNEL QUALIFICATIONS AND SIGN-OFF SHEET

(UFP-QAPP Manual Sections 2.3.2 – 2.3.4)
(USEPA 2106-G-05 Sections 2.2.1 and 2.2.7)

This worksheet is used to identify key site-specific personnel for each organization performing tasks defined in this QAPP Addendum.

LEAD ORGANIZATIONS: USACE, USAEC, and YTC

Name	Agency	Project Title/Role	Signature[1] (check box)
Ms. Amanda Chirpich	USACE	Regional POC	☐
Mr. Martin Roberts	USAEC	Environmental Support Manager	☐
Ms. Meseret Ghebresllassie	YTC	Directorate of Public Works Installation Restoration Program Manager	☐

[1] Signature check boxes indicate personnel have read and agree to implement this QAPP Addendum as written

ORGANIZATION: Arcadis

Name	Project Title/Role[1]	Education/Experience	Specialized Training/Certifications	Signature[2] (check box)
Hoa Voscott	Site Inspection Project Manager	Bachelor of Science (B.S.), Civil Engineering, 27 years of experience. Site investigation and remediation experience, specifically innovative groundwater remedial actions. Project manager for commercial and federal performance-based projects.	• Professional Engineer, California • Occupational Safety and Health Administration (OSHA): Initial 40-Hour Hazardous Waste Operations and Emergency Response (HAZWOPER) • OSHA: HAZWOPER 8-Hour Refresher 29 Code of Federal Regulations (CFR) 1910.120(e)(8)	☒

Name	Project Title/Role[1]	Education/Experience	Specialized Training/Certifications	Signature[2] (check box)
Joe Quinnan	Technical Lead	B.S. Geological Engineering, Master of Science (M.S.) Geological Engineering. 28 years of experience. Global lead for site characterization, North American lead for emerging contaminants.	• Professional Geologist • Professional Engineer	☒
Olivia Miller	Task Manager, Installation Support, Field Sampling Staff, Site Safety and Health Officer	B.S. Environmental Science, M.S. Geology. 6 years of experience. Comprehensive Environmental Responsibility and Compensation Liability Act (CERCLA) reporting; site characterization through groundwater, soil, surface water, and sediment sampling, drilling oversight (direct push technology, hollow stem auger, and rotosonic methods) and monitoring well installation; and CSM development.	• Professional Geologist, Texas • OSHA: Initial 40-Hour HAZWOPER • OSHA: HAZWOPER 8-Hour Refresher 29 Code of Federal Regulation (CFR) 1910.120(e)(8) • OSHA: 8-Hour Site Supervisor • OSHA: 30-Hour Construction Safety • First Aid/Cardiopulmonary Resuscitation (CPR)	☒
Nick Henwood	Field Sampling Staff	B.S. Geology, M.S. Geology. 3 years of experience. CERCLA reporting; site characterization through groundwater, soil, and surface water sampling (including drilling oversight and monitoring well installation).	• OSHA: Initial 40-Hour HAZWOPER • OSHA: HAZWOPER 8-Hour Refresher 29 CFR 1910.120(e)(8) • First Aid/CPR	☒

[1] Field sampling personnel may be subject to change based on staff availability.
[2] Signature check boxes indicate personnel have read and agree to implement this QAPP Addendum as written.

QAPP ADDENDUM WORKSHEET #9: PROJECT PLANNING SESSION SUMMARY

(UFP-QAPP Manual Section 2.5.1 and Figures 9-12)
(USEPA 2106-G-05 Section 2.2.5)

Programmatic project planning session summaries are provided in Worksheet #9 of the PQAPP. The project planning session summary presented below is that which is specific to the USAEC PFAS PA/SI activities at YTC. Meeting minutes summarizing the planning session are provided in **Attachment 1**. The key participants who have been involved in the YTC SI Planning Session are listed below.

Name	Initials	Organization	Title/Role	Email
Meseret Ghebresllassie	MG	YTC	Installation Restoration Program Manager	Meseret.C.Ghebresllassie.civ@mail.mil
Amanda Chirpich	AC	USACE, Kansas City District	POC	Amanda.Chirpich@usace.army.mil
Karah Haskins	KH	USACE, Seattle District	Chief Environmental Engineer	Karah.A.Haskins@usace.army.mil
Bill Gardiner	BG	USACE, Seattle District	Risk Assessor	William.W.Gardiner@usace.army.mil
Wendy Stonestreet	WS	USACE, Kansas City District	Technical Review	Wendy.E.Stonestreet@usace.army.mil
Martin Roberts	MR	USAEC	Environmental Support Manager	Martin.E.Roberts.civ@mail.mil
Kimberley Schrupp	KS	Arcadis	SI and Deputy Project Manager	Kimberley.Schrupp@arcadis.com
Rhonda Stone	RS	Arcadis	Project Manager	Rhonda.Stone@arcadis.com
Olivia Miller	OM	Arcadis	Installation Support Staff	Olivia.Miller@arcadis.com
Nick Henwood	NH	Arcadis	Installation Support Staff	Nick.Henwood@arcadis.com

Date of Planning Session: 09 March 2020
Location: Teleconference
Purpose: SI Kickoff and Scoping Teleconference
Participant Initials: MG, AC, KH, BG, WS, KS, RS, OM, NH

Summary of discussion topics: See meeting minutes included as **Attachment 1**.

Documented Changes since Planning Session: See meeting minutes included as **Attachment 1**.

Date of Planning Session: 02 June 2020
Location: Teleconference
Purpose: SI Additional Storage Areas Scoping Teleconference
Participant Initials: MG, AC, KH, BG, MR, KS, OM, JQ

Summary of discussion topics: Under direction of USACE, AFFF storage areas originally categorized as non-AOPIs in the Final PA Report for YTC should be sampled as part of the SI. See meeting minutes included as **Attachment 1**.

Documented Changes since Planning Session: Three AFFF storage areas at YTC are now included as additional AOPIs and will be sampled as part of the SI. See meeting minutes included as **Attachment 1**.

QAPP ADDENDUM WORKSHEET #10: CONCEPTUAL SITE MODEL

(UFP-QAPP Manual Section 2.5.2)
(USEPA 2106-G-05 Section 2.2.5)

Preliminary CSMs for YTC AOPIs included in the PA/SI sampling scope of work are presented below. Data collected during the completion of the PA/SI sampling scope of work within this QAPP Addendum will be used to further develop CSMs for each AOPI in the PA/SI Report for YTC.

Background Information

YTC (originally known as the Yakima Firing Center) is a satellite installation of Joint Base Lewis-McChord and is located approximately 100 miles east of Joint Base Lewis-McChord and about 5 miles northeast of the city of Yakima (population 75,000; **Figure 1**). It encompasses 327,231 acres within Yakima and Kittitas Counties in central Washington state. The eastern border of the facility is the Columbia River. The YTC population is predominantly transient soldiers performing maneuvers, with a few permanent adult residents and on-site workers, and no children. Less than 500 military and civilians are permanently stationed at YTC including active duty service members, the Washington National Guard, the Army Reserves, and Marine Reserves members; transient units can swell the YTC population into the thousands for short periods. The only significant adjacent population center is Selah, to the west (population 6,300; YTC 2017).

Physical Setting

Topography and Climate

Information in this section is excerpted from the PA (Shapiro and Associates 1991), Resource Conservation Recovery Act (RCRA) Facility Assessment Report (Science Applications International Corporation [SAIC] 1995), and Periodic Review Report (USACE 2012) for YTC. YTC is located within the Walla Walla Plateau, a sub-province of the Columbia Plateau physiographic province. The area constitutes a transitional zone between the Cascade Mountains to the west and the main part of the Columbia Plateau to the east. The Walla Walla Plateau consists of a series of southeast-trending ridges and intervening valleys; this topography is a result of folding and uplifting of basalts and interbedded sediments of the Columbia Basalt Group (Shapiro and Associates 1991). Landforms in the Columbia Basin are characterized by irregular plains and table lands with moderate to high relief. Elevations on YTC vary from approximately 440 feet above mean sea level along the eastern border with the Columbia River to over 4,000 feet along some of the major east-west trending anticlinal and synclinal ridges (SAIC 1995). Continued uplift of the plateau has allowed streams and rivers to cut deeply into the basalts, resulting in steep-sided ravines. North-south trending drainages dissect the ridges and flow parallel toward the Columbia River to the east or the Yakima River to the west. In general, the western part of the installation is rolling to hilly, and the topography becomes increasingly rugged to the east in transition down to the Columbia River (Shapiro and Associates 1991).

YTC is located within the semiarid Columbia Basin, which is characterized by sagebrush/wheatgrass steppe and grasslands (SAIC 1995). Precipitation is generally limited to the winter months in the form of snow and averages 8.8 inches; winters are cool, and summers are hot and dry. Mean annual temperature is 51 degrees Fahrenheit (ºF). The average January temperature is 28 ºF and the average July temperature is 72 ºF. Prevailing winds are from the west-northwest in both seasons and are controlled by valley trends (Shapiro and Associates 1991). Average annual potential evapotranspiration is estimated to be between 25 and 37 inches which significantly limits local recharge to aquifers at the site from precipitation (USACE 2012).

Surface Water Hydrology

Information in this section is excerpted from the PA for the YTC (Shapiro and Associates, Inc. 1991), the Final RCRA Facility Assessment Report (SAIC 1995), and the Fort Lewis Grow the Army Final Environmental Impact Statement: Chapter 5 Affected Environment - YTC (Department of Defense [DoD] 2010). The dominant surface water bodies in the region around YTC are the Columbia River to the east and the Yakima River to the west. Both rivers flow from north to south in the vicinity of YTC. The Yakima River flows into the Columbia River approximately 120 miles downstream from YTC. The Columbia River's flow (more than 120,000 cubic feet per second) is regulated by a series of dams. Two major hydroelectric dams (Wanapum and Priest Rapids) are located on the Columbia River near the eastern border of YTC (SAIC 1995). The Columbia River receives runoff from several streams draining from the eastern side of YTC, including Hanson Creek, Alkali Canyon Creek, Corral Canyon Creek, Sourdough Canyon Creek, and Cold Creek. The Yakima River's flow (average of approximately 2,500 cubic feet per second) is regulated by the Roza Dam in the vicinity of YTC. The Yakima River receives runoff from several streams draining from the western side of YTC, including Squaw, Burbank, and Selah Creeks. Selah Creek receives flow from several on-post ephemeral drainages and springs (e.g., Selah Springs). High evapotranspiration and low precipitation limit surface runoff from YTC. Only Alkali, Cold, and Squaw Creeks are perennial; most other creeks and drainages are ephemeral though a few are intermittent following a large storm event (Shapiro and Associates, Inc. 1991). Though some flash runoff events may occur at YTC if rain falls on snow or frozen ground, flooding is not an issue within the YTC boundaries (DoD 2010).

Several springs (ranging from seasonal to perennial) and seeps also feed some streams. Approximately 148 springs have been developed at YTC to provide water for agriculture and livestock. Three surface water impoundments or ponds (Kiddies Pond, Taylor Pond, and Eaton's Pond) are located at YTC, supported by earthen dams to hold water year-round. Taylor Pond has historically been used primarily in support of fire suppression activities; Kiddies Pond is a fishing pond for juvenile use. Two irrigation canals divert water from the Yakima River in the vicinity of YTC to supplement irrigation water. Peak surface water runoff occurs during the winter-spring snowmelt period (Shapiro and Associates, Inc. 1991).

Geology and Hydrogeology

Information in this section is excerpted from the Periodic Review Report for YTC (USACE 2012) and the Groundwater Monitoring Report for the Fire Training Pit and Tracked Vehicle Repair/Old Mobilization and Training Equipment Site (Tetra Tech 2017). The YTC and surrounding region is underlain by a thick sequence of basalt lava flows with interbedded, weakly consolidated sediments. The lava flows, known collectively as the Columbia River Basalt Group, underlie much of eastern Washington, and have a total thickness of greater than 10,000 feet in parts of the region. Individual flows range from a few feet to more than 100 feet thick. Each flow typically consists of a vesicular or rubbly flow top, a relatively thick internal zone that has a hackly texture of random cooling joints, and lower zone that is characterized by columnar jointing perpendicular to the base of the flow (USACE 2012). Overlying the basalt sequence in the YTC vicinity is a sequence of sedimentary strata known as the Ellensburg Formation. This formation is composed of partially consolidated sand and gravel, and sediments ranging from unconsolidated sand, silt, and clay to weakly indurated sandstone, siltstone, and claystone. These sediments range from a few feet to several hundred feet thick and are generally thickest underlying lowland areas. Younger deposits that locally overlie the Ellensburg Formation and the Columbia River Basalt in the YTC area include unconsolidated quaternary alluvial sand and gravel along the stream channels and floodplains, alluvial fan deposits of silty sand and gravel along the flanks of the ridges, and windblown silt (loess) deposits (USACE 2012).

Within the Yakima Fold Belt, the Columbia River Basalt and Ellensburg Formation have been deformed into a series of east-northeast-trending anticlines and synclines. Owing to the relatively young age of this deformation, the anticlines are expressed as ridges and intervening synclines form valleys. The YTC cantonment area is mostly located within the synclinal valley between the anticlinal Yakima Ridge to the south and Umtanum Ridge to the north (Tetra Tech 2017).

Extensive folding of the sedimentary and Columbia River basalt strata in the area has created a complex groundwater system with highly variable hydraulic properties, depths to water, and flow directions at any given location at YTC. Groundwater in the region occurs principally within the following principal aquifers (not all are present everywhere across YTC): surficial unconsolidated alluvial deposits, sedimentary units (principally the sand and gravels) of the Ellensburg Formation, the Saddle Mountains Basalt, the Wanapum Basalt, and the Grande Ronde Basalt (Tetra Tech 2017).

The alluvial deposits are typically moderately to highly permeable, and groundwater within them generally is unconfined. The water table in these deposits is typically at or near the elevation of the nearby streams. In the Ellensburg Formation, groundwater is found in the gravel layers within the surficial sedimentary formations and can be either unconfined or confined by overlying finer-grained materials, depending on the thickness and composition of the formation. Within the sequences of basalt, groundwater is predominantly found within the weathered, more fractured contact zones and within sedimentary interflow zones (Tetra Tech 2017 and USACE 2012). The basalt flows and associated sedimentary interbeds form the most productive aquifer system in the region. Groundwater within this system occurs principally within fracture and rubble zones of the basalt flows and in the sand and gravel layers that occur between some of the flows. The water-yielding zones within this sequence range from a few feet to over 50 feet thick. Their lateral extent ranges from short distances or up to several miles, depending on the stratigraphic continuity of the water-bearing unit (USACE 2012).

Reported depths to groundwater range from 20 feet below ground surface (bgs) in stream valleys to more than 200 feet bgs at higher elevations at YTC. Groundwater springs occur where incised stream valleys intercept aquifers (Tetra Tech 2017). In the cantonment area of YTC, the uppermost groundwater occurs in shallow, perched zones (Selah Interbed Aquifer) in the vesiculated fractured basalt near the top or bottom of the Pomona Flow of the Saddle Mountain Basalt, depending on the area. Depth to groundwater can range from 10 to 100 feet bgs in the cantonment area, and the flow direction of the perched water is generally to the west and southwest off-post toward the Yakima River. The Selah Interbed Aquifer is underlain by a thick sequence of basalt flows within the Columbia River Basalt Group (Tetra Tech 2017).

A highly productive regional basalt aquifer underlies the cantonment area at depth. The groundwater at depth in this area occurs in basalt fractures and interbedded sediments. This flow system is presumably recharged from a considerably higher area farther up slope and is confined under pressure beneath less permeable strata consisting of basalt or fine-grained sediment (USACE 2012). Groundwater in the basalt aquifers generally flows westward toward the Yakima River with a more northwesterly flow component closer to the river (Ecology and Environment, Inc. 1993, SAIC 1995).

The drinking water supply for YTC is provided entirely from groundwater sources. Six wells (i.e., Pomona, Jordan, Badger Gap, Bowers, Multi-Purpose Range Complex, and Yakima Research Station wells) provide water for three permitted drinking water distribution systems located in the cantonment area and at the Yakima Research Station and the Multi-Purpose Range Complex (DoD 2010). Prior to distribution and use, this water is treated, typically at the wellhead, by chlorination. Water for the permitted drinking water distribution system in the cantonment area is stored in two tanks with a combined storage capacity of 1,130,000 gallons. Additional wells designated for potable water supply are located within the range/training areas (**Figure 1**) and have a combined storage capacity of 415,300 gallons (DoD 2010). Water from these remaining wells located throughout the range/training areas is treated as needed and is not part of the primary drinking water system (DoD 2010).

Known or Suspected Chemicals of Concern and Sources

In May 2016, the USEPA issued a lifetime health advisory (LHA) for PFOS and PFOA of 70 nanograms per liter (ng/L; USEPA 2016); subsequently, in 2016, the Army issued a guidance publication for PFAS assessments (Army 2016a, 2016b, 2016c). In response to these actions, the third Unregulated Contaminant Monitoring Regulation, and IMCOM Operations Order 16-088, Army installations began initial PFAS sampling in 2016 at water supply wells.

The Pomona well was sampled for 23 PFAS (including PFOS and PFOA) in April 2016. PFAS were detected at low concentrations (less than 10 ng/L combined, and less than the LHA); however, the laboratory utilized experienced severe quality control issues, and the data is considered unreliable. This data is excluded from **Attachment 2**. Follow-up sampling was therefore conducted in October 2016 at six drinking water and potable water supply wells: the Pomona, Bowers, Jordan, Multi-Purpose Range Complex, Badger Gap, and Yakima Research Station wells. The samples collected were analyzed for six PFAS; results were non-detect at all six wells for all six constituents analyzed, including PFOS, PFOA, and PFBS (**Attachment 2**).

In August 2019, 11 of the potable wells on-post were sampled for 14 PFAS (**Attachment 2**); all results were non-detect except at the Selah Airstrip well (which is installed in the perched aquifer to a total depth of 91 feet below ground surface and has a static water level of approximately 47 feet below ground surface). At the Selah Airstrip well, the water stand detections included PFOS (4.2 ng/L), PFOA (96 ng/L), and PFBS (11 ng/L). Concentrations of PFOA at the Selah Airstrip are greater than the USEPA LHA and the 2019 Office of the Secretary of Defense (OSD) risk screening levels (**Attachment 3**). The water stand is used to fast-fill vehicles and is supplied water via piping from the Selah Airstrip well. To evaluate PFAS in groundwater at its withdrawal point, follow-up samples were collected at the Selah Airstrip well house in November 2019; the well house samples yielded similar PFAS concentrations (**Attachment 2**). Water supplied from the Selah Airstrip production well (and water stand) has also been piped to buildings at the airstrip. Currently, however, the well pump has been turned off and is in no-use status.

Three AOPIs were identified during the PA; four additional areas were categorized as AOPIs following the PA due to additional available PFAS data and at the direction of the Army. A brief history for each of the locations is provided below. The AOPIs are shown on **Figures 2** and **3**.

Area Description	Relevant Site History
Former Fire Training Pit (YFCR-53)	The YFCR-53 Former Fire Training Pit site is in the northeast portion of the cantonment area and was identified as SWMU 59 in the 1995 RCRA Facility Investigation. The site was used to practice extinguishing fires two or three times per year from an unknown start date until 1987, with a single training event in 1990. Practice events consisted of saturating an open, unlined earthen pit with water, adding and igniting 500 to 1,000 gallons of waste fuel, and then extinguishing the fire. Given the period of operation, it is suspected that aqueous film-forming foam (AFFF) was used during the firefighter training activities. During the 1990s, the site was used for storing stockpiles of waste sand filter material and sediments from the adjacent vehicle wash rack treatment system (i.e., Bird Bath Wash Rack) as well as storing fuel bladders. A RCRA Facility Investigation was conducted in 2001 to determine the extent of petroleum impacts in soil, and based on the results, a removal action of

Area Description	Relevant Site History
	approximately 1,350 tons of petroleum-impacted soil was completed in 2003; much of the area was excavated to bedrock (approximately 8 feet; USACE 2012). The disposal location of the soil is not known; however, it has been documented that some of the excavated material was used as the excavation's own backfill and may therefore still contain PFAS. A 2016 groundwater monitoring report indicated that Teflon® bailers have been used to purge groundwater from the existing monitoring wells at the site (Tetra Tech, Inc. 2017).
Bird Bath Wash Rack	Retired installation personnel noted historical firefighter training activities (and therefore likely AFFF use) in the area prior to construction of the wash rack facility. Google Earth aerial imagery indicates that the current wash rack structure was built sometime between 1996 and 2003; the imagery of the area from 1996 appears to show a rectangular depression or bermed pit, potentially with a prop in the center where the wash rack pad is located. The area is adjacent to the YFCR-53 Former Fire Training Pit AOPI.
Refractometer Solutions Testing Area	East of the fire station storage facility, the asphalt parking lot was reportedly used for refractometer testing of mixed AFFF solutions from at least 1997 to 2004 (quarterly testing). The AFFF and water were mixed at this location, and some of the solution was discharged to the asphalt ground. Most of the solution reportedly dried up on the asphalt before it could flow to the ditch to the north of the parking lot; however, residual PFAS may have run off during precipitation events to the ditch (which flows to an oil/water separator that eventually leads to an outfall off-post). Based on its proximity to the old Tracked Vehicle Repair/Mobilization and Training Equipment Site where groundwater monitoring wells have been installed, groundwater may be expected to be encountered at 10 to 45 feet bgs near this AOPI.
AFFF Storage Area (Fire Department Bay, Building 321)	Two racks of firefighting agents including Class A foams and Class B foams remained in storage at this building at the time of the PA site visit. Some empty Class B AFFF containers have been repurposed to store Class A foams that have been drained from other equipment and scheduled for disposal. The fire department noted that these Class A foams stored in Class B containers were not used elsewhere due to cross-contamination concerns. A drain exists in the building that directs wastewater to the on-post wastewater treatment plant. There has been no evidence of a release.
AFFF Storage Area (Building 821)	Building 821 was formerly utilized as a storage area by the YTC fire department. Approximately one pallet of AFFF (consisting of 27 to 36 five-gallon containers) was historically stored here at the north end of the building near the loading dock. No drains exist in the building. There has been no evidence of a release.
AFFF Storage Area (Vehicle Maintenance Shop, Building 751)	An area south of Building 751 was formerly utilized by the YTC fire department to store AFFF. Two pallets of AFFF were reportedly stored outside, adjacent to Conex containers under a metal cover. There has been no evidence of a release.

Area Description	Relevant Site History
Selah Airstrip	Following completion of the PA, the Selah Airstrip was identified as an AOPI based on the detections of PFAS at the Selah Airstrip water stand and well house (non-potable water). The area of AFFF use at the airstrip is unknown. The former crash truck station (former Building 2065) was reportedly used in the 1980s and 1990s (U.S. Army Public Health Command 2010); personnel interviews indicated that an AFFF crash truck was parked outside and stored AFFF in its tank. However, there were no reports of AFFF use, leaks, or spills. The former crash truck station building was demolished in 2016.

Potential Receptors and Exposure Pathways

Potential receptors and exposure pathways based on current and/or reasonably anticipated future land uses for each of the installation's AOPIs are presented in the CSMs on **Figure 4** and **Figure 5**. The CSMs were prepared in accordance with the USACE Engineer Manual on Conceptual Site Models, EM 200-1-12 (USACE 2012). Based on the suspected or confirmed historical use of AFFF at the AOPIs, affected media are likely to consist of soil, groundwater, ephemeral surface water, and/or sediment. Release and transport mechanisms include dissolution/desorption from soil to groundwater, transport via sediment carried in and dissolution to stormwater and surface water, and recharge from surface water to groundwater. Human exposure pathways are shown as "potentially complete" or "incomplete" on the CSM figures. A potentially complete exposure pathway consists of a constituent source and release mechanism, a transport or retention medium, an exposure point where human contact with the impacted medium could occur, and an exposure route at the exposure point. If any of these elements is missing, the exposure pathway is incomplete.

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

- Site workers (i.e., installation personnel) could contact constituents in soil via incidental ingestion, dermal contact and inhalation of dust; therefore, the soil exposure pathways for on-installation site workers are considered potentially complete. There are no on-post residences in the vicinity of the AOPIs, and the AOPIs are not likely to be accessed by on-installation residents and recreational users, or by off-installation receptors (except for members of the Yakama Nation, described as a separate receptor population in the CSM for the Selah Airstrip AOPI, below). Therefore, the soil exposure pathways for these receptors are considered incomplete.
- Groundwater originating at the AOPIs has the potential to flow off-post. The groundwater contained in the shallow aquifer above the confining layer may be used by off-post receptors. Therefore, the groundwater exposure pathways for off-post installation receptors are considered potentially complete.

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

Figure 4 shows the CSM for the following AOPIs: Former Fire Training Pit (YFCR-53), Bird Bath Vehicle Wash Rack Building 868, the Refractometer Solutions Testing Area, and the three AFFF Storage Areas (Buildings 321, 821, and 751). AFFF releases to soil and/or paved surfaces have been confirmed or suspected at these AOPIs.

- The AOPIs are upgradient or cross-gradient of the on-post drinking water wells (i.e., Pomona and Jordan wells). However, these wells are screened greater than 350 feet bgs, below a confining layer and are artesian. The deeper aquifer used for these drinking water wells is not hydraulically connected to the shallow aquifer beneath YTC. Therefore, the groundwater exposure pathways for on-post receptors (who obtain potable water sourced from the Pomona and Jordan Wells installed in the deep confined aquifer) are considered incomplete.

- Surface water bodies on-post are ephemeral (i.e., only flowing after heavy precipitation events) downgradient of the AOPIs and are not used for drinking water or recreation. On-installation site workers, residents, and recreational users are not likely to contact surface water and sediment; therefore, these exposure pathways are considered incomplete.
- Constituents are not likely to migrate from soil to off-post surface water bodies due to YTC's arid climate and ephemeral nature of on-post surface water features. Therefore, surface water and sediment exposure pathways for off-installation receptors are considered incomplete.

Figure 5 shows the CSM for the Selah Airstrip AOPI. AFFF use was not reported in the area; however, PFAS were detected in groundwater at the Selah Airstrip water stand and well house. Based on personnel interviews and the PFAS detections, it is likely that AFFF was historically released to soil and/or paved surfaces at this AOPI, although no leaks or spills were reported. A subsistence user was selectively added to the CSM for Selah Airstrip due to the known use of the on-post area around the airstrip by the Yakima Nation for subsistence activities (e.g., root digging, hunting, and fishing).

- Subsistence users could contact constituents in soil via incidental ingestion, dermal contact and inhalation of dust; therefore, the soil exposure pathways for on-installation subsistence users are considered potentially complete.
- Although the groundwater supplied by the Selah Airstrip well is not currently designated for potable use, groundwater from the well at the Selah Airstrip has the potential to be used by on-installation site workers (i.e., for dust suppression or other industrial activities). Therefore, the groundwater exposure pathway (via ingestion and dermal contact) for on-installation site workers is potentially complete. Groundwater in this area is not used as drinking water by on-installation residents, subsistence users, or recreational users. Therefore, the groundwater exposure pathways for these on-post receptors are considered incomplete.
- Surface water bodies on-post are ephemeral (i.e., only flowing after heavy precipitation events) and are not used for drinking water. Therefore, the surface water exposure pathways (via drinking water ingestion and dermal contact) for on-installation site workers and residents are considered incomplete. Site workers and residents are not likely to otherwise contact surface water and sediment via incidental ingestion or dermal contact; therefore, these exposure pathways are also incomplete. However, on-installation subsistence users and recreational users could contact constituents in Selah Creek through incidental ingestion and dermal contact; therefore, the surface water and sediment exposure pathways for these receptor populations are considered potentially complete.
- Surface water runoff from this AOPI drains to Selah Creek, which then flows a distance greater than 5 stream miles to the installation boundary before flowing off-post. Due to this distance, off-post surface water bodies are not likely to be impacted by the AOPI. Therefore, surface water and sediment exposure pathways for off-installation receptors are considered incomplete.

The preliminary CSMs will be further detailed in the PA/SI Report for YTC and will be updated based on the results of the SI.

Data Gaps

While PFAS has been detected in groundwater from one potable well at YTC, presence or absence of PFAS in groundwater, soil, surface water, and/or sediment has not been determined at every AOPI and will be investigated as part of this PA/SI. Additional groundwater, soil, surface water, and/or sediment samples will be collected to evaluate presence or absence at or near individual AOPIs. Groundwater and surface water samples will also be collected at the installation boundary. **Figures 6** through **11** show the proposed sampling locations for groundwater, shallow soil, surface water and/or sediment. **Worksheet #17** of this QAPP Addendum provides the rationale and sampling design for the PA/SI sampling scope of work to address the above data gaps. **Worksheets #18** and **#20** of this QAPP Addendum list the proposed sample identifications and required QC samples for each medium.

QAPP ADDENDUM WORKSHEET #11: PROJECT/DATA QUALITY OBJECTIVES

(UFP-QAPP Manual Section 2.6.1)
(USEPA 2106-G-05 Section 2.2.6)

This worksheet states the problem, identifies the goal of the study, identifies information inputs, defines boundaries of the sampling, develops the analytical approach, specifies performance or acceptance criteria, and identifies the developed plan for obtaining data in accordance with USEPA's 7-step DQO process, *Guidance on Systematic Planning Using the Data Quality Objectives Process* (USEPA 2006). This QAPP Addendum presents the selected investigation design and rationale in **Worksheet #17**, and the sampling summary in **Worksheet #18** and **Worksheet #20**.

Step 1: State the Problem:
PFOS, PFOA, and PFBS are recognized as PFAS that present potentially unacceptable human health impacts if ingested via drinking water. Initial findings of a PA identified three AOPIs at the installation; following the finalization of the PA, additional PFAS analytical data was made available and one additional AOPI was identified at the installation due to presence of PFAS in groundwater. These potential releases are primarily related to the use or storage of AFFF. The presence, types, and concentrations of potential PFAS at these AOPIs, the potential for human receptors (i.e., residential or industrial/commercial receptors) to contact PFAS-containing media via ingestion, dermal contact, or inhalation, and the relationship to previous detections of PFAS in groundwater have not been determined.
Step 2: Identify the Goal of the Study:
The primary goals of the sampling activities are to confirm PFAS absence or presence at individual AOPIs on the installation and refine the AOPI CSMs. The sampling activities as part of this PA/SI for YTC will be conducted in conformance with the 2018 Army Guidance for Addressing Releases of Per-and Polyfluoroalkyl Substances (Army 2018), DoD instructions 4715.07 (DoD 2013), and 4715.18 (DoD 2019a) and the DoD Manual 4715.20 (DoD 2012); the DoD Instructions 4715.18 requires DoD components to respond to emerging chemicals of concern like PFOS, PFOA, and PFBS.

Step 3: Identify Information Inputs:

The data needed to accomplish the goals of the sampling activities for this project are as follows:

- All information reviewed to date as part of the PA to identify the AOPIs, including: historical use and personnel’s accounts of historical activities, spill records, previous remedial actions completed, previous analytical data and validation packages
- Observations made during the site reconnaissance and conference calls after site visits, and during the investigation
- New analytical data from sampled media applicable to each AOPI, which may include groundwater, soil, surface water, and/or sediment, and which may be accomplished through sampling of existing monitoring or potable supply wells, soil boring advancement via hand auger, grab surface water collection, and sediment coring.
- Logs that include detailed descriptions where soil borings are advanced or sediment cores are collected.

Sampling will be limited to areas where AFFF (which contained PFAS, including PFOS, PFOA, and PFBS) use or storage is documented or areas that may have received PFAS-containing material. Parameters and analytical methods are identified in Worksheet #19 & #30 of the PQAPP. Field sample collection methods are summarized in **Worksheet #17** of this QAPP Addendum and in Worksheet #21 of the PQAPP.

Step 4: Define the Boundaries of the Sampling:

Analytical sample collection at YTC will be completed within or near seven AOPIs: Former Fire Training Pit (YFCR-53), Bird Bath Wash Rack, the Refractometer Solutions Testing Area, three AFFF storage areas (Fire Department Bay [Building 321], Building 821, and the Vehicle Maintenance Shop [Building 751]), and the Selah Airstrip. The first six AOPIs are located in the main cantonment area in the southwest portion of the installation; the Selah Airstrip AOPI is located northeast of the cantonment area. Tentative sample identifications for each medium and location to be sampled are listed in **Worksheet #18** of this QAPP Addendum.

At the Former Fire Training Pit, all five existing groundwater monitoring wells will be sampled; soil will not be sampled at this AOPI because the ground has been excavated and reworked. At the Bird Bath Wash Rack, three groundwater samples will be collected at first encountered groundwater through sonic drilling methods. At the Refractometer Solutions Testing Area, groundwater will be sampled at three nearby monitoring wells in the perched aquifer (two downgradient of where surface water runoff from the AOPI would have infiltrated, and one near the oil/water separator which may have received PFAS-containing material). The well near the oil/water separator will also serve as a boundary sampling well. Soil will also be sampled at two locations along the stormwater drainage ditch downgradient of the parking lot of the Refractometer Solutions Testing Area, and at one location under the asphalt of the main testing area in the parking lot. At the AFFF storage area in Building 321, soil will be sampled at two locations along the ditch downgradient of the fire department bay. At each of the AFFF storage areas at Buildings 821 and 751, two soil samples will be collected near the points of storage. At the Selah Airstrip, five shallow soil samples will be collected around the former crash truck station and along the runway where former surface water diversion features have been noted on historical aerial photographs; additionally, two surface water samples will be collected to evaluate PFAS in surface runoff at the airfield and in groundwater discharging at Selah Spring (which flows to Selah Creek). If the proposed surface water locations are dry during the SI sampling event, sediment samples will be collected instead. Three additional samples will be collected to evaluate PFAS presence or absence in groundwater and surface water flowing off-post; this includes two monitoring wells and one stream sample (Selah Creek) near the installation boundary. Tentative sampling locations are shown on **Figures 6** through **11**.

Step 5: Develop the Analytic Approach:

Samples will be collected in accordance with the technical guidance instructions (TGI) and SOP documents included as Appendix A to the PQAPP (Arcadis 2019). The samples will be submitted for analysis to Shealy Environmental Services, Inc. (Shealy; which has recently been acquired by Pace Analytical). Liquid chromatography/tandem mass spectrometry will be used to analyze samples for PFAS; **Worksheet #15** of this QAPP Addendum identifies the laboratory limits of detection (LODs) for PFAS. The LOD is defined as “the lowest concentration for reliable reporting of a non-detect of a specific analyte in a specific medium with a specific method at 99 percent confidence” (DoD 2017) and will be used as the project screening levels (PSLs) for this PA/SI. PSLs will only be used to identify presence or absence of PFAS (i.e., PSLs are not utilized for risk-based comparisons which may relate to future remedial decisions). On 15 October 2019, the OSD distributed guidance that provides risk screening levels (calculated using the USEPA’s regional screening level calculator) for PFOA, PFOS, and PFBS in groundwater (tap water) and soil for residential and industrial/commercial worker receptor scenarios (**Attachment 3**).

- If PFAS concentrations are less than the PSLs, then no further action will be recommended at this time.
- If PFAS concentrations are greater or equal to than the PSLs (i.e., the laboratory LODs), PFAS are present.
- If PFOS/PFOA/PFBS concentrations are greater than the PSLs but less than the OSD risk screening levels (OSD 2019), then no further action will be recommended at this time.
- If PFOS/PFOA/PFBS concentrations are greater than or equal to the OSD risk screening levels (OSD 2019), further investigation will be recommended.

Groundwater and surface water will be sampled to identify PFAS presence, type (of the 18 selected constituents as listed in Worksheet #18 of the PQAPP, including PFOS, PFOA, and PFBS), and concentrations; field parameters (temperature, pH, dissolved oxygen, oxidation-reduction potential, and specific conductivity) will also be measured for water samples. Sediment samples will be collected and analyzed for PFAS instead if the proposed surface water sampling locations are dry during the SI sampling event. Soil will be sampled to identify PFAS presence, type, and concentrations, as well as for total organic carbon (TOC), pH, and grain size in one soil sample collected per AOPI with planned soil sampling (i.e., not in every soil sample collected). TOC, pH, and grain size data will be collected as they may be useful in future fate and transport studies.

The final waste characterization and disposal plan for investigation-derived waste (IDW) will be conducted in accordance with Army guidance (Army 2018) and state/local regulations. Disposition of IDW is discussed in **Worksheet #17** of this QAPP Addendum.
Step 6: Specify Performance or Acceptance Criteria:
Controls on precision, reporting, and accuracy are provided in Worksheets #12 and #28 of the PQAPP. Field monitoring and detection equipment will be routinely calibrated, as detailed in Worksheet #22 of the PQAPP, to confirm that equipment used is of the proper type, range, accuracy, and precision to provide data compatible with the specified requirements and desired results.
Step 7: Develop the Plan for Obtaining Data:
The detailed sampling plan and rationale for this PA/SI is presented in **Worksheet #17** of this QAPP Addendum. Sampling plans may be revised based on field conditions or site planning meetings.

QAPP ADDENDUM WORKSHEET #13: SECONDARY DATA USES AND LIMITATIONS

(UFP-QAPP Manual Section 2.7)

(USEPA 2106-G-05 Chapter 3: QAPP Elements for Evaluating Existing Data)

This worksheet identifies sources of secondary data not generated for the specific purpose of this project, or data generated under a separate QAPP, and summarizes their uses for this project. A full list of references reviewed to complete the PA/SI at YTC will be provided in the PA/SI Report.

Data Type	Source	Data Uses Relative to Current Project	Factors Affecting the Reliability of Data and Limitations on Data Use
Aerial Imagery	ESRI, ArcGIS Online Aerial Imagery	Provided georeferenced aerial photos for figure backdrops.	There are no known limitations on aerial imagery.
Past Site Investigations	PA (Shapiro and Associates 1991) RCRA Facility Assessment Report (SAIC 1995) Periodic Review Report (USACE 2012) Groundwater Monitoring Report for the Fire Training Pit and Tracked Vehicle Repair/Old Mobilization and Training Equipment Site (Tetra Tech 2017) Various laboratory reports	Provided regional site conditions, historical site usage, historical contaminant identification and concentrations, and remedial actions.	Site usage histories may omit records of AFFF procurement and use. Limited PFAS data are available from previous investigations. It cannot be verified that historical sample collection or laboratory analysis for PFAS constituents was conducted in accordance with best practices for PFAS sampling in order to obtain technically defensible/usable data (i.e., not affected by sampling methods and procedures).
Installation Personnel Interviews	Various	Provided anecdotal histories of site use, AFFF use, and remedial actions completed.	Several installation personnel who would have worked on site during the peak of AFFF use are retired or out of contact.

QAPP ADDENDUM WORKSHEET #14 & #16: PROJECT TASKS & SCHEDULE

(UFP-QAPP Manual Section 2.8.2)
(USEPA 2106-G-05 Section 2.2.4)

The project schedule is presented below for sampling activities planned at YTC as part of the PA/SI following completion of previous steps listed in Worksheet #14 & #16 of the PQAPP.

Activity	Responsible Party	Planned Start Date	Planned Completion Date	Deliverable(s)	Deliverable Due Date
Installation site visits	Arcadis	June 2018	June 2018	Field notes (included in PA/SI Report)	Complete
Draft QAPP Addendum and Site Safety and Health Plan (SSHP; provided as **Attachment 4** under a separate cover)	Arcadis	December 2019	April 2020	Draft QAPP Addendum and SSHP	April 2020
Monthly Progress Calls (as requested by the installation)	Arcadis, YTC	April 2020	March 2021	Not Applicable	Monthly
Technical Project Planning Teleconference	Arcadis, YTC, USACE, and USAEC	May 2020	May 2020	Not Applicable	May 2020
Draft Final QAPP Addendum and SSHP (as requested by YTC for regulator review time)	Arcadis	June 2020	August 2020	Draft Final QAPP Addendum and SSHP	August 2020
Final QAPP Addendum and SSHP	Arcadis	August 2020	August 2020	Final QAPP Addendum and SSHP	August 2020
Coordinating/permitting	Arcadis	June 2020	August 2020	Site permits	Not Applicable
Mobilization and set up	Arcadis and subcontractors	August or September 2020	August or September 2020	Field notes (included in PA/SI Report)	20 days after QAPP Addendum approval

Activity	Responsible Party	Planned Start Date	Planned Completion Date	Deliverable(s)	Deliverable Due Date
Sample collection of groundwater from existing monitoring and potable water wells	Arcadis	August or September 2020	August or September 2020	Field notes and measurements (included in PA/SI Report)	Submitted in PA/SI Report
Soil boring advancement, soil sample collection, and boring abandonment	Arcadis and subcontractors	August or September 2020	August or September 2020	Field notes and measurements (included in PA/SI Report)	Submitted in PA/SI Report
Field Work Summary Teleconference (as requested by YTC)	Arcadis	August or September 2020	August or September 2020	Field work completion summary from daily updates	August or September 2020
Sample Analysis	Shealy	September through October 2020	September through October 2020	Analytical data package and electronic data deliverable	Submitted in PA/SI Report
Preliminary Data Review Teleconference	Arcadis	November 2020	November 2020	Draft data figures and tables	November 2020
Data Validation	Arcadis	October through November 2020	October through November 2020	Data validation report	Submitted in PA/SI Report
Draft PA/SI Report	Arcadis	January 2021	January 2021	Draft PA/SI Report	(90 days after data validation)
Draft Final PA/SI Report	Arcadis	February 2021	March 2021	Draft Final PA/SI Report	March 2021
Final PA/SI Report	Arcadis	March 2021	April 2021	Final PA/SI Report	April 2021

QAPP ADDENDUM WORKSHEET #15: REFERENCE LIMITS AND EVALUATION TABLES

(UFP-QAPP Manual Section 2.6.2.3)
(USEPA 2106-G-05 Section 2.2.6)

This worksheet provides the laboratory-specific limits for the PFAS compounds that will be analyzed, including the typical limit of quantitation (LOQ) and LOD. The LOQs and LODs are what the laboratory can achieve and were supplied by the laboratory. The LOQ is the lowest concentration of a substance that produces a quantitative result within specified limits of precision and bias, and the LOD is the lowest concentration for reliable reporting of a non-detect of a specific analyte in a specific medium with a specific method at 99 percent (%) confidence (DoD 2017). For the purposes of this PA/SI, the PSLs are defined as the compound LODs. Because PSLs are equivalent to the LODs, PSLs will vary slightly depending on batch- or sample-specific LODs reported by the laboratory for each analyte. If PFAS are detected greater than the PSLs, PFAS are present. Concentrations detected between the LOD and LOQ are estimates, and therefore, will be qualified and indicated as such on laboratory analytical reports. All soil results will be reported in dry weight.

Medium: Groundwater/Surface Water		Analytical Group: PFAS (Shealy) per DoD Quality Systems Manual (QSM; DoD 2018) 5.1.1 (or later version) Table B-15		
Analyte	CAS Number	PSL (ng/L)	Laboratory-Specific Limits	
			LOQ (ng/L)	LOD (ng/L)
Perfluorobutanoic acid (PFBA)	375-22-4	2	4	2
Perfluoropentanoic acid (PFPA)	2706-90-3	2	4	2
Perfluorohexanoic acid (PFHxA)	307-24-4	2	4	2
Perfluoroheptanoic acid (PFHpA)	375-85-9	2	4	2
Perfluorooctanoic acid (PFOA)	335-67-1	2	4	2
Perfluorononanoic acid (PFNA)	375-95-1	2	4	2

Medium: Groundwater/Surface Water		**Analytical Group: PFAS (Shealy) per DoD Quality Systems Manual (QSM; DoD 2018) 5.1.1 (or later version) Table B-15**		
Analyte	**CAS Number**	**PSL (ng/L)**	**Laboratory-Specific Limits**	
			LOQ (ng/L)	**LOD (ng/L)**
Perfluorodecanoic acid (PFDA)	335-76-2	2	4	2
Perfluoroundecanoic acid (PFUnA)	2058-94-8	2	4	2
Perfluorododecanoic acid (PFDoA)	307-55-1	2	4	2
Perfluorotridecanoic acid (PFTrDA)	72629-94-8	2	4	2
Perfluorotetradecanoic acid (PFTA)	376-06-7	4	8	4
Perfluorobutanesulfonic acid (PFBS)	375-73-5	2	4	2
Perfluorohexanesulfonic acid (PFHxS)	355-46-4	2	4	2
Perfluorooctane sulfonate (PFOS)	1763-23-1	2	4	2
N-ethyl perfluorooctane sulfonamidoacetic acid (NEtFOSAA)	2991-50-6	4	8	4
N-methyl perfluorooctane sulfonamidoacetic acid (NMeFOSAA)	2355-31-9	4	8	4
6:2 Fluorotelomer sulfonate	27619-97-2	4	8	4
8:2 Fluorotelomer sulfonate	39108-34-4	4	8	4

Media: Soil/Sediment		Analytical Group: PFAS (Shealy) per DoD QSM 5.1.1 (or later version) Table B-15		
Analyte	**CAS Number**	**PSL (mg/kg)**	**Laboratory-Specific Limits**	
			LOQ (mg/kg)	**LOD (mg/kg)**
Perfluorobutanoic acid (PFBA)	375-22-4	0.0005	0.001	0.0005
Perfluoropentanoic acid (PFPA)	2706-90-3	0.0005	0.001	0.0005
Perfluorohexanoic acid (PFHxA)	307-24-4	0.0005	0.001	0.0005
Perfluoroheptanoic acid (PFHpA)	375-85-9	0.0005	0.001	0.0005
Perfluorooctanoic acid (PFOA)	335-67-1	0.0005	0.001	0.0005
Perfluorononanoic acid (PFNA)	375-95-1	0.0005	0.001	0.0005
Perfluorodecanoic acid (PFDA)	335-76-2	0.0005	0.001	0.0005
Perfluoroundecanoic acid (PFUnA)	2058-94-8	0.0005	0.001	0.0005
Perfluorododecanoic acid (PFDoA)	307-55-1	0.0005	0.001	0.0005
Perfluorotridecanoic acid (PFTrDA)	72629-94-8	0.0005	0.001	0.0005
Perfluorotetradecanoic acid (PFTA)	376-06-7	0.0005	0.001	0.0005
Perfluorobutanesulfonic acid (PFBS)	375-73-5	0.0005	0.001	0.0005
Perfluorohexanesulfonic acid (PFHxS)	355-46-4	0.0005	0.001	0.0005
Perfluorooctane sulfonate (PFOS)	1763-23-1	0.0005	0.001	0.0005
N-ethyl perfluorooctane sulfonamidoacetic acid (NEtFOSAA)	2991-50-6	0.0005	0.001	0.0005
N-methyl perfluorooctane sulfonamidoacetic acid (NMeFOSAA)	2355-31-9	0.0005	0.001	0.0005

Media: Soil/Sediment		Analytical Group: PFAS (Shealy) per DoD QSM 5.1.1 (or later version) Table B-15		
Analyte	CAS Number	PSL (mg/kg)	Laboratory-Specific Limits	
			LOQ (mg/kg)	LOD (mg/kg)
6:2 Fluorotelomer sulfonate	27619-97-2	0.0006	0.002	0.0006
8:2 Fluorotelomer sulfonate	39108-34-4	0.0006	0.002	0.0006

Acronyms and Abbreviations:
CAS = Chemical Abstracts Service
mg/kg = milligram per kilogram

QAPP ADDENDUM WORKSHEET #17: SAMPLING DESIGN AND RATIONALE

UFP-QAPP, PFAS Sampling Activities

(UFP-QAPP Manual Section 3.1.1)
(USEPA 2106-G-05 Section 2.3.1)

The DQOs for the sampling are described in **Worksheet #11** of this QAPP Addendum. This worksheet provides the detailed rationale and approach for site-specific sampling at YTC. This QAPP Addendum has been developed to ensure the amount, type, and quality of data are sufficient to determine which areas and environmental media are impacted with detectable levels of PFAS and refine the CSMs for each AOPI.

The planned project schedule to complete the PA/SI for YTC is provided in **Worksheet #14 & 16** of this QAPP Addendum. The mobilization schedule will be determined upon the finalization of this QAPP Addendum. Necessary permits, forms, or other project documentation, subcontracts, or project equipment will be procured before mobilization. Before conducting intrusive activities, the location of underground utilities will be determined. Utility companies and other responsible authorities will be contacted to locate and mark the locations. No required installation-specific training or additional requirements for installation access have been identified at this time.

Environmental data will be collected as presented within this QAPP Addendum and in accordance with the field SOPs provided in Appendix A to the PQAPP at the locations defined in **Worksheet #18** and on **Figures 6** through **9** of this QAPP Addendum, along with the QC sample requirements listed in **Worksheet #20** of this QAPP Addendum. Components of some SOPs may require modification or be superseded by the PFAS TGI (P-10 in Appendix A to the PQAPP) and/or PFAS Sampling and Analysis White Paper (Appendix B to the PQAPP) to accommodate PFAS-specific sampling requirements (Arcadis 2019). The sampling methods described in the SOPs establish equipment requirements; procedures for equipment and containers before sampling; sampling procedures under various conditions; equipment blank samples and field duplicate collection requirements; and requirements for storing samples to ensure that sample cross-contamination does not occur during collection, and transport. All field activities will be conducted in accordance with the approved Programmatic Accident Prevention Plan (Arcadis 2018) and SSHP.

The areas of focus for this SI (i.e., sites within the main cantonment area in the southwest portion of the installation and at the Selah Airstrip) were selected based on a review of historical documents and data and information obtained by conducting personnel interviews during the PA; these information inputs were used to develop the preliminary CSMs provided in **Worksheet #10** and on **Figures 4** and **5** of this QAPP Addendum. Groundwater, soil, surface water, and/or sediment samples will be collected from the AOPIs where there has been a known or suspected PFAS release, or where AFFF has been stored. The media will be sampled to identify PFAS presence, type (of the selected constituents as listed in **Worksheet #15** of this QAPP Addendum, including PFOS, PFOA, and PFBS), and concentrations. Soil will also be sampled for TOC, pH, and grain size analyses in one soil sample collected at each AOPI if sampled for soil (i.e., not in every soil sample collected). These targeted sampling areas are believed to have the potential for the greatest PFAS concentrations closest to known releases of AFFF.

Results of the sampling will be compiled and analyzed by Arcadis and presented in a PA/SI Report. The report will summarize the field effort and present the validated sampling results, including QA/QC.

Soil cuttings will be returned to their respective boreholes following sample collection; sand or bentonite may be used to further backfill the boreholes. Groundwater purged during sampling, and wastewater from decontamination of equipment (which may potentially contain PFAS) will be temporarily containerized; a composite liquid IDW sample will be collected and analyzed for PFAS and the results will determine the disposal plan. If results of the waste characterization sample indicate PFAS concentrations in the IDW water are less than the USEPA LHA, the IDW water will be disposed in an on-post oil/water separator at the main vehicle wash rack. Otherwise, the IDW water will be run through granular activated carbon treatment before disposing to the oil/water separator. Disposable sampling equipment (e.g., tubing, sheeting, gloves) will be bagged and disposed of in on-post waste receptacles. Non-IDW wastes will be removed from the site immediately upon completion of each day’s field activities. A post-activity inspection will be conducted by the field team lead/regional lead and Site Safety and Health Officer identified in the this QAPP Addendum and the attached SSHP (**Attachment 4**) to ensure the location is left clean. The investigation team will demobilize once field activities are complete.

Groundwater Sampling

Thirteen groundwater samples will be collected to inform the interpretation of PFAS presence and update the individual AOPI CSMs and identify PFAS presence or absence in groundwater at the installation boundary. Grab groundwater samples will be collected via low-flow purging using a peristaltic pump or portable bladder pump. At existing wells monitoring wells, groundwater samples will be collected from approximately the center of the saturated screened interval. Five existing groundwater monitoring wells will be sampled within the footprint of and downgradient of the Former Fire Training Pit (YFCR-53, **Figure 6**). Three groundwater samples will be collected at the first encountered groundwater via sonic drilling methods at the Bird Bath Wash Rack (**Figure 6**). Three existing groundwater monitoring wells (screened in the perched aquifer) will be sampled at the Refractometer Solutions Testing Area (**Figure 7**). Two of the wells are downgradient of where surface water runoff from the area would have infiltrated in stormwater ditches; one of the proposed wells to be sampled (TVR-5) is located near the oil/water separator to which surface runoff from the AOPI may have been directed and will also serve as a boundary monitoring well. Additionally, two other boundary monitoring wells (MRC-2 and 815-2) will be sampled to evaluate PFAS concentrations in groundwater flowing off-post (**Figure 11**). The construction details for the existing monitoring wells to be sampled are included in **Attachment 5**. Dedicated equipment is not expected to be encountered at the wells proposed to be sampled for PFAS at YTC.

Groundwater samples will be analyzed for select PFAS, and field parameters (temperature, pH, specific conductivity, dissolved oxygen, turbidity, and oxidation-reduction potential) will be measured during purging and allowed to stabilize in accordance with the TGI for PFAS Sampling Procedures and Low-Flow Groundwater Purging for Monitoring Wells (P-11 in Appendix A to the PQAPP; Arcadis 2019) before groundwater sampling to ensure a representative sample is collected and, potentially, to inform the interpretation of analytical data.

Soil Sampling

Fourteen shallow soil samples will be collected to evaluate PFAS presence or absence at potential release areas, to evaluate the potential for those areas to be sources of PFAS to surface water and groundwater as an influence to drinking water, and to update the individual AOPI CSMs. At the Refractometer Solutions

Testing Area AOPI, three soil samples will be collected from the 0 to 2 feet bgs depth interval via hand auger from discrete points within and downgradient of the suspected AFFF use area (**Figure 7**). At each of the AFFF storage area AOPIs (Buildings 321, 821, and 751), two soil samples will be collected from the 0 to 2 feet bgs depth interval via hand auger from discrete points downgradient of the suspected AFFF use area (**Figures 7** through **9**). At the Selah Airstrip AOPI, five soil samples will be collected from the 0 to 2 feet bgs interval via hand auger from discrete points within and downgradient of the area of the suspected AFFF use associated with the former crash truck station building. Three of the samples will be collected near the former building, and two of the samples will be collected along the runway where former surface water diversion features have been noted on historical aerial photographs (**Figure 10**).

If non-native fill is encountered at proposed soil sampling locations, the hand auger will be advanced to native soil, and the sample will be collected from the upper two feet of native soil. If refusal is encountered with the hand auger before reaching native fill, the sampling plan may be adapted to utilize the sonic rig that will be onsite for the groundwater sampling scope in order to achieve DQOs. The sampling plan will thus be to attempt sampling hand auger locations prior to the drilling subcontractor arriving onsite. Soil samples will be analyzed for select PFAS; TOC, pH, and grain size will be analyzed in one soil sample per each AOPI sampled for soil (i.e., these analytes will not be analyzed for in every soil sample collected). Soil descriptions will be logged and documented on field forms. The soil sampling are tentative, and final coordinates will be dependent on field conditions and infrastructure (if present). Soil sampling locations will be adjusted in the field to avoid augering through concrete or asphalt, if possible. Coordinates for each soil sampling location will be recorded using a handheld global positioning unit.

Surface Water Sampling

Surface water samples will be collected to inform the presence or absence of PFAS downgradient of potential source areas. Grab surface water samples will be collected from the following locations: at the ephemeral stream southeast of the Selah Airstrip, at Selah Springs which discharges to Selah Creek, and at Selah Creek before the creek flows off-post (**Figures 10** and **11**). If the ephemeral stream southwest of the Selah Airstrip is dry during the field sampling event, the retention pond at the southwest corner of the airstrip will be sampled instead (if water is present). Sediment samples will be collected instead if the proposed surface water sampling locations are dry during the SI sampling event (see below).

All surface water samples will be analyzed for select PFAS, and field parameters (temperature, pH, specific conductivity, dissolved oxygen, turbidity, and oxidation-reduction potential) will be measured during surface water sampling to potentially inform the interpretation of analytical data. Coordinates for each surface water sampling location will be recorded using a handheld global positioning unit.

Sediment Sampling (Tentative)

If the surface water sampling locations proposed for the Selah Airstrip AOPI are dry during the SI field event, sediment samples will be collected instead to evaluate PFAS presence or absence downstream of potential release areas to evaluate the potential for those areas to be sources of PFAS to surface water, sediment, and groundwater as an influence to drinking water, and to update the individual AOPI CSMs. Sediment samples will be collected from the upper 10 centimeters using PFAS-free equipment (i.e., Lexan™ tubes or equivalent or stainless steel trowels), and the sediment will be decanted before bottling for laboratory analysis of select PFAS only. Sediment descriptions will be documented on field forms. If sediment samples are collected, coordinates for each sediment sampling location will be recorded using a handheld GPS.

Laboratories

Shealy will be used for this study. PFAS analysis will be conducted in accordance with the DoD QSM 5.1.1 (or later version as the laboratory obtains updated certification), Table B-15 for the analytes listed in Worksheet #18 of the PQAPP and **Worksheet #15** of this QAPP Addendum. Arcadis will validate the data from the laboratory in accordance with Worksheets #34, #35, and #36 of the PQAPP. A Data Usability Summary Report will be prepared in accordance with the November 2019 Draft DoD General Data Validation Guidelines (DoD 2019b) and the May 2020 Final DoD Data Validation Procedure for Per-and Polyfluoroalkyl Substances Analysis by QSM Table B-15 (DoD 2020), that will review precision, accuracy, completeness, representativeness, comparability, and sensitivity of the analytical methods performed under the USACE PFAS PA/SI contract. This information will be included in a PA/SI Report.

QAPP ADDENDUM WORKSHEET #18: SAMPLING LOCATIONS AND METHODS

(UFP-QAPP Manual Section 3.1.1 and 3.1.2)
(USEPA 2106-G-05 Section 2.3.1 and 2.3.2)

The tentative sampling locations, identifications, and associated analytes and parameters are summarized below; sampling locations are depicted on **Figures 6** through **9**. Sample identifications will follow the following format:

- Existing well: [Installation acronym]-[well identification]-[MMDDYY].
- All other media parent samples: [Installation acronym]-[AOPI Name]-[sample number (out of how many samples in that medium are sampled at the AOPI)]-[medium type]-[sample depth interval if sampling in multiple intervals]-[MMDDYY].
- Field Duplicates: [Installation acronym]-FD-[field duplicate sample number for that medium]-[medium type]-[MMDDYY].
- Blank QC samples: [Installation acronym]-[QC sample type]-[QC sample type number]-[MMDDYY].

The group of PFAS constituents (including PFOS, PFOA, and PFBS) noted for analysis for groundwater and soil samples in the table below is summarized for all media in **Worksheet #15** of this QAPP Addendum. **Worksheet #17** of this QAPP Addendum describes the rationale for the various sampling locations and media. Field activities and sampling procedures will be conducted in accordance with the TGI and SOP documents in Appendix A to the PQAPP (Arcadis 2019). Additional information on PFAS sampling is available in the PFAS Sampling and Analysis White Paper (Appendix B to the PQAPP; Arcadis 2019). The frequency requirements for QA/QC samples noted in Worksheet #20 of the PQAPP will be met. **Worksheet #20** of this QAPP Addendum lists the number and type of QA/QC samples anticipated for each medium based on the sampling plan presented herein; however, the final number and identifications of QA/QC samples listed in the table below are to be determined based on progression of daily field activities.

Site Location	Medium	Sample ID	Depth Interval (Approximate)	Sample Method	Sample Type	Number of Samples	Analytes
Former Fire Training Pit (YFCR-53)	GW	YTC-FTP-1-MMDDYY	Mid-Saturated Screen	Low-flow	N	1	PFAS, field parameters[1]
		YTC-FTP-13-MMDDYY (YTC-FD-1-GW-MMDDYY)			N, FD, MS/MSD	4	
		YTC-FTP-14-MMDDYY			N	1	

Site Location	Medium	Sample ID	Depth Interval (Approximate)	Sample Method	Sample Type	Number of Samples	Analytes
Former Fire Training Pit (YFCR-53)	GW	YTC-FTP-15-MMDDYY	Mid-saturated screen	Low-flow	N	1	PFAS, field parameters
		YTC-FTP-16-MMDDYY				1	
Bird Bath Wash Rack	GW	YTC-BBWR-1-GW-MMDDYY	First encountered	Sonic drilling methods	N	1	PFAS, field parameters
		YTC-BBWR-2-GW-MMDDYY				1	
		YTC-BBWR-3-GW-MMDDYY				1	
Refractometer Solutions Testing Area	GW	YTC-MMP-1-MMDDYY	Mid-saturated screen	Low-flow	N	1	PFAS, field parameters
		YTC-MMP-2-MMDDYY				1	
		YTC-TVR-5-MMDDYY				1	
	SO	YTC-RSTA-1-SO-MMDDYY (YTC-FD-1-SO-MMDDYY)	0-2 feet bgs	Hand auger	N, FD, MS/MSD	4	PFAS, TOC, pH, grain size
		YTC-RSTA-2-SO-MMDDYY			N	1	PFAS
		YTC-RSTA-3-SO-MMDDYY				1	
AFFF Storage Area (Fire Department Bay, Building 321)	SO	YTC-B321-1-SO	0-2 feet bgs	Hand auger	N	1	PFAS, TOC, pH, grain size
		YTC-B321-2-SO				1	PFAS
AFFF Storage Area (Building 821)	SO	YTC-B821-1-SO	0-2 feet bgs	Hand auger	N	1	PFAS, TOC, pH, grain size
		YTC-B821-2-SO				1	PFAS
AFFF Storage Area (Vehicle	SO	YTC-VMS-1-SO	0-2 feet bgs	Hand auger	N	1	PFAS, TOC, pH, grain size

Site Location	Medium	Sample ID	Depth Interval (Approximate)	Sample Method	Sample Type	Number of Samples	Analytes
Maintenance Shop, Building 751)		YTC-VMS-2-SO				1	PFAS
Selah Airstrip	SO	YTC-SELAH-1-SO-MMDDYY	0-2 feet bgs	Hand Auger	N	1	PFAS, TOC, pH, grain size
		YTC-SELAH-2-SO-MMDDYY				1	PFAS
		YTC-SELAH-3-SO-MMDDYY				1	
		YTC-SELAH-4-SO-MMDDYY				1	
		YTC-SELAH-5-SO-MMDDYY				1	
	SW (SE)	YTC-SELAH-1-SW-MMDDYY[2] (YTC-SELAH-1-SE-MMDDYY)	Below water surface (Upper 10 centimeters)	Grab	N	1	PFAS, field parameters
		YTC-SELAHSP-SW-MMDDYY[2] (YTC-FD-1-SW-MMDDYY) (YTC-SELAHSP-SE-MMDDYY; YTC-FD-1-SE-MMDDYY)	At spring discharge (Upper 10 centimeters)		N, FD, MS/MSD	4	
Boundary Monitoring Points	GW	YTC-MRC-2-MMDDYY	Mid-Saturated Screen	Low-flow	N	1	PFAS, field parameters
		YTC-815-2-MMDDYY				1	
	SW	YTC-SELAHCR-SW	Below water surface	Grab	N	1	PFAS, field parameters
Quality Control Samples	EB	YTC-EB-1-MMDDYY	Bladder pump	Grab	N	1	PFAS
		YTC-EB-2-MMDDYY	Tubing			1	
		YTC-EB-3-MMDDYY	Water level meter			1	

Site Location	Medium	Sample ID	Depth Interval (Approximate)	Sample Method	Sample Type	Number of Samples	Analytes
		YTC-EB-4-MMDDYY	Hand auger			1	
		YTC-EB-5-MMDDYY	Screen point sampler			1	
		YTC-EB-6-MMDDYY	Cutting shoe			1	
		YTC-EB-7-MMDDYY	(Other)			1	
Quality Control Samples	FB	YTC-FB-1-MMDDYY	Field blank	Grab	N	1	PFAS
		YTC-FB-2-MMDDYY				1	
	SB	YTC-SB-1-MMDDYY	Source blank for drilling decontamination water	Grab	N	1	PFAS
IDW Characterization	(Liquid IDW)	YTC-IDW-1-MMDDYY	Composite purge/ decontamination water	Grab	N	1	PFAS

Notes:

1. Field parameters will be collected by field staff upon sample collection, not analyzed in a laboratory. Field parameters include temperature, pH, specific conductivity, dissolved oxygen, turbidity, oxidation-reduction potential.
2. If the ephemeral stream location is dry during the field sampling event, an alternative surface water sample will be collected at the Selah Airstrip’s retention pond (if water is present during the field sampling event). If proposed (and alternative) surface water sampling locations are dry during the SI field event, a sediment sample will be collected instead and analyzed for PFAS only. The sample will be identified as “-SE-“ instead of “-SW-” as noted in the tentative sample identifications in parentheses.

Acronyms and Abbreviations:

EB = equipment blank
FB = field blank
FD = field duplicate
GW = groundwater
MS = matrix spike
MSD = matrix spike duplicate
N = normal (parent sample)
SB = source blank
SE = sediment
SO = soil
SW = surface water

QAPP ADDENDUM WORKSHEET #20: FIELD QC SUMMARY

(UFP-QAPP Section 3.1.1 and 3.1.2)
(USEPA 2106-G-05 Section 2.3.5)

Primary and QA/QC samples will be collected during field activities as noted below at the frequencies prescribed in Worksheet #20 of the PQAPP (Arcadis 2019). Field blanks will be collected at a frequency of 1 per 20 primary samples (not medium-specific). Source blanks will be collected from each source of water used for the initial decontamination step. Equipment blanks, field blanks, and source blanks will be analyzed for PFAS only (same analyte list for groundwater and soil on **Worksheet #15** of this QAPP Addendum).

Matrix	Analyte/ Analytical Group	Normal Samples	FD	MS	MSD	EB	FB	SB	Total # analyses
Groundwater	PFAS	13	1	1	1	5	2	1	21 (includes FB and SB count)
Soil	PFAS	14	1	1	1	1		Not applicable (N/A)	18
	TOC	5	N/A	N/A	N/A	N/A		N/A	5
	pH	5	N/A	N/A	N/A	N/A		N/A	5
	Grain size	5	N/A	N/A	N/A	N/A		N/A	5
Surface Water	PFAS	3	1	1	1	N/A		N/A	6
(Sediment[1])	(PFAS)	(2)	(1)	(1)	(1)	(1)		N/A	(6)
IDW	PFAS	1 (aqueous)	N/A	N/A	N/A	N/A		N/A	1

Notes:

1. Sediment samples are tentative and will only be collected if the proposed (and alternative) Selah Airstrip surface water sampling locations are dry during the SI field event.

QAPP ADDENDUM WORKSHEET #21: FIELD SOPS

(UFP-QAPP Section 3.1.2)
(USEPA 2106-G-05 Section 2.3.2)

SOP # or Reference[1]	Title, Revision, Date, and URL (if available)	Originating Organization	SOP Option or Equipment Type (if SOP provides different options)[2]	Modified for Project? Yes/No
P-01	Quality Procedure (QP)- Field Activities Documentation, Rev. C, November 2016	Arcadis	Applies to all Arcadis field personnel.	No
P-02	SOP – Sample Chain of Custody, Rev. 1, 23 May 2017	Arcadis	Applies to all Arcadis field personnel with 40-hour HAZWOPER and Department of Transportation HazMat #1 training.	No
P-03	Health and Safety Standard – Utility Location and Clearance, Rev. 16, 17 March 2017	Arcadis	Applies to all subsurface intrusive work	No
P-04	QP – Calibration and Control of measuring and test equipment, Rev. C, November 2016	Arcadis	Applies to all Arcadis field personnel using equipment that is capable of calibration.	No
P-05	QP - Field Sampling, Measurement, and Observation, Rev. D, October 2017	Arcadis	Applies to all Arcadis field personnel completing field sampling, measurement, and observations.	No
P-06	TGI - Soil Description, Rev. 2, 16 Feb 2018	Arcadis	Applies to all Arcadis field personnel conducting soil logging.	No

SOP # or Reference[1]	Title, Revision, Date, and URL (if available)	Originating Organization	SOP Option or Equipment Type (if SOP provides different options)[2]	Modified for Project? Yes/No
P-08	TGI- Monitoring Well Integrity Survey, Rev. 0, April 2017	Arcadis	See TGI for specific equipment needs.	No
P-09	TGI – Groundwater and Soil Sampling Equipment Decontamination, Rev. 0, 23 February 2017	Arcadis	Applies to soil sampling tools; groundwater, sediment, and surface-water sampling devices; water testing instruments; down-hole instruments; and other activity-specific sampling equipment	No
P-10	TGI - Poly- and Perfluorinated Alkyl Substances (PFAS) Field Sampling (all media) Guidance, Rev. 4, 26 March 2019	Arcadis	Applies to all Arcadis field personnel collecting environmental samples for PFAS analysis. See TGI for specific equipment needs.	Yes
P-11	TGI – PFAS Sampling Procedures and Low-Flow Groundwater Purging for Monitoring Wells, Rev. 0, 19 June 2018	Arcadis	Applies to low-flow sampling for PFAS.	Yes
P-12	PFAS-Specific Drilling and Monitoring Well Installation TGI, Rev. 3, 15 April 2020 (**Attachment 6**)	Arcadis	Applies to all Arcadis field personnel sampling soil or groundwater for PFAS via hand auger, drilling or installing monitoring wells for PFAS analysis. See TGI for specific equipment needs.	Yes
P-13	TGI – Equipment and Reagent Blank Sample Collection for PFAS Analysis, Rev. 0, October 2018	Arcadis	Applies to all Arcadis field personnel sampling soil or groundwater for PFAS via hand auger, drilling or	Yes

SOP # or Reference[1]	Title, Revision, Date, and URL (if available)	Originating Organization	SOP Option or Equipment Type (if SOP provides different options)[2]	Modified for Project? Yes/No
			installing monitoring wells for PFAS analysis. See TGI for specific equipment needs.	
P-15	TGI – Sediment, Surface Water, and Stormwater Sample Collection for PFAS Analysis, Rev. 1, 27 March 2020 (**Attachment 7**)	Arcadis	Applies to all Arcadis field personnel collecting sediment, surface water, and stormwater samples. See TGI for specific equipment needs.	Yes
P-16	TGI – Investigation-Derived Waste Handling and Storage, Rev. 0, 23 February 2017	Arcadis	See TGI for specific equipment needs.	No

Notes:

[1] Copies of the field SOPs are included in Appendix A of the PQAPP (Arcadis 2019).

[2] For all TGIs pertaining to the collection of samples for PFAS analysis, there is concern that sampling for PFAS using sampling equipment manufactured from fluoropolymers could result in sample cross-contamination. The materials of construction of all downhole and surface sampling and monitoring equipment — including pumps, packers, transducers, tubing, liners, valves, and wiring — should be free from polytetrafluorethylene or ethylene tetrafluoroethylene to the maximum extent practicable. In addition, well drilling procedures and completion materials should avoid the use of fluorocarbon-based lubricants, O-rings and pipe thread pastes, tapes and sealants. If possible, a confirmation letter with analytical testing results should be obtained from a manufacturer or service provider certifying that the equipment (or supplies) are free of any PFAS.

QAPP ADDENDUM WORKSHEET #22: FIELD EQUIPMENT CALIBRATION, MAINTENANCE, TESTING, AND INSPECTION

(UFP-QAPP Section 3.1.2.4)
(USEPA 2016-G-05 Section 2.3.6)

Instrument or Equipment	Description	Field Calibration Procedure	Performance Criteria	Responsible Personnel
Water Quality Meter – YSI 6-Series Multi-Parameter Instrument or Equivalent	Multi-parameter tool designed for field use with battery operation. Ranges: 0 – 14 pH -999 to +999 millivolt Oxidation-Reduction Potential -5 to 50 degrees Celsius 0 to 50 milligrams per liter Dissolved Oxygen 0 to 100 millisiemens per centimeter Specific Conductivity 0 to 1,000 nephelometric turbidity unit Turbidity	The unit is factory calibrated. Unit responsiveness will be checked prior to use each day with appropriate standards provided by the supplier. Unit responsiveness is checked against the solution standards provided by each manufacturer.	+/- 10% of included standard solutions with meter	Sample Collection Personnel
Turbidimeter – Hach 2100P or Equivalent	Designed for field use with battery operation. Range: 0 to 1,000 nephelometric turbidity unit	Each day prior to use, the turbidimeter is calibrated against the standard solutions provided by each manufacturer.	+/- 10% of included standard solutions with turbidimeter	Sample Collection Personnel
4-Gas Meter – MultiRAE or Equivalent	Designed for field use with battery operation. Ranges: 0 to 100% lower explosive limit 0 to 100 parts per million (ppm) H_2S 0 to 30% (by volume) O_2 0 to 2,000 ppm CO 0 to 20,000 µRem/h Gamma 0.1 to 5,000 ppm volatile organic compound	Each day prior to use, the 4-Gas Meter is calibrated against clean (ambient) air and supplier-provided standard (mixed gas cannister).	+/- 10% of included standard gas value	Sample Collection Personnel

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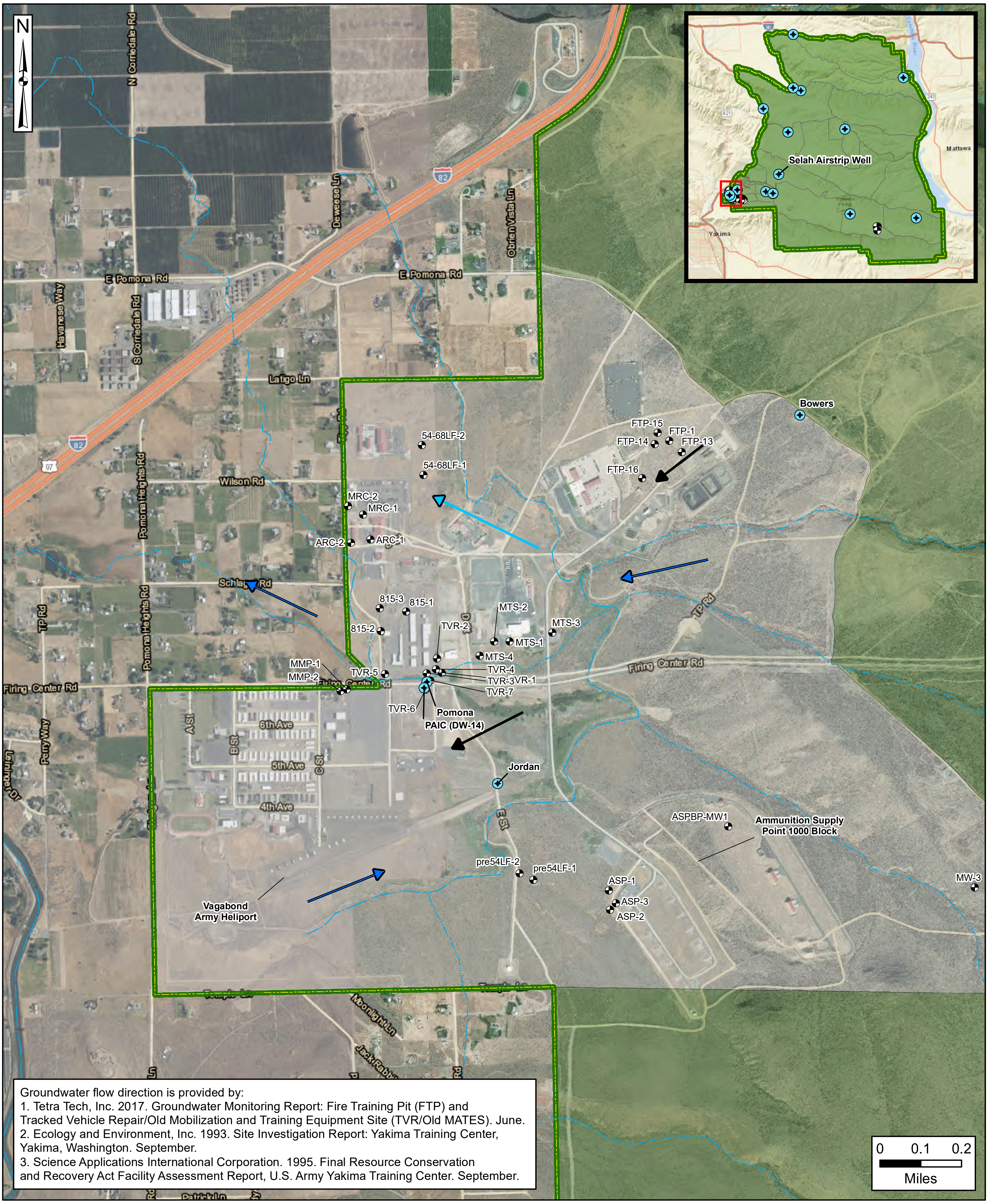
Figures

Quality Assurance Project Plan Addendum
USAEC PFAS Preliminary Assessments/Site Inspection
Yakima Training Center, WA

Figure 1
Installation Layout



Groundwater flow direction is provided by:
1. Tetra Tech, Inc. 2017. Groundwater Monitoring Report: Fire Training Pit (FTP) and Tracked Vehicle Repair/Old Mobilization and Training Equipment Site (TVR/Old MATES). June.
2. Ecology and Environment, Inc. 1993. Site Investigation Report: Yakima Training Center, Yakima, Washington. September.
3. Science Applications International Corporation. 1995. Final Resource Conservation and Recovery Act Facility Assessment Report, U.S. Army Yakima Training Center. September.

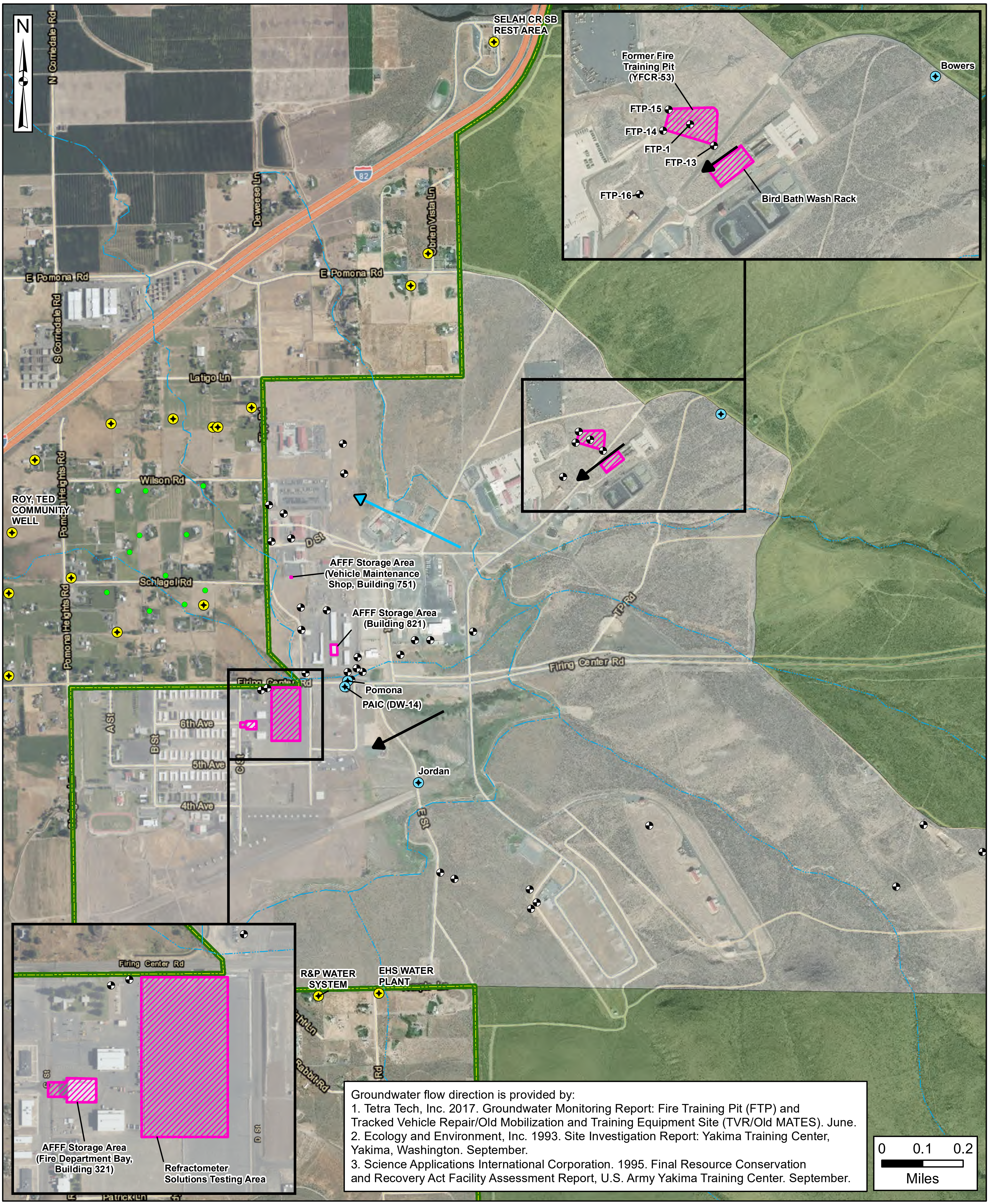
▭	Installation Boundary	⊕	Potable Water Well
▢	Cantonment Area	◐	Monitoring Well
🟩	Range/Training Area	→	Surface Water Flow Direction
⋯	River/Stream (Intermittent)	→	Deep Groundwater Flow Direction
╱	Canal/Ditch	→	Perched Groundwater Flow Direction

Data Sources:
Yakima Training Center, GIS Data, 2018
ESRI ArcGIS Online, Aerial Imagery

Coordinate System:
WGS 1984, UTM Zone 10 North

Quality Assurance Project Plan Addendum
USAEC PFAS Preliminary Assessments/Site Inspection
Yakima Training Center, WA

Figure 2
Cantonment Area AOPI Locations and Extent of AFFF Use



Groundwater flow direction is provided by:
1. Tetra Tech, Inc. 2017. Groundwater Monitoring Report: Fire Training Pit (FTP) and Tracked Vehicle Repair/Old Mobilization and Training Equipment Site (TVR/Old MATES). June.
2. Ecology and Environment, Inc. 1993. Site Investigation Report: Yakima Training Center, Yakima, Washington. September.
3. Science Applications International Corporation. 1995. Final Resource Conservation and Recovery Act Facility Assessment Report, U.S. Army Yakima Training Center. September.

🟩	Installation Boundary	⊕	Drinking Water Well (On-Installation)	→	Deep Groundwater Flow Direction
⬜	Cantonment Area	⊕	Water Supply Well (Off-Installation)	→	Perched Groundwater Flow Direction
🟩	Range/Training Area	●	Residential Supply Well*		
🟥	AOPI		River/Stream (Intermittent)		
▨	Approximate AFFF Use Area		Canal/Ditch		
●	Monitoring Well				

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

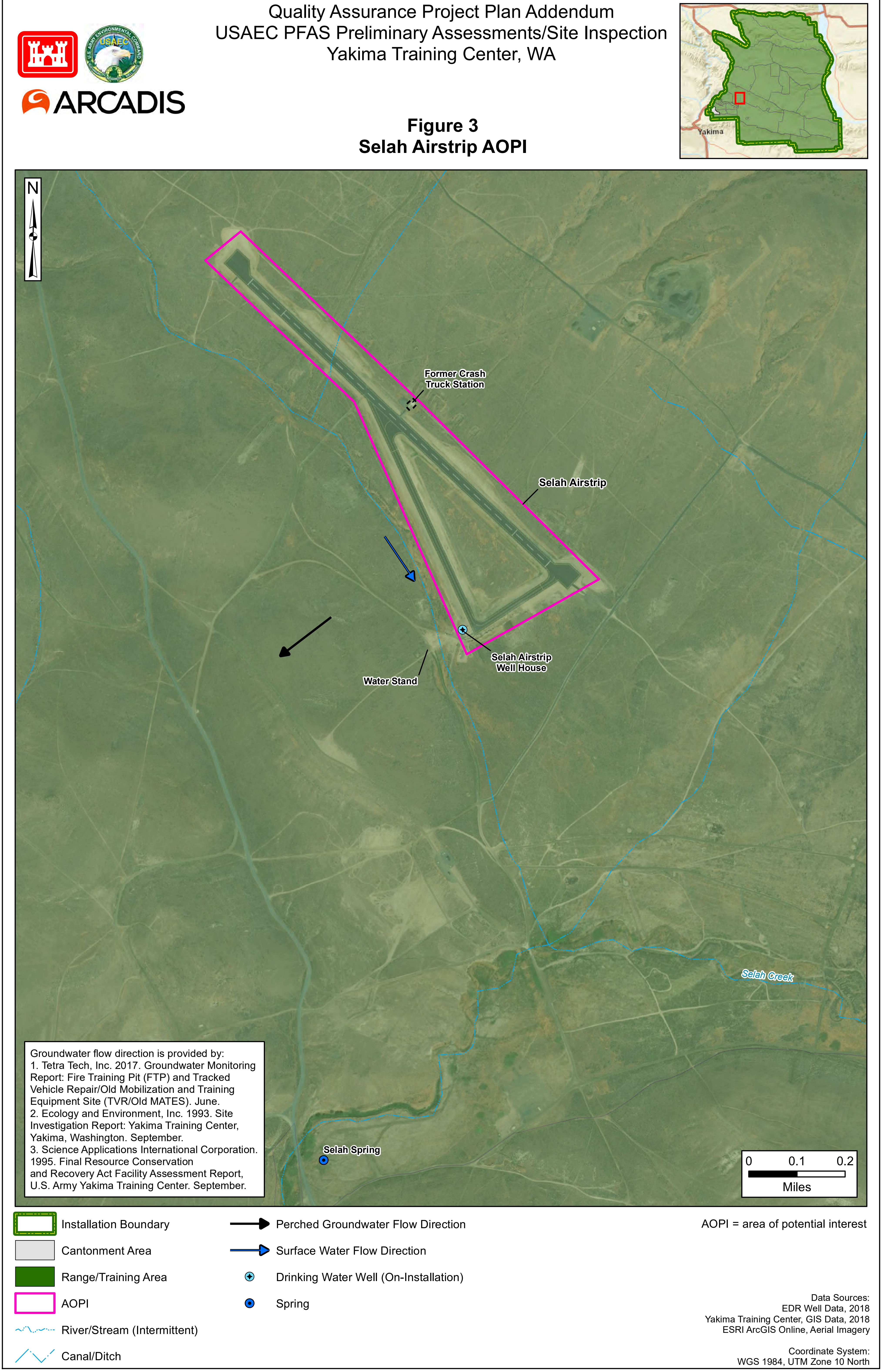
*Location of residential wells are as provided in the Final Groundwater Monitoring Report: Fire Training Pit and Tracked Vehicle Repair/Old Mobilization and Training Equipment Site, Joint Base Lewis-McChord and Yakima Training Center, Yakima, Washington (Tetra Tech, 2017).

Data Sources:
EDR Well Data, 2018
Yakima Training Center, GIS Data, 2018
ESRI ArcGIS Online, Aerial Imagery

Coordinate System:
WGS 1984, UTM Zone 10 North

Quality Assurance Project Plan Addendum
USAEC PFAS Preliminary Assessments/Site Inspection
Yakima Training Center, WA

Figure 3
Selah Airstrip AOPI

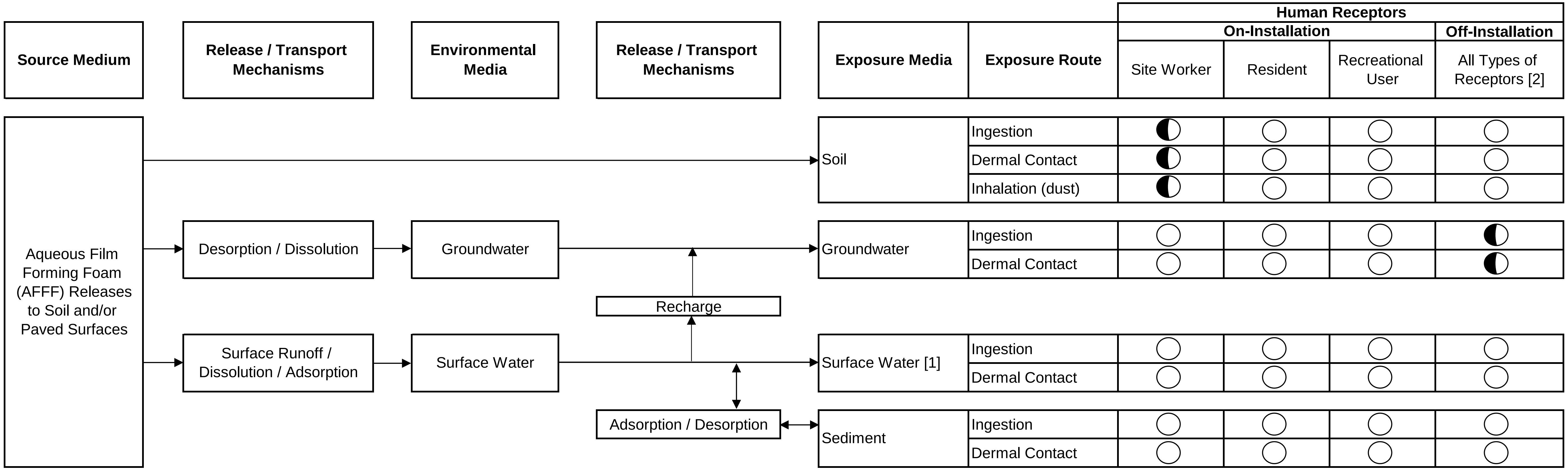


Groundwater flow direction is provided by:
1. Tetra Tech, Inc. 2017. Groundwater Monitoring Report: Fire Training Pit (FTP) and Tracked Vehicle Repair/Old Mobilization and Training Equipment Site (TVR/Old MATES). June.
2. Ecology and Environment, Inc. 1993. Site Investigation Report: Yakima Training Center, Yakima, Washington. September.
3. Science Applications International Corporation. 1995. Final Resource Conservation and Recovery Act Facility Assessment Report, U.S. Army Yakima Training Center. September.

AOPI = area of potential interest

Data Sources:
EDR Well Data, 2018
Yakima Training Center, GIS Data, 2018
ESRI ArcGIS Online, Aerial Imagery

Coordinate System:
WGS 1984, UTM Zone 10 North



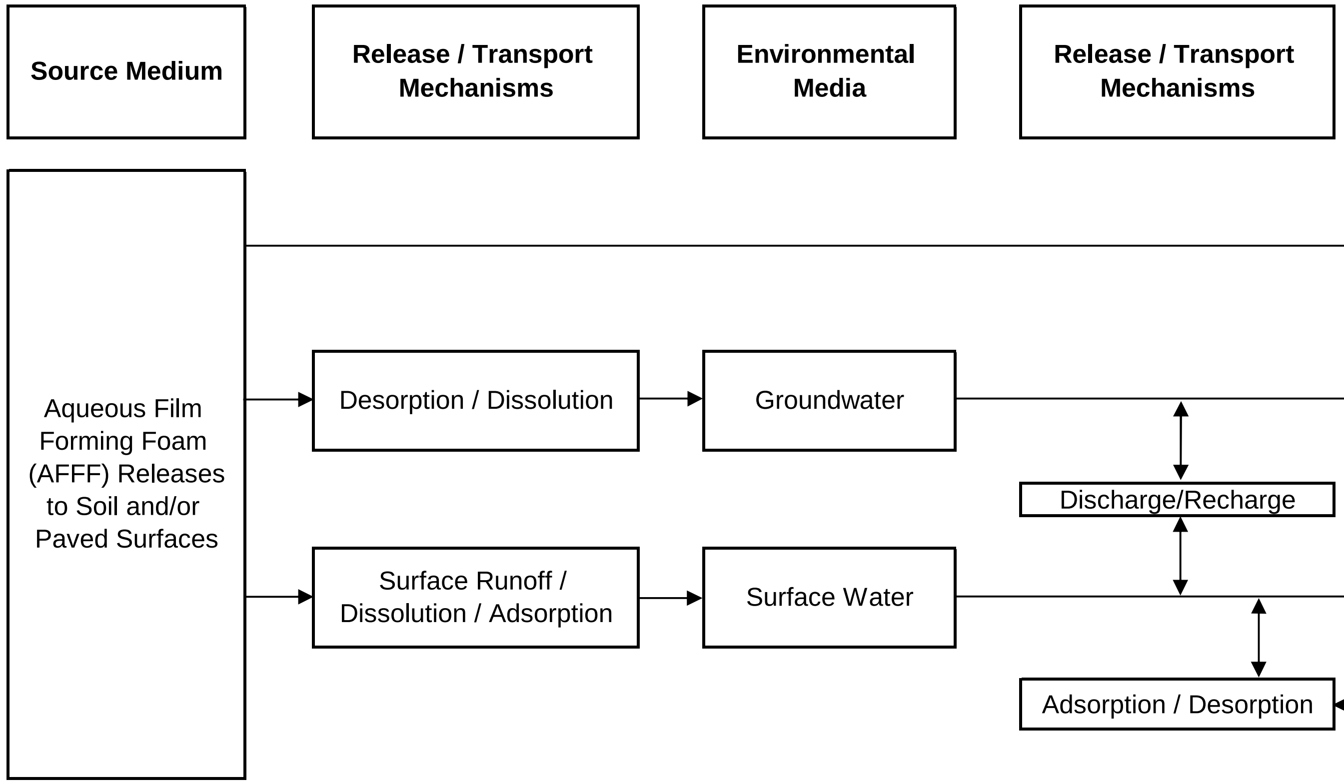
		Human Receptors			
		On-Installation			Off-Installation
Exposure Media	Exposure Route	Site Worker	Resident	Recreational User	All Types of Receptors [2]
Soil	Ingestion	◐	○	○	○
	Dermal Contact	◐	○	○	○
	Inhalation (dust)	◐	○	○	○
Groundwater	Ingestion	○	○	○	◐
	Dermal Contact	○	○	○	◐
Surface Water [1]	Ingestion	○	○	○	○
	Dermal Contact	○	○	○	○
Sediment	Ingestion	○	○	○	○
	Dermal Contact	○	○	○	○

Legend:
◐ = Potentially Complete Exposure Pathway
○ = Incomplete Exposure Pathway

Notes:
[1] Surface water exposure pathway for Site Workers and Residents describes a drinking water scenario, and for Recreational Users describes incidental ingestion and dermal contact during outdoor activities.
[2] All types of off-installation human receptors include drinking water receptors and recreational users.

Conceptual Site Model - Former Fire Training Pit (YFCR-53), Bird Bath Wash Rack, Refractometer Solutions Testing Area, and AFFF Storage Areas (Buildings 321, 821, and 751) Areas of Potential Interest
USAEC PFAS Preliminary Assessment / Site Inspection
Yakima Training Center, WA

Figure 4



		Human Receptors				
		On-Installation				Off-Installation
Exposure Media	Exposure Route	Site Worker	Resident	Subsistence User [2]	Recreational User	All Types of Receptors [3]
Soil	Ingestion	◐	○	◐	○	○
	Dermal Contact	◐	○	◐	○	○
	Inhalation (dust)	◐	○	◐	○	○
Groundwater	Ingestion	◐	○	○	○	◐
	Dermal Contact	◐	○	○	○	◐
Surface Water [1]	Ingestion	○	○	◐	◐	○
	Dermal Contact	○	○	◐	◐	○
Sediment	Ingestion	○	○	◐	◐	○
	Dermal Contact	○	○	◐	◐	○

Legend:
◐ = Potentially Complete Exposure Pathway
○ = Incomplete Exposure Pathway

Notes:
[1] Surface water exposure pathway for Site Workers and Residents describes a drinking water scenario, and for Subsistence Users and Recreational Users describes incidental ingestion and dermal contact during outdoor activities.
[2] A subsistence user was selectively added to the conceptual site model for Selah Airstrip due to the known use of the on-post area around the airstrip by the Yakama Nation for subsistence activities (e.g., root digging, hunting, and fishing).
[3] All types of off-installation human receptors include drinking water receptors and recreational users.

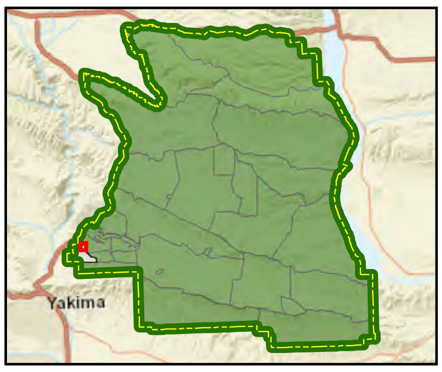
ARCADIS

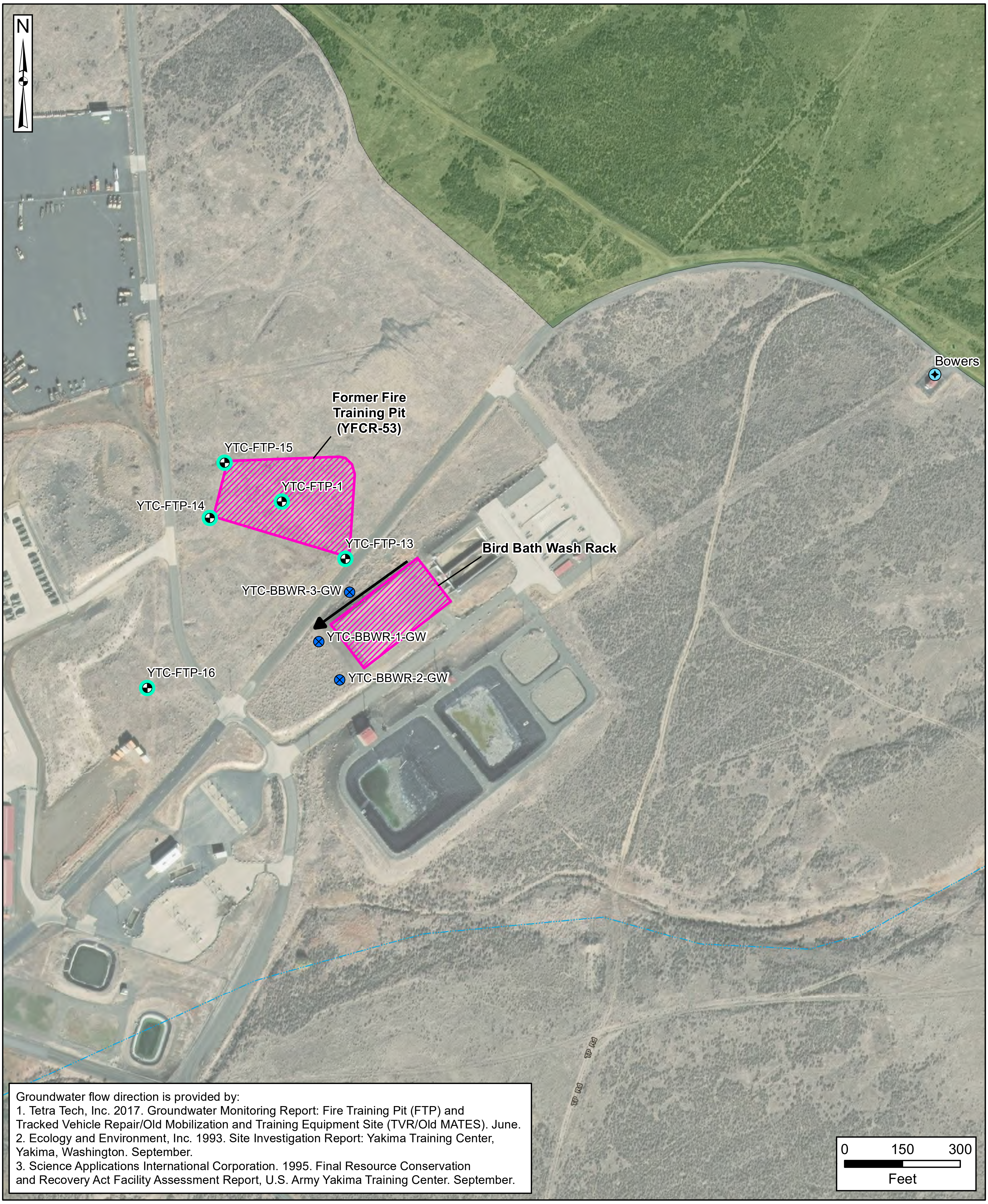
Conceptual Site Model - Selah Airstrip Area of Potential Interest
USAEC PFAS Preliminary Assessment / Site Inspection
Yakima Training Center, WA

Figure 5

Quality Assurance Project Plan Addendum
USAEC PFAS Preliminary Assessments/Site Inspection
Yakima Training Center, WA

Figure 6
Proposed Sampling Locations - Former Fire Training Pit (YFCR-53) and Bird Bath Wash Rack





Groundwater flow direction is provided by:
1. Tetra Tech, Inc. 2017. Groundwater Monitoring Report: Fire Training Pit (FTP) and Tracked Vehicle Repair/Old Mobilization and Training Equipment Site (TVR/Old MATES). June.
2. Ecology and Environment, Inc. 1993. Site Investigation Report: Yakima Training Center, Yakima, Washington. September.
3. Science Applications International Corporation. 1995. Final Resource Conservation and Recovery Act Facility Assessment Report, U.S. Army Yakima Training Center. September.

- 🟩 Installation Boundary
- ⬜ Cantonment Area
- 🟩 Range/Training Area
- ⬜ AOPI
- ▨ Approximate AFFF Use Area
- River/Stream (Intermittent)
- → Perched Groundwater Flow Direction
- ✦ Drinking Water Well (On-Installation)
- ◐ Monitoring Well
- ● Proposed Groundwater Sampling Location - Existing Well
- ⊗ Proposed Grab Groundwater Sampling Location at First Encountered - Sonic Drilling Methods

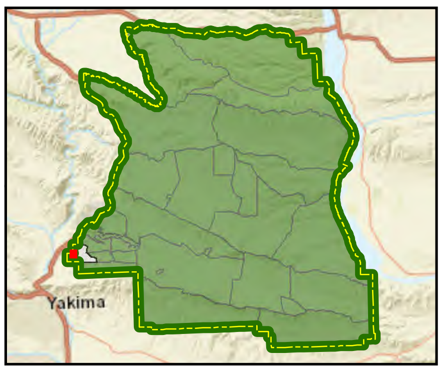
AFFF = aqueous film-forming foam
AOPI = area of potential interest

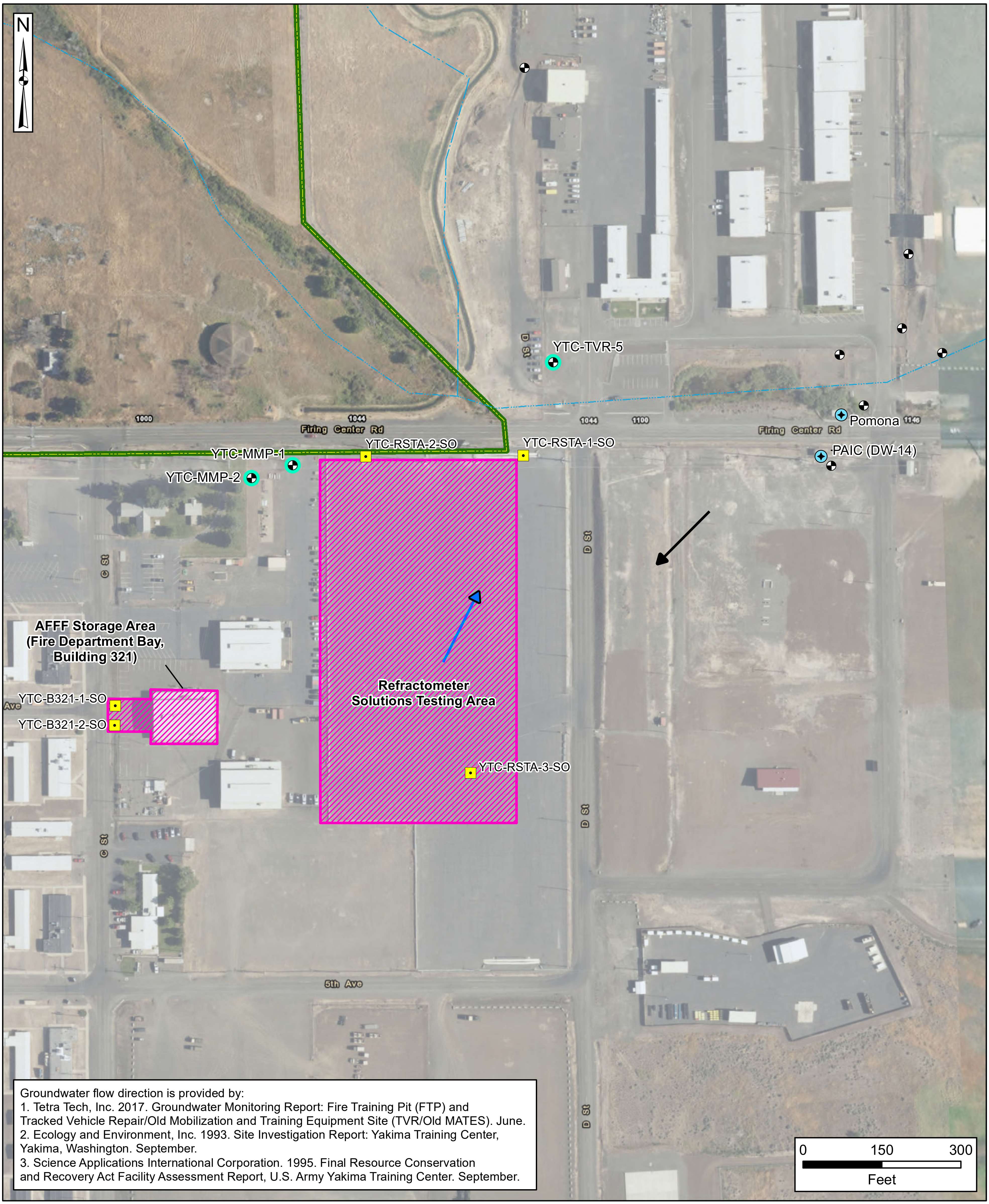
Data Sources:
Yakima Training Center, GIS Data, 2018
ESRI ArcGIS Online, Aerial Imagery

Coordinate System:
WGS 1984, UTM Zone 10 North

Quality Assurance Project Plan Addendum
USAEC PFAS Preliminary Assessments/Site Inspection
Yakima Training Center, WA

Figure 7
Proposed Sampling Locations - Refractometer Solutions Testing Area and AFFF Storage Area (Fire Department Bay, Building 321)





Groundwater flow direction is provided by:
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2. Ecology and Environment, Inc. 1993. Site Investigation Report: Yakima Training Center, Yakima, Washington. September.
3. Science Applications International Corporation. 1995. Final Resource Conservation and Recovery Act Facility Assessment Report, U.S. Army Yakima Training Center. September.

▭	Installation Boundary	⁄\⁄	Canal/Ditch	●	Proposed Groundwater Sampling Location - Existing Well
▭	Cantonment Area	→	Surface Runoff Flow Direction	▪	Proposed Soil Sampling Location (0-2 feet)
■	Range/Training Area	→	Perched Groundwater Flow Direction		
▭	AOPI	✦	Drinking Water Well (On-Installation)		
▨	Approximate AFFF Use Area	●	Monitoring Well		
~	River/Stream (Intermittent)				

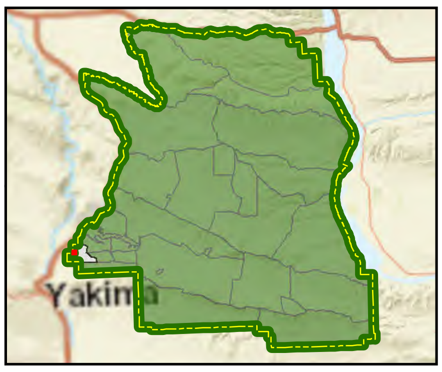
AFFF = aqueous film-forming foam
AOPI = area of potential interest

Data Sources:
Yakima Training Center, GIS Data, 2018
ESRI ArcGIS Online, Aerial Imagery

Coordinate System:
WGS 1984, UTM Zone 10 North

Quality Assurance Project Plan Addendum
USAEC PFAS Preliminary Assessments/Site Inspection
Yakima Training Center, WA

Figure 8
Proposed Sampling Locations - AFFF Storage Area (Building 821)



Groundwater flow direction is provided by:
1. Tetra Tech, Inc. 2017. Groundwater Monitoring Report: Fire Training Pit (FTP) and Tracked Vehicle Repair/Old Mobilization and Training Equipment Site (TVR/Old MATES). June.
2. Ecology and Environment, Inc. 1993. Site Investigation Report: Yakima Training Center, Yakima, Washington. September.
3. Science Applications International Corporation. 1995. Final Resource Conservation and Recovery Act Facility Assessment Report, U.S. Army Yakima Training Center. September.

🟩 Installation Boundary
⬜ Cantonment Area
🟩 Range/Training Area
🟪 AOPI
〰 River/Stream (Intermittent)

→ Perched Groundwater Flow Direction
◐ Monitoring Well
✦ Drinking Water Well (On-Installation)
▪ Proposed Soil Sampling Location (0-2 feet)
● Proposed Groundwater Sampling Location - Existing Well

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

Data Sources:
Yakima Training Center, GIS Data, 2018
ESRI ArcGIS Online, Aerial Imagery

Coordinate System:
WGS 1984, UTM Zone 10 North

Quality Assurance Project Plan Addendum
USAEC PFAS Preliminary Assessments/Site Inspection
Yakima Training Center, WA

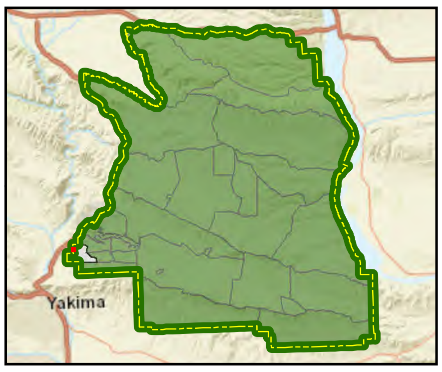


Figure 9
Proposed Sampling Locations - AFFF Storage Area (Vehicle Maintenance Shop, Building 751)

Groundwater flow direction is provided by:
1. Tetra Tech, Inc. 2017. Groundwater Monitoring Report: Fire Training Pit (FTP) and Tracked Vehicle Repair/Old Mobilization and Training Equipment Site (TVR/Old MATES). June.
2. Ecology and Environment, Inc. 1993. Site Investigation Report: Yakima Training Center, Yakima, Washington. September.
3. Science Applications International Corporation. 1995. Final Resource Conservation and Recovery Act Facility Assessment Report, U.S. Army Yakima Training Center. September.

🟩	Installation Boundary
⬜	Cantonment Area
🟩	Range/Training Area
☐	AOPI
╱	Canal/Ditch
🟨	Proposed Soil Sampling Location (0-2 feet)

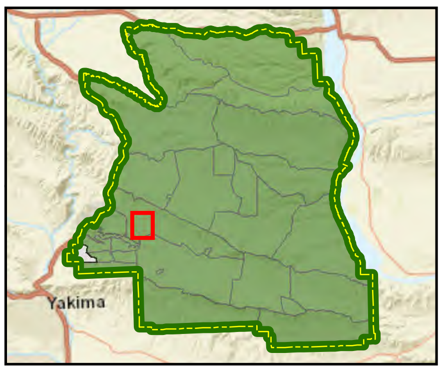
AFFF = aqueous film-forming foam
AOPI = area of potential interest

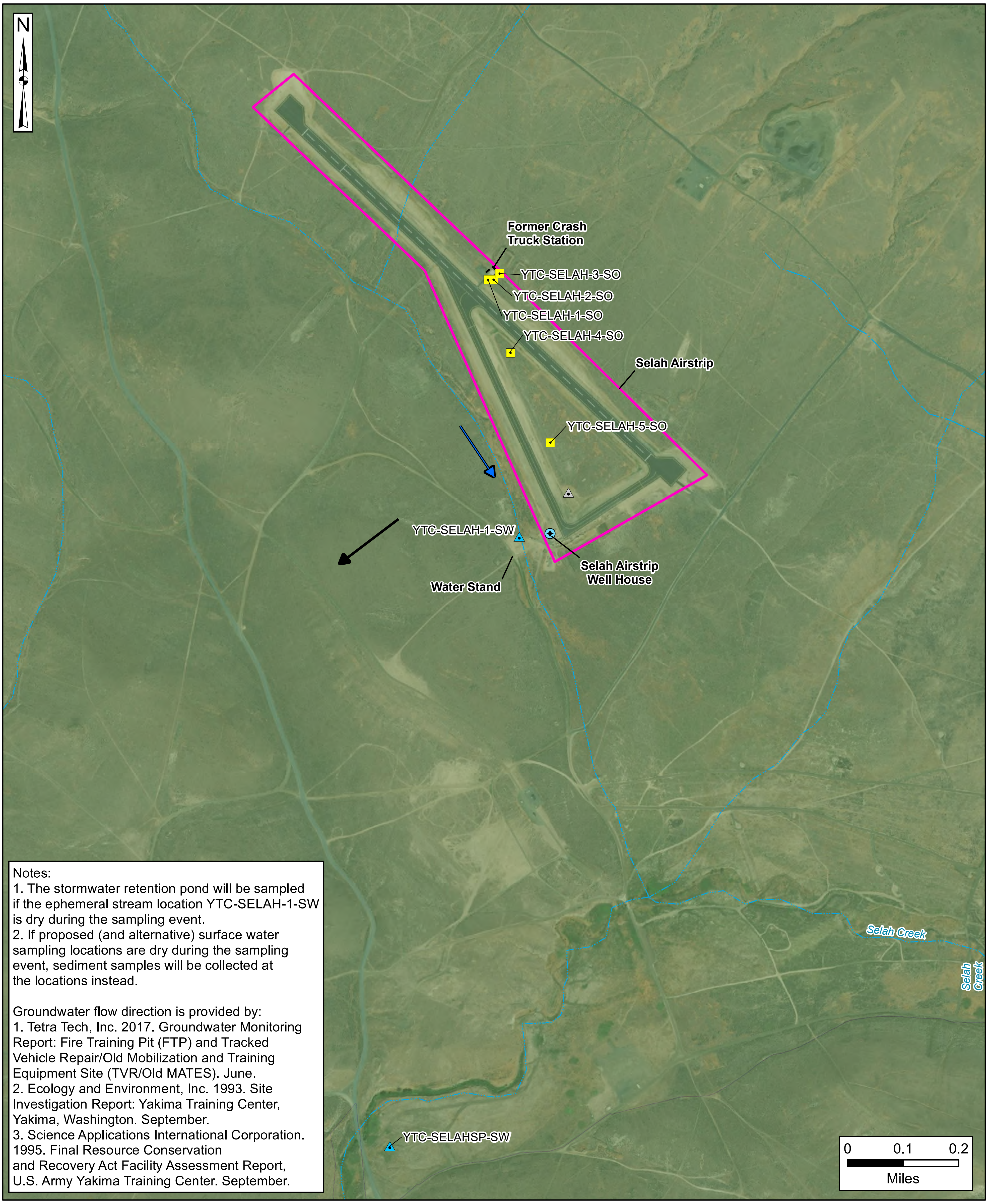
Data Sources:
Yakima Training Center, GIS Data, 2018
ESRI ArcGIS Online, Aerial Imagery

Coordinate System:
WGS 1984, UTM Zone 10 North

Quality Assurance Project Plan Addendum
USAEC PFAS Preliminary Assessments/Site Inspection
Yakima Training Center, WA

Figure 10
Proposed Sampling Locations - Selah Airstrip





Notes:
1. The stormwater retention pond will be sampled if the ephemeral stream location YTC-SELAH-1-SW is dry during the sampling event.
2. If proposed (and alternative) surface water sampling locations are dry during the sampling event, sediment samples will be collected at the locations instead.

Groundwater flow direction is provided by:
1. Tetra Tech, Inc. 2017. Groundwater Monitoring Report: Fire Training Pit (FTP) and Tracked Vehicle Repair/Old Mobilization and Training Equipment Site (TVR/Old MATES). June.
2. Ecology and Environment, Inc. 1993. Site Investigation Report: Yakima Training Center, Yakima, Washington. September.
3. Science Applications International Corporation. 1995. Final Resource Conservation and Recovery Act Facility Assessment Report, U.S. Army Yakima Training Center. September.

🟩 Installation Boundary
▢ Cantonment Area
🟩 Range/Training Area
▢ AOPI
River/Stream (Intermittent)
Canal/Ditch
→ Perched Groundwater Flow Direction
→ Surface Water Flow Direction
🟨 Proposed Soil Sampling Location (0-2 feet)
▲ Proposed Surface Water Sampling Location
▲ Alternative Surface Water Sampling Location
⊕ Drinking Water Well (On-Installation)

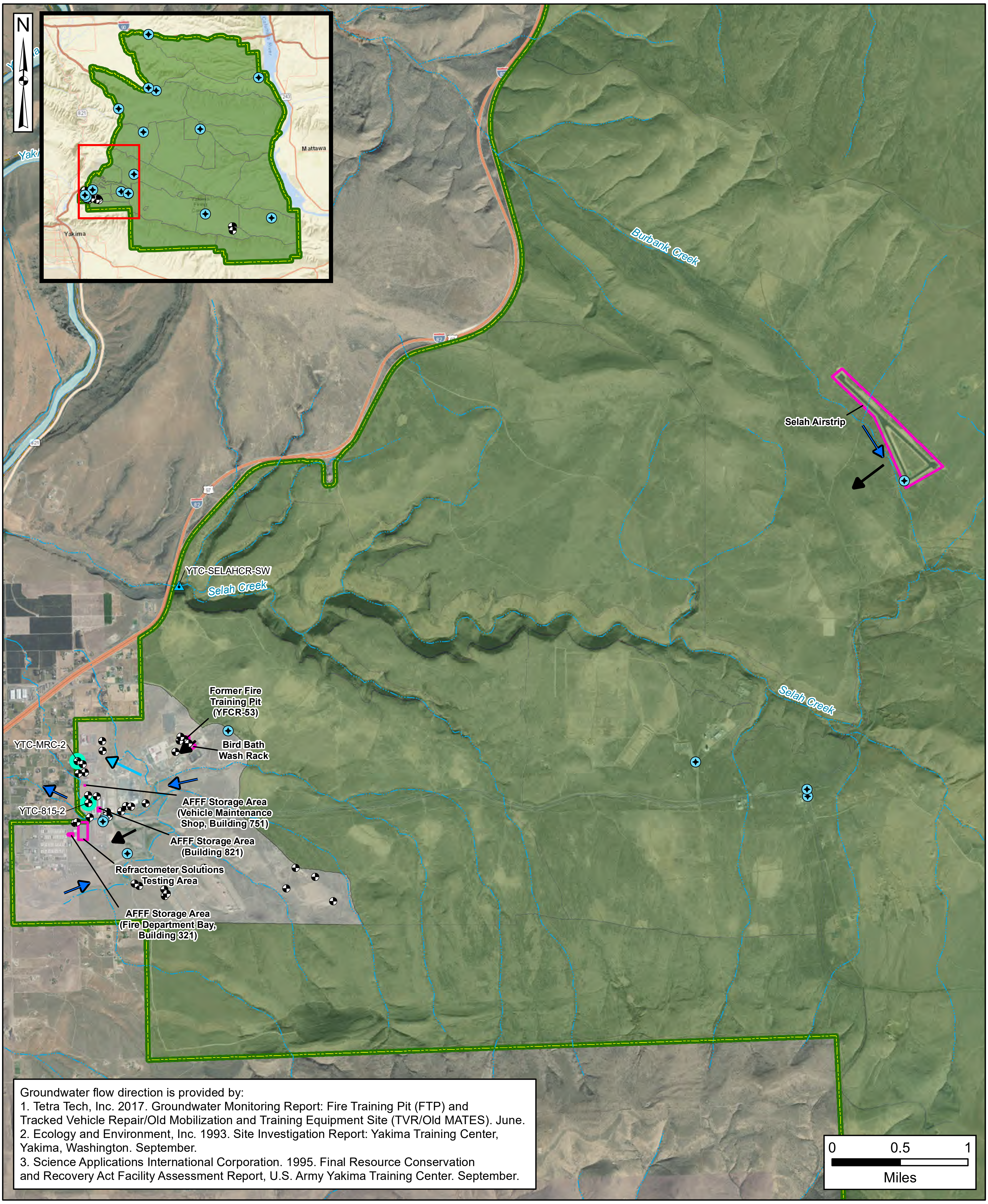
AOPI = Area of Potential Interest

Data Sources:
EDR Well Data, 2018
Yakima Training Center, GIS Data, 2018
ESRI ArcGIS Online, Aerial Imagery

Coordinate System:
WGS 1984, UTM Zone 10 North

Quality Assurance Project Plan Addendum
USAEC PFAS Preliminary Assessments/Site Inspection
Yakima Training Center, WA

Figure 11
Other Proposed Sampling Locations



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3. Science Applications International Corporation. 1995. Final Resource Conservation and Recovery Act Facility Assessment Report, U.S. Army Yakima Training Center. September.

🟩	Installation Boundary	→	Surface Water Flow Direction	●	Proposed Groundwater Sampling Location - Existing Well
⬜	Cantonment Area	→	Deep Groundwater Flow Direction	▲	Proposed Surface Water Sampling Location
🟩	Range/Training Area	→	Perched Groundwater Flow Direction		
🟪	AOPI	✦	Potable Water Well		
‐‐‐	River/Stream (Intermittent)	●	Monitoring Well		
‐‐‐	Canal/Ditch				

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

Data Sources:
Yakima Training Center, GIS Data, 2018
ESRI ArcGIS Online, Aerial Imagery

Coordinate System:
WGS 1984, UTM Zone 10 North

Attachment 1

Project Planning Session Summary

Contract Number: W912DR-18-D-0004

Delivery Order: W912DR18F0685

RECORD OF MEETING

Subject:

KICK-OFF/SCOPING TELECONFERENCE
PFAS SITE INSPECTION
YAKIMA TRAINING CENTER, WA

Participants:

Meseret Ghebresllassie (JBLM/YTC)
Amanda Chirpich (USACE, Kansas City District)
Wendy Stonestreet (USACE, Kansas City District)
Bill Gardiner (USACE, Seattle District)
Karah Haskins (USACE, Seattle District)
Kimberley Schrupp (Arcadis)
Olivia Miller (Arcadis)
Nick Henwood (Arcadis)
Rhonda Stone (Arcadis)

Meeting Date	Issue Date:
09 March 2020	13 March 2020

MEETING SUMMARY

GOALS AND SCOPE OF THE SITE INSPECTION

- Arcadis U.S., Inc. was contracted by the U.S. Army Corps of Engineers, Baltimore District, to conduct preliminary assessments (PAs) and site inspections (SIs) for the U.S. Army Environmental Command (USAEC) on the use of per- and polyfluoroalkyl substances (PFAS) at active U.S. Army and Reserve installations nationwide.

- The PA program was intended to provide a consistent product for the USAEC and U.S. Army Headquarters to support decision-making regarding PFAS issues throughout the U.S. Army. No inspections, audits, or ratings were conducted as part of the PA program. The PA program consisted of a records search, personnel interviews, and site reconnaissance to identify areas where a PFAS release could have occurred.

- Eighteen PFAS chemicals will be evaluated as part of the SI process. Perfluorooctane sulfonate (PFOS), perfluorooctanoic acid (PFOA), and perfluorobutanesulfonic acid (PFBS) are the three main compounds of interest within the PFAS group of compounds.

- SI sampling will be conducted because the results of the PA yielded areas of potential interest (AOPIs) that necessitated continuing onto the SI phase in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980.
- The overall objective of the SI is to evaluate the AOPIs identified during the PA process where potential release of PFAS due to aqueous film-forming foam use, chromium plating operations, or other PFAS-related sources warranted further investigation. The SI goals include:
  - Determine whether each AOPI identified in the PA process represents a significant source area or directly impacts a receptor.
  - Update the AOPI conceptual site models (CSMs) for human exposure based on sampling results.
- As part of the SI process, technically defensible and useful data will be compiled to determine whether media (soil, sediment, surface water, and groundwater) associated with individual AOPIs contains detectable levels of PFAS and to refine the AOPI CSMs.

Site Inspection Components

The SI process follows the PA phase of the program and includes:

- Development of a scope of work based on the CSMs established during the PA process.
- Development of an installation-specific Quality Assurance Project Plan (QAPP) Addendum, which will include the CSMs, the proposed scope of work, and the investigation-derived waste (IDW) disposal plan.
- Development of a Site Safety and Health Plan (SSHP) for each installation with installation-specific emergency procedures.
- Sampling at specific AOPIs identified during the PA process.

Meeting Agenda

- Review the PA phase findings and project status for the SI phase of work at Yakima Training Center, Washington (YTC).
- Discuss the SI phase schedule for the QAPP Addendum and SSHP (including emergency procedures on-post), the SI field effort, and the PA/SI report.
- Review the list of AOPIs identified during the PA and the proposed sampling locations and media for each AOPI.
- Discuss the IDW disposal plan.
- Discuss stakeholder engagement.

Discussion Points and Meeting Decisions

1. Ms. Ghebresllassie (Joint Base Lewis-McChord [JBLM]/YTC) asked for clarification of project roles for the teleconference participants. Ms. Chirpich (USACE) noted that, originally, the USACE, Kansas City District reviewed the PA for YTC; however, they are now engaging the Seattle District (Ms. Haskins and Mr. Gardiner) for technical review of documents associated with the PFAS PA/SI program at YTC.
2. Ms. Ghebresllassie inquired about the level of interaction between YTC, USACE, USAEC, and Arcadis during development of the QAPP Addendum. Ms. Miller (Arcadis) described the programmatic SI process. Ms. Schrupp (Arcadis) clarified that this teleconference is the beginning of the process and noted that scope changes could be accommodated if necessary.
3. Ms. Ghebresllassie asked to see the programmatic contract and noted that JBLM and YTC are receiving questions from the community. She also asked if there would be regulatory involvement or opportunity for public comment during the drafting of the documents associated with the SI. Ms. Schrupp noted that that is up to the installation whether to involve regulators or the public and that Arcadis has contractual placeholders to host technical project planning (TPP) meetings if desired. During the call, Ms. Schrupp provided the programmatic contract to Ms. Ghebresllassie and Ms. Chirpich.
4. Ms. Ghebresllassie asked for three boundary monitoring wells to be sampled: MRC-2, 815-2, and TVR-5 (the latter of which is already included in the proposed scope of work). Ms. Schrupp asked if these monitoring wells have dedicated equipment, and Ms. Ghebresllassie noted that they do not.
5. Ms. Miller asked YTC for more information regarding the Selah Airstrip retention pond and location of former Building 2065. Ms. Ghebresllassie indicated she would track down this information in April while on-post. Ms. Haskins (USACE, Seattle District) offered to help locate this information.
6. The IDW disposal plan was discussed and it was noted that the proposed disposal plan was in line with the current practices of the installation. The IDW disposal plan is as follows:
    - Soil cuttings will be returned to their respective boreholes. Boreholes are expected to be less than 30 feet deep at locations where direct push technology will be utilized and less than 2 feet deep at locations where hand augers will be utilized.
    - Liquid IDW (i.e., purge water and decontamination water) will be discarded to the ground at point of collection or generation in accordance with current IDW

disposal practices at the installation, except at FTP-1. Liquid IDW generated at FTP-1 will be temporarily containerized and disposed of in the main vehicle wash rack catch basin in an oil/water separator.

- Disposables (i.e., tubing, plastic sheeting, personal protective equipment) will be bagged and disposed of in the on-post waste receptacles.

7. Ms. Miller noted that additional monitoring well construction details are needed in order to prepare the appropriate equipment needed to sample the wells. Ms. Ghebresllassie noted that she will provide this information for the proposed wells, as well as confirm the status of the second well shown in the Selah Airstrip area.
8. Ms. Haskins inquired about the proposed groundwater sampling locations at the Refractometer Solutions Testing Area AOPI. Ms. Schrupp clarified that while groundwater flow is generally to the southeast, the surface runoff from the parking lot area would have flowed north/northeast to the unlined ditch before infiltrating upgradient of the MMP-1 and MMP-2 monitoring wells.
9. Mr. Gardiner (USACE, Seattle District) inquired about the soil sampling location placement at the Refractometer Solutions Testing Area AOPI and what procedures would be followed if the locations need to be moved. Ms. Miller noted that the locations are tentative and will be dependent on field conditions. Minor changes may be expected and will be noted in the QAPP; major changes, if necessary, will be communicated between the Arcadis team, YTC, USAEC, and USACE via phone or email.
10. Ms. Haskins inquired about the surface water sample collection and implications of comparing results to Office of the Secretary of Defense risk screening levels. Ms. Stone (Arcadis) noted that Arcadis has not been directed to avoid surface water sampling as it is still useful data to collect. Ms. Ghebresllassie noted that they collected PFAS surface water samples at JBLM, and that all Washington state water should be considered drinking water.
11. Mr. Gardiner inquired about the proposed sampling plan at Selah Airstrip does not include groundwater samples. Ms. Miller noted that the recent (August 2019) groundwater data from the AOPI will suffice for the purposes of the SI.
12. During discussion of potential public outreach and regulatory involvement, Ms. Ghebresllassie noted that there has been significant interest from the public and regulatory agencies at JBLM, and it is desirable to involve regulators and the public during the YTC PFAS SI. Ms. Schrupp noted that Arcadis has contract line items for TPP meetings, and these meetings can be included in a more refined SI schedule. Ms. Ghebresllassie noted that the residential wells off-post are all private, and that some residents have reviewed and commented on other YTC

environmental monitoring and restoration reports.

13. Ms. Ghebresllassie inquired about what method will be utilized for soil sampling as the USEPA has now approved Method 533 for PFAS analyses. Ms. Schrupp noted that Arcadis will still utilize Method 537 for PFAS analysis, complying with the Table B-15 in the Department of Defense Quality Systems Manual, Version 5.1.1. Ms. Ghebresllassie noted that Washington state has provided draft state action levels for PFAS in drinking water. Ms. Schrupp and Ms. Stone noted that, programmatically, the Army has asked that state action levels not be discussed in the body of the PA/SI report as they are not considered applicable or relevant or appropriate requirements until there is an established risk to a receptor.

ACTION ITEMS

1. Arcadis will include the two boundary monitoring wells in the sampling plan in the draft QAPP Addendum as requested by YTC.
2. Ms. Haskins (USACE, Seattle District) will look for information regarding the Selah Airstrip retention pond and the location of former Building 2065. Since the teleconference, partial information has been received regarding the location of former Building 2065 and the location of a former surface-water runoff collection feature at Selah Airstrip. Based on this information, proposed sampling locations will be revised in the draft QAPP Addendum accordingly.
3. Since the teleconference, Arcadis has contacted YTC to request additional monitoring well construction details needed to plan for the necessary equipment needed to sample the wells, and boring logs have been provided for select existing monitoring wells. Arcadis has also contacted YTC to request boring logs for the on-post potable wells in the cantonment area to better understand the depth and thickness of the confining layer separating the perched aquifer and drinking water aquifer. Logs for potable wells other than the Pomona well have been received.
4. Ms. Ghebresllassie will provide the additional monitoring well construction details for the proposed existing monitoring wells to be sampled during the SI, as well as confirm whether the second well shown in the Selah Airstrip area is functional.
5. Arcadis will include the surface runoff direction in Refractometer Solutions Testing area on the figures of the QAPP Addendum.
6. Ms. Ghebresllassie will provide proposed dates for TPP meetings to be added to the tentative SI phase schedule.

RECORD OF MEETING

Subject:

ADDITIONAL AFFF STORAGE AREAS SCOPING TELECONFERENCE

PFAS SITE INSPECTION

YAKIMA TRAINING CENTER (YTC), WA

Participants:

Meseret Ghebresllassie (JBLM/YTC)
Amanda Chirpich (USACE, Kansas City District)
Bill Gardiner (USACE, Seattle District)
Karah Haskins (USACE, Seattle District)
Martin Roberts (USAEC)

Kimberley Schrupp (Arcadis)
Olivia Miller (Arcadis)
Joe Quinnan (Arcadis)

Meeting Date	**Issue Date:**
02 June 2020	11 June 2020

MEETING SUMMARY

GOALS AND SCOPE OF THE SITE INSPECTION

- Arcadis U.S., Inc. was contracted by the U.S. Army Corps of Engineers, Baltimore District, to conduct preliminary assessments (PAs) and site inspections (SIs) for the U.S. Army Environmental Command (USAEC) on the use of per- and polyfluoroalkyl substances (PFAS) at active U.S. Army and Reserve installations nationwide.

- The PA program was intended to provide a consistent product for the USAEC and U.S. Army Headquarters to support decision-making regarding PFAS issues throughout the U.S. Army. No inspections, audits, or ratings were conducted as part of the PA program. The PA program consisted of a records search, personnel interviews, and site reconnaissance to identify areas where a PFAS release could have occurred.

- Eighteen PFAS chemicals will be evaluated as part of the SI process. Perfluorooctane sulfonate (PFOS), perfluorooctanoic acid (PFOA), and perfluorobutanesulfonic acid (PFBS) are the three main compounds of interest within the PFAS group of compounds.

- SI sampling will be conducted because the results of the PA yielded areas of potential interest (AOPIs) that necessitated continuing onto the SI phase in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980.

- The overall objective of the SI is to evaluate the AOPIs identified during the PA process where potential release of PFAS due to aqueous film-forming foam use, chromium plating operations, or other PFAS-related sources warranted further investigation. The SI goals include:
    - Determine whether each AOPI identified in the PA process represents a significant source area or directly impacts a receptor.
    - Update the AOPI conceptual site models (CSMs) for human exposure based on sampling results.
- As part of the SI process, technically defensible and useful data will be compiled to determine whether media (soil, sediment, surface water, and groundwater) associated with individual AOPIs contains detectable levels of PFAS and to refine the AOPI CSMs.

Site Inspection Components

The SI process follows the PA phase of the program and includes:

- Development of a scope of work based on the CSMs established during the PA process.
- Development of an installation-specific Quality Assurance Project Plan (QAPP) Addendum, which will include the CSMs, the proposed scope of work, and the investigation-derived waste (IDW) disposal plan.
- Development of a Site Safety and Health Plan (SSHP) for each installation with installation-specific emergency procedures.
- Sampling at specific AOPIs identified during the PA process.

Meeting Agenda

- Discuss additional aqueous film-forming foam (AFFF) storage areas to be added as AOPIs and sampled as part of the SI.
- Discuss comments received to date on the Draft QAPP Addendum.

Discussion Points and Meeting Decisions

1. Since the initial kickoff/scoping teleconference and submittal of the Draft QAPP Addendum for the PFAS SI at YTC, the Army provided programmatic direction to sample all AFFF storage areas. Thus, three AFFF storage areas were added as AOPIs for sampling at YTC during the PFAS SI:
    - Building 321 (Fire Department Bay)
    - Building 821
    - Building 751 (Vehicle Maintenance Shop)

Two soil sampling locations are proposed at each of the AOPIs. Additionally, groundwater downgradient of Building 821 is already planned to be sampled via existing well TVR-5. No additional comments or concerns regarding these proposed sampling plan revisions were noted.

2. Ms. Miller (Arcadis) inquired about a comment received from Mr. Jerome Lambiotte (YTC) regarding soil sampling at all AOPIs (i.e., including those at which the ground surface has been significantly reworked). Ms. Ghebresllassie (YTC) noted she would look further into the comment. Ms. Schrupp (Arcadis) noted that soil sampling in disturbed areas was not proposed as to avoid false-nondetect results. Ms. Haskins (USACE) asked if soil sampling locations will be re-assessed in the field based on evidence of disturbance. Ms. Miller confirmed that the proposed locations are tentative and that the field team will be responsible for ensuring that final sampling locations are placed in appropriate areas. The final sampling locations will take into account drainage pathways and avoid fill areas if possible. Ms. Haskins asked what the bermed areas at the Selah Airstrip were used for; neither YTC nor Arcadis was aware of their purpose.
3. Ms. Miller (Arcadis) inquired about a comment regarding IDW disposal received from Mr. Jerome Lambiotte (YTC). Ms. Ghebresllassie (YTC) indicated that all purge and decontamination water should be composited and temporarily stored in a drum and sampled for waste characterization. If results of the PFAS analysis of the waste characterization sample are less than the United States Environmental Protection Agency’s Lifetime Health Advisory concentrations, the IDW water can be disposed in an on-post oil/water separator; otherwise, the IDW water will need to be run through granular activated carbon treatment before disposing to the oil/water separator. Ms. Ghebresllassie will need to coordinate with the Directorate of Public Works environmental office to determine a temporary storage location for the liquid IDW drum.
4. Ms. Miller discussed the revisions to the Selah Airstrip CSM to include subsistence users (i.e., Yakima Nation). Mr. Gardiner (USACE) asked for Arcadis to provide the revised figure and text. Ms. Miller will provide these revisions.
5. Ms. Ghebresllassie asked for confirmation of the field work schedule. Ms. Miller (Arcadis) noted that the timing of the field event would depend on the availability of drillers, but the tentative schedule is to complete field work in September 2020.
6. Ms. Miller inquired about the timeline for USACE’s review of the Draft QAPP Addendum. Mr. Gardiner noted that he would review and provide comments today. Ms. Ghebresllassie asked Mr. Roberts (USAEC) if the QAPP Addendum could then be provided to the Washington Department of Ecology as a courtesy for review. Mr. Roberts and Ms. Schrupp clarified that the document needs to be approved by YTC Operations Security (OPSEC) for review prior to sharing the document with regulators. Ms. Ghebresllassie will coordinate this review. Ms. Miller inquired about the timeline expected for OPSEC review, and Ms.

Ghebresllassie noted that we should receive responses from OPSEC officers within two weeks. Mr. Roberts requested that the SI schedule not be delayed while waiting for regulatory review.

ACTION ITEMS

1. Ms. Ghebresllassie will follow up with Mr. Lambiotte regarding his comment on the draft QAPP Addendum and the recommendation to sample soil at all AOPIs (including those at which the ground surface has been significantly reworked).
2. Ms. Ghebresllassie will coordinate with the Directorate of Public Works environmental office to determine a temporary storage location for the liquid IDW drum.
3. Ms. Miller provided the revised Selah Airstrip CSM to the teleconference participants.
4. Ms. Ghebresllassie will coordinate the review of the Draft QAPP Addendum with OPSEC officers.
5. Mr. Gardiner (USACE) provided comments on the Draft QAPP Addendum on 05 June 2020. Following completion of revisions by Arcadis, Ms. Miller will compile a Draft Final QAPP Addendum for YTC to share with regulators.

Attachment 2

Historical PFAS Data

Contract Number: W912DR-18-D-0004

Delivery Order: W912DR18F0685

Attachment 2 - Historical PFAS Data
Quality Assurance Project Plan Addendum
USAEC PFAS Preliminary Assessment/Site Inspection
Yakima Training Center, WA

Well ID			Pomona (Bldg 829)	Pomona (Bldg 829)	Bowers (Bldg 860)	Bowers (Bldg 860)	Jordan (Bldg 550)	Jordan (Bldg 550)	MPRC (Bldg 84B)	MPRC (Bldg 84B)	Badger Gap (Bldg 2110)
Sample ID			YTC_GW_991042 PomonaWell_FW	YTC_GW_991042 PAMONA_RW Drinking Water	YTC_GW_991042 BowersWell_FW	YTC_GW_991042 BOWERSWELL_RW Drinking Water	YTC_GW_991042 JordanWell_FW	YTC_GW_991042 JordanWell_RW	YTC_GW_07035 TMPRCWell_FW	YTC_GW_07035 T_MPRC_S01_FW	YTC_GW_070349 BadgerGap_FW
Laborty			EEA	ELLE	EEA	ELLE	EEA	ELLE	EEA	ELLE	EEA
Sample Date			10/26/2016	8/19/2019	10/25/2016	8/19/2019	10/26/2016	8/20/2019	10/25/2016	8/20/2019	10/25/2016
PFAS (ng/L)	**LHA**	**OSD RSL**									
N-ethyl perfluorooctanesulfonamidoacetic acid (NEtFOSAA)			NA	< 1.7	NA	< 1.8	NA	< 1.8	NA	< 1.7	NA
N-methyl perfluorooctanesulfonamidoacetic acid (NMeFOSAA)			NA	< 1.7	NA	< 1.8	NA	< 1.8	NA	< 1.7	NA
Perfluorobutanesulfonic acid (PFBS)		40,000	< 2.0	< 1.7	< 2.0	< 1.8	< 2.0	< 1.8	< 2.0	< 1.7	< 2.0
Perfluorodecanoic acid (PFDA)			NA	< 1.7	NA	< 1.8	NA	< 1.8	NA	< 1.7	NA
Perfluorododecanoic acid (PFDoA)			NA	< 1.7	NA	< 1.8	NA	< 1.8	NA	< 1.7	NA
Perfluoroheptanoic acid (PFHpA)			< 2.0	< 1.7	< 2.0	< 1.8	< 2.0	< 1.8	< 2.0	< 1.7	< 2.0
Perfluorohexanesulfonic acid (PFHxS)			< 2.0	< 1.7	< 2.0	< 1.8	< 2.0	< 1.8	< 2.0	< 1.7	< 2.0
Perfluorohexanoic acid (PFHxA)			NA	< 1.7	NA	< 1.8	NA	< 1.8	NA	< 1.7	NA
Perfluorononanoic acid (PFNA)			< 2.0	< 1.7	< 2.0	< 1.8	< 2.0	< 1.8	< 2.0	< 1.7	< 2.0
Perfluorooctanesulfonic acid (PFOS)	70	40	< 2.0	< 1.7	< 2.0	< 1.8	< 2.0	< 1.8	< 2.0	< 1.7	< 2.0
Perfluorooctanoic acid (PFOA)	70	40	< 2.0	< 1.7	< 2.0	< 1.8	< 2.0	< 1.8	< 2.0	< 1.7	< 2.0
Perfluorotetradecanoic acid (PFTeDA)			NA	< 1.7	NA	< 1.8	NA	< 1.8	NA	< 1.7	NA
Perfluorotridecanoic acid (PFTrDA)			NA	< 1.7	NA	< 1.8	NA	< 1.8	NA	< 1.7	NA
Perfluoroundecanoic acid (PFUnA)			NA	< 1.7	NA	< 1.8	NA	< 1.8	NA	< 1.7	NA

Notes and Acronyms:

1. All data and qualifier definitions are as provided in laboratory analytical reports.

-- = not applicable
< = concentration not detected greater than the noted method reporting limit
Bldg = building
EEA = Eurofins Eaton Analytical
ELLE = Eurofins Lancaster Laboratories Environmental
MPRC = Multi-purpose Range Complex
NA = not analyzed
ng/L = nanograms per liter
OSD = Office of the Secretary of Defense
PFAS = per- and polyfluoroalkyl substances
RSL = risk screening level
YRS = Yakima Research Station

	Badger Gap (Bldg U084E)	YRS (Bldg 1901)	YRS (Bldg 1901)	Hester (Bldg unavailable)	Range 55 (Bldg 2555)	Selah Airstrip (Water stand)	Selah Airstrip (Well House, Bldg 2060)	Exit 11 (Bldg 2239)	New Doris Well (Bldg unavailable)
	YTC_GW_70349 BadgerGAP_S01_FW	YTC_GW_07029LYRSBLDG1901_FW	YTC_GW_07029LYRS_RW	YTC_GW_07029LHESTER_RW	YTC_GW_70307_RANGE55_S01_FW	YTC_GW_SELAH_FW	YTC_GW_SELAH_RW	YTC_GW_070328_Exit11S01_FW	YTC_NEWDORISWELL_FW
	ELLE	EEA	ELLE	ELLE	ELLE	ELLE	ELLE	ELLE	ELLE
	8/20/2019	10/26/2016	8/19/2019	8/20/2019	8/20/2019	8/20/2019	11/14/2019	8/20/2019	8/21/2019
PFAS (ng/L)									
N-ethyl perfluorooctanesulfonamidoacetic acid (NEtFOSAA)	< 1.8	NA	< 1.8	< 1.7	< 1.8	< 1.8	< 1.8	< 1.8	< 1.8
N-methyl perfluorooctanesulfonamidoacetic acid (NMeFOSAA)	< 1.8	NA	< 1.8	< 1.7	< 1.8	< 1.8	< 1.8	< 1.8	< 1.8
Perfluorobutanesulfonic acid (PFBS)	< 1.8	< 2.0	< 1.8	< 1.7	< 1.8	**11**	**11**	< 1.8	< 1.8
Perfluorodecanoic acid (PFDA)	< 1.8	NA	< 1.8	< 1.7	< 1.8	< 1.8	< 1.8	< 1.8	< 1.8
Perfluorododecanoic acid (PFDoA)	< 1.8	NA	< 1.8	< 1.7	< 1.8	< 1.8	< 1.8	< 1.8	< 1.8
Perfluoroheptanoic acid (PFHpA)	< 1.8	< 2.0	< 1.8	< 1.7	< 1.8	**24**	**20**	< 1.8	< 1.8
Perfluorohexanesulfonic acid (PFHxS)	< 1.8	< 2.0	< 1.8	< 1.7	< 1.8	**330**	**300**	< 1.8	< 1.8
Perfluorohexanoic acid (PFHxA)	< 1.8	NA	< 1.8	< 1.7	< 1.8	**95**	**100**	< 1.8	< 1.8
Perfluorononanoic acid (PFNA)	< 1.8	< 2.0	< 1.8	< 1.7	< 1.8	< 1.8	< 1.8	< 1.8	< 1.8
Perfluorooctanesulfonic acid (PFOS)	< 1.8	< 2.0	< 1.8	< 1.7	< 1.8	**4.2**	**3.4**	< 1.8	< 1.8
Perfluorooctanoic acid (PFOA)	< 1.8	< 2.0	< 1.8	< 1.7	< 1.8	**96**	**100**	< 1.8	< 1.8
Perfluorotetradecanoic acid (PFTeDA)	< 1.8	NA	< 1.8	< 1.7	< 1.8	< 1.8	< 1.8	< 1.8	< 1.8
Perfluorotridecanoic acid (PFTrDA)	< 1.8	NA	< 1.8	< 1.7	< 1.8	< 1.8	< 1.8	< 1.8	< 1.8
Perfluoroundecanoic acid (PFUnA)	< 1.8	NA	< 1.8	< 1.7	< 1.8	< 1.8	< 1.8	< 1.8	< 1.8

Notes and Acronyms:

1. All data and qualifier definitions are as provide

-- = not applicable
< = concentration not detected greater than the n
Bldg = building
EEA = Eurofins Eaton Analytical
ELLE = Eurofins Lancaster Laboratories Environ
MPRC = Multi-purpose Range Complex
NA = not analyzed
ng/L = nanograms per liter
OSD = Office of the Secretary of Defense
PFAS = per- and polyfluoroalkyl substances
RSL = risk screening level
YRS = Yakima Research Station

	Dead Truck Farm (Bldg 0020)
	YTC_DEADTRUCK FARM
	ELLE
	8/21/2019
PFAS (ng/L)	
N-ethyl perfluorooctanesulfonamidoacetic acid (NEtFOSAA)	< 1.8
N-methyl perfluorooctanesulfonamidoacetic acid (NMeFOSAA)	< 1.8
Perfluorobutanesulfonic acid (PFBS)	< 1.8
Perfluorodecanoic acid (PFDA)	< 1.8
Perfluorododecanoic acid (PFDoA)	< 1.8
Perfluoroheptanoic acid (PFHpA)	< 1.8
Perfluorohexanesulfonic acid (PFHxS)	< 1.8
Perfluorohexanoic acid (PFHxA)	< 1.8
Perfluorononanoic acid (PFNA)	< 1.8
Perfluorooctanesulfonic acid (PFOS)	< 1.8
Perfluorooctanoic acid (PFOA)	< 1.8
Perfluorotetradecanoic acid (PFTeDA)	< 1.8
Perfluorotridecanoic acid (PFTrDA)	< 1.8
Perfluoroundecanoic acid (PFUnA)	< 1.8

Notes and Acronyms:

1. All data and qualifier definitions are as provide

-- = not applicable
< = concentration not detected greater than the n
Bldg = building
EEA = Eurofins Eaton Analytical
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MPRC = Multi-purpose Range Complex
NA = not analyzed
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OSD = Office of the Secretary of Defense
PFAS = per- and polyfluoroalkyl substances
RSL = risk screening level
YRS = Yakima Research Station

Attachment 3

Office of the Secretary of Defense. 2019. Memorandum: Investigating Per- and Polyfluoroalkyl Substances within the Department of Defense Cleanup Program. October 15.

ASSISTANT SECRETARY OF DEFENSE
3500 DEFENSE PENTAGON
WASHINGTON, DC 20301-3500

SUSTAINMENT

OCT 15 2019

MEMORANDUM FOR ASSISTANT SECRETARY OF THE ARMY (INSTALLATIONS, ENERGY AND ENVIRONMENT)
ASSISTANT SECRETARY OF THE NAVY (ENERGY, INSTALLATIONS AND ENVIRONMENT)
ASSISTANT SECRETARY OF THE AIR FORCE (INSTALLATIONS, ENVIRONMENT AND ENERGY)
DIRECTOR, NATIONAL GUARD BUREAU (JOINT STAFF, J8)
DIRECTOR, DEFENSE LOGISTICS AGENCY (INSTALLATION SUPPORT)

SUBJECT: Investigating Per- and Polyfluoroalkyl Substances within the Department of Defense Cleanup Program

The Department of Defense (DoD) conducts cleanup under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and the Defense Environmental Restoration Program (DERP). Our goal is protection of human health and the environment in a risk-based, fiscally-sound manner. This memorandum provides clarifying technical guidance on the investigation of perfluorooctane sulfonate (PFOS), perfluorooctanoic acid (PFOA), and perfluorobutanesulfonic acid (PFBS). This guidance is applicable to investigating PFOS, PFOA, and PFBS at Environmental Restoration Account-funded, Base Realignment and Closure Account-funded, and Operation and Maintenance accounts for the National Guard-funded sites.

PFOS, PFOA, and PFBS are part of a larger class of chemicals known as per- and polyfluoroalkyl substances (PFAS). PFAS shall be addressed in the same manner as other contaminants of concern within the DERP.

Under CERCLA, site-specific regional screening levels[1] (RSLs) for PFOS and PFOA are calculated using the Environmental Protection Agency (EPA) online calculator using the oral reference dose (RfD) of 2E-05 mg/kg-day. The RSL for PFBS is calculated using the EPA Provisional Peer Reviewed Toxicity Value (PPRTV) RfD of 2E-02 mg/kg-day, or it may be read off the tables available on the EPA RSL website. The values are provided in the attachment. These RSLs should be used for screening to determine if further investigation in the remedial investigation (RI) phase is warranted or if the site can proceed to site closeout. 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 40 parts per billion (40,000 ppt).

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[1] For sites on the National Priorities List, the DoD Components will use the EPA site specific screening levels, if provided.

During the RI phase, the RfDs for PFOS, PFOA, and PFBS and the oral cancer slope factor (CSF) for PFOA of 0.07 $(\text{mg/kg-day})^{-1}$ will be used to conduct site specific risk assessments in accordance with Risk Assessment Guidance for Superfund Volume I, Part A (EPA/540/1-89/002, December 1989). Site-specific risk assessment results will be used to determine if any necessary remedial actions are required in accordance with CERCLA, DERP, and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP).

My point of contact for this matter is Ms. Deborah Morefield at 703-571-9067 or deborah.a.morefield.civ@mail.mil.

Robert H. McMahon

Attachment:
As stated

Attachment: 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-day)$^{-1}$	Non-Carcinogenic Reference Dose (RfD) (mg/kg-day)	Residential Scenario Screening Levels Calculated Using EPA RSL Calculator								Industrial/Commercial Composite Worker Screening Levels Calculated Using EPA RSL Calculator			
			Tap Water (µg/L or ppb)				Soil (mg/kg or ppm)				Soil (mg/kg or ppm)			
			HQ = 0.1	HQ = 1.0	ILCR = 1E-06	ILCR = 1E-04	HQ = 0.1	HQ = 1.0	ILCR = 1E-06	ILCR = 1E-04	HQ = 0.1	HQ = 1.0	ILCR = 1E-06	ILCR = 1E-04
PFOS	NA	2.00E-05	0.040	0.40	NA	NA	0.13	1.3	NA	NA	1.6	16	NA	NA
PFOA	7.00E-02	2.00E-05	0.040	0.40	1.1	111	0.13	1.3	7.8	775	1.6	16	33	3,280
PFBS	NA	2.00E-02	40	400	NA	NA	130	1300	NA	NA	1600	16000	NA	NA

HQ=Hazard Quotient
ILCR=Incremental Lifetime Cancer Risk
NA=Not available/applicable

NOTES:

- The table represents screening levels based on residential and industrial/commercial worker receptor scenarios for either direct ingestion of groundwater (residential scenario only) or incidental ingestion of contaminated soil (both residential and composite worker scenarios).
- All values were calculated using slope factors or reference doses for PFOS and PFOA published by EPA Office of Water in support of the LHA, and default exposure assumptions for each potential receptor scenario, contained in EPA's RSL Calculator on April 6, 2018.
- Peer reviewed toxicity values considered valid for risk assessment exist for PFBS, and the screening levels may be found in EPA's RSL table or EPA's RSL calculator used to develop them.
- Other potential receptor scenarios (e.g., recreational user, site trespasser, construction worker) are not included in the above table, but could be relevant receptors at a site potentially contaminated with PFOS, PFOA and/or PFBS. These receptors, and their associated exposure scenarios, should be further considered in the scoping phase and completion of the Baseline Human Health Risk Assessment typically completed during an RI.
- The shaded values represent conservative screening levels for PFOS and PFOA in groundwater or soil that when exceeded should be considered a contaminant of potential concern in the risk assessment process and calculations of site-specific risk posed.

Attachment 4

Site Safety and Health Plan (provided under separate cover)

Attachment 5

Monitoring Well Construction Details

Attachment 5 - Monitoring Well Construction Details
Quality Assurance Project Plan Addendum
USAEC PFAS Preliminary Assessment/Site Inspection
Yakima Training Center, WA

Well Identification	Elevation at TOC (ft amsl)	Ground Surface Elevation (ft amsl)	Total Depth (ft bgs)	Approximate Depth to Water (ft btoc)	Screen Interval (ft bgs)	Well Diameter (inches)	Screened Lithologic Unit
Fire Training Pit Monitoring Wells							
FTP-1	1467.72	1464.59	21.0	11-18	8 – 18	Unk	Fractured Basalt
FTP-13	1473.07	1470.96	25.0		10 – 20	Unk	
FTP-14	1457.48	1455.35	22.0		12 – 22	Unk	
FTP-15	1460.88	1458.72	20.0		10 – 20	Unk	
FTP-16	1444.81	1442.68	30.0	26	20 – 30	Unk	
Tracked Vehicle Repair/Old Mobilization and Training Equipment Site Monitoring Wells							
MMP-1	1301.37	1298.39	100.5	47-66	88 – 98	Unk	Fractured Basalt
MMP-2	1301.31	1298.55	75.5		64 – 74	Unk	
TVR-5	1302.04	1299.42	142.0	48-60	132 – 142	2	Sand/Silt beneath Basalt
Installation Boundary Monitoring Wells							
MRC-2	1312.11	1309.64	113.5	68-81	101 - 111	4	Fractured Basalt with Sand Interbeds
815-2	1304.28	1301.86	127.0	52-66	115 - 130	2	Sand/Silt beneath Basalt

Notes and Acronyms:

amsl – above mean sea level
bgs – below ground surface
ft – feet
m – meters
PAIC – Pomona Artesian Irrigation Company
TOC – top of casing
Unk – Unknown
UTM – Universal Transverse Mercator

Source:

Tetra Tech, Inc. 2017. 2016 Annual Groundwater Monitoring Report: Fire Training Pit and Tracked Vehicle Repair/Old Mobilization and Training Equipment Site, Joint Base Lewis-McChord and Yakima Training Center, Yakima, WA. June.

Attachment 6

Updated Technical Guidance Instruction (P-12 from the Programmatic QAPP): PFAS-Specific Drilling and Monitoring Well Installation, Rev #3, 15 April 2020

PFAS-SPECIFIC DRILLING AND MONITORING WELL INSTALLATION TECHNICAL GUIDANCE INSTRUCTION

Rev: #3

Rev Date: 4/15/2020

VERSION CONTROL

Revision No	Revision Date	Page No(s)	Description	Reviewed by
0	10/12/2018	All	Generated from generic Well Installation TGI (Rev 0, April 24, 2017). Revised to be PFAS-specific, provide more instruction on soil sample collection, and only include DPT and Sonic methods	Ankit Gupta
1	3/26/2019	Attachments	Added a restriction against all fluoropolymer materials in Table 2 for sampling; Removed Citranox as an appropriate decon solution in Table 1. Made a correction that Liquinox contains trace levels of 1,4 Dioxane, not Alconox.	Erika Houtz
2	12/19/2019	5-7, 9-10, 13-15, 18-19, 22-28	Updated equipment list. Added procedures for single-interval groundwater sampling during drilling activities. Added procedures for hollow stem auger drilling.	Joseph Quinnan
3	4/15/2020	28-34	Added procedures for air rotary drilling	Eric Killenbeck

APPROVAL SIGNATURES

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1 INTRODUCTION

This document describes general and/or specific procedures, methods, actions, steps, and considerations to be used and observed by Arcadis staff when performing work, tasks, or actions under the scope and relevancy of this document. This document may describe expectations, requirements, guidance, recommendations, and/or instructions pertinent to the service, work task, or activity it covers.

It is the responsibility of the Arcadis Certified Project Manager (CPM) to provide this document to the persons conducting services that fall under the scope and purpose of this procedure, instruction, and/or guidance. The Arcadis CPM will also ensure that the persons conducting the work falling under this document are appropriately trained and familiar with its content. The persons conducting the work under this document are required to meet the minimum competency requirements outlined herein, and inquire to the CPM regarding any questions, misunderstanding, or discrepancy related to the work under this document.

This document is not considered to be all inclusive nor does it apply to any and all projects. It is the CPM's responsibility to determine the proper scope and personnel required for each project. There may be project- and/or client- and/or state-specific requirements that may be more or less stringent than what is described herein. The CPM is responsible for informing Arcadis and/or Subcontractor personnel of omissions and/or deviations from this document that may be required for the project. In turn, project staff are required to inform the CPM if or when there is a deviation or omission from work performed as compared to what is described herein.

In following this document to execute the scope of work for a project, it may be necessary for staff to make professional judgment decisions to meet the project's scope of work based upon site conditions, staffing expertise, state-specific requirements, health and safety concerns, etc. Staff are required to consult with the CPM when or if a deviation or omission from this document is required that has not already been previously approved by the CPM. Upon approval by the CPM, the staff can perform the deviation or omission as confirmed by the CPM.

2 SCOPE AND APPLICATION

This Technical Guidance Instruction (TGI) describes methods for the following at sites impacted by per- and polyfluoroalkyl substances (PFASs):

- Advance soil borings via direct push technology (DPT), rotosonic, hollow stem auger, or air rotary drilling techniques
- Collect single or multiple depth-discrete dry and/or saturated soil samples
- Collect single-interval grab groundwater samples
- Install groundwater monitoring wells in unconsolidated aquifers (as necessary).

This TGI covers specific considerations relevant for PFASs due to their unique chemical and physical properties, low detection limits, and low regulatory standards. A more detailed discussion of general PFAS sampling procedures is provided in PFAS Field Sampling Guidance TGI (Arcadis 2018a).

If monitoring wells are to be installed upon completion of borehole drilling and soil sampling, it is assumed that the monitoring well has been designed consistent with the approach and methods presented in the American Society of Testing and Materials (ASTM) D5092 – *Standard Practice for Design and Installation of Groundwater Monitoring Wells* (ASTM D5092). This includes sizing of the filter pack and screen slot size, the length of the screen, total depth of the well, material strength and compatibility and surface completion. Typical monitoring wells are constructed of manufactured screen and engineered filter pack and are generally suitable for formations with granular materials having a grain size distribution with up to 50% passing a #200 sieve and up to 20% clay-sized material. Monitoring wells installed in formations finer than this may not be able to produce turbidity free water.

The procedures set out herein are designed to produce standard groundwater monitoring wells suitable for: (1) groundwater sampling; (2) water level measurement; and (3) hydraulic conductivity testing of formation sediments immediately adjacent to the open interval of the well (e.g., slug testing).

This TGI will focus specifically on four drilling methods most likely to be utilized during drilling and soil sampling activities: DPT, rotosonic, hollow stem auger, and air rotary techniques. The drilling method to be used at a given site will be selected based on site-specific consideration of anticipated drilling depths, site or regional geologic knowledge, type of sampling to be conducted, project objectives, and cost.

No oils or grease will be used on equipment introduced into the boring (e.g., drill rod, casing, or sampling tools). No polyvinyl chloride (PVC) glue/cement will be used in constructing or retrofitting monitoring wells that will be used for water-quality monitoring. No coated bentonite pellets will be used in the well drilling or construction process. Specifications of materials to be installed in the borehole will be obtained prior to mobilizing onsite; these materials generally include:

- Well casing (length, material, and diameter);
- Well screen (length, material, diameter, and slot size);
- Bentonite (type, as applicable, chips, non-coated and granular bentonite are acceptable);
- Filter pack (filter pack type and fine sand seal type, as applicable); and
- Grout (type, as applicable).

Well materials will be inspected and, if needed, cleaned or replaced prior to installation.

3 PERSONNEL QUALIFICATIONS

Drilling and soil sampling activities will be performed by persons who have been trained in proper procedures under the guidance of an experienced field geologist, engineer, or technician, with particular emphasis on PFAS sampling procedures outlined in PFAS Field Sampling Guidance TGI (Arcadis 2018a). Field personnel will have undergone in-field training in soil description methods, as described in Soil Description TGI (Arcadis 2018b).

4 EQUIPMENT LIST

The following equipment and materials must be available for borehole advancement, single-interval groundwater sampling, and well construction activities:

- Site plan with proposed sampling locations;
- Relevant work plan (e.g., installation-specific Quality Assurance Project Plan [QAPP] Addendum);
- Site Safety and Health Plan (SSHP);
- Appropriate health and safety equipment, as specified in the SSHP;
- Drilling Equipment:
    - DPT, rotosonic, hollow stem auger, or air rotary drill rig, to be provided by drilling subcontractor. Type to be determined based on site-specific details.
    - Direct push groundwater samplers (e.g., Geoprobe® SP-22 or Geoprobe® SP-16) rotosonic sampling devices (e.g., Cascade Packer Isolation Groundwater Profiler or Geoprobe® SP-60 Sonic Groundwater Sampler), or hollow stem auger/air rotary sampling devices (e.g., pre-packed PVC well screens and PVC riser), to be provided by drilling subcontractor.
    - Traffic cones, delineators, caution tape, and/or fencing as appropriate for securing the work area, if not provided by the drillers.
    - <u>Note</u>: Prior to mobilizing to the site, Arcadis personnel will contact the drilling subcontractor or in-house driller (as appropriate) to confirm that appropriate sampling equipment will be provided in quantities capable of achieving estimated target depths. Specifications of the sampling and well installation equipment are expected to vary by project, so communication with the driller is necessary to ensure that the materials provided will meet the project objectives. Equipment and materials typically provided by the driller could include:
        - Disposable acetate (or Lexan TM) liners (when drilling with direct-push equipment)
        - Appropriate length of drilling rods and tooling
        - Drilling and sampling equipment decontamination materials
        - Decontamination pad materials
        - Well construction materials
        - Drums for investigation derived waste
- Sampling:
    - Appropriate PFAS-free groundwater sampling equipment (e.g., disposable bailers for volumetric sampling, peristaltic pump for shallow groundwater sampling, submersible bladder pump for deeper sampling). Refer to the PFAS Field Sampling Guidance TGI (Arcadis 2018a) and Low-Flow Groundwater Purging and Sampling Procedures for Monitoring Wells TGI (Arcadis 2016) for necessary equipment.
    - Stainless-steel spatulas, spoons, and trowels.

  - Stainless-steel hand auger with at least 10-ft of extension rods.
  - PVC piping of larger diameter than hand auger, if necessary, to keep hand auger borings open.
  - Soil logging equipment as specified in the appropriate project documents.
  - Dedicated low-density polyethylene (LDPE) plastic sheeting to prevent sample contact with the ground.
  - Photoionization detector (PID) or flame ionization detector (FID) with calibration gas.
  - 4-gas meter with calibration gas.
  - Water level meter with fluorine-free materials (Geotech ET 3/8" with Delrin tip and Buna-N O-ring).
  - YSI 6-Series multi-parameter water quality probe or equivalent (e.g., conductivity, temperature, dissolved oxygen, oxidation reduction potential) with flow-through cell.
  - Turbidity meter.
  - Laboratory provided PFAS-free water for field and equipment blank QC samples.
  - Laboratory-provided HPDE PFAS shaker test vials.
  - Appropriate sample containers and labels:
    - Laboratory-supplied HDPE sample bottles: see the Poly- and Perfluorinated Alkyl Substances (PFAS) Field Sampling Guidance (Arcadis 2018a) for PFAS-specific considerations.
    - Polyethylene bags (Ziploc® brand only) to hold ice and samples.
    - Appropriate blanks (field reagent blanks supplied by the laboratory).
    - Packing and shipping materials.
    - Chain-of-Custody (COC) Forms; see the Sample Chain of Custody Standard Operating Procedure (SOP) for reference (Arcadis 2017a).
    - Appropriate transport containers (coolers) with ice and appropriate labeling; no blue ice.
- Decontamination/Waste Management:
  - PFAS-free decontamination fluids and equipment:
    - HDPE or PVC brushes and squirt bottles
    - Stainless steel bowl
    - HDPE buckets to hold decontamination fluids
    - Alconox or Liquinox (other detergents prohibited)
    - Distilled or laboratory-supplied deionized water
    - Laboratory provided PFAS-free water

  - See the Poly- and Perfluorinated Alkyl Substances (PFAS) Field Sampling Guidance (Arcadis 2018a) or the Groundwater and Soil Sampling Equipment Decontamination TGI (Arcadis 2017b) for additional guidance.
  - Portable field hand washing setup.
  - Non-hazardous drum labels as required for investigation-derived waste handling: see the Investigation-Derived Waste Handling and Storage TGI for details (Arcadis 2017c).
- Field Notes:
  - Pens, pencils, and/or Sharpies® for writing
  - Appropriate field forms
  - Clipboards, field binders, field notebook, and field note pages that are not waterproof
  - Digital camera
- Other:
  - Field clothing made of cotton or other natural fibers that is well laundered (i.e., washed at least 6 times)
  - Well laundered cotton blankets for covering field vehicle seats
  - PFAS-free sunscreen and insect repellant
  - Garbage bags
  - Paper towels
- Locks and keys for securing the well after installation
- Engineer’s tape/measuring wheel

5 CAUTIONS

5.1 Utility Clearance

The appropriate drilling authorities will be contacted and a site visit for public utility line clearance at the proposed boring locations will be conducted at least 72 hours prior to work commencing. As applicable, utility maps will be reviewed during field reconnaissance of the proposed inspection locations to determine if any are co-located with public utility lines. Arcadis will also contract an independent geophysical survey company to verify that proposed boring locations are not co-located with existing underground utility/substructure features, as necessary. Arcadis will clear locations with soft dig methods to assess the presence of underground utilities as necessary. See the Utility Location and Clearance Arcadis Health and Safety Standard (Arcadis 2017d) for reference.

5.2 General Drilling and Well Construction Considerations

Prior to beginning field work, contact the project technical team to ensure that all field logistics (e.g., access issues, health and safety issues, communication network, schedules, etc.) and task objectives are clearly understood by all team members.

Some regulatory agencies require a minimum annular space between the well or permanent casing and the borehole wall. When specified, the minimum clearance is typically 2 inches on all sides (e.g., a 2-inch diameter well requires a 6-inch diameter borehole). In addition, some regulatory agencies have specific requirements regarding grout mixtures. Determine whether the oversight agency has any such requirements prior to finalizing the drilling and well installation plan.

If dense non-aqueous phase liquids (DNAPL) are known or expected to exist at the site, refer to the project specific documents for additional details regarding drilling and well installation to reduce the potential for inadvertent DNAPL remobilization.

Similarly, if light non-aqueous phase liquids (LNAPLs) are known or expected to be present as “perched” layers above the water table, refer to the DNAPL Contingency Plan. Follow the general provisions and concepts in the DNAPL contingency plan during drilling above the water table at known or expected LNAPL sites.

Consider the compatibility between the well materials and the surrounding environment. For example, PVC well materials are not preferred when DNAPL is present. In addition, some groundwater conditions leach metals from stainless steel or are corrosive to metal well materials. If questions arise, contact the CPM and/or project technical lead to discuss.

Specifications of materials used for backfilling the borehole will be obtained, reviewed and approved to meet project quality objectives. Bentonite is not recommended where DNAPLs are likely to be present or in groundwater with high salinity. In these situations, neat cement grout is preferred.

As noted above, coated bentonite pellets will not be used in monitoring well construction, as the coating could impact the water quality in the completed well.

Heat of hydration during neat cement grout curing must be considered to avoid damage to PVC well materials. The annular space for a typical monitoring well is small enough that heat of hydration should not create excessive temperature increases which may damage PVC well material. However, washouts in the borehole can lead to thick accumulations of grout which can produce enough heat during curing to weaken and potentially damage PVC casing. If heat of hydration is a concern, contact the project technical lead to address the issue.

5.3 PFAS-Specific General Sampling Considerations

This section provides a summary of methods and procedures applicable to the collection of environmental samples for field screening or laboratory analysis during PFAS site characterization activities. In general, sampling techniques used for PFAS site characterization are consistent with conventional sampling techniques used in the environmental industry, but special consideration is made regarding PFAS-containing materials and cross-contamination potential. For example, Teflon™ and other fluoropolymer containing materials are found in pumps, tubing, and sample storage containers and therefore should be avoided (Department of Environment Regulation [DER], Western Australia 2016; New Hampshire Department of Environmental Services [NHDES] 2016). Certain field documentation materials such as waterproof paper or field books, adhesive paper products, and some writing utensils (grouped as non-Sharpie® markers) are also prohibited items during PFAS sampling (DER 2016; NHDES 2016).

New nitrile gloves should be donned before any of the following activities:

- Decontamination of re-usable sampling equipment;
- Contact with sample bottles or PFAS-free water bottles;
- Handling clean sample tubing/down-well equipment or connecting tubing;
- Handling QC samples including field blanks and equipment blanks.

Additionally, new nitrile gloves should also be donned after handling of any non-dedicated sampling equipment; contact with contaminated surfaces; and whenever judged necessary by field personnel. **When in doubt change your gloves.**

Prior to initiating field activities, water sources to be used during drilling activities (e.g., rotosonic drilling, should be sampled to verify those sources are PFAS-free. While not part of the PQAPP, this is considered best practice and should be completed to the extent possible.

Waterproof field books must not be used for field notes. Instead, field notes should be on loose paper on Masonite, plastic, or aluminum clip boards. Other requirements for field notes include:

- Keep field notes, writing implements, and electronic data collection tablets away from samples and sampling materials; and,
- Do not write on sampling bottles unless they are closed.

Tables 1 and **2** in **Attachment 1** provide recommendations for PFAS Site Inspection equipment. **Table 1** provides a summary of materials that have been approved for site inspection; this list is expected to grow longer as industry experience increases. **Table 2** provides a summary of field equipment and materials that have available testing information and/or industry knowledge regarding PFAS cross-contamination potential and it is recommended that these materials be prohibited for sample collection. For materials that are suspected of containing PFASs and/or retaining PFASs, these recommendations are considered preliminary and subject to change.

Given the extremely low detection limits associated with PFAS analysis and the many potential sources of trace levels of PFASs, field personnel are typically advised to err on the side of caution by strictly following field wear guidelines and decontamination procedures as specified in the Poly- and Perfluorinated Alkyl Substances (PFAS) Field Sampling Guidance (Arcadis 2018a). **The most important consideration during PFAS related drilling and soil sampling is to prevent contact between sample media and suspect PFAS sources.**

5.4 PFAS-Specific Groundwater Sampling

The potential presence of PFASs in equipment that may come in contact with the target water sample must be evaluated as part of the sample planning process to maintain sample integrity. For example, low-flow sampling with a peristaltic pump should be conducted using silicone or HDPE tubing; Teflon™ tubing is prohibited (DER 2016). If a bladder pump is used to collect samples, the bladder and other internal parts (e.g., check balls, o-rings, compression fittings) should not be made of Teflon™ either, and bladder and o-rings should be changed between samples (DER 2016).

Note that if high concentrations of PFASs related to Class B firefighting foams are expected in a groundwater sample, it has been recommended to collect and shake a small portion of the sample at the time of sample collection (USACE 2016; Arcadis 2018a). If foaming is noted within the sample, it indicates elevated concentrations of PFASs may be present and the sample should be proactively diluted at the laboratory prior to analysis. The foaming should be noted on the sample chain of custody form. It is recommended to collect sampling equipment blanks following foam observation to confirm the effectiveness of decontamination procedures.

5.5 PFAS-Specific Soil Sampling

Equipment that contacts soil cuttings during sampling activities should be carefully considered and selected. PFAS-containing materials are potentially present in some of the equipment typically used for soil sampling. This includes any lubricants, connections, fittings, etc. used on the cutting shoe on the head of a direct push drill string. Additionally, no materials that pose a cross-contamination risk should be introduced to the bucket of a hand auger. **To minimize the risk of cross-contamination, all hand augering activities (i.e. augering, sample collection, decontamination) should be performed by Arcadis personnel (as opposed to drilling subcontractor) when surface soil samples will be collected**. Each piece of reusable drilling/sampling equipment that comes into direct contact with soil cuttings or groundwater must be inspected before use to confirm that PFAS-containing materials are not present, which could be a source of cross-contamination and cause false positives, and that PFASs will not adhere to the material, which has the potential to cause low bias sample results. If equipment cannot be verified as being PFAS-free and there is a concern that it could potentially introduce contamination, a conservative number of equipment blanks should be collected to confirm that materials in the sample equipment do not cause false positives by introducing PFASs. Other quality assurance methods may be implemented to avoid materials that could result in potential losses associated with PFASs adhering to surfaces. For example, collecting soil samples for laboratory analysis from an “undisturbed” portion of a large diameter soil core is a good practice.

The following additional notes are provided regarding soil sampling materials:

- Where drilling or decontamination water is needed, a sample of the source water must be collected and analyzed for PFAS before drilling begins to ensure that background PFASs will not be introduced. Some water systems may be constructed with PFAS-containing thread and gasket sealants; therefore, an inspection of the source water distribution system may provide an additional level of assurance for identifying a source of PFAS-free water for site inspections.
- It is often standard practice to cover the ends of sample sleeves and protect the sample from potential cross-contamination from the plastic end caps with Teflon™ or other PTFE tape (Geotechnical Services, Inc. 2018); this practice is prohibited for PFAS sample collection (DER 2016).
- Lexan™ liner sleeves are made of polycarbonate and they are not expected to contain PFASs based on review of the Safety Data Sheet (Sabic 2016).

- Acetate (i.e., cellulose acetate butyrate) liners are commonly used as sleeves and are not expected to contain PFASs.
- Studies evaluating the use of stainless steel indicate that PFASs do not strongly sorb to stainless-steel (Obal et al. 2012). Therefore, stainless-steel sleeves and equipment should be acceptable for collection of soil samples for PFAS analysis.

6 HEALTH AND SAFETY CONSIDERATIONS

Field activities associated with drilling, soil sampling, and monitoring well installation will be performed in accordance with the SSHP, a copy of which will be present on site during such activities.

7 PROCEDURE

The procedures for drilling, soil sampling, and installing groundwater monitoring wells (if necessary), are presented below. All field sampling should be completed by a two-person team, with one collecting the samples, and the other handling documentation and providing support. This will help to limit the potential for accidental cross-contamination of the sample media.

7.1 Direct Push Technology (DPT) Method

Direct-push drilling may be used to complete soil borings and install monitoring wells. Examples of this technique include the Diedrich ESP vibratory probe system, GeoProbe®, or AMS Power Probe® dual-tube system. Environmental probe systems typically use a hydraulically operated percussion hammer. Depending on the equipment used, the hammer delivers 140- to 350-foot pounds of energy with each blow. The hammer provides the force needed to penetrate very stiff to medium dense soil formations. The hammer simultaneously advances an outer steel casing that contains a dual-tube liner for sampling soil. The outside diameter (OD) of the outer casing ranges from 1.75 to 2.4 inches and the OD of the inner sampling tube ranges from 1.1 to 1.8 inches. The outer casing isolates shallow layers and permits the unit to continue to probe at depth. The double-rod system provides a borehole that may be tremie-grouted from the bottom up. Alternatively, the inside diameter (ID) of the steel casing provides clearance for the installation of small-diameter (e.g., 0.75- to 1-inch ID) micro-wells. The procedures for drilling, soil sampling, single-interval groundwater sampling, and installing monitoring wells in soil using the direct-push method are described below.

1. Place LDPE plastic sheeting over core/sampling processing area to create a clean working surface, if conditions allow. Otherwise, prevent sampling equipment from contacting the ground or other surface that could compromise sample integrity.
2. Clear the ground surface of brush, root mat, grass, leaves, or other debris prior to sampling.
3. Decontaminate all non-disposable sampling equipment and tooling that will or may to come into direct contact with soil prior to first use. Disposable sampling equipment must be kept in sealed PFAS-free packaging until it is used.
4. Use stainless-steel hand auger to collect samples from 0 - 5 ft bgs surface interval, if applicable. All hand auguring to collect soil samples will be completed by Arcadis personnel, not the drilling

subcontractor. These samples can be collected either during other Utility Clearance activities (e.g., third party clearance) or immediately prior to drilling.

   a. The sample should be collected manually directly from the hand auger bucket (using stainless steel scoop, spatula, or trowel as necessary) and placed directly into the sample jar, following Steps 7 – 15 below. The sample should not contact the ground or LDPE sheeting.
   b. If collecting multiple samples from the same boring, after collecting sample from the surface or shallowest depth interval examine the stability of the soil in the boring sidewalls. If sidewalls appear to be at risk of collapsing into the borehole insert a length of PVC pipe into the boring to maintain the opening and prevent collapse prior to augering to the next deeper sampling interval.

5. Use dual tube rod system and collect soil cores in acetate or Lexan ™ liners. The cutting shoe and core extractor must be stainless steel with no PFAS-containing materials present (e.g., gaskets, coatings).
6. After each drilling run, drillers extract and cut open liners and provide to Arcadis personnel for characterization and sampling. Drillers must not touch soil inside of liners during this process. Arcadis personnel decontaminate cutter between uses (see below).
7. Don a new set of nitrile gloves prior to handling sample core, then characterize soils in accordance with P-04 TGI - Soil Description (Arcadis 2018b). Record descriptions in the field notes, boring logs, and/or tablet/cell phone via Arcadis Fulcrum application. It is also beneficial to photo document the samples. It should be noted that logs collected via tablet or cell phone must be electronically backed up and transferred to a location accessible to other project team members as soon as feasible to retain and protect the field data.
8. Don a new set of nitrile gloves prior collecting soil samples for analysis. Do not use gloved hands to handle items (e.g., papers, pens, clothes) before collecting samples. Do not touch outside of sample liner with gloved hands.
9. Collect field samples and any required QC samples from recovered soil cores using a clean stainless-steel trowel and place in clean, labeled bottles supplied by the laboratory for the required analyses. If collecting samples for multiple analyses, collect PFAS samples first. Make sure caps remain on PFAS sample bottles until immediately prior to filling. Caps must remain in the hand of the sampler until replacing on the bottle.
10. Once the sample has been placed in the bottle, and the bottle cap has been completely tightened, label the sample with sample identification number, date, and time of collection. Labels must be completed only after the caps have been placed back on each bottle. (See P-01 QP#3.06 Field Activities documentation for sample label information).
11. Place soil sample bottles in a sealed Ziploc© bag, and then into sample coolers. Store PFAS samples in separate cooler from other samples.
12. Record the label information and time of sampling in the field notes and sampling forms.
13. Fill out laboratory COC and check against the labels on the sample bottles progressively after each sample is collected.
14. Decontaminate all reusable sampling equipment between sample intervals and borings as described in Section 10.
15. Repeat Steps 7 – 14 until all samples have been collected from the boring location.

16. Abandon soil boring to grade in accordance with the site-specific work plan upon completion and before moving to the next boring location. **If single-interval groundwater sample is required, see Section 7.1.1 for procedure. If well is to be installed, see Section 7.1.2 for well construction procedure**.
17. Mark boring location with wooden stake that identifies boring ID for subsequent surveying, as necessary.
18. Manage investigation-derived-waste (IDW) as specified in Section 8 and in accordance with the site-specific work plan.
19. If samples are not shipped the same day as collected, add fresh ice to sample coolers at the end of the day to maintain the temperature between 0 and 6°C. Place ice in sealed Ziplock® bags. Do not use blue ice. Sample coolers must remain in the possession of the sampling team at all times or secured under lock and key until shipment to the laboratory.

7.1.1 DPT Single-Interval Groundwater Sampling

The steps below describe the procedure for collecting a single-interval groundwater sample at a desired sample interval, commonly from the first encountered shallow groundwater. It should be verified that samples are taken below the water table (i.e., not perched water in the vadose zone). Single-interval sampling should be performed with a Geoprobe® SP-22 sampling device or similar (e.g., HydroPunch ™). A primary difference with single-interval methods relative to multi-interval vertical aquifer profiling (VAP) sampling is that the sampling screen is driven to the appropriate depth by the drill rig instead of lowering the sampling screen through the drill tools after reaching the appropriate depth. If multi-interval VAP sampling is required, refer to Arcadis TGI for Vertical Aquifer Profiling for PFAS Analysis (Arcadis 2019).

If using a Geoprobe® SP-22 sampling device, the following steps will be followed:

1. Ensure 4-gas meter, YSI 6-Series multi-parameter water quality probe, and turbidity meter are calibrated each morning (see QAPP worksheet #22 and P-09 Calibration and Control of Measuring and Test Equipment in PQAPP Appendix A). Document calibration results on equipment calibration log.
2. Advance Geoprobe® SP-22, equipped with stainless-steel screen, using standard Geoprobe® rods to the target depth interval in accordance with **Section 7.1**.
3. Retract the outer casing to expose the screen for the desired sample interval length, using extension rods to hold the screen in place. The Geoprobe® SP-22 sampling screen can be either 12” or 48”. Note: no soil cores will be retrieved using the Geoprobe® SP-22.
4. Go to Step 9.

If using a HydroPunch ™ sampling device, the following steps will be followed:

1. Ensure 4-gas meter, YSI 6-Series multi-parameter water quality probe, and turbidity meter are calibrated each morning (see QAPP worksheet #22 and P-09 Calibration and Control of Measuring and Test Equipment in PQAPP Appendix A). Document calibration results on equipment calibration log.
2. The drilling subcontractor will advance the borehole to approximately 2 feet above the depth from which a discrete water sample is to be obtained.

3. The drilling subcontractor will disassemble the HydroPunch™ sampling device according to the manufacturer's instructions to allow the sampler to be decontaminated. The sampler should be completely disassembled, including O-rings and/or check valves.
4. Decontaminate the sampler per instructions in Section 10 as appropriate for the range of groundwater analytes to be sampled for, by washing with laboratory-grade detergent and potable water wash, followed by solvent rinse (if sampling for organics) and final rinse with deionized or distilled water. Check the condition of the O-rings during each cleaning and replace if necessary.
5. The drilling subcontractor will reassemble the decontaminated HydroPunch™ sampling device according to the manufacturer's instructions and lower the device to the bottom of the borehole.
6. The drilling subcontractor will push or drive the HydroPunch™ 5 feet below the bottom of the casing or augers, then retract the sampler 3 feet upward. Subsurface friction will retain the drive point in place, exposing the screen and allowing groundwater to enter the sampling tool.
7. Allow sufficient time to allow the sampler to fill with water. Typically, 30 minutes is sufficient, except in low permeability materials. If sufficient water has not accumulated in approximately 30 minutes, leave the temporary well casing and screen in the borehole to allow for overnight recovery of groundwater for follow-up sampling the next day.
8. Go to Step 9.

Complete the following steps for sample collection:

9. Place LDPE plastic sheeting adjacent to the sample port for use as a clean work area if conditions allow. Otherwise, prevent sampling equipment from contacting the ground or other surface that could compromise sample integrity. Do not allow vehicle exhaust to point towards the sample point.
10. Don a new set of nitrile gloves, connect tubing to sampling pump and flow-through cell, and slowly lower tubing and/or pump into well. If possible, use two field personnel to insert tubing/pump into well to avoid contact with surrounding ground surface or other materials that could cause cross-contamination. Insert tubing (peristaltic pump, if depth to water <25 ft bgs), or pump intake (small-diameter bladder pump, if depth to water >25 ft bgs) at the approximate mid-depth of the sampler screen interval.
    - Alternately, a Waterra-type inertial pump can be used to retrieve the water sample. If the formation has low-permeability and enough water is not anticipated in the tooling to allow purging of water, a stainless-steel bailer may be considered (after consulting with Arcadis RL).
11. Purge until water is visually clear of sediment, or for a maximum of 20 minutes before collecting GW samples.
    - Note: for low-permeability formations, collect a grab sample from the screen point sampling device and/or saturated soil sample from the soil core. Leave temporary well casing and screen in the borehole to allow for overnight recovery of groundwater for follow-up sampling the next day.
12. Don a new set of nitrile gloves prior to collecting groundwater sample and each QC sample. Do not use gloved hands to handle items (e.g., papers, pens, clothes, equipment) before collecting samples.

13. Fill sample bottles using labeled HDPE bottles that are supplied by laboratory only. Ensure the cap remains on the bottle until immediately prior to sample collection and gets placed back on the bottle immediately after sample collection. Do not place the cap on any surface; keep in hand opposite of sample collection and do not touch the inside of the cap.
14. If high concentrations of PFASs related to Class B firefighting foams are expected in a groundwater sample (as specified in the QAPP Addendum), collect and shake a small portion of the sample (approximately 10-25 mL) on site. If foaming is observed, document the foaming on the sample log and on the COC to notify laboratory personnel. The “shaker test” vial can then be disposed of as specified in Section 8.
15. Collect QC samples at frequency specified in PQAPP Worksheet #20. QC sample locations to be selected based on consultation with Arcadis RL.
16. Place filled sample bottles in a sealed (Ziploc©) bag, record any label information that was not previously filled out (e.g., sample time). Record the label information and time of sampling in the field notes and sampling forms. Place samples into sample coolers. Store PFAS samples in separate cooler from any other types of samples.
17. Fill out laboratory COC and check against the labels on the sample bottles progressively after each sample is collected.
18. Pull the Geoprobe® SP-22, HydroPunch™, or other sampling device back up and decontaminate per instructions in Section 10.

7.1.2 DPT Monitoring Well Construction

1. Upon advancing the borehole to the desired depth, install the well through the inner drill casing. The well will consist of 2-inch ID PVC or stainless-steel slotted screen and blank riser. Screen length and construction will be specified in the Work Plan or discussed with the Arcadis PM.

2. When the monitoring well assembly has been set in place, place a washed silica filter pack in the annular space from the bottom of the boring to a height of 1 to 2 feet above the top of the well screen (following specifications in the Work Plan) using a tremie pipe. The filter pack is placed, and drilling equipment (i.e., rods) extracted in increments until the top of the sand pack is at the appropriate depth. Verify that the expected volume of filter pack matches with the actual amount installed. There can be differences due to irregularities in the borehole. Washout of the borehole will result in the need for greater than calculated well materials. If a difference of more than 10% is noted, consult with the project technical team. The filter pack will be consistent with the screen slot size and the soil particle size in the screened interval, as specified in the Work Plan. The well should be gently surged to prevent filter pack material bridging and to settle the filter pack prior to well seal installation.

    a. Alternately, a monitoring well assembly with a pre-packed screen can be installed. The monitoring well assembly (i.e., regular PVC or pre-packed) should be discussed and decided prior to beginning field work and specified in the QAPP addendum. Pre-packed filters should be verified as PFAS-free prior to use.

3. A hydrated bentonite seal (a minimum of 2 feet thick) will then be placed in the annular space above the sand pack (alternatively, in some cases a fine sand seal may be installed instead of bentonite—follow the specifications in the Work Plan). Use of a tremie pipe is not required for placement of the bentonite seal (though may be required if a well is very deep and borehole bridging is reasonably anticipated). However, bentonite should be poured into the annular space slowly enough to ensure borehole bridging does not occur. If non-hydrated bentonite is used, the bentonite should be permitted to hydrate in place for a minimum of 30 minutes before proceeding. *No coated bentonite pellets will be used in monitoring well drilling or construction*. PFAS-free water (verified by laboratory analysis of source water) should be added to hydrate the bentonite if the seal is above the water table. Continuously monitor the placement of the sand pack and bentonite with a weighted tape measure.

4. During the extraction of the augers or casing, a cement/bentonite or neat cement grout will be placed in the annular space from the bentonite seal to a depth approximately 2 ft bgs or as specified in the Work Plan. As with the filter pack, it is recommended that seal material be placed with a tremie pipe. Ensure that seal materials are mixed at the proper ratios with PFAS-free water (verified by laboratory analysis of source water) following manufacturer's recommendations.

5. Install the monitoring well completion as specified in the Work Plan. Typical completions are a locking, steel protective casing (extended at least 1.5 feet below grade and 2 feet above grade) over the riser casing set within a neat cement pad at grade. Alternatively, for flush-mount completions, place a steel curb box with a bolt-down lid over the riser casing set within a neat cement pad. In either case, the cement pad will extend approximately 1.5 to 2.0 feet below grade and laterally at least 1 foot in all directions from the protective casing and should slope gently away to promote drainage away from the well.

6. During well installation, record construction details and tabulate materials used in field notebook as well as appropriate field forms.

7. After completing the well installation, lock the well, clean the area, and dispose of materials in accordance with the procedures outlined in Section 8 below.

7.2 Rotosonic Drilling Methods

For sites with deep unconsolidated aquifers or challenging drilling conditions (e.g., presence of dense tills, caliche, cobbles), DPT drilling may not be feasible or cost effective due to limited production rates. In these cases, alternate drilling methods (e.g., rotosonic) are required. Rotosonic drilling produces soil cores that, for the most part, are relatively undisturbed, but note that when drilling in consolidated or finer-grained sediment the vibratory action during core barrel advancement may create secondary fractures or breaks.

1. Place LDPE plastic sheeting over core/sampling processing area to create a clean working surface, if conditions allow. Otherwise, prevent sampling equipment from contacting the ground or other surface that could compromise sample integrity.

2. Clear the ground surface of brush, root mat, grass, leaves, or other debris prior to sampling.
3. Decontaminate all non-disposable sampling equipment/tooling that will or may to come into direct contact with soil prior to first use. Disposable sampling equipment must be kept in sealed PFAS-free packaging until it is used.
4. Use stainless-steel hand auger to collect samples from 0 - 5 ft bgs surface interval, if applicable. All hand augering to collect soil samples will be completed by Arcadis personnel, not the drilling subcontractor. These samples can be collected either during other Utility Clearance activities (e.g., third party clearance) or immediately prior to drilling.
    a. Hand auger soil sample should be collected manually from the hand auger bucket (using stainless steel scoop, spatula, or trowel as necessary) and placed directly into the sample jar. The sample should not contact the ground or LDPE sheeting.
    b. If sampling by hand auger, after collecting sample from the surface or shallowest depth interval examine the stability of the soil in the boring sidewalls. If sidewalls appear to be at risk of collapsing into the borehole insert a length of polyvinyl chloride (PVC) pipe into the boring to maintain the opening and prevent collapse prior to augering to the next deeper sampling interval.
5. During rotosonic drilling, drillers extract soil core bags after each drilling run, place the core bag onto LDPE sheeting, and cut open bags so Arcadis personnel can perform characterization and sampling. Arcadis personnel should confirm with drilling subcontractor that core bags are constructed of PFAS-free material. Drillers must not touch soil inside of bags during this process. Arcadis personnel decontaminate cutter between uses (see below).
6. Don a new set of nitrile gloves prior to collecting each sample. Do not use gloved hands to handle papers, pens, clothes, etc., before collecting samples. Do not touch outside of sample bag with gloved hands.
7. During sampling, characterize soils in accordance with P-04 TGI - Soil Description (Arcadis 2018b). Record descriptions in the field notes, boring logs, and/or personal digital assistant (PDA). It is also beneficial to photo document the samples. It should be noted that PDA logs must be electronically backed up and transferred to a location accessible to other project team members as soon as feasible to retain and protect the field data.
8. Collect sample volumes from recovered soil cores using a clean stainless-steel trowel and place in clean, labeled bottles supplied by the laboratory for the required analyses (see sample container list in PQAPP Worksheets #19&30). Make sure caps remain on PFAS sample bottles until immediately prior to filling. Caps must remain in the hand of the sampler until replacing on the bottle.
9. Once the sample has been placed in the bottle, and the bottle cap has been completely tightened, label the sample with sample identification number, date, and time of collection. Labels must be completed only after the caps have been placed back on each bottle. (See P-01 QP#3.06 Field Activities documentation for sample label information).
10. Collect QC samples at frequency specified in PQAPP Worksheet #20. QC sample locations to be selected based on consultation with Arcadis RL.
11. Place soil sample bottles in a sealed Ziploc© bag, and then into sample coolers. Store PFAS samples in separate cooler from other samples.
12. Record the label information and time of sampling in the field notes and sampling forms.

13. Fill out laboratory COC and check against the labels on the sample bottles progressively after each sample is collected.
14. Abandon all soil borings to grade as specified in the QAPP Addendum upon completion and before moving to the next boring location. **If single-interval groundwater sample is required, see Section 7.2.1 for procedure. If well is to be installed, see Section 7.2.2 for well construction procedure**.
15. Mark boring location with wooden stake that identifies boring ID for subsequent surveying, as necessary.
16. Manage investigation-derived-waste (IDW) as specified in site-specific work plan.
17. If samples are not shipped the same day as collected, add fresh ice to sample coolers at the end of the day to maintain the temperature between 0 and 6°C. Place ice in sealed polyethylene bags (Ziplock). Do not use blue ice. See QAPP worksheet #19 and 30 for sample containers, preservation and hold times. Sample coolers must remain in the possession of the sampling team at all times or secured under lock and key until shipment to the laboratory.

7.2.1 Rotosonic Single-Interval Groundwater Sampling

Groundwater profilers can be used to collect single-interval groundwater samples at a desired sample interval, commonly biased towards transport zones determined from soil lithological core, or from the first encountered groundwater. If multi-interval VAP sampling is required, refer to Arcadis TGI for Vertical Aquifer Profiling for PFAS Analysis (Arcadis 2019).

The configuration of individual samplers varies based on their manufacturer and drilling contractor (e.g., Cascade Packer Isolation Groundwater Profiler, Geoprobe® SP-60 Packer Sampler). The overall strategy of rotosonic drilling sampling is consistent with DPT sampling; however, drilling with sonic or some rotary methods requires the introduction of drilling water that can potentially affect the integrity of the groundwater sample. If drilling water is used, a source blank sample will be collected prior to the start of work. If state or local regulations allow, source water can be spiked with non-toxic fluorescent dyes per Arcadis SOP for use of visible tracer in drilling fluid to obtain representative groundwater samples during drilling (Arcadis 2010).

Rotosonic single-interval groundwater sampling will be performed using dual-tube casing. Packer Isolation Groundwater Profilers will be used to conduct groundwater sampling. The biggest advantage of this device is that the groundwater sampling depth interval can be determined based on lithological logs obtained from the same borehole since hydraulic profiling tool is not deployable via rotosonic drilling methods.

The following steps will be followed:

1. Ensure 4-gas meter, YSI 6-Series multi-parameter water quality probe, and turbidity meter are calibrated each morning (see QAPP worksheet #22 and P-09 Calibration and Control of Measuring and Test Equipment in PQAPP Appendix A). Document calibration results on equipment calibration log.
2. Advance dual-tube sonic tooling casing to target depth interval in accordance with **Section 7.2**.
3. Retrieve the soil core and the inner sonic core barrel. Characterize soils in accordance with Arcadis TGI for Soil Descriptions (Arcadis 2018b).

4. Insert the stainless-steel screen and packer assembly (e.g., Cascade Packer Isolation Groundwater Profiler, Geoprobe® SP60 Packer Sampler) to the base of the sonic casing.
5. Extract the outer sonic casing to expose the screen to the formation.
6. Inflate the packer to isolate the screened interval from any water that might be above the packer in the sonic casing.
7. Place LDPE plastic sheeting adjacent to the sample port for use as a clean work area, if conditions allow. Otherwise, prevent sampling equipment from contacting the ground or other surface that could compromise sample integrity. Do not allow vehicle exhaust to point towards the sample point.
8. Don a new set of nitrile gloves, connect tubing to sampling pump and flow-through cell, and slowly lower tubing and/or pump into well. If possible, use two field personnel to insert tubing/pump into well to avoid contact with surrounding ground surface or other materials that could cause cross-contamination. Insert tubing (peristaltic pump, if depth to water <25 ft bgs), or pump intake (bladder pump, if depth to water >25 ft bgs) at the approximate mid-depth of the sampler screen interval.
9. Purge well until water is visually clear of sediment, or for a maximum of 20 minutes before collecting GW samples.
    - Note: for low-permeability formations, collect a grab sample from the screen point sampling device and/or saturated soil sample from the soil core. Leave temporary well casing and screen in the borehole to allow for overnight recovery of groundwater for follow-up sampling the next day.
10. Don a new set of nitrile gloves prior to collecting the groundwater sample and each QC sample. Do not use gloved hands to handle items (e.g., papers, pens, clothes, equipment) before collecting samples.
11. Fill sample bottles using labeled HDPE bottles that are supplied by laboratory only. Make sure that the cap remains on the bottle until immediately prior to sample collection and gets placed back on the bottle immediately after sample collection. Do not place the cap on any surface; keep in hand opposite of sample collection and do not touch the inside of the cap.
12. If high concentrations of PFASs related to Class B Firefighting foams are expected in a groundwater sample (as specified in the QAPP Addendum), collect and shake a small portion of the sample (approximately 10-25 mL) on site. If foaming is observed, document the foaming on the sample log and on the COC to notify laboratory personnel. The "shaker test" vial can then be disposed of as IDW as specified in Section 8.
13. Collect QC samples at frequency specified in PQAPP Worksheet #20. QC sample locations to be selected based on consultation with Arcadis RL;
14. Place filled sample bottles in a sealed (Ziploc©) bag, record any label information that was not pre-filled out (e.g., sample time). Record the label information and time of sampling in the field notes and sampling forms. Place samples into sample coolers. Store PFAS samples in separate cooler from any other types of samples.
15. Fill out laboratory COC and check against the labels on the sample bottles progressively after each sample is collected.
16. Deflate the packer.
17. Pull the Packer Isolation Groundwater Profiler back up and decontaminate per instructions in Section 10.

7.2.2 Rotosonic Monitoring Well Construction

1. If it is necessary to install a monitor well into a permeable zone below a confining layer, particularly if the deeper zone is believed to have water quality that differs significantly from the zone above the confining layer, then a telescopic well construction will be considered. In this case, the borehole is advanced approximately 3 to 5 feet into the top of the confining layer, and a permanent casing (typically PVC, black steel or stainless steel) is installed into the socket drilled into the top of the confining layer. The casing is then grouted in place. Grout should be mixed with PFAS-free water (verified by laboratory analysis of source water). The preferred methods of grouting telescoping casings include: pressure-injection grouting using an inflatable packer installed temporarily into the base of the casing, such that grout is injected out the bottom of the casing until it is observed at ground surface outside the casing; displacement-method grouting (also known as the Halliburton method), which entails filling the casing with grout and displacing the grout out the bottom of the casing by pushing a drillable plug, typically made of wood to the bottom of the casing, following by tremie grouting the remainder of the annulus outside the casing; or tremie grouting the annulus surrounding the casing using a tremie pipe installed to the base of the borehole. In all three cases, the casing is grouted to the ground surface, and the grout is allowed to set prior to drilling deeper through the casing. Site-specific criteria and work plans should be created for the completion of non-standard monitoring wells, including telescopic wells.

2. Before installing a screened well, it is important to confirm that the borehole has been advanced into the targeted saturated zone. This is particularly important for wells installed to monitor the water table and/or the shallow saturated zone, as the capillary fringe may cause soils above the water table to appear saturated. If one or more previously installed monitoring wells exist nearby, use the depth to water at such well(s) to estimate the water-table depth at the new borehole location.

   To verify that the borehole has been advanced into the saturated zone, it is necessary to measure the water level in the borehole. For boreholes drilled using water (e.g., Rotosonic), monitor the water level in the borehole as it re-equilibrates to the static level. In low-permeability units like clay, fine-grained glacial tills, shale and other bedrock formations, it may be necessary to wait overnight to allow the water level to equilibrate. Document depth to water in the borehole on the appropriate field forms and field notebook. If there are questions concerning the depth of the well/screen interval, consult with the project technical lead or PM prior to finalizing well depth/screen interval. To the extent practicable, ensure that the depth of the well below the apparent water table is deep enough so that the installed well can monitor groundwater year-round, accounting for seasonal water-table fluctuations. When in doubt, err on the side of slightly deeper well installation.

3. Upon completing the borehole to the desired depth, if a screened well construction is desired, install the monitoring well by lowering the screen and solid PVC risers through the augers or casing. Monitoring wells typically will be constructed of 2-inch-diameter (although sometimes 4-inch), flush-threaded PVC or stainless steel slotted or wire wrapped well screen and blank riser

casing. Smaller diameters may be used if multiple wells are to be installed in a single borehole. The screen length will be specified in the Work Plan (or equivalent) based on regulatory requirements and specific monitoring objectives. Monitoring well screens should be limited to 5 to 10 feet long. The screen length will depend on the purpose for the well and the objectives of the groundwater investigation and will (in most cases) be determined prior to the field mobilization.

The slot size and filter pack gradation should be predetermined in the Work Plan (or equivalent) based on site-specific grain-size analysis (sieve analysis) or other geologic considerations or monitoring objectives. Typically, slot sizes for monitoring wells will range from 0.010 inches to 0.020 inches while the filter pack will be 20-40, Morie No. 0, or equivalent. In very fine-grained formations where sample turbidity needs to be minimized, it may be preferred to use a 0.006-inch slot size and 30-65, Morie No. 00, or equivalent filter pack. Alternatively, where monitoring wells are installed in coarse-grained deposits and higher well yield is required, a 0.020-inch slot size and 10-20, Morie No. 1, or equivalent filter pack may be preferred. If the screen slot size and filter pack have not been based on site-specific grain-size analysis, consider collecting soil samples during well installation so future wells can be properly designed.

Alternately, a monitoring well assembly with a pre-packed screen can be installed. The monitoring well assembly (i.e., regular PVC or pre-packed) should be discussed and decided prior to beginning field work and specified in the QAPP addendum. Pre-packed filters should be verified as PFAS-free prior to use.

A blank riser will extend from the top of the screen to approximately 2.5 feet above grade or, if necessary, just below grade where conditions warrant a flush-mounted monitoring well. For wells greater than 50 feet deep, centralizers may be desired to assist in centering the monitoring well in the borehole during construction.

4. When the monitoring well assembly has been set in place, place a washed silica filter pack in the annular space from the bottom of the boring to a height of 1 to 2 feet above the top of the well screen (following specifications in the Work Plan) using a tremie. The filter pack is placed, and drilling equipment extracted in increments until the top of the sand pack is at the appropriate depth. Verify that the expected volume of filter pack matches with the actual amount installed. There can be differences due to irregularities in the borehole. Washout of the borehole will result in the need for greater than calculated well materials. If a difference of more than 10% is noted, consult with the project technical team. The filter pack will be consistent with the screen slot size and the soil particle size in the screened interval, as specified in the Work Plan (or equivalent). The well should be gently surged to prevent filter pack material bridging and to settle the filter pack prior to well seal installation.

5. A hydrated bentonite seal (a minimum of 2 feet thick) will then be placed in the annular space above the sand pack (alternatively, in some cases a fine sand seal may be installed instead of bentonite—follow the specifications in the Work Plan). Use of a tremie pipe is not required for placement of the bentonite seal (though may be required if a well is very deep and borehole

bridging is reasonably anticipated). However, bentonite should be poured into the annular space slowly enough to ensure borehole bridging does not occur. If non-hydrated bentonite is used, the bentonite should be permitted to hydrate in place for a minimum of 30 minutes before proceeding. *No coated bentonite pellets will be used in monitoring well drilling or construction*. PFAS-free water (verified by laboratory analysis of source water) should be added to hydrate the bentonite if the seal is above the water table. Continuously monitor the placement of the sand pack and bentonite with a weighted tape measure.

6. During the extraction of the augers or casing, a cement/bentonite or neat cement grout will be placed in the annular space from the bentonite seal to a depth approximately 2 ft bgs or as specified in the Work Plan (or equivalent). As with the filter pack, it is recommended that seal material be placed with a tremie pipe. Ensure that seal materials are mixed at the proper ratios with PFAS-free water (verified by laboratory analysis of source water) following manufacturer's recommendations.

7. Install the monitoring well completion as specified Work Plan (or equivalent). Typical completions are a locking, steel protective casing (extended at least 1.5 feet below grade and 2 feet above grade) over the riser casing and secure with a neat cement seal. Alternatively, for flush-mount completions, place a steel curb box with a bolt-down lid over the riser casing and secure with a neat cement seal. In either case, the cement seal will extend approximately 1.5 to 2.0 feet below grade and laterally at least 1 foot in all directions from the protective casing and should slope gently away to promote drainage away from the well.

8. Monitoring wells should be labeled using indelible ink or paint with the appropriate designation on both the inner and outer well casings or inside of the curb box lid. Use caution when labeling the well as paint or indelible ink could potentially contain PFAS materials.

9. When an above-grade completion is used, the riser will be sealed using an expandable locking plug and the top of the well will be vented by drilling a small-diameter (1/8 inch) hole near the top of the well casing or through the locking plug, or by cutting a vertical slot in the top of the well casing. When a flush-mount installation is used, the riser will be sealed using an unvented, expandable locking plug.

10. During well installation, record construction details and actual measurements relayed by the drilling contractor and tabulate materials used (e.g., screen and riser footages; bags of bentonite, cement, and sand) in the field notebook as well as appropriate field forms.

11. After completing the well installation, lock the well, clean the area, and dispose of materials in accordance with the procedures outlined in Section 8 below.

7.3 Hollow Stem Auger Drilling Methods

For some sites, direct push drilling may not be feasible and rotosonic drilling may not be cost effective. In these cases, hollow stem auger (HSA) drilling may be required. HSA drilling procedures are similar to rotosonic drilling, but HSA is not well suited to very coarse materials (e.g. cobbles and boulder) and it produces disturbed soil samples.

1. Place LDPE plastic sheeting over core/sampling processing area to create a clean working surface, if conditions allow. Otherwise, prevent sampling equipment from contacting the ground or other surface that could compromise sample integrity.
2. Clear the ground surface of brush, root mat, grass, leaves, or other debris prior to sampling.
3. Decontaminate all non-disposable sampling equipment/tooling that will or may to come into direct contact with soil prior to first use. Disposable sampling equipment must be kept in sealed PFAS-free packaging until it is used.
4. Use stainless-steel hand auger to collect samples from 0 - 5 ft bgs surface interval, if applicable. All hand augering to collect soil samples will be completed by Arcadis personnel, not the drilling subcontractor. These samples can be collected either during other Utility Clearance activities (e.g., third party clearance) or immediately prior to drilling.
    a. Hand auger soil sample should be collected manually from the hand auger bucket (using stainless steel scoop, spatula, or trowel as necessary) and placed directly into the sample jar. The sample should not contact the ground or LDPE sheeting.
    b. If sampling by hand auger, after collecting sample from the surface or shallowest depth interval examine the stability of the soil in the boring sidewalls. If sidewalls appear to be at risk of collapsing into the borehole insert a length of polyvinyl chloride (PVC) pipe into the boring to maintain the opening and prevent collapse prior to augering to the next deeper sampling interval.
5. During HSA drilling, soil cuttings will accumulate around the outside of the borehole. Periodically the drillers will shovel cuttings into containers for disposal. Arcadis personnel can also perform characterization and sampling directly from these cuttings.
6. Drillers must not touch soil that will be collected for sampling. Arcadis personnel will use a stainless-steel spatula, spoon, or trowel to collect soil direct from the cuttings pile at the desired sample depth. Arcadis personnel decontaminate spatula, spoon, or trowel between uses in accordance with Section 10.
7. Don a new set of nitrile gloves prior to collecting each sample. Do not use gloved hands to handle papers, pens, clothes, etc., before collecting samples. Do not touch outside of sample bag with gloved hands.
8. During sampling, characterize soils in accordance with P-04 TGI - Soil Description (Arcadis 2018b). Record descriptions in the field notes, boring logs, and/or personal digital assistant (PDA). It is also beneficial to photo document the samples. It should be noted that PDA logs must be electronically backed up and transferred to a location accessible to other project team members as soon as feasible to retain and protect the field data.
9. Collect sample volumes from cuttings pile using a clean stainless-steel trowel and place in clean, labeled bottles supplied by the laboratory for the required analyses (see sample container list in PQAPP Worksheets #19&30). Make sure caps remain on PFAS sample bottles until immediately prior to filling. Caps must remain in the hand of the sampler until replacing on the bottle.
10. Once the sample has been placed in the bottle, and the bottle cap has been completely tightened, label the sample with sample identification number, date, and time of collection. Labels must be completed only after the caps have been placed back on each bottle. (See P-01 QP#3.06 Field Activities documentation for sample label information).

11. Collect QC samples at frequency specified in PQAPP Worksheet #20. QC sample locations to be selected based on consultation with Arcadis RL.
12. Place soil sample bottles in a sealed Ziploc© bag, and then into sample coolers. Store PFAS samples in separate cooler from other samples.
13. Record the label information and time of sampling in the field notes and sampling forms.
14. Fill out laboratory COC and check against the labels on the sample bottles progressively after each sample is collected.
15. Abandon all soil borings to grade as specified in the QAPP Addendum upon completion and before moving to the next boring location. **If single-interval groundwater sample is required, see Section 7.3.1 for procedure. If well is to be installed, see Section 7.3.2 for well construction procedure**.
16. Mark boring location with wooden stake that identifies boring ID for subsequent surveying, as necessary.
17. Manage investigation-derived-waste (IDW) as specified in site-specific work plan.
18. If samples are not shipped the same day as collected, add fresh ice to sample coolers at the end of the day to maintain the temperature between 0 and 6°C. Place ice in sealed polyethylene bags (Ziplock). Do not use blue ice. See QAPP worksheet #19 and 30 for sample containers, preservation and hold times. Sample coolers must remain in the possession of the sampling team at all times or secured under lock and key until shipment to the laboratory.

7.3.1 Hollow Stem Auger Single-Interval Groundwater Sampling

Unlike direct push and rotosonic methods, there are limited single-interval groundwater sampling devices for HSA drilling. Commonly, groundwater samples will be collected with pre-packed PFAS-free temporary PVC well screen and PVC riser. This method is most appropriate for sampling the first encountered groundwater. Because soil samples are disturbed, it is often not possible to target specific intervals based on transport properties.

The following steps will be followed to collect the groundwater sample:

1. Ensure 4-gas meter, YSI 6-Series multi-parameter water quality probe, and turbidity meter are calibrated each morning (see QAPP worksheet #22 and P-09 Calibration and Control of Measuring and Test Equipment in PQAPP Appendix A). Document calibration results on equipment calibration log.
2. Advance augers until groundwater is encountered.
3. Arcadis will continuously characterize soil and/or rock cuttings.
4. When groundwater is encountered, the water level in the borehole will be allowed to reach static condition. If a grab groundwater sample is required, a pre-packed PFAS-free temporary PVC well screen will be lowered to the desired sample depth. Then, the augers will be raised to above the temporary well screen to expose the screen.
5. Place LDPE plastic sheeting adjacent to the sample port for use as a clean work area, if conditions allow. Otherwise, prevent sampling equipment from contacting the ground or other surface that could compromise sample integrity. Do not allow vehicle exhaust to point towards the sample point.

6. Don a new set of nitrile gloves, connect tubing to sampling pump and flow-through cell and slowly lower tubing and/or pump into well. If possible, use two field personnel to insert tubing/pump into well to avoid contact with surrounding ground surface or other materials that could cause cross-contamination. Insert tubing (peristaltic pump, if depth to water <25 ft bgs), or pump intake (small-diameter bladder pump, if depth to water >25 ft bgs) at the approximate mid-depth of the sampler screen interval.
    a. Alternately, a Waterra-type inertial pump can be used to retrieve the water sample. If the formation has low-permeability and enough water is not anticipated in the tooling to allow purging of water, a stainless-steel bailer may be considered (after consulting with Arcadis RL).
7. Purge until water is visually clear of sediment, or for a maximum of 20 minutes before collecting GW samples.
    a. Note: for low-permeability formations, collect a grab sample from the screen point sampling device and/or saturated soil sample from the soil core. Leave temporary well casing and screen in the borehole to allow for overnight recovery of groundwater for follow-up sampling the next day.
8. Don a new set of nitrile gloves prior to collecting the groundwater sample and each QC sample. Do not use gloved hands to handle items (e.g., papers, pens, clothes, equipment) before collecting samples.
9. Fill sample bottles using labelled HDPE bottles that are supplied by laboratory only. Make sure that the cap remains on the bottle until immediately prior to sample collection and gets placed back on the bottle immediately after sample collection. Do not place the cap on any surface; keep in hand opposite of sample collection and do not touch the inside of the cap.
10. If high concentrations of PFASs related to Class B Firefighting foams are expected in a groundwater sample (as specified in the QAPP Addendum), collect and shake a small portion of the sample (approximately 10-25 mL) on site. If foaming is observed, document the foaming on the sample log and on the COC to notify laboratory personnel. The “shaker test’ vial can then be disposed of as IDW as specified in Section 8.
11. Collect QC samples at frequency specified in PQAPP Worksheet #20. QC sample locations to be selected based on consultation with Arcadis RL.
12. Place filled sample bottles in a sealed (Ziploc©) bag, record any label information that was not pre-filled out (e.g., sample time). Record the label information and time of sampling in the field notes and sampling forms. Place samples into sample coolers. Store PFAS samples in separate cooler from any other types of samples.
13. Fill out laboratory COC and check against the labels on the sample bottles progressively after each sample is collected.
14. Retrieve the temporary well screen dispose of as specified in Section 8.

7.3.2 Hollow Stem Auger Monitoring Well Construction

HAS well construction methods are the same as when using rotosonic drilling methods and are outlined below.

1. If it is necessary to install a monitor well into a permeable zone below a confining layer, particularly if the deeper zone is believed to have water quality that differs significantly from the

zone above the confining layer, then a telescopic well construction will be considered. In this case, the borehole is advanced approximately 3 to 5 feet into the top of the confining layer, and a permanent casing (typically PVC, black steel or stainless steel) is installed into the socket drilled into the top of the confining layer. The casing is then grouted in place. Grout should be mixed with PFAS-free water (verified by laboratory analysis of source water). The preferred methods of grouting telescoping casings include: pressure-injection grouting using an inflatable packer installed temporarily into the base of the casing, such that grout is injected out the bottom of the casing until it is observed at ground surface outside the casing; displacement-method grouting (also known as the Halliburton method), which entails filling the casing with grout and displacing the grout out the bottom of the casing by pushing a drillable plug, typically made of wood to the bottom of the casing, following by tremie grouting the remainder of the annulus outside the casing; or tremie grouting the annulus surrounding the casing using a tremie pipe installed to the base of the borehole. In all three cases, the casing is grouted to the ground surface, and the grout is allowed to set prior to drilling deeper through the casing. Site-specific criteria and work plans should be created for the completion of non-standard monitoring wells, including telescopic wells.

2. Before installing a screened well, it is important to confirm that the borehole has been advanced into the targeted saturated zone. This is particularly important for wells installed to monitor the water table and/or the shallow saturated zone, as the capillary fringe may cause soils above the water table to appear saturated. If one or more previously installed monitoring wells exist nearby, use the depth to water at such well(s) to estimate the water-table depth at the new borehole location.

   To verify that the borehole has been advanced into the saturated zone, it is necessary to measure the water level in the borehole. For boreholes drilled using water (e.g., Rotosonic), monitor the water level in the borehole as it re-equilibrates to the static level. In low-permeability units like clay, fine-grained glacial tills, shale and other bedrock formations, it may be necessary to wait overnight to allow the water level to equilibrate. Document depth to water in the borehole on the appropriate field forms and field notebook. If there are questions concerning the depth of the well/screen interval, consult with the project technical lead or PM prior to finalizing well depth/screen interval. To the extent practicable, ensure that the depth of the well below the apparent water table is deep enough so that the installed well can monitor groundwater year-round, accounting for seasonal water-table fluctuations. When in doubt, err on the side of slightly deeper well installation.

3. Upon completing the borehole to the desired depth, if a screened well construction is desired, install the monitoring well by lowering the screen and solid PVC risers through the augers or casing. Monitoring wells typically will be constructed of 2-inch-diameter (although sometimes 4-inch), flush-threaded PVC or stainless steel slotted or wire wrapped well screen and blank riser casing. Smaller diameters may be used if multiple wells are to be installed in a single borehole. The screen length will be specified in the Work Plan (or equivalent) based on regulatory requirements and specific monitoring objectives. Monitoring well screens should be limited to 5 to

10 feet long. The screen length will depend on the purpose for the well and the objectives of the groundwater investigation and will (in most cases) be determined prior to the field mobilization.

The slot size and filter pack gradation should be predetermined in the Work Plan (or equivalent) based on site-specific grain-size analysis (sieve analysis) or other geologic considerations or monitoring objectives. Typically, slot sizes for monitoring wells will range from 0.010 inches to 0.020 inches while the filter pack will be 20-40, Morie No. 0, or equivalent. In very fine-grained formations where sample turbidity needs to be minimized, it may be preferred to use a 0.006-inch slot size and 30-65, Morie No. 00, or equivalent filter pack. Alternatively, where monitoring wells are installed in coarse-grained deposits and higher well yield is required, a 0.020-inch slot size and 10-20, Morie No. 1, or equivalent filter pack may be preferred. If the screen slot size and filter pack have not been based on site-specific grain-size analysis, consider collecting soil samples during well installation so future wells can be properly designed.

Alternately, a monitoring well assembly with a pre-packed screen can be installed. The monitoring well assembly (i.e., regular PVC or pre-packed) should be discussed and decided prior to beginning field work and specified in the QAPP addendum. Pre-packed filters should be verified as PFAS-free prior to use.

A blank riser will extend from the top of the screen to approximately 2.5 feet above grade or, if necessary, just below grade where conditions warrant a flush-mounted monitoring well. For wells greater than 50 feet deep, centralizers may be desired to assist in centering the monitoring well in the borehole during construction.

4. When the monitoring well assembly has been set in place, place a washed silica filter pack in the annular space from the bottom of the boring to a height of 1 to 2 feet above the top of the well screen (following specifications in the Work Plan) using a tremie. The filter pack is placed, and drilling equipment extracted in increments until the top of the sand pack is at the appropriate depth. Verify that the expected volume of filter pack matches with the actual amount installed. There can be differences due to irregularities in the borehole. Washout of the borehole will result in the need for greater than calculated well materials. If a difference of more than 10% is noted, consult with the project technical team. The filter pack will be consistent with the screen slot size and the soil particle size in the screened interval, as specified in the Work Plan (or equivalent). The well should be gently surged to prevent filter pack material bridging and to settle the filter pack prior to well seal installation.

5. A hydrated bentonite seal (a minimum of 2 feet thick) will then be placed in the annular space above the sand pack (alternatively, in some cases a fine sand seal may be installed instead of bentonite—follow the specifications in the Work Plan). Use of a tremie pipe is not required for placement of the bentonite seal (though may be required if a well is very deep and borehole bridging is reasonably anticipated). However, bentonite should be poured into the annular space slowly enough to ensure borehole bridging does not occur. If non-hydrated bentonite is used, the bentonite should be permitted to hydrate in place for a minimum of 30 minutes before proceeding.

No coated bentonite pellets will be used in monitoring well drilling or construction. PFAS-free water (verified by laboratory analysis of source water) should be added to hydrate the bentonite if the seal is above the water table. Continuously monitor the placement of the sand pack and bentonite with a weighted tape measure.

6. During the extraction of the augers or casing, a cement/bentonite or neat cement grout will be placed in the annular space from the bentonite seal to a depth approximately 2 ft bgs or as specified in the Work Plan (or equivalent). As with the filter pack, it is recommended that seal material be placed with a tremie pipe. Ensure that seal materials are mixed at the proper ratios with PFAS-free water (verified by laboratory analysis of source water) following manufacturer's recommendations.

7. Install the monitoring well completion as specified Work Plan (or equivalent). Typical completions are a locking, steel protective casing (extended at least 1.5 feet below grade and 2 feet above grade) over the riser casing and secure with a neat cement seal. Alternatively, for flush-mount completions, place a steel curb box with a bolt-down lid over the riser casing and secure with a neat cement seal. In either case, the cement seal will extend approximately 1.5 to 2.0 feet below grade and laterally at least 1 foot in all directions from the protective casing and should slope gently away to promote drainage away from the well.

8. Monitoring wells should be labeled using indelible ink or paint with the appropriate designation on both the inner and outer well casings or inside of the curb box lid. Use caution when labeling the well as paint or indelible ink could potentially contain PFAS materials.

9. When an above-grade completion is used, the riser will be sealed using an expandable locking plug and the top of the well will be vented by drilling a small-diameter (1/8 inch) hole near the top of the well casing or through the locking plug, or by cutting a vertical slot in the top of the well casing. When a flush-mount installation is used, the riser will be sealed using an unvented, expandable locking plug.

10. During well installation, record construction details and actual measurements relayed by the drilling contractor and tabulate materials used (e.g., screen and riser footages; bags of bentonite, cement, and sand) in the field notebook as well as appropriate field forms.

11. After completing the well installation, lock the well, clean the area, and dispose of materials in accordance with the procedures outlined in Section 8 below.

7.4 Air Rotary Drilling Methods

For sites that require bedrock investigations but no collection of undisturbed rock cores, air rotary drilling may be required. Air rotary drilling procedures are similar to HSA. It produces disturbed soil and rock samples that are lifted to the surface by blowing compressed air into the borehole. Air rotary drilling is not well suited for situations that require high-resolution bedrock logging, but can be an effective way to generally characterize bedrock lithology and sample bedrock groundwater.

1. Place LDPE plastic sheeting over sampling processing area to create a clean working surface, if conditions allow. Otherwise, prevent sampling equipment from contacting the ground or other surface that could compromise sample integrity.
2. Clear the ground surface of brush, root mat, grass, leaves, or other debris prior to sampling.
3. Decontaminate all non-disposable sampling equipment/tooling that will or may to come into direct contact with soil prior to first use. Disposable sampling equipment must be kept in sealed PFAS-free packaging until it is used.
4. Use stainless-steel hand auger to collect samples from 0 - 5 ft bgs surface interval, if applicable. All hand augering to collect soil samples will be completed by Arcadis personnel, not the drilling subcontractor. These samples can be collected either during other Utility Clearance activities (e.g., third party clearance) or immediately prior to drilling.
    a. Hand auger soil sample should be collected manually from the hand auger bucket (using stainless steel scoop, spatula, or trowel as necessary) and placed directly into the sample jar. The sample should not contact the ground or LDPE sheeting.
    b. If sampling by hand auger, after collecting sample from the surface or shallowest depth interval examine the stability of the soil in the boring sidewalls. If sidewalls appear to be at risk of collapsing into the borehole insert a length of polyvinyl chloride (PVC) pipe into the boring to maintain the opening and prevent collapse prior to augering to the next deeper sampling interval.
5. During air rotary drilling, soil and rock cuttings will accumulate around the outside of the borehole. Periodically the drillers will shovel cuttings into containers for disposal. Arcadis personnel can also perform characterization and sampling directly from these cuttings.
6. Drillers must not touch soil that will be collected for sampling. Arcadis personnel will use a stainless-steel spatula, spoon, or trowel to collect soil direct from the cuttings pile at the desired sample depth. Arcadis personnel decontaminate spatula, spoon, or trowel between uses in accordance with Section 10.
7. Don a new set of nitrile gloves prior to collecting each sample. Do not use gloved hands to handle papers, pens, clothes, etc., before collecting samples. Do not touch outside of sample bag with gloved hands.
8. During sampling, characterize soils in accordance with P-04 TGI - Soil Description (Arcadis 2018b). Record descriptions in the field notes, boring logs, and/or personal digital assistant (PDA). It is also beneficial to photo document the samples. It should be noted that PDA logs must be electronically backed up and transferred to a location accessible to other project team members as soon as feasible to retain and protect the field data.
9. Collect sample volumes from cuttings pile using a clean stainless-steel trowel and place in clean, labeled bottles supplied by the laboratory for the required analyses (see sample container list in PQAPP Worksheets #19&30). Make sure caps remain on PFAS sample bottles until immediately prior to filling. Caps must remain in the hand of the sampler until replacing on the bottle.
10. Once the sample has been placed in the bottle, and the bottle cap has been completely tightened, label the sample with sample identification number, date, and time of collection. Labels must be completed only after the caps have been placed back on each bottle. (See P-01 QP#3.06 Field Activities documentation for sample label information).
11. Collect QC samples at frequency specified in PQAPP Worksheet #20. QC sample locations to be selected based on consultation with Arcadis RL.

12. Place soil sample bottles in a sealed Ziploc© bag, and then into sample coolers. Store PFAS samples in separate cooler from other samples.
13. Record the label information and time of sampling in the field notes and sampling forms.
14. Fill out laboratory COC and check against the labels on the sample bottles progressively after each sample is collected.
15. Abandon all soil borings to grade as specified in the QAPP Addendum upon completion and before moving to the next boring location. **If single-interval groundwater sample is required, see Section 7.4.1 for procedure. If well is to be installed, see Section 7.4.2 for well construction procedure**.
16. Mark boring location with wooden stake that identifies boring ID for subsequent surveying, as necessary.
17. Manage investigation-derived-waste (IDW) as specified in site-specific work plan.
18. If samples are not shipped the same day as collected, add fresh ice to sample coolers at the end of the day to maintain the temperature between 0 and 6°C. Place ice in sealed polyethylene bags (Ziplock). Do not use blue ice. See QAPP worksheet #19 and 30 for sample containers, preservation and hold times. Sample coolers must remain in the possession of the sampling team at all times or secured under lock and key until shipment to the laboratory.

7.4.1 Air Rotary Single-Interval Groundwater Sampling

Similar to HSA drilling methods, there are limited single-interval groundwater sampling devices for air rotary drilling. Commonly, groundwater samples will be collected with pre-packed PFAS-free temporary PVC well screen and PVC riser. This method is most appropriate for sampling the first encountered groundwater when it is expected to occur in bedrock. Because soil and rock samples are disturbed, it is often not possible to target specific intervals based on transport properties. Unlike single-interval groundwater sampling with DPT, rotosonic, and HSA boreholes, air rotary drill tooling (a.k.a. drill bit stem or drill bit pipe) is a smaller diameter than the drill bit advancing the borehole. Additionally, the central opening of the drill bit is generally too narrow to accommodate a pre-packed PFAS-free temporary PVC well screen. Therefore, single-interval groundwater samples will be collected by inserting the pump through the annular space between the borehole wall and the air rotary drill tooling.

The following steps will be followed to collect the groundwater sample:

1. Ensure 4-gas meter, YSI 6-Series multi-parameter water quality probe, and turbidity meter are calibrated each morning (see QAPP worksheet #22 and P-09 Calibration and Control of Measuring and Test Equipment in PQAPP Appendix A). Document calibration results on equipment calibration log.
2. Advance rotary bit until groundwater is encountered.
3. Arcadis will continuously characterize soil and/or rock cuttings.
4. When groundwater is encountered, the water level in the borehole will be allowed to reach static condition. If a grab groundwater sample is required, a pre-packed PFAS-free temporary PVC well screen will be lowered through the annular space between the borehole wall and the air rotary drill tooling to the desired sample depth.
5. Place LDPE plastic sheeting adjacent to the sample port for use as a clean work area, if conditions allow. Otherwise, prevent sampling equipment from contacting the ground or other

surface that could compromise sample integrity. Do not allow vehicle exhaust to point towards the sample point.

6. Don a new set of nitrile gloves, connect tubing to sampling pump and flow-through cell and slowly lower tubing and/or pump into well. If possible, use two field personnel to insert tubing/pump into well to avoid contact with surrounding ground surface or other materials that could cause cross-contamination. Insert tubing (peristaltic pump, if depth to water <25 ft bgs), or pump intake (small-diameter bladder pump, if depth to water >25 ft bgs) at the approximate mid-depth of the sampler screen interval.
   a. Alternately, a Waterra-type inertial pump can be used to retrieve the water sample. If the formation has low-permeability and enough water is not anticipated in the tooling to allow purging of water, a stainless-steel bailer may be considered (after consulting with Arcadis RL).
7. Purge until water is visually clear of sediment, or for a maximum of 20 minutes before collecting GW samples.
   a. Note: for low-permeability formations, collect a grab sample from the screen point sampling device and/or saturated soil sample from the soil core. Leave temporary well casing and screen in the borehole to allow for overnight recovery of groundwater for follow-up sampling the next day.
8. Don a new set of nitrile gloves prior to collecting the groundwater sample and each QC sample. Do not use gloved hands to handle items (e.g., papers, pens, clothes, equipment) before collecting samples.
9. Fill sample bottles using labelled HDPE bottles that are supplied by laboratory only. Make sure that the cap remains on the bottle until immediately prior to sample collection and gets placed back on the bottle immediately after sample collection. Do not place the cap on any surface; keep in hand opposite of sample collection and do not touch the inside of the cap.
10. If high concentrations of PFASs related to Class B Firefighting foams are expected in a groundwater sample (as specified in the QAPP Addendum), collect and shake a small portion of the sample (approximately 10-25 mL) on site. If foaming is observed, document the foaming on the sample log and on the COC to notify laboratory personnel. The “shaker test’ vial can then be disposed of as IDW as specified in Section 8.
11. Collect QC samples at frequency specified in PQAPP Worksheet #20. QC sample locations to be selected based on consultation with Arcadis RL.
12. Place filled sample bottles in a sealed (Ziploc©) bag, record any label information that was not pre-filled out (e.g., sample time). Record the label information and time of sampling in the field notes and sampling forms. Place samples into sample coolers. Store PFAS samples in separate cooler from any other types of samples.
13. Fill out laboratory COC and check against the labels on the sample bottles progressively after each sample is collected.
14. Retrieve the temporary well screen dispose of as specified in Section 8.

7.4.2 Air Rotary Monitoring Well Construction

Air rotary well construction methods are the same as when using HSA drilling methods and are outlined below.

1. If it is necessary to install a monitor well into a permeable zone below a confining layer, particularly if the deeper zone is believed to have water quality that differs significantly from the zone above the confining layer, then a telescopic well construction will be considered. In this case, the borehole is advanced approximately 3 to 5 feet into the top of the confining layer, and a permanent casing (typically PVC, black steel or stainless steel) is installed into the socket drilled into the top of the confining layer. The casing is then grouted in place. Grout should be mixed with PFAS-free water (verified by laboratory analysis of source water). The preferred methods of grouting telescoping casings include: pressure-injection grouting using an inflatable packer installed temporarily into the base of the casing, such that grout is injected out the bottom of the casing until it is observed at ground surface outside the casing; displacement-method grouting (also known as the Halliburton method), which entails filling the casing with grout and displacing the grout out the bottom of the casing by pushing a drillable plug, typically made of wood to the bottom of the casing, following by tremie grouting the remainder of the annulus outside the casing; or tremie grouting the annulus surrounding the casing using a tremie pipe installed to the base of the borehole. In all three cases, the casing is grouted to the ground surface, and the grout is allowed to set prior to drilling deeper through the casing. Site-specific criteria and work plans should be created for the completion of non-standard monitoring wells, including telescopic wells.

2. Before installing a screened well, it is important to confirm that the borehole has been advanced into the targeted saturated zone. This is particularly important for wells installed to monitor the water table and/or the shallow saturated zone, as the capillary fringe may cause soils above the water table to appear saturated. If one or more previously installed monitoring wells exist nearby, use the depth to water at such well(s) to estimate the water-table depth at the new borehole location.

   To verify that the borehole has been advanced into the saturated zone, it is necessary to measure the water level in the borehole. For boreholes drilled using water (e.g., Rotosonic), monitor the water level in the borehole as it re-equilibrates to the static level. In low-permeability units like clay, fine-grained glacial tills, shale and other bedrock formations, it may be necessary to wait overnight to allow the water level to equilibrate. Document depth to water in the borehole on the appropriate field forms and field notebook. If there are questions concerning the depth of the well/screen interval, consult with the project technical lead or PM prior to finalizing well depth/screen interval. To the extent practicable, ensure that the depth of the well below the apparent water table is deep enough so that the installed well can monitor groundwater year-round, accounting for seasonal water-table fluctuations. When in doubt, err on the side of slightly deeper well installation.

3. Upon completing the borehole to the desired depth, if a screened well construction is desired, install the monitoring well by lowering the screen and solid PVC risers through the augers or casing. Monitoring wells typically will be constructed of 2-inch-diameter (although sometimes 4-inch), flush-threaded PVC or stainless steel slotted or wire wrapped well screen and blank riser casing. Smaller diameters may be used if multiple wells are to be installed in a single borehole. The screen length will be specified in the Work Plan (or equivalent) based on regulatory

requirements and specific monitoring objectives. Monitoring well screens should be limited to 5 to 10 feet long. The screen length will depend on the purpose for the well and the objectives of the groundwater investigation and will (in most cases) be determined prior to the field mobilization.

The slot size and filter pack gradation should be predetermined in the Work Plan (or equivalent) based on site-specific grain-size analysis (sieve analysis) or other geologic considerations or monitoring objectives. Typically, slot sizes for monitoring wells will range from 0.010 inches to 0.020 inches while the filter pack will be 20-40, Morie No. 0, or equivalent. In very fine-grained formations where sample turbidity needs to be minimized, it may be preferred to use a 0.006-inch slot size and 30-65, Morie No. 00, or equivalent filter pack. Alternatively, where monitoring wells are installed in coarse-grained deposits and higher well yield is required, a 0.020-inch slot size and 10-20, Morie No. 1, or equivalent filter pack may be preferred. If the screen slot size and filter pack have not been based on site-specific grain-size analysis, consider collecting soil samples during well installation so future wells can be properly designed.

Alternately, a monitoring well assembly with a pre-packed screen can be installed. The monitoring well assembly (i.e., regular PVC or pre-packed) should be discussed and decided prior to beginning field work and specified in the QAPP addendum. Pre-packed filters should be verified as PFAS-free prior to use.

A blank riser will extend from the top of the screen to approximately 2.5 feet above grade or, if necessary, just below grade where conditions warrant a flush-mounted monitoring well. For wells greater than 50 feet deep, centralizers may be desired to assist in centering the monitoring well in the borehole during construction.

4. When the monitoring well assembly has been set in place, place a washed silica filter pack in the annular space from the bottom of the boring to a height of 1 to 2 feet above the top of the well screen (following specifications in the Work Plan) using a tremie. The filter pack is placed, and drilling equipment extracted in increments until the top of the sand pack is at the appropriate depth. Verify that the expected volume of filter pack matches with the actual amount installed. There can be differences due to irregularities in the borehole. Washout of the borehole will result in the need for greater than calculated well materials. If a difference of more than 10% is noted, consult with the project technical team. The filter pack will be consistent with the screen slot size and the soil particle size in the screened interval, as specified in the Work Plan (or equivalent). The well should be gently surged to prevent filter pack material bridging and to settle the filter pack prior to well seal installation.

5. A hydrated bentonite seal (a minimum of 2 feet thick) will then be placed in the annular space above the sand pack (alternatively, in some cases a fine sand seal may be installed instead of bentonite—follow the specifications in the Work Plan). Use of a tremie pipe is not required for placement of the bentonite seal (though may be required if a well is very deep and borehole bridging is reasonably anticipated). However, bentonite should be poured into the annular space slowly enough to ensure borehole bridging does not occur. If non-hydrated bentonite is used, the

bentonite should be permitted to hydrate in place for a minimum of 30 minutes before proceeding. *No coated bentonite pellets will be used in monitoring well drilling or construction*. PFAS-free water (verified by laboratory analysis of source water) should be added to hydrate the bentonite if the seal is above the water table. Continuously monitor the placement of the sand pack and bentonite with a weighted tape measure.

6. During the extraction of the augers or casing, a cement/bentonite or neat cement grout will be placed in the annular space from the bentonite seal to a depth approximately 2 ft bgs or as specified in the Work Plan (or equivalent). As with the filter pack, it is recommended that seal material be placed with a tremie pipe. Ensure that seal materials are mixed at the proper ratios with PFAS-free water (verified by laboratory analysis of source water) following manufacturer’s recommendations.

7. Install the monitoring well completion as specified Work Plan (or equivalent). Typical completions are a locking, steel protective casing (extended at least 1.5 feet below grade and 2 feet above grade) over the riser casing and secure with a neat cement seal. Alternatively, for flush-mount completions, place a steel curb box with a bolt-down lid over the riser casing and secure with a neat cement seal. In either case, the cement seal will extend approximately 1.5 to 2.0 feet below grade and laterally at least 1 foot in all directions from the protective casing and should slope gently away to promote drainage away from the well.

8. Monitoring wells should be labeled using indelible ink or paint with the appropriate designation on both the inner and outer well casings or inside of the curb box lid. Use caution when labeling the well as paint or indelible ink could potentially contain PFAS materials.

9. When an above-grade completion is used, the riser will be sealed using an expandable locking plug and the top of the well will be vented by drilling a small-diameter (1/8 inch) hole near the top of the well casing or through the locking plug, or by cutting a vertical slot in the top of the well casing. When a flush-mount installation is used, the riser will be sealed using an unvented, expandable locking plug.

10. During well installation, record construction details and actual measurements relayed by the drilling contractor and tabulate materials used (e.g., screen and riser footages; bags of bentonite, cement, and sand) in the field notebook as well as appropriate field forms.

11. After completing the well installation, lock the well, clean the area, and dispose of materials in accordance with the procedures outlined in Section 8 below.

8 WASTE MANAGEMENT

Investigation-derived waste (IDW) including soil cuttings, purge water, and decontamination water generated during cleaning procedures will be collected and placed in Department of Transportation approved containers, segregated by waste streams: see the Investigation-Derived Waste Handling and

Storage TGI for details (Arcadis 2017c). All containers will be labeled as non-hazardous unless otherwise instructed by the project manager. Containerized IDW will be stored on site until it is profiled and subsequently transported to an approved facility for disposal or recycling. Waste manifests for all IDW suspected to have come into contact with PFAS should clearly note the presence of PFAS. Additional IDW sampling and management details will be provided in the site-specific Work Plan (QAPP addendum) and will be consistent with applicable Army policies and Army post requirements. Personal protective equipment (e.g., gloves, disposable clothing, disposable equipment) resulting from personnel cleaning procedures and soil sampling activities will be placed in plastic bags. These bags will be transferred into appropriately labeled waste containers for appropriate disposal.

9 DATA RECORDING AND MANAGEMENT

The supervising field lead will be responsible for documenting drilling events to record all relevant information in a clear and concise format. The record of drilling events should include:

- Start and finish drilling dates;
- Project name and location;
- Project number, client, and site location;
- Boring number and depths;
- Soil descriptions;
- Depth to water;
- Well construction specifications, if applicable (screen and riser material and diameter, sump length, screen length and slot size, riser length, sand pack type);
- Quantities of materials used (e.g., bentonite, grout);
- Type of drilling tools used (e.g., rig type);
- Core barrel size;
- Names of contractor’s drillers, inspectors, or other people onsite; and,
- Weather conditions.

Field staff should ensure COC Forms are properly completed, and verify which PFAS analytes (e.g., just PFOS and PFOA, some or all of the modified method 537 target analyte list) are required for analysis and note on the COC.

All documents (and photographs) should be scanned and electronically filed in the appropriate project directory for easy access. In addition, the locations of newly-installed wells will be documented photographically or in a site sketch. If appropriate, a measuring wheel or engineer’s tape will be used to determine approximate distances between important site features.

The well location, ground surface elevation, and inner and outer casing elevations will be surveyed using the method specified in the site Work Plan. Generally, a local baseline control will be set up. This local baseline control can then be tied into the appropriate vertical and horizontal datum, such as the National

Geodetic Vertical Datum of 1929 or 1988 and the State Plane Coordinate System. At a minimum, the elevation of the top of the inner casing used for water-level measurements should be measured to the nearest 0.01 foot. Elevations will be established in relation to the National Geodetic Vertical Datum of 1929. A permanent mark will be placed on top of the inner casing to mark the point for water-level measurements.

10 DECONTAMINATION

To avoid cross-contamination during drilling and sampling, all reusable groundwater sampling equipment that has or is suspected to have come into contact with groundwater or soil will be decontaminated between each sample using the following steps. If Class B firefighting foam is a suspected PFAS source at any sampling location, then these steps should be performed twice.

- Don new pair of Nitrile gloves prior to decontamination
- Scrub using a plastic brush and a non-phosphate soap free of VOCs (e.g., Liquinox, Alconox) and plastic brush;
- Double-rinse in potable deionized or distilled water;
- Rinse once with methanol or isopropyl alcohol;
- Rinse once with laboratory-certified PFAS-free water;
- Collect all rinsate in a sealed pail for disposal
- Allow time for equipment to air dry prior to re-use.

While strongly recommended, the use of solvents may be excluded for project-specific H&S concerns. If solvents are prohibited after DQO development, then additional procedures should be evaluated by the project team. Contingencies could include the use of dedicated sampling equipment at each sampling location or amending laboratory procedures to mitigate the increased risk of cross-contamination.

Additionally, the following decontamination procedure could be utilized when organic solvent use is not possible.

- Don new pair of Nitrile gloves prior to decontamination
- Scrub using a plastic brush and a non-phosphate soap free of VOCs (e.g., Liquinox, Alconox) and plastic brush;
- Single-rinse in potable deionized or distilled water;
- Scrub using a plastic brush and a non-phosphate soap free of VOCs (e.g., Liquinox, Alconox) and plastic brush;
- Rinse twice with deionized water and once with PFAS-free water;
- Collect all rinsate in a sealed pail for disposal
- Allow time for equipment to air dry prior to re-use.

Drive casings and other drilling tooling will be steam cleaned or replaced with new equipment between boreholes. Steam cleaning will be performed by the drillers within a temporary decontamination or other containment area designated by the supervising engineer or geologist that is located outside of the work zone. All decontamination water will be collected and containerized for disposal.

See additional specifics in P-04, TGI - Groundwater and Soil Sampling Equipment Decontamination in PQAPP Appendix A.

11QUALITY ASSURANCE

In general, the following quality assurance and quality control (QA/QC) samples should be collected:

- Equipment blanks
- Field (i.e., reagent) blanks
- Field duplicates
- Matrix spike/matrix spike duplicate

Details on QC sampling requirements (e.g., frequency of collection, types of QA/QC samples) are provided in the PQAPP and will be outlined in various Site-specific sampling scopes of work in the QAPP Addendum. Additionally, detailed procedures related to equipment and field (i.e., reagent) blank sample collection are outlined in the Equipment and Reagent Blank Sample Collection TGI (Arcadis 2018c). In general, equipment blanks should be collected from every piece of downhole equipment that could come in contact with soil or groundwater during sample collection. This includes all downhole tooling (e.g., drill bits, drill rods).

Prior to initiating field activities, water sources to be used during drilling and well construction activities should be sampled to verify those sources are PFAS-free. While not part of the PQAPP, this is considered best practice and should be completed to the extent possible.

Refer to quality control requirements for the project to ensure that appropriate quality assurance and quality control (QA/QC) samples are collected. When collecting QA/QC samples, the same guidelines apply as when collecting regular samples – specifically that:

- Samples should be collected in laboratory-supplied HDPE bottles;
- Bottle caps must remain in the hand of the sampler until replaced on the bottle;
- Labels must be completed after the caps have been placed back on each bottle; and,
- Samples must be stored in appropriate transport containers (coolers) with ice (Ziploc®-type bags for use as ice containers) with appropriate labeling. **Do not use blue ice. Store PFAS samples in a separate cooler from other types of samples.**

12 REFERENCES

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ATTACHMENT 1

Table 1 and Table 2: PFAS Inspection Material Recommendations

Table 1: Summary of Acceptable Sampling Equipment and Materials for PFAS Site Inspections

Sampling Materials	Additional Considerations	References
Water Sampling Materials		
High density polyethylene (HDPE) or silicone tubing materials	--	DER 2016; USACE 2016; NHDES 2016; MassDEP 2017
HDPE HydraSleeves^{TM}	Low density polyethylene (LDPE) HydraSleeves^{TM} are not recommended	USACE 2016; MassDEP 2017
Drilling and Soil Sampling Materials		
PFAS-free drilling fluids	--	DER 2016
PFAS-free makeup water	Confirm PFAS-free water source via laboratory analysis prior to inspections	--
Acetate liners	For use in soil sampling	USACE 2016
Sample Containers and Storage		
HDPE sample containers with HDPE lined lids for soil and water samples	Laboratory should provide; whole bottle analysis of aqueous samples combined with a solvent rinse of bottle is recommended	DER 2016, MassDEP 2017
Ice contained in plastic (polyethylene) bags (double bagged)	--	DER 2016; USACE 2016; NHDES 2016; MassDEP 2017
Field Documentation		
Sharpie®	--	NHDES 2016; USACE 2016; MassDEP 2017
Ball point pens	--	MassDEP 2017
Standard paper and paper labels	--	DER 2016; USACE 2016; NHDES 2016; MassDEP 2017
Decontamination		
Water-only decontamination	Confirm PFAS-free water source via laboratory analysis prior to inspections	DER 2016
Alconox® or Liquinox® followed by deionized water or PFAS-free water rinse	Liquinox® known to contain trace levels of 1,4-dioxane	NHDES 2016; USACE 2016; MassDEP 2017
Methanol, isopropanol, or acetone	Special health and safety precautions are necessary	UNEP 2015; USACE 2016

Note: This list is considered preliminary and additional materials may be added as additional information becomes available. Project teams are expected to follow a methodical evaluation process of materials to be used and confirm acceptance prior to implementation of field activities.

Table 2: Summary of Equipment and Materials Not Recommended for PFAS Site Inspections

Sampling Materials	Known PFAS-Containing Materials	Suspected PFAS-Containing Materials	Materials with Potential to Retain PFASs	References
Water Sampling Materials				
Teflon®, PTFE-containing or other fluoropolymer coated or containing field equipment (e.g., tubing, bailers, liners, tape, plumbing paste, pump parts)	x			DER 2016; USACE 2016; NHDES 2016; MassDEP 2017
Passive diffusion bags			x	MassDEP 2017
LDPE HydraSleeves ™			x	USACE 2016; MassDEP 2017
Water particle filters			x	MassDEP 2017
Drilling and Soil Sampling Materials				
Aluminum foil			x	DER 2016; USACE 2016; NHDES 2016; MassDEP 2017
Drilling fluid containing PFASs	x	x		DER 2016
Sample Containers and Storage				
Glass sample containers with lined lids			x	DER 2016; USACE 2016; NHDES 2016; MassDEP 2017
LDPE containers and lined lids			x	USACE 2016
Teflon® or PTFE- lined lids on containers (e.g., sample containers, rinsate water storage containers)	x			DER 2016; USACE 2016; NHDES 2016; MassDEP 2017
Reusable chemical or gel ice packs (e.g., BlueIce®)		x		DER 2016; USACE 2016; NHDES 2016; MassDEP 2017
Field Documentation				
Self-sticking notes and similar office products (e.g., 3M Post-it-notes)		x		DER 2016; USACE 2016; NHDES 2016; MassDEP 2017
Waterproof paper, notebooks, and labels	x			DER 2016, MassDEP 2017
Non-Sharpie® markers		x		NHDES 2016
Decontamination				
Some detergents and decontamination solutions (e.g., Decon 90® Decontamination Solution)	x	x		DER 2016; NHDES 2016; MassDEP 2017

Note: For materials that are suspected of containing PFASs, or have the potential to retain PFASs, project specific considerations may provide adequate justification for use during the field event. For example, further evaluation may be conducted in the form of pre-field equipment blank sample analysis.

Attachment 7

Updated Technical Guidance Instruction (P-15 from the Programmatic QAPP): Sediment, Surface Water, and Stormwater Sample Collection for PFAS Analysis, Rev. 1, 27 March 2020

Contract Number: W912DR-18-D-0004

Delivery Order: W912DR18F0685

TGI – SEDIMENT, SURFACE WATER, AND STORMWATER SAMPLE COLLECTION FOR PFAS ANALYSIS

Rev: 1

Rev Date: March 27, 2020

VERSION CONTROL

Revision No	Revision Date	Page No(s)	Description	Reviewed by
0	October 5, 2018	All	Combined aspects of generic Sediment Sample Collection TGI (Rev 0, June 18, 2018) and Stormwater Sampling TGI (Rev 0, August 29, 2018). Added surface water collection guidance and made this TGI PFAS-specific. Added stormwater and surface water sections; made PFAS-specific	Shannon Dunn
1	March 27, 2020	15, 16	Revised the depth criteria to 0.5 to 1 feet for shallow surface water and >1 for deeper surface water	Shannon Dunn

APPROVAL SIGNATURES

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Date:

1 INTRODUCTION

This document describes general and/or specific procedures, methods, actions, steps, and considerations to be used and observed by Arcadis staff when performing work, tasks, or actions under the scope and relevancy of this document. This document may describe expectations, requirements, guidance, recommendations, and/or instructions pertinent to the service, work task, or activity it covers.

It is the responsibility of the Arcadis Certified Project Manager (CPM) to provide this document to the persons conducting services that fall under the scope and purpose of this procedure, instruction, and/or guidance. The Arcadis CPM will also ensure that the persons conducting the work falling under this document are appropriately trained and familiar with its content. The persons conducting the work under this document are required to meet the minimum competency requirements outlined herein, and inquire to the CPM regarding any questions, misunderstanding, or discrepancy related to the work under this document.

This document is not considered to be all inclusive nor does it apply to any and all projects. It is the CPM's responsibility to determine the proper scope and personnel required for each project. There may be project- and/or client- and/or state-specific requirements that may be more or less stringent than what is described herein. The CPM is responsible for informing Arcadis and/or Subcontractor personnel of omissions and/or deviations from this document that may be required for the project. In turn, project staff are required to inform the CPM if or when there is a deviation or omission from work performed as compared to what is described herein.

In following this document to execute the scope of work for a project, it may be necessary for staff to make professional judgment decisions to meet the project's scope of work based upon site conditions, staffing expertise, state-specific requirements, health and safety concerns, etc. Staff are required to consult with the CPM when or if a deviation or omission from this document is required that has not already been previously approved by the CPM. Upon approval by the CPM, the staff can perform the deviation or omission as confirmed by the CPM.

2 SCOPE AND APPLICATION

This Technical Guidance Instruction (TGI) describes the collection of sediment, surface water, and stormwater samples, including field screening and logging of sediment samples. Sediment samples will be collected using a hand-held dredge, push cores, and/or stainless-steel scoop or trowel (the proper technique will be selected in the field depending on site conditions) for the laboratory analysis of sediment chemistry samples. Surface water and stormwater samples will be collected using direct-fill methods or peristaltic pumps. The general procedures to be utilized in obtaining sediment, surface water, and stormwater samples are outlined below. The intent of this TGI is to provide instructions for sampling during United States Army Environmental Command (USAEC) per- and polyfluoroalkyl substances (PFASs) Preliminary Assessment and Site Inspection (PA/SI) at various installations. It also covers specific considerations for PFASs due to their unique chemical and physical properties, low detection limits, and regulatory standards.

This TGI may change depending upon field conditions, equipment limitations, or limitations imposed by the procedure. Substantive modification to this TGI will be approved in advance by the Project Manager.

3 PERSONNEL QUALIFICATIONS

All field personnel must have the appropriate training required by Arcadis as described in the project Site Safety and Health Plan (SSHP). Arcadis field sampling personnel will be trained in proper sampling procedures under the guidance of an experienced field geologist, engineer, or technician. Arcadis field sampling personnel will also be versed in the relevant TGIs and standard operating procedures (SOPs) necessary to successfully complete the desired field work.

4 EQUIPMENT LIST

The following materials will be available, as required, during sampling. Not all equipment listed below may be necessary for a specific activity. Additional equipment may be required, pending field conditions.

Site plan with proposed sampling locations;

Relevant work plan (e.g., Programmatic Quality Assurance Project Plan [PQAPP]);

SSHP;

Health and Safety equipment, as required by the site SSHP and task-specific Job Safety Analysis;

Sediment Sampling Equipment:

- Boat with outboard motor and associated equipment (as necessary);
- Global Positioning System (GPS) unit;
- Navigation chart(s) for on-water activities (if available and as applicable);
- Stainless-steel hand-held dredge (6-inch x 6-inch Ekman or Petite Ponar);
- Lexan™ tubes (4-inch) and PFAS-free plastic caps;
- Stainless-steel bowl;
- Stainless-steel spatula, scoop, bent spoon, or trowel;
- Steel core driver (i.e., slide hammer);
- YSI 6-Series Multi-Parameter Instrument water quality meter with flow-through cell for monitoring temperature, conductivity, oxidation reduction potential (ORP), and dissolved oxygen (DO);
- Supplemental turbidity meter;
- Stainless-steel probe rod – for evaluating bottom softness when wading to sampling locations
- Polypropylene twine/rope
- Hacksaw with stainless steel blade;
- Tape measure;
- Stainless steel, polyvinyl chloride (PVC) or high-density polyethylene (HDPE) yard stick for measuring water depth.
- Stainless-steel extension rod (if necessary to extend reach of scoop or trowel);

- Rubber boots or rubber waders (only non-coated rubber, other more high-tech waterproof material is not permitted);
- Life jacket or other personal flotation device (PFD) as necessary based on water depth (note, these will likely have PFAS-containing materials so need to be careful to avoid cross-contamination when using).

Surface Water Sampling Equipment:

- If not using direct-fill method:
  - ISCO Model 150 peristaltic pump;
  - Rechargeable marine or car battery (for peristaltic pump);
  - Dedicated HDPE and silicon tubing (Teflon® or polytetrafluoroethylene [PTFE] tubing is prohibited);
  - Stainless steel rod (1/4-inch diameter x 4-feet long or similar) to support HDPE sampling tubing;
  - HDPE zip ties (nylon zip ties are not allowed) to attach tubing to rod;
  - YSI 6-Series Multi-Parameter Instrument water quality meter with flow-through cell for monitoring temperature, conductivity, ORP, and DO;
  - Supplemental turbidity meter;
  - Pail or bucket with closable lid for pump discharge;
- Rubber boots or rubber waders (only non-coated rubber, other more high-tech waterproof material is not permitted);
- Life jacket or other PFD as necessary based on water depth (note, these will likely have PFAS-containing materials so need to be careful to avoid cross-contamination when using).

Stormwater Sampling Equipment:

- Wrench, socket, manhole cover hook or magnetic manhole cover remover for access;
- Approximately 1-inch outer diameter Lexan™ pipe long enough to extend from bottom of storm drain to at least 2 feet above the manhole;
- HDPE zip ties (nylon zip ties are not allowed) to attach tubing to the Lexan™ pipe;
- Tape measure;
- ISCO Model 150 peristaltic pump;
- Rechargeable marine or car battery (for peristaltic pump);
- Dedicated HDPE and silicon tubing (Teflon® or PTFE tubing is prohibited);
- YSI 6-Series Multi-Parameter Instrument water quality meter with flow-through cell for monitoring temperature, conductivity, ORP, and DO;
- Supplemental turbidity meter;

- Pail or bucket with closable lid for pump discharge.

Appropriate sample containers and labels:

- Labeled sample bottles: see the TGI - Poly- and Perfluorinated Alkyl Substances (PFAS) Field Sampling Guidance (Arcadis 2018a) for PFAS-specific considerations;
- 1-quart and 1-gallon polyethylene bags (Ziploc® brand only) to hold ice and samples;
- Appropriate blanks (field reagent blanks supplied by the laboratory);
- Packing and shipping materials;
- Chain-of-Custody (COC) Forms; see the Sample Chain of Custody Standard Operating Procedure (SOP) for reference (Arcadis 2017a);
- Appropriate transport containers (coolers) with ice and appropriate labeling, no blue ice;

Decontamination/Water Management:

- PFAS-free decontamination fluids and equipment
  - HDPE or PVC brushes and squirt bottles
  - Stainless steel bowl
  - HPDE buckets to hold decontamination fluids
  - Alconox® or Liquinox® (other detergents are prohibited)
  - Methanol or isopropyl alcohol (for sediment sampling equipment decontamination only)
  - Distilled or laboratory-supplied deionized water
  - Laboratory-provided PFAS-free water
- See the TGI - Poly- and Perfluorinated Alkyl Substances (PFAS) Field Sampling Guidance (Arcadis 2018a) or the TGI - Groundwater and Soil Sampling Equipment Decontamination (Arcadis 2017b) for additional guidance;
- Portable field hand washing setup;
- Non-hazardous drum labels as required for investigation-derived waste handling: see the TGI - Investigation-Derived Waste Handling and Storage for details (Arcadis 2017c);

Field Notes:

- Pens, pencils, and/or Sharpies® for writing;
- Appropriate field forms;
- Clipboards, field binders, field notebook, and field note pages that are <u>not</u> waterproof;
- Digital camera.

Other

  - Garbage bags;
  - Paper towels;
  - Duct and packing tape;
  - Dedicated low-density polyethylene (LDPE) plastic sheeting to prevent sample contact with the ground;
  - Field clothing made of cotton or other natural fibers that is well laundered (i.e., washed at least 5 times);
  - PFAS-free sunscreen and insect repellant.

5 CAUTIONS

5.1 Utility Clearance

Sediment sampling requires a minimum of three reliable lines of evidence for utility clearance to demonstrate that sample locations are clear of subsurface utilities. A site visit for public utility line clearance at the proposed boring locations will be conducted at least 72 hours prior to work commencing. As applicable, utility maps will be reviewed during field reconnaissance of the proposed inspection locations to determine if any are co-located with public utility lines. Arcadis will also contract an independent geophysical survey company to verify, if possible, that proposed boring locations are not co-located with existing underground utility/substructure features. See the Utility Location and Clearance Arcadis Health and Safety Standard (Arcadis 2017d), including Supplement 6 Utility Location Procedures for Aquatic Work Activities, for reference.

5.2 PFAS-Specific General Sampling Considerations

This section provides a summary of methods and procedures applicable to the collection of environmental samples for field screening or laboratory analysis during PFAS site characterization activities. In general, sampling techniques used for PFAS site characterization are consistent with conventional sampling techniques used in the environmental industry, but special consideration is made regarding PFAS-containing materials and cross-contamination potential. For example, Teflon™ and other fluoropolymer containing materials are found in pumps, tubing, and sample storage containers and therefore should be avoided if possible (Department of Environment Regulation [DER], Western Australia 2016; New Hampshire Department of Environmental Services [NHDES] 2016). Certain field documentation materials such as waterproof paper or field books, adhesive paper products, and some writing utensils (grouped as non-Sharpie® markers) are also prohibited items during PFAS sampling (DER 2016; NHDES 2016).

New nitrile gloves should be donned before any of the following activities:

- Decontamination of re-usable sampling equipment;
- Contact with sample bottles or PFAS-free water bottles;
- Handling clean sample tubing or connecting tubing;
- Handling QC samples including field blanks and equipment blanks.

Additionally, new nitrile gloves should also be donned after handling of any non-dedicated sampling equipment; contact with contaminated surfaces; and whenever judged necessary by field personnel. **When in doubt change your gloves.**

Waterproof field books must not be used for field notes. Instead, field notes should be on loose paper on Masonite, plastic, or aluminum clip boards. Other requirements for field notes include:

- Keep field notes, writing implements, and electronic data collection tablets away from samples and sampling materials; and
- Do not write on sampling bottles unless they are closed.

Tables 1 and **2** in **Attachment 1** provides recommendations for PFAS Site Inspection equipment. **Table 1** provides a summary of materials that have been approved for site inspection; this list is expected to grow longer as industry experience increases. **Table 2** provides a summary of field equipment and materials that have available testing information and/or industry knowledge regarding PFAS cross-contamination potential and it is recommended that these materials be prohibited for sample collection. For materials that are suspected of containing PFASs and/or retaining PFASs, these recommendations are considered preliminary and subject to change.

Given the extremely low detection limits associated with PFAS analysis and the many potential sources of trace levels of PFASs, field personnel are typically advised to err on the side of caution by strictly following field wear guidelines and decontamination procedures as specified in the Poly- and Perfluorinated Alkyl Substances (PFAS) Field Sampling Guidance (Arcadis 2018a).**The most important consideration during PFAS-related sampling is to prevent contact between sample media and suspect PFAS sources.**

5.3 PFAS-Specific Sediment Sampling

Because of the potential presence of PFASs in equipment typically used to collect samples, consideration for other sampling materials that contact sediment through the sampling process is necessary. Each piece of equipment that comes into direct contact with the sediment needs to be evaluated to determine if there are either PFAS-containing materials present, which could be a source of cross-contamination and cause false positives, or if PFASs adhere to the material, which has the potential to cause low bias sample results. For each additional piece of equipment that may introduce contamination, an equipment blank should be collected to confirm that materials in the sample equipment do not cause false positives by introducing PFASs. Equipment blanks are particularly important for any device/component where PFASs may be present or cannot be verified as being a non-PFAS containing material. Other quality assurance methods may be implemented to avoid materials that could result in potential losses associated with PFASs adhering to surfaces.

The following additional notes are provided regarding sediment sampling materials:

- Lexan™ liner sleeves are made of polycarbonate and they are not expected to contain PFASs based on review of the Safety Data Sheet (Sabic 2016).
- Studies evaluating the use of stainless steel indicate that PFASs do not strongly sorb to stainless-steel (Obal et al. 2012). Therefore, stainless-steel sleeves and equipment should be acceptable for collection of sediment samples for PFAS analysis.

5.4 PFAS-Specific Surface Water and Stormwater Sampling

As described for sediment sampling, the potential presence of PFASs in equipment that may come in contact with the target water sample must be evaluated as part of the sample planning process to maintain sample integrity.

Note that if high concentrations of PFASs related to Class B firefighting foams are expected in a surface water sample, it has been recommended to collect and shake a small portion of the sample at the time of sample collection (USACE 2016; Arcadis 2018a). If foaming is noted within the sample, it indicates elevated concentrations of PFASs may be present and the sample should be proactively diluted at the laboratory prior to analysis. The foaming should be noted on the sample COC form. It is recommended to collect sampling equipment blanks following foam observation to confirm the effectiveness of decontamination procedures.

While permissible during fog or intermittent showers, surface water samples should not be collected during steady, prolonged rainfall. Avoid entraining sediment in surface water samples. If accessing the sample location from water, approach slowly from downstream to avoid disturbing the bottom.

6 HEALTH AND SAFETY CONSIDERATIONS

Field activities associated with sediment, surface water, and stormwater sampling and description will be performed in accordance with a site-specific SSHP, a copy of which will be present on site during such activities. Additional health and safety discussions are specifically discussed below.

6.1 Sediment Sampling

- Walk established paths whenever possible to avoid slip/trip hazards. Take your time and watch your footing.
- A PFD may be required to complete sediment sampling. Review the Arcadis Water Operations Health and Safety Standard and the SSHP to determine if a PFD is required.
- To the extent possible, maintain three points of physical contact (i.e., two feet and one hand, or one foot and two hands) when entering and exiting a stream channel.
- Ensure the state One Call has been completed and the Arcadis Utilities and Structures Checklist is completed before sampling.
- Take breaks as needed to avoid repetitive use injury or muscle strain and take turns with co-workers as needed.
- Do not touch sediments with bare hands or detect odors by placing sediments close to your nose.
- STOP WORK when conditions change or become unsafe and discuss if/how to proceed safely before resuming work.
- If boats are required for sampling, the following considerations should be made:
  - Good housekeeping and three-points of physical contact should be maintained when entering/exiting the boat to prevent falls or trips
  - Boat operator will be properly trained
  - To avoid impact with other water traffic, ensure navigational lighting is functional (if applicable). Be vigilant and maintain situational awareness of other water traffic.

6.2 Surface Water Sampling

- A PFD may be required to complete surface water sampling. Review the Arcadis Water Operations Health and Safety Standard and the SSHP to determine if a PFD is required.
- Always have three points of contact when entering and exiting a stream channel, if necessary.
- If boats are required for sampling, the following considerations should be made:
    - Good housekeeping and three-points of physical contact should be maintained when entering/exiting the boat to prevent falls or trips
    - Boat operator will be properly trained
    - To avoid impact with other water traffic, ensure navigational lighting is functional (if applicable). Be vigilant and maintain situational awareness of other water traffic.

6.3 Stormwater Sampling

- The ability to safely access the stormwater sampling vaults or manholes should be verified prior to sampling. Confined space entry is not allowed.

7 PROCEDURE

7.1 Sediment Sampling

Sediment samples will be collected by one of the following methods considered most appropriate for the site conditions.

- Hand-held scoop or trowel – for shallow water depths (e.g., < 2 feet) that are nearshore and that sediment conditions preclude sampling by push core or grab sampler
- Push core – for sampling in deeper water (e.g., > 2 feet) or offshore
- Petite Ponar Grab Sampler – for sampling in deeper water offshore with coarse sediment or hard bottom.

Sampling Mobilization/Prep

- Don personal protective equipment (PPE) as discussed in Section 5.2 and the Poly- and Perfluorinated Alkyl Substances (PFAS) Field Sampling Guidance (Arcadis 2018a).
- Mobilize to sampling location.
    - If accessing by wading, approach slowly from a downstream direction to limit disturbance of the bottom and resulting suspension of sediment into the surface water at sampling location.
    - If accessing by boat, maneuver to the target sample location using GPS and secure the vessel in place.
- Identify the proposed sample location in the field notebook along with other appropriate information (e.g., location, date, time, personnel, weather).

- Verify all dedicated sample gear has been properly decontaminated as discussed in Section 10.
- Measure and record water depth at the sampling location.

Sample Collection by Stainless Steel Scoop or Trowel

- Attach stainless steel scoop, bent spoon, or trowel to a stainless-steel extension rod (if needed) and lower vertically downward through the water column until it reaches the bottom. Collect sediment from the top 2 inches (5 centimeters [cm]) of the bottom surface.
- Retrieve the scoop, bent spoon, or trowel. Slowly decant overlying water and take care to prevent fine sediment from being poured out with the water. Inspect recovered sediment to confirm it does not contain vegetation (e.g., grass, leaves, sticks or similar undecomposed organic material). Use the stainless-steel trowel to remove any vegetation prior to filling sample bottles. If the sample contains too much vegetation to be removed effectively, collect another sediment sample from the bottom.
- Place the sediment in a decontaminated stainless-steel bowl.
- Photograph the grab sample to provide reference for post-processing questions regarding descriptions of color/staining, general texture, recovery, and other characteristics. Photos of the sample will include the grab sample ID, date, and time, written on loose paper with a Sharpie® marker. The photo will also include a view of a tape measure for scale.
- Describe lithology of recovered sediment in accordance with Arcadis TGI for Soil Descriptions (Arcadis 2018b).
- Homogenize the sediment with a stainless-steel mixing spoon until the sediment is of uniform color.
- Collect sediment samples. If additional sediment is needed to fill the bottles, collect additional sample volume approximately 1-2 feet upstream from the first to minimize disturbance.
- Measure surface water pH, conductivity, temperature, and turbidity at the sampling location and record on sampling forms.
    - Use YSI 6-Series Multi-Parameter Instrument water quality meter with flow-through cell for monitoring temperature, conductivity, ORP, and DO.
    - Use the supplemental turbidity meter to measure turbidity.

Sample Collection by Push Core

- Lower section of clean Lexan™ tube (at least as long as the target sediment penetration depth plus the water depth) until it contacts the top of the sediment.
- Push Lexan™ tube with a straight vertical entry into the sediment to a depth of approximately 4 inches (10 cm) below the sediment surface. If necessary, drive the tube a few more inches down into the sediment either by hand or using a steel core driver to obtain a plug at the bottom of the core

that will prevent the sediment from falling out during core retrieval. Note that only the top 2 inches (5 cm) of soil will be used for laboratory sampling.

- Place a cap made of PFAS-free materials (e.g., HDPE, silicon) on the top of the sediment tube and slowly pull the tube from the sediment, twisting it slightly as it is removed (if necessary)
- Before the tube is fully removed from the water, place a PFAS-free cap on the bottom end of the tube while it is still submerged. Ensure that the bottom end cap fits tightly and will not inadvertently slip off. Remove the tube from the water.
- Keeping the tube upright, wipe the bottom end dry and double check that the bottom cap is tight. If necessary (e.g., walking away from the sampling area to a more secure area to fill sample jars), keep one hand beneath the bottom cap to prevent the cap from falling off. Measure the length of sediment recovered and evaluate the integrity of the core.
- While keeping the core upright, use a hacksaw to make a horizontal cut in the tube approximately 2 - 3 inches above the sediment and carefully drain water from the core to prepare it for inspection and sampling.
    - Note: If possible, use a section of Lexan ™ tubing short enough to allow for sampling without cutting the core. This is only possible in shallow water conditions, as the Lexan ™ tubing should be at least long enough to keep the top of the tube above water.
- Slowly decant overlying water and take care to prevent fine sediment from being poured out with the water. Inspect recovered sediment to confirm it does not contain vegetation (e.g., grass, leaves, sticks or similar undecomposed organic material). Use the stainless-steel trowel to remove any vegetation prior to filling sample bottles. If the sample contains too much vegetation to be removed effectively, collect another sediment sample from the bottom.
- Using a stainless-steel bent spoon, scoop, or trowel, place the top 2 inches (5 cm) of sediment in a decontaminated stainless-steel bowl.
- Photograph the grab sample to provide reference for post-processing questions regarding descriptions of color/staining, general texture, recovery, and other characteristics. Photos of the sample will include the grab sample ID, date, and time written on loose paper with a Sharpie® marker. The photo will also include a view of a tape measure for scale.
- Describe the lithology of recovered sediment in accordance with Arcadis TGI for Soil Descriptions (Arcadis 2018b).
- Homogenize the sediment with a stainless-steel mixing spoon until the sediment is of uniform color.
- Collect sediment samples. If additional sediment is needed to fill the bottles, collect additional sample volume approximately 1-2 feet upstream from the first to minimize disturbance
- Measure surface water pH, conductivity, temperature, and turbidity at the sampling location and record on sampling forms.
    - Use YSI 6-Series Multi-Parameter Instrument water quality meter with flow-through cell for monitoring temperature, conductivity, ORP, and DO.

  - Use supplemental turbidity meter to measure turbidity.

Sample Collection by Petite Ponar Grab Sampler

- Use polypropylene twine/rope with the dredge or similar PFAS-free approved material.
- Set the stainless-steel Petite Ponar grab sampler dredge and slowly lower the open dredge from the side of the boat until it is just above the top of the sediment surface. Then drop the open dredge into the sediment.
- Once the dredge has been allowed to settle into the bottom sediment, pull hard on the rope, or send the messenger to trigger the dredge and close the sediment inside.
- Retrieve the dredge onto the boat.
- Inspect the sample for acceptability in accordance with the following criteria:
  - Sampler is not overfilled with sample such that the sediment surface presses against the top of the sampler or is extruding through the top of the sampler.
  - Overlying water is present above the sediment (indicates minimal leakage)
  - At least 4 inches (10 cm) of sediment penetration depth has been achieved.
- Tilt the dredge over slightly to drain the overlying water to prepare the sediment for inspection and sampling, being careful not to disturb the recovered sediment. Also take care to prevent fine sediment from being poured out with the water.
- Inspect recovered sediment to confirm it does not contain vegetation (e.g., grass, leaves, sticks or similar undecomposed organic material). Use the stainless-steel trowel to remove any vegetation prior to filling sample bottles if possible to do so with minimum disturbance of the recovered sediment. If the sample contains too much vegetation to be removed effectively without disturbing sediment, collect another sediment sample from the bottom.
- Using a stainless-steel bent spoon, scoop, or trowel, place the top 2 inches (5 cm) of sediment in a decontaminated stainless-steel bowl.
- Photograph the grab sample to provide reference for post-processing questions regarding descriptions of color/staining, general texture, recovery, and other characteristics. Photos of the sample will include the grab sample ID, date, and time written on loose paper with a Sharpie® marker. The photo will also include a view of a tape measure for scale.
- Describe the lithology of recovered sediment in accordance with Arcadis TGI for Soil Descriptions (Arcadis 2018b).
- Homogenize the sediment with a stainless-steel mixing spoon until the sediment is of uniform color.
- If additional sediment volume is needed to fill sample bottles, redeploy the dredge 1 – 2 feet upstream from the previous sampling location.

- Measure surface water pH, conductivity, temperature, and turbidity at the sampling location and record on sampling forms.
    - Use YSI 6-Series Multi-Parameter Instrument water quality meter with flow-through cell for monitoring temperature, conductivity, ORP, and DO.
    - Use supplemental turbidity meter to measure turbidity.

Laboratory Sample Collection/Management, Post-Sampling

- Fill the sample bottle for PFAS analysis first, then fill bottles for any remaining analyses.
- Don clean nitrile gloves and use a stainless-steel trowel to fill clean labeled bottles supplied by the laboratory for the required analyses with sediment. Collect lab samples from the top 5 cm of the recovered 10 cm interval only. Do not overfill bottles.
- Make sure caps remain on PFAS sample bottles until immediately prior to filling. Caps must remain in the hand of the sampler until replaced on the bottle.
- Once the PFAS sample has been placed in the bottle, and the bottle cap has been completely tightened, label the sample with sample identification number, date, and time of collection. Labels must be completed only after the caps have been placed back on each bottle. (See P-01 QP#3.06 Field Activities documentation for sample label information).
- Collect QC samples at the frequency specified in Quality Assurance Project Plan (QAPP) Addendum Worksheet #20. QC sample locations are to be selected based on consultation with the Arcadis Regional Lead (RL). **Note, if using waders to access sampling locations, collect equipment blank off of the waders.**
- Record the label information and time of sampling in the field notes and sampling forms.
- Fill out the laboratory COC and check against the labels on the sample bottles progressively after each sample is collected.
- Place the sample bottles in a sealed Ziploc© bag, and then into sample coolers. Store PFAS samples in separate cooler from other samples.

7.2 Surface Water Sampling

Sampling Mobilization/Prep

- Don PPE as discussed in Section 5.2 and the Poly- and Perfluorinated Alkyl Substances (PFAS) Field Sampling Guidance (Arcadis 2018a).
- Mobilize to sampling location.
    - If accessing by wading, approach slowly from downstream direction to limit disturbance of bottom and resulting suspension of sediment into the surface water at the sampling location.

  - If accessing by boat, maneuver to the target sample location using GPS and secure the vessel in place.

- Identify the proposed sample location in the field notebook along with other appropriate information (e.g., location, date, time, personnel, weather).
- Verify all dedicated sample gear has been properly decontaminated as discussed in Section 10.
- Measure and record water depth at the sampling location.
- Do not sample surface water when it is raining. Fog or intermittent showers are okay, but not steady rainfall. Avoid entraining sediment in surface water samples.

Shallow Surface Water (0.5 – 1 feet)

- Cut a length of new HDPE tubing to the appropriate size for desired sampling depth and pump location and attach to stainless steel rod using HDPE zip ties. Insert a new length of silicon tubing into the peristaltic pump and connect HDPE tubing on intake side and a shorter length of new HDPE tubing on discharge side.
- Direct pump discharge into pail/bucket during sampling.
- Lower the HPDE tubing on intake side of pump to the desired depth in the water column. For water depths < 2 ft, place tubing intake at approximately mid-depth of the water column.
- Do not collect samples from the water surface. Do not disturb sediment at bottom of water body with sampling equipment, as this could cause suspension of sediment into the surface water that could introduce cross contamination into the sample.
- Verify pump flow direction and turn on pump.
- Once water fills the tubing and begins flowing out of the discharge end turn off pump and prepare to sample.
- Don fresh set of nitrile gloves. Disconnect HDPE tubing from silicon tubing on discharge end. Keep silicon tubing in clean gloved hand and do not allow it to contact any surfaces or equipment. Turn on pump and fill sample bottle to the neck directly from silicon tubing, headspace is acceptable. Do not rinse PFAS sample bottles during sampling.
- Only use labelled HDPE bottles that are supplied by the laboratory. Make sure the cap remains on the bottle until immediately prior to sample collection and gets placed back on the bottle immediately after sample collection. Do not place the cap on any surface, and keep cap in gloved hand opposite of sample collection, do not touch the inside of the cap.
- Measure surface water pH, conductivity, temperature, and turbidity at the sampling location and record on the sampling forms.
  - Use YSI 6-Series Multi-Parameter Instrument water quality meter with flow-through cell for monitoring temperature, conductivity, ORP, and DO.
  - Use supplemental turbidity meter to measure turbidity.

Deeper Surface Water (>1 feet)

- Don fresh set of nitrile gloves immediately prior to collecting samples. Use nitrile glove with long cuff that covers the forearm, as this will help avoid submerging clothing or skin during sampling.
- Only use labelled HDPE bottles that are supplied by the laboratory. Do not rinse PFAS sample bottles prior to collecting sample. Do not remove cap prior to or after sample collection. Do not place the cap on any surface, and keep cap in gloved hand opposite of sample collection, do not touch the inside of the cap.
- Facing the upstream direction (if the surface water body is flowing), place sample container in freshly gloved hand and gently submerge the sample container beneath the water surface with the cap on.
- Tilt the container so the mouth is angled slightly upward, then with the other gloved hand gently unscrew the cap, open it a crack and allow water to flow slowly down the inner wall of the container filling it.
- Do not submerge hands below top of gloves during sampling such that clothing or bare skin of sampling personnel comes into contact with the surface water.
- When the sample container is full, replace and tighten the cap while the container is still submerged, then remove it from the water.
- Measure surface water pH, conductivity, temperature, and turbidity at sampling location and record on sampling forms.
    - Use YSI 6-Series Multi-Parameter Instrument water quality meter with flow-through cell for monitoring temperature, conductivity, ORP, and DO.
    - Use supplemental turbidity meter to measure turbidity.

Laboratory Sample Management, Post-Sampling

- Once the PFAS sample has been placed in the bottle, and the bottle cap has been completely tightened, label the sample with sample identification number, date, and time of collection. Labels must be completed only after the caps have been placed back on each bottle. (See P-01 QP#3.06 Field Activities documentation for sample label information).
- Collect QC samples at the frequency specified in the QAPP Addendum Worksheet #20. QC sample locations are to be selected based on consultation with the Arcadis RL. **Note, if using waders to access sampling locations, collect equipment blank off of the waders.**
- Record the label information and time of sampling in the field notes and sampling forms.
- Fill out the laboratory COC and check against the labels on the sample bottles progressively after each sample is collected.
- Place sample bottles in a sealed Ziploc® bag, and then into sample coolers. Store PFAS samples in separate cooler from other samples.

7.3 Stormwater Sampling

The following general guidelines apply when sampling stormwater.

- Sampling should be started from the manhole farthest downstream and work upstream. This mitigates the impact of subsequent samples if anything on the bottom is disturbed and migrates downstream.
- Care should be taken not to disturb the bottom sediments in catch basin sumps or other storm water sampling locations.
- Stormwater samples should only be collected from active flow. Stormwater will not be collected from pools or standing water.

Use the following procedure to collect grab stormwater samples.

- Verify all dedicated sample gear has been properly decontaminated as discussed in Section 10.
- Mobilize to stormwater sampling location.
- Confirm that active flow is entering the sampling space.
- Measure the depths from the top of the manhole to the top of the stormwater surface and to the bottom of the stormwater system with a tape measure (do this downstream from the spot where the sample will be collected).
- Subtract the depth of the water surface from the depth of the stormwater system. This is the thickness of the stormwater column. Divide the thickness by two. Add the result to the depth of the stormwater surface. This is the sampling depth.
- Strap the HDPE sampling tubing to the Lexan ™ pipe using the HDPE zip ties.
- Place a HDPE zip tie on the Lexan ™ pipe that marks the sampling depth, as measured above. This HDPE zip tie will be used as a marker to guide how far to insert the pipe and tubing into the manhole. The HDPE zip tie marker will prevent over inserting the Lexan ™ pipe and tubing and thus prevent disturbing the deposited sediment in the stormwater system.
- Attach the other end of the tubing (the end that will not be placed into the stormwater for sampling) to the peristaltic pump.
- Collect active flow sample.
    - Slowly lower the Lexan ™ pipe and tubing into the stormwater system to the sample collection depth, using the marker HDPE zip tie as a guide.
- Verify pump flow direction and turn on pump.
- Once water fills the tubing and begins flowing out of the discharge end turn off pump and prepare to sample.
- Don fresh set of nitrile gloves. Disconnect HDPE tubing from silicon tubing on discharge end. Keep silicon tubing in clean gloved hand and do not allow it to contact any surfaces or equipment. Turn on pump and fill sample bottle to the neck directly from silicon tubing, headspace is acceptable. Do not rinse PFAS sample bottles during sampling.

- Only use labelled HDPE bottles that are supplied by laboratory. Make sure that the cap remains on the bottle until immediately prior to sample collection and gets placed back on the bottle immediately after sample collection. Do not place the cap on any surface, and keep cap in gloved hand opposite of sample collection, do not touch the inside of the cap.
- Measure surface water pH, conductivity, temperature, and turbidity at the sampling location and record on sampling forms.
    - Use YSI 6-Series Multi-Parameter Instrument water quality meter with flow-through cell for monitoring temperature, conductivity, ORP, and DO.

Use supplemental turbidity meter to measure turbidity.

Laboratory Sample Management, Post-Sampling

- Once the PFAS sample has been placed in the bottle, and the bottle cap has been completely tightened, label the sample with sample identification number, date, and time of collection. Labels must be completed only after the caps have been placed back on each bottle. (See P-01 QP#3.06 Field Activities documentation for sample label information).
- Collect QC samples at the frequency specified in the QAPP Addendum Worksheet #20. QC sample locations are to be selected based on consultation with the Arcadis RL. **Note, if using waders to access sampling locations, collect equipment blank off of the waders.**
- Record the label information and time of sampling in the field notes and sampling forms.
- Fill out the laboratory COC and check against the labels on the sample bottles progressively after each sample is collected.
- Place sample bottles in a sealed Ziploc® bag, and then into sample coolers. Store PFAS samples in separate cooler from other samples.

8 WASTE MANAGEMENT

Investigation-derived waste (IDW) including excess sediment, surface water, stormwater and decontamination fluids will be collected and placed in Department of Transportation approved containers, segregated by waste streams: see the Investigation-Derived Waste Handling and Storage TGI for details (Arcadis 2017c). All containers will be labeled as non-hazardous unless otherwise instructed by the Project Manager. Containerized IDW will be stored on site until it is profiled and subsequently transported to an approved facility for disposal or recycling. Waste manifests for all IDW suspected to have come into contact with PFAS should clearly note the presence of PFAS. Additional IDW sampling and management details will be provided in the site-specific QAPP Addendum and will be consistent with applicable Army policies and Army post requirements. Personal protective equipment (e.g., gloves, disposable clothing, disposable equipment) resulting from personnel cleaning procedures and soil sampling activities will be placed in plastic bags. These bags will be transferred into appropriately labeled waste containers for appropriate disposal.

9 DATA RECORDING AND MANAGEMENT

The supervising field lead will be responsible for documenting sampling events to record all relevant information in a clear and concise format. The record of sampling events should include:

- Sample dates
- Project name and location
- Project number, client, and site location
- Sampling details (e.g., field measured water quality parameters, standing water column depth)
- Sediment core log
- Type of tools used
- Weather conditions

Field staff should ensure COC Forms are properly completed, and verify which PFAS analytes (e.g., just PFOS and PFOA, some or all of the 537 list) are required for analysis and note on the COC.

10 DECONTAMINATION

To avoid cross-contamination during sampling, all reusable sampling equipment will be cleaned between sampling locations as follows. Repeat these steps twice at all locations suspected of containing a Class B firefighting foam source.

Sediment Sampling

With Organic Solvent Rinse (Preferred Method)

- Don new pair of nitrile gloves prior to decontamination
- Scrub using a plastic brush and non-phosphate soap (Liquinox® or Alconox® only)
- Double-rinse in deionized or distilled water
- Rinse once with methanol or isopropyl alcohol
- Rinse once with PFAS-free water
- Collect all rinsate in a sealed pail for disposal
- Allow time to air dry prior to re-use

Without Organic Solvent Rinse (Contingency Method)

- Don new pair of nitrile gloves prior to decontamination
- Scrub using a plastic brush and non-phosphate soap (Liquinox® or Alconox® only);
- Single-rinse in deionized or distilled water;
- Scrub using a plastic brush and non-phosphate soap (Liquinox® or Alconox® only);
- Double-rinse in deionized or distilled water and single-rinse with PFAS-free water;
- Collect all rinsate in a sealed pail for disposal;
- Allow time to air dry prior to re-use.

Surface Water/Stormwater Sampling

- Don new pair of nitrile gloves prior to decontamination
- Scrub using a plastic brush and non-phosphate soap (Liquinox® or Alconox® only);
- Double-rinse in deionized or distilled water;
- Collect all rinsate in a sealed pail for disposal;
- Allow time to air dry prior to re-use.

See additional specifics in P-04, TGI - Groundwater and Soil Sampling Equipment Decontamination in PQAPP Appendix A.

11 QUALITY ASSURANCE

In general, the following quality assurance and quality control (QA/QC) samples should be collected:

- Equipment blanks
- Field (i.e., reagent) blanks
- Field duplicates
- Matrix spike/matrix spike duplicate

Details on QC sampling requirements (e.g., frequency of collection, types of QA/QC samples) are provided in the PQAPP and will be outlined in various Site-specific sampling scopes of work in the QAPP Addendum. Additionally, detailed procedures related to equipment and field (i.e., reagent) blank sample collection are outlined in the Equipment and Reagent Blank Sample Collection TGI (Arcadis 2018c).

Refer to QC requirements for the project to ensure that appropriate QA/QC samples are collected. When collecting QA/QC samples, the same guidelines apply as when collecting regular samples – specifically that:

- Samples should be collected in laboratory-supplied HDPE bottles
- Bottle caps must remain in the hand of the sampler until replaced on the bottle
- Labels must be completed after the caps have been placed back on each bottle
- Samples must be stored in appropriate transport containers (coolers) with ice (Ziploc®-type bags for use as ice containers) with appropriate labeling. **Do not use blue ice. Store PFAS samples in a separate cooler from other types of samples.**

12 REFERENCES

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Arcadis. 2018b. TGI – Soil Description. Rev. #2. February 16.

Arcadis. 2018c. TGI – Equipment and Reagent Blank Sample Collection for PFAS. Rev. #0. October 2.

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Arcadis. 2017c. TGI – Investigation-Derived Waste Handling and Storage, Rev. #0. February 23.

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Sabic. 2016. Article Safety Data Sheet for Generic SFS-PC Lexan™ Film/Sheet. Revised May 12.

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ATTACHMENT 1

Table 1 and Table 2: PFAS Inspection Material Recommendations

Table 1: Summary of Acceptable Sampling Equipment and Materials for PFAS Site Inspections

Sampling Materials	Additional Considerations	References
Water Sampling Materials		
High density polyethylene (HDPE) or silicone tubing materials	--	DER 2016; USACE 2016; NHDES 2016; MassDEP 2017
HDPE HydraSleeves$^{\text{TM}}$	Low density polyethylene (LDPE) HydraSleeves$^{\text{TM}}$ are not recommended	USACE 2016; MassDEP 2017
Drilling and Soil Sampling Materials		
PFAS-free drilling fluids	--	DER 2016
PFAS-free makeup water	Confirm PFAS-free water source via laboratory analysis prior to inspections	--
Acetate liners	For use in soil sampling	USACE 2016
Sample Containers and Storage		
HDPE sample containers with HDPE lined lids for soil and water samples	Laboratory should provide; whole bottle analysis of aqueous samples combined with a solvent rinse of bottle is recommended	DER 2016, MassDEP 2017
Ice contained in plastic (polyethylene) bags (double bagged)	--	DER 2016; USACE 2016; NHDES 2016; MassDEP 2017
Field Documentation		
Sharpie®	--	NHDES 2016; USACE 2016; MassDEP 2017
Ball point pens	--	MassDEP 2017
Standard paper and paper labels	--	DER 2016; USACE 2016; NHDES 2016; MassDEP 2017
Decontamination		
Water-only decontamination	Confirm PFAS-free water source via laboratory analysis prior to inspections	DER 2016
Alconox®, Liquinox® or Citranox® followed by deionized water or PFAS-free water rinse	Alconox® known to contain trace levels of 1,4-dioxane	NHDES 2016; USACE 2016; MassDEP 2017
Methanol, isopropanol, or acetone	Special health and safety precautions are necessary	UNEP 2015; USACE 2016

Note: This list is considered preliminary and additional materials may be added as additional information becomes available. Project teams are expected to follow a methodical evaluation process of materials to be used and confirm acceptance prior to implementation of field activities.

Table 2: Summary of Equipment and Materials Not Recommended for PFAS Site Inspections

Sampling Materials	Known PFAS-Containing Materials	Suspected PFAS-Containing Materials	Materials with Potential to Retain PFASs	References
Water Sampling Materials				
Teflon® or polytetrafluoroethylene (PTFE)-containing or coated field equipment (e.g., tubing, bailers, tape, plumbing paste)	x			DER 2016; USACE 2016; NHDES 2016; MassDEP 2017
Passive diffusion bags			x	MassDEP 2017
LDPE HydraSleeves ™			x	USACE 2016; MassDEP 2017
Water particle filters			x	MassDEP 2017
Drilling and Soil Sampling Materials				
Aluminum foil			x	DER 2016; USACE 2016; NHDES 2016; MassDEP 2017
Drilling fluid containing PFASs	x	x		DER 2016
Sample Containers and Storage				
Glass sample containers with lined lids			x	DER 2016; USACE 2016; NHDES 2016; MassDEP 2017
LDPE containers and lined lids			x	USACE 2016
Teflon® or PTFE- lined lids on containers (e.g., sample containers, rinsate water storage containers)	x			DER 2016; USACE 2016; NHDES 2016; MassDEP 2017
Reusable chemical or gel ice packs (e.g., BlueIce®)		x		DER 2016; USACE 2016; NHDES 2016; MassDEP 2017
Field Documentation				
Self-sticking notes and similar office products (e.g., 3M Post-it®-notes)		x		DER 2016; USACE 2016; NHDES 2016; MassDEP 2017
Waterproof paper, notebooks, and labels	x			DER 2016, MassDEP 2017
Non-Sharpie® markers		x		NHDES 2016
Decontamination				
Some detergents and decontamination solutions (e.g., Decon 90® Decontamination Solution)	x	x		DER 2016; NHDES 2016; MassDEP 2017

Note: For materials that are suspected of containing PFASs, or have the potential to retain PFASs, project specific considerations may provide adequate justification for use during the field event. For example, further evaluation may be conducted in the form of pre-field equipment blank sample analysis.

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APPENDIX B

Site Safety and Health Plan

DRAFT

March 2023

DRAFT SITE SAFETY AND HEALTH PLAN

Yakima Training Center

Yakima, Washington

Joint Base Lewis-McChord Public Works – Environmental Division

IMLM-PWE

MS 17 Box 339500
Joint Base Lewis-McChord, Washington 98433

CONTENTS

TABLES (IN-TEXT)

FIGURES

ATTACHMENTS

ACRONYMS AND ABBREVIATIONS

ºC	degrees Celsius
ºF	degrees Fahrenheit
%	percent
ACGIH	American Conference of Governmental Industrial Hygienists
AFFF	aqueous film forming foam
AHA	activity hazard analysis
ANSI	American National Standards Institute
AOI	area of interest
Arcadis	Arcadis U.S., Inc.
BBP	bloodborne pathogen
C	ceiling
CAS	Chemical Abstract Service
CDC	Centers for Disease Control and Prevention
COVID-19	corona virus disease 2019
CPR	cardiopulmonary resuscitation
DEET	n,n-diethyl-m-toluamide
DOT	Department of Transportation
eV	electron volt
FP	flash point
HazMat	hazardous material
HAZWOPER	Hazardous Waste Operations and Emergency Response
installation	United States Army and Reserve installation
IP	ionization potential
LEL	lower explosive limit
MEC	munitions and explosives of concern
mg/m^3	milligrams per cubic meter
mmHg	millimeter of mercury
NA	not available
NE	not established

ng/L	nanogram per liter
NIOSH	National Institute of Occupational Safety and Health
OSHA	Occupational Safety and Health Administration
PA	preliminary assessment
PEL	permissible exposure limit
PFAS	per- and polyfluoroalkyl substances
PFBS	perfluorobutane sulfonate
PFOA	perfluorooctanoic acid
PFOS	perfluorooctane sulfonate
PM	Project Manager
PPE	personal protective equipment
ppm	parts per million
RD	relative density
RI	remedial investigation
RVD	relative vapor density
SDS	safety data sheet
SHM	Safety and Health Manager
SI	site inspection
SSHO	Site Safety and Health Officer
SSHP	Site Safety and Health Plan
STEL	short-term exposure limit
SVOC	semivolatile organic compound
TLV	threshold limit value
TM	Task Manager
TPH	total petroleum hydrocarbon
TWA	time weighted average
UEL	upper explosive limit
USEPA	U.S. Environmental Protection Agency
VOC	volatile organic compound
UXO	unexploded ordnance
VP	vapor pressure

WBGT	wet bulb globe temperature
YTC	Yakima Training Center

Yakima Training Center

Site Safety and Health Plan

Remedial Investigation

Yakima, Yakima County, Washington

Contract Number: W9124J18D0004, Delivery Order Number W9124J22F0144

Plan preparer (Competent Person in Health and Safety) and plan reviser:

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Plan approved, by company/corporate officer authorized to obligate the company's Corporate Industrial Hygienist. This Site Safety and Health Plan was prepared under the supervision of and has been reviewed and approved by a Certified Industrial Hygienist certified by the American Board of Industrial Hygiene. Demonstration of competency is included in **Attachment 6**.

Grey Coppi, Certified Industrial Hygienist
Designated Health and Safety Plan Reviewer/ Safety and Health Manager
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Plan concurrence (Project Manager)

Jesse Hemmen
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1 SITE DESCRIPTION AND CONTAMINATION CHARACTERIZATION

This Site Safety and Health Plan (SSHP) was prepared to address the potential health and safety hazards associated with the remedial investigation (RI) activities at Yakima Training Center (YTC), Washington (**Figure 1**).

The scope of work covered in this investigation includes the installation of groundwater monitoring wells, borehole and surface transect geophysics activities, and sampling of soil, groundwater, sediment, and surface water throughout the scope of the RI. These activities will be performed within the YTC installation boundaries to address delineation of per- and polyfluoroalkyl substances (PFAS) at YTC associated with areas of interest (AOIs) previously identified in the Preliminary Assessment/Site Inspection (PA/SI). The locations of the AOIs and associated investigation activities are shown in the work plan for the field event.

1.1 Site Description

YTC is a satellite installation of Joint Base Lewis-McChord and is located approximately 100 miles east of Joint Base Lewis-McChord and about 5 miles northeast of the city of Yakima. It encompasses 327,231 acres within Yakima and Kittitas Counties in central Washington state. The eastern border of the facility is the Columbia River. The YTC population is predominantly transient soldiers performing maneuvers with a few permanent adult residents and on-site workers and no children. Less than 500 military personnel and civilians are permanently stationed at YTC, including active-duty service members, the Washington National Guard, the Army Reserves, and Marine Reserves members. Transient units can swell the YTC population into the thousands for short periods.

The Pomona well (potable water supply well) was sampled for 23 PFAS (including perfluorooctane sulfonate [PFOS] and perfluorooctanoic acid [PFOA]) in April 2016. PFAS were detected at low concentrations (less than 10 nanograms per liter [ng/L] combined, and less than the U.S. Environmental Protection Agency (USEPA) lifetime health advisory); however, the laboratory utilized experienced severe quality control issues, and the data is considered unreliable. Follow-up sampling was conducted in October 2016 at six drinking water and potable water supply wells: the Pomona, Bowers, Jordan, Multipurpose Range Complex, Badger Gap, and Yakima Research Station wells. The samples collected were analyzed for six PFAS; results were non-detect at all six wells for all six constituents analyzed, including PFOS, PFOA, and perfluorobutane sulfonate (PFBS). In August 2019, 11 of the potable wells on-post were sampled for 14 PFAS; all results were non-detect except at the Selah Airstrip well, where at the water stand detections included PFOS (4.2 ng/L), PFOA (96 ng/L), and PFBS (11 ng/L).

Concentrations of PFOA at the Selah Airstrip are greater than the United States Environmental Protection Agency’s lifetime health advisory and Office of the Secretary of Defense risk screening levels. Follow-up samples were collected at the Selah Airstrip Well House in November 2019 with similar results.

Three AOIs were identified for further investigation at YTC following the PA/SI: YFCR-53 – Former Fire Training Pit, Building 868-Bird Bath Wash Rack/Former Fire Training Pit Area, and Building 323 – Refractometer AFFF Solutions Testing Area. Seven additional potential areas of PFAS releases were investigated but were not ultimately identified as PFAS sources. Site-specific drinking-water pathway conceptual site models were developed for each of the three AOIs based on an assessment of existing records, personnel interviews, and site reconnaissance trips. The drinking water pathway conceptual site model for the AOIs did not identify impacts or potential impacts to on-post drinking water receptors. However, the exposure pathway for off-post drinking water receptors was determined to be potentially complete for the three AOIs.

1.2 Contamination Characterization

The hazards associated with YTC are PFAS primarily related to the release of aqueous film-forming foam. A PFAS Fact Sheet is included in **Attachment 1**. PFOS, PFOA, and PFBS are three of the most common PFAS. Based on historical site uses and previous investigation results associated with the YFRC-53 - Former Fire Training Pit, total petroleum hydrocarbons (TPH), volatile organic compounds (VOCs), and polycyclic aromatic hydrocarbons contamination could also be encountered during RI activities. These potential constituents of concern are presented in **Table 1.**

Table 1. Site Constituents of Concern

COMPOUND	CAS#	OSHA PEL	ACGIH TLV	ROUTE OF EXPOSURE	SYMPTOMS OF EXPOSURE	TARGET ORGANS	PHYSICAL DATA
VOCs (PEL and TLV units – ppm)							
Benzene	71-43-2	1 TWA	0.5 TWA 2.5 STEL	Inhalation Skin Absorption Ingestion Skin and/or Eye Contact	**Effects of short-term exposure**: The substance is irritating to the eyes, skin, and respiratory tract. If this liquid is swallowed, aspiration into the lungs may result in chemical pneumonitis. The substance may cause effects on the central nervous system. This may result in lowering of consciousness. Exposure could cause unconsciousness and death. If swallowed the substance easily enters the airways and could result in aspiration pneumonitis. **Effects of long-term exposure**: The substance defats the skin, which may cause dryness or cracking. The substance may have effects on the central nervous system and immune system. The substance may have effects on the bone marrow. This may result in anemia. This substance is carcinogenic to humans. May cause heritable genetic damage to human germ cells.	Eyes, skin, respiratory system, blood, central nervous system, bone marrow	IP: 9.24 eV VP: 75 mmHg RD: 0.88 RVD: 2.7 LEL: 1.2 % UEL: 8.0 % FP: 12.2 °F
1,3,5-Trimethylbenzene	108-67-8	NE	25 TWA	Inhalation Ingestion Skin and/or Eye Contact	**Effects of short-term exposure**: The substance is irritating to the eyes, skin, and respiratory tract. If this liquid is swallowed, aspiration into the lungs may result in chemical pneumonitis. The substance may cause effects on the central nervous system.	Eyes, skin, respiratory system, central nervous system, blood	IP: 8.39 eV VP: 2 mmHg RD: 0.88 RVD: 4.1 LEL: NE

COMPOUND	CAS#	OSHA PEL	ACGIH TLV	ROUTE OF EXPOSURE	SYMPTOMS OF EXPOSURE	TARGET ORGANS	PHYSICAL DATA
					Effects of long-term or repeated exposure: The substance defats the skin, which may cause dryness or cracking. Repeated or prolonged inhalation may cause effects on the lungs. This may result in chronic bronchitis. The substance may have effects on the central nervous system and blood		UEL: NE FP: 122 ºF
Polycyclic Aromatic Hydrocarbons/Semivolatile Organic Compounds (SVOCs) (PEL and TLV units – mg/m^3 unless otherwise noted)							
Benzo(a)anthracene	56-55-3	NE	NE	Inhalation Ingestion Skin Contact	**Effects of short-term exposure**: Insufficient data are available on the effect of this substance on human health **Effects of long-term exposure**: Carcinogenic to humans (suspected)	NA	IP: NA VP: 2.19 mmHg RD: 1.274 RVD: NA
Benzo(b)fluoranthene	205-99-2	NE	NE	Inhalation Skin Contact	**Effects of short-term exposure**: Insufficient data are available on the effect of this substance on human health **Effects of long-term exposure**: Carcinogenic to humans (suspected). May cause genetic damage in humans.	Genetic damage in humans	IP: NA VP: NA RD: NA RVD: NA
Benzo(k)fluoranthene	207-08-9	NE	NE	Inhalation Skin Contact	**Effects of short-term exposure**: Insufficient data are available on the effect of this substance on human health **Effects of long-term exposure**: Carcinogenic to humans (suspected)	NA	IP: NA VP: NA RD: NA RVD: NA

COMPOUND	CAS#	OSHA PEL	ACGIH TLV	ROUTE OF EXPOSURE	SYMPTOMS OF EXPOSURE	TARGET ORGANS	PHYSICAL DATA
Benzo(g,h,i) perylene	191-24-2	NE	NE	Inhalation Skin Contact	**Effects of short-term exposure**: Insufficient data are available on the effect of this substance on human health **Effects of long-term exposure**: Insufficient data are available on the effect of this substance on human health	NA	IP: NA VP: NA RD: NA RVD: NA
Benzo(a)pyrene[1]	50-32-8	0.2 TWA	NE	Inhalation Skin Absorption (maybe) Ingestion Skin Contact	**Effects of short-term exposure**: Insufficient data are available on the effect of this substance on human health **Effects of long-term exposure**: Carcinogenic to humans (suspected), may cause heritable genetic damage to human germ cells, possibly causes toxicity to human reproduction or development	NA	IP: NA VP: Negligible RD: NA RVD: NA
Bis(2-ethylhexyl) phthalate	117-81-7	5 TWA	5	Inhalation Ingestion Skin	**Effects of short-term exposure:** The substance is irritating to the eyes and respiratory tract. **Effects of long-term exposure:** The substance may have effects on the testes. Animal tests show that this substance possibly causes toxicity to human reproduction or development.	Eyes, respiratory tract, central nervous system, liver, reproductive system, gastrointestinal tract.	IP: NA VP: < 0.01 mmHg RD: 0.986 RVD: 13.45
Chrysene[1]	218-01-9	0.2 TWA	NE	Inhalation Ingestion Skin Contact	**Effects of short-term exposure**: Insufficient data are available on the effect of this substance on human health **Effects of long-term exposure**: Carcinogenic to humans (suspected).	NA	IP: NA VP: NA RD: NA RVD: NA

COMPOUND	CAS#	OSHA PEL	ACGIH TLV	ROUTE OF EXPOSURE	SYMPTOMS OF EXPOSURE	TARGET ORGANS	PHYSICAL DATA
Dibenzo(a,h)anthracene	53-70-3	NE	NE	Inhalation Ingestion Skin and/or Eye Contact	**Effects of short-term exposure**: Skin and eye irritation. **Effects of long-term exposure**: The substance may have effects on the skin. This may result in photosensitization. Carcinogenic to humans (suspected).	Skin	IP: NA VP: 9.55X10-10 mmHg at 25°C RD: 1.28 RVD: NA
Indeno(1,2,3-cd) pyrene[1]	193-39-5	0.2 TWA	NE	Inhalation Skin Contact	**Effects of short-term exposure**: Insufficient data are available on the effect of this substance on human health **Effects of long-term exposure**: Carcinogenic to humans (suspected).	NA	IP: NA VP: 1.25X10-10 mmHg RD: NA RVD: NA
2-methylnaphthalene	91-57-6	NE	0.5 ppm (TWA)	Inhalation Ingestion Skin and/or Eye Contact	**Effects of short-term exposure**: The substance is irritating to the eyes **Effects of long-term exposure**: Repeated or prolonged inhalation may cause effects on the lungs	Eyes, skin, respiratory system	IP: NA VP: 0.055 mmHg at 25°C RD: 1.00 RVD: NA
Naphthalene	91-20-3	10 ppm	10 ppm (TWA) 15 ppm (STEL)	Inhalation Skin Absorption Ingestion Skin Contact	**Effects of short-term exposure**: The substance may cause effects on the blood. This may result in lesions of blood cells (haemolysis). The effects may be delayed. Ingestion could cause death. **Effects of long-term exposure**: The substance may have effects on the blood. This may result in chronic haemolytic anaemia. The substance may have effects on the eyes. This	Effects on blood, eyes	IP: NA VP: 0.087 mmHg at 25°C RD: NA RVD: 4.42

COMPOUND	CAS#	OSHA PEL	ACGIH TLV	ROUTE OF EXPOSURE	SYMPTOMS OF EXPOSURE	TARGET ORGANS	PHYSICAL DATA
					may result in development of cataract. Carcinogenic to humans (suspected).		
Nitrobenzene	98-95-3	1 ppm	1 ppm TWA	Inhalation Skin Absorption Ingestion Skin and/or Eye Contact	**Effects of short-term exposure**: The substance may cause effects on the blood. This may result in the formation of methaemoglobin. Exposure could cause lowering of consciousness. The effects may be delayed. **Effects of long-term exposure**: The substance may have effects on the blood, spleen and liver. Carcinogenic to humans (suspected). Animal tests show that this substance possibly causes toxicity to human reproduction or development.	Eyes, skin, blood, spleen, liver, kidneys, cardiovascular system, reproductive system	IP: 9.92 eV VP: 0.3 mmHg RD: 1.2 RVD: 4.2
Phenanthrene[1]	85-01-8	0.2 TWA	NE	Inhalation Skin Absorption Skin and/or Eye Contact	**Effects of short-term exposure**: The substance may cause irritation to skins, eyes, nose and throat. **Effects of long-term exposure**: Insufficient data are available on the long-term effect of this substance on human health	Eyes, skin, respiratory system	IP: 7.89 eV VP: 9.00 x 10^{-5} mmHg RD: 1.025 RVD: 6.14
Phenol	108-95-2	5 pm TWA	NE	Inhalation Skin Absorption Ingestion Skin and/or Eye Contact	**Effects of short-term exposure** The substance and the vapor are corrosive to the eyes, skin, and respiratory tract. Corrosive on ingestion. Inhalation of the vapor may cause lung edema, but only after initial corrosive effects on eyes and/or airways have become manifest. See Notes. The substance may cause effects on the central nervous system, heart, and kidneys. This may result in	Eyes, skin, respiratory system, liver, kidneys	IP: 8.50 eV VP: 0.4 mmHg RD: NA RVD: NA LEL: 1.8% UEL: 8.6%

COMPOUND	CAS#	OSHA PEL	ACGIH TLV	ROUTE OF EXPOSURE	SYMPTOMS OF EXPOSURE	TARGET ORGANS	PHYSICAL DATA
					convulsions, coma, cardiac disorders, respiratory failure and collapse. The effects may be delayed. Medical observation is indicated. Exposure could cause death. **Effects of long-term or repeated exposure** The substance may have effects on the liver, kidneys and nervous system.		FP: 175 °F
Fuels (PEL and TLV units – ppm)							
Total Petroleum Hydrocarbons (TPH)[2]	--	--	--	Inhalation	**Effects of short-term exposure:** may include headache, or dizziness. **Effects of long-term exposure or repeated exposure:** may include peripheral neuropathy	Reproductive (during periods where organs are developing), blood, liver, immune system, kidneys, respiratory system, skin and eyes	--
Site Specific Constituent of Concern							
PFAS[3,4]	--	--	--	Ingestion Skin Absorption Inhalation	Associations between exposure and adverse reproductive, developmental, and systemic effects; reasonably anticipated to be carcinogenic	Liver, reproductive (adverse developmental outcomes), endocrine system, immune system	--

Note:

1. Check Permissible Exposure Limit: Table Z-1 8-hr Time Weighted Avg: 0.2 mg/m^3. Coal tar pitch volatiles (benzene soluble fraction), anthracene, BaP, phenanthrene, acridine, chrysene, pyrene
2. No health or environmental benchmarks have been developed for TPH as a general category, though many exist for individual petroleum chemicals or products, such as gasoline. (Agency for Toxic Substances and Disease Registry Toxicological Profile for Total Petroleum Hydrocarbons, August 14, 2018)
3. Occupational Safety and Health Administration (OSHA) Permissible Exposure Limit (PEL) and American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Value (TLV) are not promulgated for PFAS.
4. Per the Agency for Toxic Substances and Disease Registry Fact Sheet (**Attachment 1**) based on potential health effects of the more widely studied PFAS groups of PFOS, PFOA, perfluorohexanefulfonic acid, and perfluorononanoic acid.

References:

International Labour Organization, 2018, International Chemical Safety Cards, available at https://www.ilo.org/dyn/icsc/showcard.listcards3?p_lang=en

U.S. Department of Labor, Occupational Safety and Health Administration, Permissible Exposure Limits – Annotated Tables, available at https://www.osha.gov/dsg/annotated-pels/index.html

National Institute for Occupational Safety and Health (NIOSH) (2016) NIOSH Pocket Guide to Chemical Hazards. Department of Health and Human Services. Centers for Disease Control and Prevention. NIOSH. Available at https://www.cdc.gov/niosh/npg

Abbreviations for Constituents of Concern Table

% = percent
ºC = degrees Celsius
ºF = degrees Fahrenheit
ACGIH = American Conference of Governmental Industrial Hygienists
CAS = Chemical Abstract Service
eV = electron volt
FP = flash point
IP = ionization potential
LEL = lower explosive limit
mg/m^3 = milligrams per cubic meter
mmHg = millimeter of mercury
NA = not available
NE = not established
OSHA = Occupational Safety and Health Administration
PEL = permissible exposure limit
ppm = parts per million
RD = relative density (Water = 1)
RVD = relative vapor density (Air = 1)
STEL = short-term exposure limit (15 minutes)
TLV = threshold limit value
TWA = time weighted average
UEL = upper explosive limit
VP = vapor pressure

2 HAZARD AND RISK ANALYSIS

Activity hazard analyses (AHAs) list and evaluate the health and safety hazards known to be associated with the planned activities for onsite workers. AHAs list each task or step, describe some of the evident safety hazards associated with that task or step, and then recommend various controls, personal protective equipment (PPE), and operating procedures to control the hazards. An AHA was developed for each task/operation to be performed. YTC AHAs are included in **Attachment 2** of this SSHP.

The Site Safety and Health Officer (SSHO) will manage the AHAs, and with the help of the field staff, improve upon or add to existing analyses as new potential hazards are identified. If additional tasks are necessary due to scope changes or changes in field conditions, or other circumstances, additional AHAs may be required. The AHAs will be reviewed, updated as necessary in the field, and signed daily or prior to each phase of work with workers. Changes in condition and markups to the AHAs will be communicated to the Project Manager (PM) and Safety and Health Manager (SHM) prior to beginning activities. The Government Designated Authority will need to review and approve any new AHAs or any AHAs where the Risk Assessment Code changes.

General field activities to be completed at YTC include:

- Site mobilization/preparation/demobilization
- Identification of general site hazards
- Utility location
- Surface geophysics transects at three locations (2,000 linear feet) using seismic methods to induce ground vibrations
- Earth work to prepare access and pads for drilling

  Air rotary drilling
- Soil sampling
- Grab and low-flow groundwater sampling
- Borehole and surface geophysics
- Monitoring well construction and development
- Surface water and sediment sampling
- Investigation-derived waste management and sampling

The field sampling plan for field activities is further described in the associated work plan. The sections below further describe hazards likely to be encountered while performing the field sampling.

2.1 Chemical Hazards

As noted in **Section 1.2**, chemical constituents beyond the constituents of concern (PFAS) may be encountered during field activities. **Table 1** summarizes the historically known chemical constituents of concern. Field personnel should be alert to this possibility; evidence of free product, stained or colored soil, and odors are possible indicators for such contamination. The SHM and PM or Task Manager (TM) should be contacted immediately regarding evidence or the suspicion of chemical contamination.

Groundwater samples will be collected for the analysis of PFAS, including PFOS, PFOA and PFBS. Due to the nature of the constituents of concern, local features, and type of site activities planned, risk of chemical exposures to site workers through inhalation, ingestion, or dermal contact is anticipated to be low. Site personnel can reduce their exposure potential to contaminants of concern by practicing contamination avoidance, following proper decontamination procedures, observing good personal hygiene, implementing engineering controls during soil disturbance (i.e., soil wetting, equipment selection and use), and properly using specified PPE. Appropriate PPE, as discussed in **Section 5**, will be worn to cover exposed skin, and hygiene practices will be sufficient to preclude ingestion and dermal contact as exposure pathways.

2.2 Physical Hazards

The physical hazards listed below are anticipated at YTC. Plans, programs, and procedures to address each hazard are described below; actions to eliminate or minimize each hazard are described in the AHAs.

- Dust (**Section 7** of this SSHP)
- Drilling (air rotary drilling) operation (AHAs included in **Attachment 2** of this SSHP)
- Equipment operation (AHAs included in **Attachment 2** of this SSHP)
- Ergonomic (e.g., lifting, pushing/pulling, pinch points, caught-in) (AHAs included in **Attachment 2** of this SSHP)
- Heat/cold stress (**Section 8** below)
- Inclement weather (**Section 14** below)
- Overhead and falling objects (AHAs included in **Attachment 2** of this SSHP)
- Power/hand tools (AHAs included in **Attachment 2** of this SSHP)
- Slips, trips, and falls (AHAs included in **Attachment 2** of this SSHP)
- Utilities (AHAs included in **Attachment 2** of this SSHP)
- Vehicular traffic (Site Traffic Safety Plan is provided in **Attachment 3** of this SSHP).

2.3 Biological Hazards

Personnel working at YTC should be aware of the possible biological hazards described below, including the novel corona virus disease 2019 (COVID-19, **Attachment 4**), bloodborne pathogens (BBPs), and the presence of hazardous wildlife, insects, and plants and associated illnesses they may cause. **Attachment 5** includes descriptions and photos of each biological hazard. Site workers will receive instruction in recognition/identification and avoidance of hazardous wildlife, insects, and plants and their common habitats from **Attachment 5**.

2.3.1 COVID-19 Guidance for Field Staff

2.3.1.1 General Guidance

Currently Arcadis U.S., Inc. (Arcadis) is following the Centers for Disease Control and Prevention (CDC) guidelines, as well as applicable government directives to address potential health hazards posed by COVID-19. The health and safety of our people is of utmost importance to us. During fieldwork, employees should complete the following:

- Practice good hygiene.
- Clean and disinfect frequently touched surfaces both before beginning work and upon completion of the work.
- Practice social distancing: The CDC definition of social distancing means remaining out of congregate settings, not shaking hands, avoiding mass gatherings, and maintaining distance (approximately 6 feet or 2 meters) from others when possible. Field situations where social distancing should be practiced are tailgate and safety briefing meetings, work in field trailers or breaks.
- Complete a risk assessment:
  - If you are sick, stay home.
  - Observe others and if they show flu-like symptoms, use Stop Work and contact the PM. Complete a CDC Risk Assessment and implement what is appropriate, outside of formal direction from federal, state, or local directives based on the documented health risks. The CDC risk assessment is included in **Attachment 4**.
- Prior to mobilizing to the site:
  - Have a health and safety check including all members of the field team and TM to confirm all attendees are complying with guidelines.
  - Confirm understanding that workers or clients should not go to the job site if they have personally tested positive for COVID-19 or have been in close contact to anyone else who has tested positive for COVID-19.
- During the field effort:
  - Out of respect for all, ask everyone to self-disclose if they are not feeling well (exhibiting flu-like symptoms), and request that they go home
  - Observe person(s) for symptoms, and use Stop Work, as necessary, and contact the TM and PM
  - Determine if arrangements can be made to simplify our ability to social distance
  - Set visual or physical barriers to keep the public away (caution tape and cones)
  - Consider if “split shifts” can be used to limit contact, or if work can be scheduled during hours of low to no facility operations
  - If the installation and/or client request completion of a COVID-19 health screening form, review the Arcadis Field and Embedded Staff for COVID-19 Guidance included in **Attachment 4**

- After the field effort, if you learn you have been in close contact with a worker, client or member of the public who is COVID-19 positive:
    - STOP WORK
    - Notify your supervisor and PM
    - Self-isolate and contact your personal physician for additional direction
    - Notify Arcadis Human Resources

2.3.1.2 Considerations for Vehicles and Transportation

When using shared vehicles (fleet, rental, ride sharing services), follow the cleaning guidance above for frequently touched surfaces and conduct a cleaning/disinfection prior to driving. Check with your rental agency before vehicle pick-up to understand their cleaning procedures, and supplement with your own as necessary. Note: if using wipes, make sure the wipe is compatible with the surface being cleaned.

When traveling with other employees, no more than four persons are to be in the vehicle and maintain as much space as feasible between persons. If only two persons are traveling in the vehicle, consider for one person to sit in the rear of the vehicle, away from the driver. Do not share a vehicle with other employees or approved individuals if, after reviewing prevention and risk information described above, you are at risk of spreading COVID-19.

2.3.1.3 Lodging Consideration

Most hotel chains have implemented additional cleaning and disinfection procedures. Check with your hotel before check-in to understand their cleaning procedures. If there’s still a concern, bring a surface cleaner and wipe down frequently touched surfaces (e.g., doorknobs, tv remote).

2.3.1.4 Rental Equipment and Sample Cooler Handling

Clean the exterior of rental equipment and sample coolers upon arrival at the job site using a cleaning product that will not impact data quality. Wear gloves and safety glasses when handling sample coolers to prevent contact with acid preservation of the bottles in coolers.

2.3.2 Bloodborne Pathogens

Workers onsite, including those who have been designated as first aid responders, have the potential for occupational exposure to BBPs and will have completed training in exposure control including universal precautions. The BBP and Exposure Control Program is detailed below.

2.3.2.1 Methods of Compliance

To help prevent exposure, we will follow “Universal Precautions”. That is, the victim’s blood and other bodily fluids will be treated as if known to be infectious for BBPs. Engineering and work practice controls will be used to minimize the risk of employee exposure.

When providing first aid:

- Wear PPE – disposable gloves, safety glasses/goggles, and protective mask (if artificial respiration is required).
- Minimize splashing, spraying, or spattering of blood or body fluids.

After providing first aid:

- Remove gloves and wash hands and other potentially contaminated skin with antiseptic cleaner. Antiseptic will be available with first aid supplies.
- Employees will flush mucous membranes with water as soon as possible after contact with potentially infectious materials.
- Employees will be given and instructed on the proper use, maintenance, and disposal of PPE.

If required to clean a surface that has been potentially contaminated with BBPs, the employee will wear gloves and will clean the area with disinfectant. Any sharp object that has been contaminated (e.g., broken glass, piece of metal) will be picked up with a tool rather than the hands. Items contaminated with a victim's blood or other body fluids will be placed in a closable and puncture/leak resistant biohazard trash bag (such bags will be available with first aid supplies). They will be taken to the nearest medical facility for disposal.

2.3.2.2 Hepatitis B Vaccination Series

Designated first aid providers will be offered the Hepatitis B vaccination series after they've received the required BBP training. The vaccination series is offered without cost to the employee and consists of three injections (the 2nd injection 1 month after first and the 3rd injection 6 months after the first). If an employee later decides to have the vaccination and is still designated to provide first aid, the vaccination will be made available at no cost to the employee.

2.3.2.3 Post Exposure Evaluation and Follow-Up

If an employee feels that he/she has had an exposure to a BBP, the employee will immediately be sent for a medical evaluation (if the employee so chooses) per current recommendations of the CDC for human immuno-deficiency virus, Hepatitis B virus, Hepatitis C virus, and Hepatitis A virus. The SHM will coordinate with corporate medical resources. The employee will receive a detailed report from the medical provider; Arcadis will receive notification that the employee has been informed of the results of the evaluation and any recommended treatment.

2.3.2.4 Training

All employees who are designated to render first aid will be given BBP training upon initial designation and annually thereafter. The training will be provided and documented before the employee is offered the Hepatitis B vaccination.

2.3.2.5 Record Keeping

Medical records regarding an exposure to a BBP and Hepatitis B vaccination information will be maintained by the healthcare provider. Records provided to Arcadis will be kept confidential in the company's Human Resource department and not disclosed without an employee's written consent except as required by law.

2.3.3 Snakes

Several species of snakes may be present at YTC; however, one species is venomous; the Pacific Rattlesnake (*Crotalus oreganus*). With the exception of some rare species of venomous snakes, snakes will typically not attack unless feeling threatened or provoked. All snakes encountered should be avoided. If a snake is discovered, the SSHO should be immediately informed of the snake's location, size, and type, if known. In most cases, only a brief interruption of work will be necessary to allow the snake to vacate the work area on its own. Species of venomous snakes which may be present at YTC, their identifying characteristics, and typical habitats, along with a photo of each species, are included in **Attachment 5**.

Site personnel should avoid rocks, timber and leaf piles, and animal burrows (including those vacated by other animals) as snakes typically use these habitats for shelter or hibernating.

Bites from venomous snakes can be painful and can result in severe illness or death, but most bites can be effectively treated in emergency rooms and rarely result in death. Symptoms of venomous snake bites may include difficulty breathing, numbness/tingling, nausea and vomiting, shock, skin color changes or swelling, thirst, tiredness or weakness, and blurred vision. In route to an emergency room, or while waiting on site for first responders, first aid for a venomous snake bite can include:

- Keep the person calm.
- Wash the bite with soap and water.
- Restrict movement of the affected area and keep it below the heart level to reduce the flow of venom in the blood stream.
- Depending on the location of the bite, wrap the limb from the further point down to the bite area.
- Remove rings or constricting items from the affected area as the area may swell.
- Observe the affected area for swelling and/or color change.
- Monitor the victim's vital signs if possible (temperature, pulse, rate of breathing, and blood pressure).
- If shock occurs, lay the victim flat, raise the feet, and cover the person with a blanket.

Any snake bite will be treated as potentially venomous, regardless of snake identification in the field, and treated immediately.

2.3.3.1 Spiders

Spiders that can typically be seen at YTC include the black widow spider.

The black widow’s bite can be deadly to humans and the bite is sharp and painful. Acute pain occurs with the bite with more symptoms following 20 minutes to an hour later, including profuse sweating, rigid abdomen muscles, muscle spasms, difficulty breathing, slurred speech, poor coordination, dilated pupils, and swelling of the face and extremities.

Victims of black widow spider bites should seek immediate medical attention.

2.3.3.2 Ticks

Working in tall grass, especially in or at the edge of wooded areas, increases the potential for ticks to bite personnel. Ticks can be particularly numerous in the spring and fall. Ticks are vectors of many different diseases including Rocky Mountain spotted fever, Q fever, tularemia, Colorado tick fever, and Lyme disease. Various ticks that may be present at YTC are described and pictured in **Attachment 5**.

Ticks attach to the skin and intravenously feed on blood, creating an opportunity for disease transmission. Covering exposed areas of the body and the use of insect repellent containing DEET help prevent tick bites. Permethrin should be applied to clothing and not to skin; permethrin treated clothing is available commercially. Mesh netting worn over legs and torso can be purchased that offer some physical barrier protection. Periodically during the workday, personnel should inspect themselves for the presence of ticks. The Arcadis Tick Bite Prevention Factsheet and the Arcadis 2019 Biological Hazards Control Permethrin Factsheet are presented in **Attachment 5**.

Notify fellow personnel if you see a tick on yourself or on a team member. Brush the tick off if it is crawling on you. Often a tick will flatten itself against the skin, so it may have to be scraped off. If a tick is discovered and has attached itself to the skin, the following procedure should be used to remove it:

- Do not try to detach a tick with your bare fingers; bacteria from a crushed tick may be able to penetrate even unbroken skin. Fine-tipped (pointy) tweezers should be used. See https://tickencounter.org/prevention/tick_removal for an example of the correct tweezers.
- Grip the tick as close to your skin as possible and gently pull it straight away from you until it releases its hold.
- Do not twist the tick as you pull and do not squeeze its body. That may actually inject bacteria into your skin.
- Thoroughly wash your hands and the bite areas with soap and water. Then apply an antiseptic to the bite area.
- Save the tick in a small container with the date and note the location of the bite on your body and where you think the tick came from.
- Notify the SHM of any tick bites as soon as possible. An accident report should be filed within 24 hours of a tick bite that occurs while working.

All personnel sustaining a tick bite should immediately call WorkCare at (888) 449-7787 as antibiotic treatment is most effective at this time.

2.3.4 Bears

Bears are curious, intelligent, and potentially dangerous animals, but undue fear of bears can endanger both bears and people. Respecting bears and learning proper behavior in their territory will help so that if a bear is encountered, neither will suffer needlessly from the experience. Most bears tend to avoid people.

- Be alert where recent bear activity has been documented by installation officials, Fish and Wildlife, and installation biologists. Common areas that bears like to frequent include stream beds, dense edge cover and, in late summer, berry patches.
- Use extreme caution when traveling on trails in the early morning, at dusk, or at night.
- Always stay near your vehicle or other mode of transportation or permanent shelter.
- Be careful with food smells. Store all foods in plastic.
- Watch for fresh bear signs (scat or bear tracks) on trails or near project sites.
- If possible, make plenty of noise on trails, especially on blind curves, in dense vegetation or areas with limited vision.
- Be conscious of the wind. Bears have an excellent sense of smell. If the wind is at your back, chances are that a bear will smell you and leave the area well before you reach it. If the wind is blowing in your face, the chances of an encounter greatly increase. In high wind situations or along creeks and streams, a bear might not hear someone approaching or staff might not hear a bear approach.
- If you come upon a dead animal carcass, immediately leave the area. Bears will often feed on a carcass for days and will stay in the area to protect their food.
- If you see a bear cub, the sow is likely nearby. Female bears will fiercely defend their young, so it is best to leave the area and find an alternative route.
- Do not travel alone; use the buddy system or small groups.

If a bear looks makes eye contact and has its ears back, it is warning someone they are too close and that it feels threatened. A bear may also make barking, woofing, or moaning sounds to indicate this. If a bear “pops” its jaws, it is very agitated and most often will charge.

A bear can reach speeds of 30 to 35 miles per hour in a matter of a split second. Never try to outrun a bear; it will only make matters worse.

- Stop, stay calm and quiet, and make no sudden moves. Do not yell or scream.
- Break eye contact. Do not stare in the bear’s eyes because this is a sign of aggression.
- Stand your ground. Do not turn your back on the bear. Sometimes a bear will bluff charge several times.
- Calmly alert other field crew if they are not already aware of the bear’s presence.
- Determine the distance to your vehicle, other mode of transportation, or secure permanent building.

- Back away slowly, speaking in a calming, monotone voice. You want to show the bear that you are being submissive and want to get out of its territory. Do not turn and run.
- Look for signs of agitation and aggression.

When a bear is standing on its hind legs, it is usually just trying to get a better look at and smell of someone. When a bear is upset it may have its ears back, lower its head, and swing it from side to side, paw at the ground, make huffing or woofing noises, snap its teeth, or not show any signs at all, and just drop and charge with no warning.

If a bear actually makes contact, you have two choices: play dead or fight back. The best choice depends on whether the bear is reacting defensively or is seeking food. Play dead if you are attacked by a bear you have surprised, encountered on a carcass, or any female bear that seems to be protecting cubs.

Lie flat on your stomach or curl up in a ball with your hands behind your neck. Typically, a bear will break off its attack once it feels the threat has been eliminated. Remain motionless for as long as possible. If you move, and the bear sees or hears you, it may return and renew its attack. Rarely, lone black bears may perceive a person as potential food. Fight any bear that follows you or breaks into a tent or building.

2.3.5 Mountain Lions or Cougars

When working in mountain lion or cougar country, use the following precautions to avoid (or during) an encounter:

- Make noise. Cougars will often retreat if given the opportunity. Walking in large groups and making noise will give the cougar the chance to retreat and reduce the likelihood of a sudden encounter.
- Be cautious at dusk and dawn. Contrary to popular belief, most predators are most active at dusk and dawn. These are times to be especially cautious.
- Do not leave food or garbage outside. The strong smell of food or garbage may attract a cougar. Keep your garbage securely stored.
- Remember, cougars are very different from bears. Cougars do not bluff charge and playing dead is never recommended in a cougar attack.
- Do not run. Cougars are a powerful predator. Running may trigger an attack.
- Face the cougar and retreat slowly. Keep direct eye contact with the cougar while you slowly retreat toward safety.
- Raise your arms above your head to make yourself look larger than normal. This may help to intimidate the cougar. You may also want to throw rocks and yell at it. Aggression will often scare it off.

If a cougar attacks, fight back. Many people have survived cougar attacks by fighting back with anything, including rocks, sticks, and bare fists. Report the sighting.

2.3.6 Other Wildlife

Other hazardous wildlife encounters may occur with centipedes, rats, mice, racoons, or stray dogs, and cats. Do not approach or aggravate wildlife, especially animals that are behaving strangely or foaming at the mouth.

2.3.7 Plants

Poison ivy, poison oak, and giant hogweed are present at YTC. Poison ivy is a rooted or climbing plant with ternate leaves (arranged in threes) and white berries. Poison oak is usually a shrub though it sometimes becomes a vine several inches in diameter, climbing up high into oak trees, attached by air-roots.

To mitigate potential exposure to poison ivy, poison oak, and giant hogweed, the following safety precautions are required:

- All personnel should inform each other if these plants are observed on a property; these plants are to be avoided.
- Wear long sleeves.
- Apply a preventative exposure product, such as Ivy X Pre-Contact Skin Solution (CoreTeX Products Inc.), prior to beginning work.
- If exposure occurs, contact WorkCare at (888) 449-7787, and follow instructions for post exposure mitigation efforts, which may include application of a post exposure soap such as Tecnu®.

Further description and photographs of poison ivy, poison oak, and giant hogweed are included in **Attachment 5**.

Giant hogweed has a stout, bright green stem often spotted with dark red and hollow red-spotted leaf stalks that produce sturdy bristles. These plants average in height from 6.5 to 18 feet tall. The stem is 1.5 to 3 inches in diameter, with leaves ranging in size from 3 to 6 feet in width. The flower crown is 31 inches wide.

The sap of the giant hogweed is phototoxic. When contacted skin is exposed to sunlight or ultraviolet light, it develops severe skin inflammation, which develops into blisters within 48 hours. Do not try to remove this plant. Report any observance of giant hogweed to the State Department of Natural Resources. Further description and photographs of giant hogweed is included in **Attachment 5.**

3 STAFF ORGANIZATION, QUALIFICATIONS, AND RESPONSIBILITIES

Staff organization, qualifications, and responsibilities are provided in **Attachment 6** of this SSHP. Grey Coppi will serve as the SHM for this project. Gabriel Hebert will serve as the SSHO.

4 TRAINING

Arcadis will only permit trained employees with current valid certificates of training onto job sites. The SSHO will verify compliance with all training requirements, maintain a copy of training records onsite, and track when employees may need to become recertified in a particular training. Training records will be maintained at field locations for the specific work activities and workers at that location.

4.1 General Training

All Arcadis personnel will have the required training to be assigned to the project and to implement all assigned work in a safe manner. Arcadis personnel are required to have completed 40-hour Hazardous Waste Operations and Emergency Response (HAZWOPER) training, as specified in 29 Code of Federal Regulations 1910.120. This training, designed to orient personnel potentially exposed to hazardous substances, health hazards, or safety hazards, includes, but is not limited to, the following:

- Safety and health risk analysis
- Use of PPE
- Work practices by which personnel can minimize risks from hazards
- Safe use of engineering controls and equipment
- Medical surveillance requirements including recognition of symptoms and signs that might indicate overexposure to hazards
- Procedures for environmental monitoring, site control, and decontamination
- Emergency response plans
- Technical knowledge of radiological hazards, acute and chronic exposure, and health and safety considerations.

Arcadis (and subcontractor) personnel are also required to have completed 8-hour HAZWOPER Refresher training within the past year if their 40-hour training was completed more than 1 year prior to their assignment at the site.

As also required by the OSHA regulations, personnel conducting supervisory activities will have a minimum of three days of actual field experience under the direction of a skilled supervisor. All supervisory personnel will have completed an additional 8-hour HAZWOPER Site Supervisor training. Copies of all current training certificates will be kept in the project file.

Prior to commencement of site activities, Arcadis employees and subcontractors engaged in site operations will be informed of the nature and degree of exposure to chemical and physical hazards that are likely to result from participation in site operations. Arcadis will accomplish this by ensuring that personnel entering the site have received the appropriate site orientation training and applicable site-specific training, prior to participation in site activities. Training will be held at the time of site mobilization and will be reinforced during the Daily Tailgate Meetings, which all site workers will be required to attend.

4.2 New Hire Training

Newly hired employees shall be given proper orientation at the time of initial hire necessary to perform work safely. Training is provided by Arcadis and delivers an overview of the Arcadis Health and Safety Program, including, but not limited to, Arcadis' incident prevention and reporting (4-Sight system), Hazard Communication Program, and general health and safety principles. All staff to be assigned to the site will be provided training to work in compliance with the requirements set forth in **Table 2.** New employees to HAZWOPER work, or employees experiencing their first environmental contact, are required to have their 24-hour supervised initial experience documented.

4.3 Project Specific Health and Safety Training

While Arcadis requires company new hire orientation training for all new hires, specific training will be required for all staff working on this project to ensure the site-specific requirements are communicated and understood. Arcadis requires all employees new to the project to undergo training based upon the existing health and sfety program to include, but is not limited to:

- Requirements and responsibilities for accident prevention and the maintenance of safe and healthful work environments as documented in the project SSHP and AHAs
- Employee and supervisor responsibilities for reporting all accidents
- Provisions for medical facilities and emergency response and procedures for obtaining medical treatment or emergency assistance
- Procedures for reporting and correcting unsafe conditions or practices

Specific training requirements are provided in **Table 2**.

Table 2 – Project-Specific Training and Other Requirements

Health and Safety Training	SSHO	Supervisors[1]	Field Staff	Site Visitors [2]	Comments
Training Required for Staff Conducting HAZWOPER, Intrusive/Construction, and Non-Intrusive/Non-Construction Work Activities					
40-Hour HAZWOPER	x	x	x		
8-Hour HAZWOPER Refresher	x	x	x		
8-Hour HAZWOPER Supervisor	x	x			
First Aid / Cardiopulmonary resuscitation (CPR) / BBP	x	x	x		Minimum of two personnel on-site will have this training (SSHO and one other)
Emergency Action and Fire Prevention	x	x	x	x	Covered during Site Orientation

Health and Safety Training	SSHO	Supervisors[1]	Field Staff	Site Visitors [2]	Comments
Fire Extinguisher (Educational)	x	x	x		
Hazard Communication (HAZCOM)	x	x	x	x	Covered during company new hire (Arcadis staff); covered during Site Orientation
Noise/Hearing Conservation	x	x	x	x	Covered in 40-Hour HAZWOPER / 8-Hour HAZWOPER Refresher
OSHA 30-Hour Construction	x				For construction/intrusive activities only
PPE	x	x	x	x	Includes: Selection/Don/Doff/Adjust/Limitations & Life/Inspection/Testing/Care/ Maintenance/Disposal Covered in 40-Hour HAZWOPER / 8-Hour HAZWOPER Refresher and during Site Orientation
Respiratory Protection Awareness	x	x	x	x	Covered in 40-Hour HAZWOPER / 8-Hour HAZWOPER Refresher and during Site Orientation
Smith System Driving or equivalent Defensive Driving course	x	x	x	x	Arcadis required training for all personnel
Spill prevention and response	x	x	x	x	Covered in site orientation
Site Orientation	x	x	x	x	Led by SSHO and PM/ Deputy PM/ Regional Leads Covers (at a minimum): SSHP/AHAs to include general site hazards, PPE usage, recognition of hazardous plants and animals, heat or cold stress monitoring, and controls for the site (e.g., spill prevention)
Medical Screening, Fit-Testing, and Other Requirements for Staff Conducting HAZWOPER, Intrusive/Construction, and Non-Intrusive/Non-Construction Work Activities					
Medical Surveillance (HAZWOPER)	x	x	x		Required for those personnel who meet the OSHA requirements and exposure criteria.

Notes:

[1] Supervisor is anybody who has supervisory responsibilities in the field (e.g., PM, Deputy PM, TMs, Site Supervisors, Team Leaders)

[2] Training for site visitors will be conducted during the site orientation

4.4 Hazard Communication

Arcadis has a written HAZCOM program, which was established to meet the requirements of 29 Code of Federal Regulations 1910.1200. Field activities will be implemented in accordance with this program, as described below. The information provided in this section acts as a refresher of Arcadis' HAZCOM program.

Arcadis personnel are required to review the list of chemicals to understand the proper use, handling, storage, and disposal of the chemicals as contained on the safety data sheets (SDSs) for those chemicals, as well as the hazards and recommended emergency responses. Arcadis personnel are not to use chemicals until they are familiar with the SDS for that chemical.

SDS for hazardous chemicals introduced to the site by Arcadis personnel will be kept with this SSHP for review by all personnel. Labels on containers used by Arcadis are as originally received (not to be defaced) and are to contain the following information: (1) the identity of the hazardous chemical(s); (2) the appropriate hazard warnings(pictogram); and (3) the name and address of the chemical manufacturer. If personnel transfer chemicals from a labeled container to a portable container, a label that contains those three items must be affixed to it. If the portable container is intended only for that individual's immediate use during the same work shift, then only the product name should be clearly marked on the container. The individual will be responsible to properly empty, clean, or dispose the portable container after using it.

A review of Arcadis' HAZCOM program will be included in the periodic health and safety briefings to inform personnel of hazardous chemicals to which they may be exposed. If the chemical hazard changes or a new chemical hazard is introduced into the area after work begins, additional training/notification will be provided by the SHM or the SHM-designee. Site-specific HAZCOM training for hazardous chemicals introduced to the site by Arcadis will include:

- Properties and hazards (i.e., chemical, physical, toxicological) of each hazardous substance
- Health hazards, including signs and symptoms of exposure and any medical condition known to be aggravated by exposure
- Measures personnel can take to protect themselves, including appropriate work practices or methods for proper use and handling, procedures for emergency response, and the proper use and maintenance of PPE, as required
- Work procedures for personnel to follow to protect themselves when cleaning hazardous chemical spills and leaks
- Use of the container labeling system and the SDS, including where SDS are located, how to read and interpret the information on both labels and SDS, and how personnel may obtain additional HAZCOM information

4.5 Periodic Safety and Health Training

All supervisors, visitors, and on-site employees will receive periodic safety and health training in the form of daily tailgate meetings to address anticipated hazards for the day's work, as well as any changing site conditions. Additionally, all employees will be required to maintain any pertinent refresher trainings on the prescribed basis (i.e., yearly HAZWOPER 8-hour refresher).

At a minimum, once daily health and safety meetings (daily tailgate meetings) will be conducted by the SSHO, or their designee, for all Arcadis and visiting personnel and documented on the daily tailgate meeting form or in the field logbook. The information and data obtained from applicable site characterization and analysis will be addressed in the health and safety meetings and used to update this SSHP, as necessary. The SSHO will review all health and safety training documentation prior to the daily tailgate meeting to track when employees may need to become recertified in a particular health and safety training. The SSHO will also review the PPE required for each task during the daily tailgate meeting. The daily tailgate meeting forms will be maintained in the project file.

Specific supervisor meetings will be conducted by the SSHO at least monthly to discuss upcoming work tasks and their hazards and risks, scheduling, health and safety requirements, health and safety performance, health and safety resource and training needs, past incidents and lessons learned, inspection findings and corrective action tracking, and other health and safety issues as necessary. These supervisor meetings will be documented including the date, persons in attendance, subjects discussed, and names of individual(s) who conducted the meeting. Documentation will be maintained and copies furnished to the government designated authority on request. The government designated authority will be informed of the scheduled monthly meetings in advance and be invited to attend.

The PM/ Deputy PM and Technical Lead will hold regularly occurring calls with the project team to discuss health and safety issues, progress status, schedules. The calls will be documented including the date, persons in attendance, subjects discussed, and names of individual(s) who conducted the meeting. The government designated authority will be notified of the schedule for the weekly meetings in advance and be invited to attend.

4.6 Authorized Visitor Briefings

It is recommended that authorized visitors attend the daily tailgate meetings, if possible. Before going on the site, visitors will be properly oriented to existing conditions, planned activities, levels of PPE, and other relevant procedures outlined in this SSHP. Visitors are required to sign into the site and should sign the daily tailgate meeting form indicating that they are aware of conditions and potential exposures/hazards. Authorized visitors must be accompanied while on the site. The SHM or SSHO designee may deny entry of a visitor to certain locations when, in their opinion, physical hazards, insufficient training, or other valid concern exists.

4.7 Emergency Response Training

All on-site employees will be trained in project-specific emergency response procedures. Training will include:

- Emergency condition recognition
- Procedures for monitoring and responding to severe weather conditions
- Fire prevention
- Evacuation
- Emergency communication

4.8 MEC Awareness Training

Site work is not anticipated to occur in areas where munitions and explosives of concern (MEC) hazards are present. However, MECs awareness will be discussed during the tailgate for all site workers. If MEC hazards are determined to be relevant at a site, workers will receive site-specific training under the direct supervision of trained/experienced personnel when they mobilize at the site. All site visitors will be given a safety brief by the SSHO prior to entering the site and then be escorted into the site.

Unexploded ordnance (UXO) qualified personnel will follow the requirements of the Arcadis Safety Program, and the Basic Safety Concepts and Considerations for Ordnance and Explosives Operations, which outline the safety and health precautions to be taken if MEC are encountered.

All non-UXO qualified personnel will follow the safe work practices listed below:

- Non-UXO qualified personnel will receive site-specific MEC recognition training prior to participation in site activities,
- No soil penetrating activities will be allowed without the area first being cleared by UXO qualified personnel,
- Non-UXO qualified personnel will be escorted on site by UXO qualified personnel, until such time as the area is cleared,
- Once an area has been cleared and flagged, non-UXO qualified personnel may perform duties in the area unescorted, but shall not leave the cleared area unescorted,
- Non-UXO qualified personnel will not touch or disturb any object which could potentially be MEC related, and they will immediately notify the nearest UXO qualified person of the presence of the object.

4.9 Project-Specific Training

Project-specific training will be given and documented to verify training prior to the start of any field work. This training will include, but should not be limited to, general site hazards, PPE usage, and recognition of physical and biological hazards.

Safety meetings will be conducted daily by the SSHO for all site personnel, subcontractors, and visiting personnel and documented on the Daily Tailgate Safety Meeting Attendance Record form provided in or in the daily quality control field logbook. The information and data obtained from applicable site characterization and analysis will be addressed in the safety meetings and used to update the SSHP, as necessary.

4.10 Department of Transportation Hazardous Materials Transportation

All analytical samples being shipped by air or ground transport will be evaluated using the Shipping Determination provided in **Attachment 7** to determine if the material or equipment being shipped is hazardous for transport. This Shipping Determination will be retained on file.

All materials identified as hazardous material (HazMat) will be shipped according to applicable Department of Transportation (DOT) and International Air Transport Association regulations and requirements as prescribed by the company DOT Program; however, no shipment of HazMat is anticipated.

All employees preparing HazMat packages or offering HazMat to a third-party carrier (such as Federal Express), will have current HazMat training as prescribed by the company DOT Program.

5 PERSONAL PROTECTIVE EQUIPMENT

5.1 General Protection Levels and Training

Level D/Modified Level D PPE will be worn by all onsite workers for adequate protection against known or anticipated hazards for all tasks included in the scope of work. The level of protection worn by site personnel will be enforced by the SSHO and may be upgraded or downgraded at the discretion of the SHM or the SSHO, based on real-time site experience. Any recommended changes in the level of protection will be documented, and a revised hazard assessment will be prepared by the SSHO for use in the field. The AHAs will be updated and approved by the SSHO to reflect any changes in the level of protection.

In addition to the PPE training received during the 40-hour HAZWOPER and associated 8-hour HAZWOPER refresher training, 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 during the daily tailgate meeting. If the SSHO determines during the daily tailgate 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.

PPE will be inspected regularly and maintained in serviceable and sanitary condition and before being reissued to another person or returned to storage, will be cleaned, disinfected, inspected, and repaired.

5.2 Required Level of Protection

The minimum level of protection (Level D/Modified Level D) that is required of the Arcadis and subcontractor personnel at YTC includes:

- Protective headgear that meets the requirements of the American National Standards Institute (ANSI) Z89.1, Class A or ANSI Z89.2, Class B.
- High-visibility safety/reflective vests.
- Clothing suitable for the weather and work conditions. The minimum will be a long-sleeve shirt and long pants.
- Safety toe boots meeting ASTM International 2413 standards.
- Safety glasses ANSI Z87:
  - Persons requiring corrective lenses in eyeglasses will be protected by one of the following:
    - Eyeglasses with protective lenses that provide optical correction.
    - Goggles that can be worn over corrective lenses without disturbing the adjustment of the spectacles; or goggles that incorporate corrective lenses mounted behind the protective lenses.
- Cut-resistant Level 2 gloves or leather gloves for work not involving the handling of decontamination equipment (cut-resistant if handling potential sharp items).

- Snake chaps (if snakes are observed in or near work zones during work).
- Nitrile gloves (when handling samples or preserved bottle ware; may be worn over cut-resistant gloves).
- Ear plugs with a minimum noise reduction rating of 22 or greater if noise levels are 85 decibel A-weighting or higher (i.e., during drilling activities).

6 MEDICAL SURVEILLANCE

All onsite Arcadis personnel who may have potential exposure to hazardous materials will have an initial employment, an annual, and a termination medical examination. Medical evaluations will be performed by an approved occupational physician in accordance with Arcadis's Medical Surveillance Program. All Arcadis personnel working at YTC will be enrolled in Arcadis's Medical Surveillance Program.

The SSHO will obtain a copy of documentation verifying participation in a medical surveillance program in accordance with Engineer Manual 385-1-1 Section 33.B.02 to include employee name, date of last examination, and name of examining physician(s) for field team members. Documentation will be maintained at field locations for the specific workers at that location, including the SSHO. This documentation will be made available upon the request of the Government Designated Authority. The information about the last medical examination completed by the SSHO is included below. Records will be kept in accordance with OSHA requirements.

Field Staff Name	Date of Last Examination	Examining Physician	Issuing State
Gabriel Hebert	2/4/2022	John Longphre, MD, MPH, DMO	Georgia

The purposes of the medical evaluation are to determine fitness for duty and establish baseline data for future reference. Such an evaluation is based upon the individual's occupational and medical history, a comprehensive physical examination, and an evaluation of the ability to work while wearing PPE. It is not anticipated that respiratory protection will be required at YTC; however, if field conditions change such that a respirator is necessary, all personnel must undergo an OSHA-type evaluation of the individual's ability to use respiratory protective equipment, including a pulmonary function test.

Supplemental examinations may be performed whenever there is an actual or suspected excessive exposure to chemical contaminants or upon experience of exposure symptoms or following injuries or temperature stress. Alcohol and/or drug testing may be required under Arcadis' drug and alcohol policy and Arcadis' contract-based Alcohol and Substance Abuse Detection and Deterrence Program when necessary to meet client requirements.

7 EXPOSURE MONITORING AND AIR SAMPLING

Particulate or chemical hazard exposure greater than threshold limit values are not expected at YTC; however, based on historical site uses of petroleum, oil, and lubricants at the sites and previous investigation results, VOCs/SVOCs may be present in the breathing zone during soil logging of drill cuttings. A photo ionization detector and particulate meter may be used during drilling activities and soil logging to ensure protection of site workers. The photo ionization detector will be calibrated to isobutylene each day prior to beginning work. The particulate meter will be zeroed in accordance with manufacturer’s specifications and will include zeroing in a dust-free environment.

Action levels for air monitoring for possible VOCs/SVOCs in the breathing zone during drilling activities are as follows:

- Less than 3 ppm – no action, continue work
- 3 to 5 ppm for more than 5 minutes – continuously monitor levels, review engineering controls, and proceed with caution
- More than 5 ppm for more than 5 minutes – stop work.

Action levels for air monitoring for dust in the breathing zone during drilling activities are as follows:

- Less than 1.5 mg/m^3 – no action, continue work
- 1.5 to 3 mg/m^3 – use engineering controls, monitor continuously
- More than 3 mg/m^3 – stop work.

Drilling activities that may result in elevated noise levels will be addressed by wearing hearing protection as described in **Section 5**, and by staying as far away from equipment as practicable and possible. Noise levels are not anticipated to be sufficient to require a noise monitoring program.

If any unusual conditions are encountered (e.g., odors, suspect liquids, excessive noise) during any work activities or if personnel experience any symptoms associated with potential exposure, work will be stopped. Site conditions and the need for additional PPE, site controls, or monitoring programs will be re-e valuated prior to resuming work.

Field teams will follow the YTC Dust Control Plan (2019). If dust is observed during earth work or drilling activities crews will be instructed to use water to suppress dust.

8 HEAT AND COLD STRESS MONITORING

Heat and cold stress monitoring are addressed below. Field work is tentatively scheduled for Fall and Winter 2022, when cold stress monitoring may be most applicable.

8.1 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. Work at the site does have the potential to be conducted in a hot environment with temperatures exceeding 75°F, which is a temperature that can produce heat stress symptoms. The SSHO will be responsible for monitoring the daily weather reports and using a handheld weather station to know when the possibility of reaching 75°F is possible. This will trigger wet bulb globe temperature (WBGT) monitoring, described below.

40-hour HAZWOPER and 8-hour HAZWOPER refresher training includes education on the signs and symptoms of heat-related illnesses and prevention techniques. Personnel will be familiar with the signs and symptoms of heat stress, including:

- 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, decontaminated promptly, 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:

- Implementing the buddy system during work in hot environments
- Scheduling more demanding tasks for cooler periods of the day
- Using cooling devices (rags, vests, misters) to keep employees comfortable
- Resting frequently in a shaded or air-conditioned area
- Allowing workers who are not acclimatized to take additional breaks
- Consuming appropriate quantities of fresh potable water and/or electrolyte-replenishing drinks (more than amount needed to simply “quench thirst”). Based on the conditions and work activities, it may be necessary for field crews to drink at least eight ounces of cool water or diluted electrolyte-replenishing

non-caffeinated sports drink every 15 to 20 minutes. This will be determined based on daily conditions by the SSHO.

- Monitoring WBGT heat stress index temperature by direct measurement.
- Physiological monitoring for employees wearing impermeable clothing with work/rest regimes and fluid replacement schedules established specifically for those employees
- Providing site workers with sunscreen of 30 sun protection factor or higher

The SSHO will be responsible for monitoring outdoor temperatures by checking local weather conditions via handheld weather station at least once per hour once temperatures reach above 60°F and then conducting WBGT monitoring whenever temperatures reach 75°F or higher. Ambient temperatures will be documented in the field logbook. The SSHO will take these measurements at frequencies of at least once per hour or more frequently as determined by the SSHO in consultation with the SHM based on the condition of the employees, specific weather conditions, work tasks, and other environmental factors and conditions during field activities. These readings will be documented on a real time monitoring log. A work/rest regimen will be implemented as necessary in accordance with the current ACGIH guidance table provided as **Table 3**.

Table 1 – ACGIH Screening Criteria for Heat Stress Exposure (WBGT values in °F)

Allocation of Work in a Work/Rest Cycle	Acclimatized				Unacclimatized			
	Light	Moderate	Heavy	Very Heavy	Light	Moderate	Heavy	Very Heavy
75-100%	87.8	82.4	--	--	82.4	77.0	--	--
50-75%	87.8	84.2	81.5	--	83.3	78.8	75.2	--
25-50%	89.6	86.0	84.2	82.4	85.1	80.6	77.9	76.1
0-25%	90.5	88.7	86.9	86.0	86.0	84.2	82.4	80.6

Notes:
Assumes 8-hour workdays in a 5-day work week with conventional breaks.
Threshold Limit Values assume that workers exposed to these conditions are adequately hydrated, are not taking medication, are wearing lightweight clothing, and are in generally good health.
Examples of workloads:
Rest - sitting (quietly or with moderate arm movements)
Light work - sitting or standing to control machines; performing light hand or arm work; occasional walking; driving
Moderate work - walking about with moderate lifting and pushing or pulling; walking at moderate pace
Heavy work - pick and shovel work, digging, carrying, pushing/pulling heavy loads; walking at fast pace
Very Heavy - very intense activity at fast to maximum pace
Adapted from: 2014 TLVs® and BEIs® - Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices. Cincinnati: ACGIH, 2014.

Other factors, such as a worker's level of acclimation, level of physical fitness, and age, may increase or decrease susceptibility to heat stress. Before assigning a task to an individual worker, these factors will be considered to prevent endangering the worker's health. Sunscreens will be provided and used per manufacturer's recommendations.

If the SSHO experiences or suspects symptoms of a heat-related illness they will move to a cool or shaded area, drink liquids, and call 911 if systems persist.

8.2 Cold Stress

The SSHO may determine that temperatures pose cold stress issues. In this case, the SSHO and the SHM will develop cold stress prevention processes. Environmental monitoring shall be conducted by the SSHO as follows:

- At air temperatures below 45°F, the temperature shall be monitored at least every 8 hours using a handheld weather station.
- At air temperatures below 45°F and above 30°F, the temperature and wind speed will be monitored at least every 4 hours using a handheld weather station.
- At air temperatures below 30°F, the temperature and wind speed will be measured and recorded in the SSHO's logbook at least every 4 hours, or more frequently if the handheld weather station shows the temperature dropping.
- The equivalent chill temperature and frost-bite precautions will be determined by using **Figure 2** and **Figure 3**.

Prolonged exposure to excessive cold and/or wet conditions may cause excessive loss of body heat (hypothermia), frostbite, slurred speech, memory lapses, drowsiness, incoherence, shivering or severe shaking. Hypothermia occurs when the body cannot maintain a normal core temperature of 98.6°F to 99.6°F. Wind, physical exhaustion, and wet clothing, all make a person more prone to hypothermia. Air temperature alone is not enough to judge the cold hazard of an environment. Most cases of hypothermia develop in an air temperature of 36°F to 50°F. The SSHO will monitor for symptoms of hypothermia any time the ambient conditions indicate the risk of hypothermia exists (as described above), and for symptoms of frostbite anytime the ambient conditions (temperature and wind speed) reach those described in **Figure 2**.

Forty-hour HAZWOPER and 8-Hour HAZWOPER refresher training includes symptoms of cold-related illnesses and prevention techniques. Personnel will be familiar with the signs and symptoms of cold stress, including:

- 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.

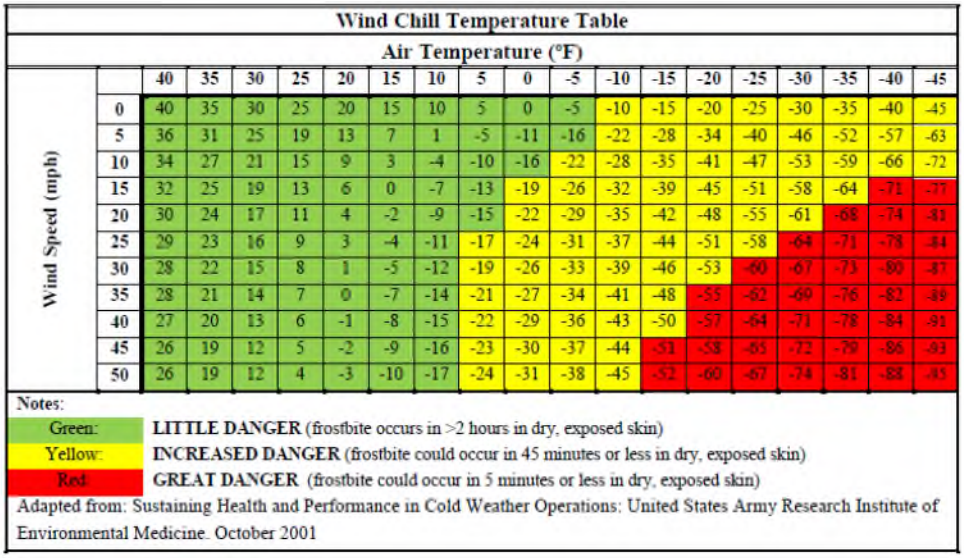
Extremity pain may be the first warning symptom of cold stress with a reduction in exposure. Severe shivering is a sign of immediate danger to the worker and exposure to cold will cease immediately. Personnel exhibiting signs and symptoms of cold stress will be removed from the site, decontaminated, 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). When air temperatures are less than 36ºF, workers who become immersed in water or whose clothing becomes wet will be immediately provided a change of clothing and be treated for hypothermia.

Protective clothing and PPE are essential to prevent hypothermia. The correct clothing depends on the specific cold stress situation. It is important to preserve the air space between the body and the outer layer of the clothing in order to retain body heat. Wearing clothing in multi-layers is preferred as it produces more air pockets, which provide better insulation. Clothing worn under PPE should be made of thin synthetic fabric, which helps to evaporate sweat by wicking it to the surface. The insulating effect is negated if the clothing interferes with the evaporation of sweat, or if the skin or clothing is wet. The most important parts of the body to protect are the feet, hands, head, and face.

Working in cold areas also causes significant water loss through the skin and lungs due to low humidity. Increased fluid intake is essential to prevent dehydration. Warm, sweet, caffeine-free, non-alcoholic drinks and soups should be made available for fluid replacement and caloric energy. If workers are experiencing signs and symptoms of cold stress, they will go to a warm area and call for emergency services if symptoms persist.

Both the outdoor temperature and the wind velocity play a part in cold injuries. Wind chill is a tool to describe the chilling effect of moving air in combination with low temperatures. **Figure 2** shows wind chill in relation to temperature with the associated frostbite times.[1]

Figure 2 – National Weather Service Wind Chill Chart



Wind Chill Temperature Table

Air Temperature (°F)

Wind Speed (mph)	40	35	30	25	20	15	10	5	0	-5	-10	-15	-20	-25	-30	-35	-40	-45
0	40	35	30	25	20	15	10	5	0	-5	-10	-15	-20	-25	-30	-35	-40	-45
5	36	31	25	19	13	7	1	-5	-11	-16	-22	-28	-34	-40	-46	-52	-57	-63
10	34	27	21	15	9	3	-4	-10	-16	-22	-28	-35	-41	-47	-53	-59	-66	-72
15	32	25	19	13	6	0	-7	-13	-19	-26	-32	-39	-45	-51	-58	-64	-71	-77
20	30	24	17	11	4	-2	-9	-15	-22	-29	-35	-42	-48	-55	-61	-68	-74	-81
25	29	23	16	9	3	-4	-11	-17	-24	-31	-37	-44	-51	-58	-64	-71	-78	-84
30	28	22	15	8	1	-5	-12	-19	-26	-33	-39	-46	-53	-60	-67	-73	-80	-87
35	28	21	14	7	0	-7	-14	-21	-27	-34	-41	-48	-55	-62	-69	-76	-82	-89
40	27	20	13	6	-1	-8	-15	-22	-29	-36	-43	-50	-57	-64	-71	-78	-84	-91
45	26	19	12	5	-2	-9	-16	-23	-30	-37	-44	-51	-58	-65	-72	-79	-86	-93
50	26	19	12	4	-3	-10	-17	-24	-31	-38	-45	-52	-60	-67	-74	-81	-88	-95

Notes:

🟩 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: United States Army Research Institute of Environmental Medicine. October 2001

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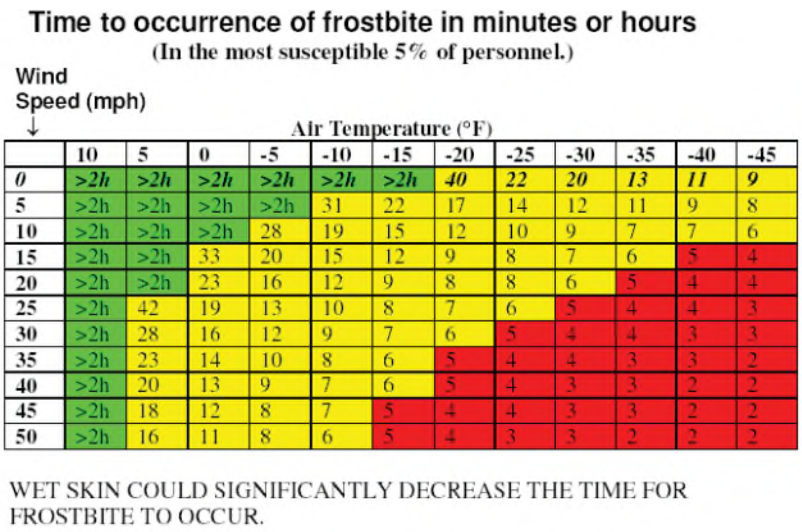
[1] National Weather Service Wind Chill Chart. Effective date November 1, 2001. http://www.weather.gov/om/windchill/index.shtml

Figure 3 – Time to Occurrence of Frostbite in Minutes or Hours



Time to occurrence of frostbite in minutes or hours

(In the most susceptible 5% of personnel.)

Wind
Speed (mph)
↓

Air Temperature (°F)

	10	5	0	-5	-10	-15	-20	-25	-30	-35	-40	-45
0	***>2h***	***>2h***	***>2h***	***>2h***	***>2h***	***>2h***	***40***	***22***	***20***	***13***	***11***	***9***
5	>2h	>2h	>2h	>2h	31	22	17	14	12	11	9	8
10	>2h	>2h	>2h	28	19	15	12	10	9	7	7	6
15	>2h	>2h	33	20	15	12	9	8	7	6	5	4
20	>2h	>2h	23	16	12	9	8	8	6	5	4	4
25	>2h	42	19	13	10	8	7	6	5	4	4	3
30	>2h	28	16	12	9	7	6	5	4	4	3	3
35	>2h	23	14	10	8	6	5	4	4	3	3	2
40	>2h	20	13	9	7	6	5	4	3	3	2	2
45	>2h	18	12	8	7	5	4	4	3	3	2	2
50	>2h	16	11	8	6	5	4	3	3	2	2	2

WET SKIN COULD SIGNIFICANTLY DECREASE THE TIME FOR FROSTBITE TO OCCUR.

*Source: USARIEM Technical Note "SUSTAINING HEALTH & PERFORMANCE IN COLD WEATHER OPERATIONS," October 2001

Recommended actions for prevention of cold stress:

- Wear non-cotton undergarments to wick perspiration from the body.
- Wear additional layers of light clothing for warmth. The layering effect holds in air, trapping body heat and some layers could be removed as the temperature rises during the workday. Caution: Wearing too much clothing will cause sweating, which may freeze next to the body, creating a hazard.
- Each worker must pay close attention to their body and take the appropriate actions to correct any symptoms of hypothermia (such as a break from work activity, move to rest area to warm up, and add additional clothing). Install a windbreak at the work site to break the cold winds from blowing directly on the crew. Field staff will use the field vehicles or field trailer as a warming station.
- Maintain good eating and drinking habits, enabling the body to operate at top capacity (e.g., avoid caffeine and alcohol).

9 STANDARD OPERATING AND SAFETY PROCEDURES

A range of chemical, physical, and biological hazards exist at YTC that must be understood by all personnel conducting PA/SI activities. At a minimum, the safe work practices to be followed will include:

- Field activities will be performed in accordance with the field guidance documents included in Appendix B of the work plan.
- Required work permits (i.e., utility clearance and permit to dig) will be obtained prior to the start of field activities.
- All personnel have the obligation to correct or report unsafe work conditions and to use Stop Work Authority when necessary to protect workers or the public. The PM will be notified if any subcontractor personnel are observed not to be able to perform to their capacity, as needed for the subcontracted work.
- The number of personnel and equipment on a property will be minimized, consistent with effective site operations. Personnel will use the buddy system (i.e., within earshot or visual contact with other personnel, generally from Arcadis or a subcontractor) on all properties. At least one person will be required to carry a cellular telephone.
- Any protective equipment and clothing must be worn by personnel as outlined in this SSHP.
- Contact with surfaces/materials either suspected or known to be contaminated will be avoided to minimize the potential for transfer to personnel, the need for decontamination and cross-contamination.
- Eating, drinking, chewing gum, tobacco smoking, or any other practice that increases the probability of hand-to-mouth transfer of contaminated material, or hand-to-equipment transfer of possible PFAS-containing material is prohibited in the work area. These practices should be conducted in field vehicles or trailers or offsite.
- Field activities will be performed to minimize dust production and soil disturbance (i.e., during drilling activities).
- During activities (e.g., well installation, purging, sampling) potentially involving contaminated material, materials will be collected and containerized in DOT-approved 55-gallon drums for characterization and disposal. Containers and drums will be properly labeled and inspected prior to being moved. Operations onsite will be organized to minimize the amount of drum or container movement.
- Work will be conducted during daylight hours only.
- Medicine and alcohol can potentiate the effects of exposure to contaminants of concern. Due to possible contraindications, use of prescribed drugs should be reviewed with the occupational medical physician. Alcoholic beverage and illegal drug intake are forbidden during investigation activities.

When it is necessary for an authorized visitor to observe the field activities, that person will be issued appropriate PPE, briefed on potential hazards, safety practices, decontamination procedures and site communications, and sign the SSHP indicating that they have been briefed and had an opportunity to read the SSHP.

10 SITE CONTROL MEASURES

All site control measures will be communicated to the field team during the daily tailgate meeting. This will include describing the standard work zones such as distance from the drill rig, position of the sample vehicle in relation to sample location, and decontamination location.

A daily log containing the names of personnel, site entry and exit times, and their expected work tasks will be maintained. Controls to preclude cross contamination will be in place, including the following:

- Work zone delineation, including a support zone, contamination reduction zone, and exclusion zone as determined by the SSHO.
- Properly using specified PPE, including nitrile gloves.
- Practicing contamination avoidance, by avoiding or minimizing contact with contaminants.
- Washing tools and equipment that has been in contact with potentially affected media (e.g., groundwater and soil).
- Observing good personal hygiene, washing hands after work tasks and before eating.

11 PERSONAL HYGIENE AND DECONTAMINATION

To the extent practicable, dedicated or disposable field equipment, that does not require decontamination will be used during these sampling efforts. Site sanitation and housekeeping plan is described in Section below. Field crews will be mobile and able to access YTC rest room facilities at communal buildings.

11.1 Housekeeping

The work site shall be kept as clean as possible, taking into consideration the nature of the work. Housekeeping of work areas will be conducted by field staff daily; additionally, the SSHO will conduct monthly inspections using the inspection form included in **Attachment 2**.

11.2 Drinking Water

An adequate supply of potable water shall be provided at the work site and in designated field vehicles for both drinking and personal cleansing. Individual bottled drinking water kept in coolers will be provided at all times for field staff.

11.3 Non-Potable Water

Outlets dispensing non-potable water, if in our vicinity, shall be conspicuously posted "CAUTION - WATER UNSAFE FOR DRINKING, WASHING, OR COOKING”.

11.4 Toilets / Handwashing

Arcadis field staff will be mobile and have transportation readily available to public toilet/washing facilities available within the site, installation, or at local commercial establishments. Staff are required to remove appropriate PPE and thoroughly wash hands and face before entering public facilities. Hand sanitizer will be available in the field vehicles.

In order to minimize the potential of spreading or contracting COVID-19, the CDC has recommended that hand washing/hygiene is one of the most effective ways to prevent the spread of germs. Key times to wash hands include before and after having been in public places and having touched an item or surface that may be a frequently touched by other people. Proper handwashing includes the five following steps:

1. Wet hands with clean, running water, turn off the tap, and apply soap
2. Lather hands by rubbing them together with the soap. Lather the backs of hands, between fingers, and under nails.
3. Scrub hands for a minimum of 20 seconds.
4. Rinse hands under clean, running water.
5. Dry hands using a clean towel or air dry

When soap and water are not available, hand sanitizer containing greater than 60% alcohol. Note that hand sanitizer is not as effective at germ removal as soap and water. To use hand sanitizer, apply the gel product to one hand (read the label to determine the correct amount). Rub hands together to apply the gel over all the surfaces of hands until the gel has dried.

Arcadis will establish and maintain hygienic sanitation provisions for all employees in all places of employment. Each vehicle is equipped with drinking water, handwashing supplies, and garbage bags to collect waste.

11.5 Waste

Refuse containers or bags will be available onsite. Food waste or other refuse that may attract pests or vermin will be removed from the site daily.

12 EQUIPMENT DECONTAMINATION AND DISPOSAL

All equipment will be decontaminated prior to the start of each workday, in between all sample locations, and at the end of each workday. Decontamination procedures are presented in standard operating procedures included in Appendix B of the work plan.

All discarded materials, waste materials, or other objects will be handled in such a way as to preclude the potential for spreading contamination, creating a sanitary hazard, or causing litter to be left on a property. All potentially contaminated materials, (e.g., clothing, gloves, PPE) will be bagged or drummed as necessary and segregated for disposal. All contaminated waste materials will be containerized onsite until characterized for proper disposal. All non-contaminated materials will be collected and bagged for appropriate disposal as domestic wastes.

13 EMERGENCY EQUIPMENT AND FIRST AID REQUIREMENTS

Emergency equipment will be readily accessible and distinctly marked. Arcadis and subcontractor personnel will be familiar with the location and trained in the use of emergency equipment. Emergency equipment that will be available includes:

- Fire extinguishers:
    - Arcadis and subcontractors will provide 10-pound ABC type, fire extinguishers. Fire extinguishers will be located in field vehicles and placed in proximity to the drill rig during drilling (direct push technology) operations.
    - All field staff with have fire extinguisher awareness instruction, with a dated training certificate.
    - Fire extinguishers will be inspected, serviced, and maintained in accordance with the manufacturer’s instructions. At a minimum, all extinguishers will be checked at the start of field activities.
    - Immediately after each use, fire extinguishers will be either recharged or replaced.
    - Fire extinguishers will be carried in all mechanical equipment or construction vehicles, distinctly marked, and readily accessible.
    - Fire extinguishers will be secured in field vehicles, distinctly marked, and readily accessible.
- First aid kits:
    - First aid kits will conform to American Red Cross and the requirements of 29 Code of Federal Regulations 1910.151. At a minimum, first aid kits will be equipped with provisions necessary for the anticipated hazards at a property. Examples are ANSI Z308.1-2015 "Minimum Requirements for Workplace First-aid Kits" and American Red Cross “Anatomy of a First Aid Kit.”
    - First aid kits will consist of a weatherproof container with individually sealed packages containing each type of item.
    - First aid kits will be fully equipped before being sent to a property and will be checked monthly by the SSHO; expended items will be immediately replaced.
    - First aid kits will be secured in field vehicles, distinctly marked, and readily accessible.
- Eyewash bottles:
    - Portable eyewash bottles (1 to 2 bottles per team) will be available with the first aid kit. The water in the unit will be maintained at a temperature between 60- and 100-^{o}F.
    - Portable eyewash bottle eyewash fluids will be visually inspected daily by the SSHO to verify they remain sanitary with no visible sediments.

  - In an eye emergency, the eye will be immediately flushed with large amounts of sterile water while lifting the lower and upper lids. Professional medical attention should be sought immediately.
  - Emergency eyewash bottles will be secured in field vehicles, distinctly marked, and readily accessible.

14 EMERGENCY RESPONSE AND CONTINGENCY PROCEDURES

An emergency is defined as a serious situation or occurrence that happens unexpectedly and demands immediate action. Field personnel will immediately stop work and report to the SSHO under the following situations:

- Medical emergency
- Discovery of unanticipated hazards (e.g., drums, heavily contaminated materials)
- Heat/cold-related injury or heat/cold stress requiring emergency medical support
- Change of conditions at the site that may cause an unsafe work environment including fire or weather-related conditions

The SSHO or designee will review the Emergency Response Plan with field personnel prior to assignment to field work. This review will be documented on the Daily Tailgate Meeting form. This will include designating rally points for assembly in case of evacuation.

Upon notification of the emergency announcement, all personnel will Stop Work and adhere to any specific announcement requirements; additionally, after the announcement, all personnel will meet at the designated rally points and check in with the SSHO. The SSHO will ensure that all field personnel are accounted for.

The SSHO will be the main point of contact for field staff to seek information or have questions answered regarding the site emergency plan.

14.1 Pre-Emergency Planning

The SSHO will implement this emergency response plan whenever conditions at YTC warrant such action. The SSHO will be responsible for assuring the evacuation, emergency treatment, and emergency transport of personnel as necessary, and notification of emergency response units and the appropriate staff.

The SSHO will inform the local fire department about the nature and duration of field investigation activities expected on a property and the type of chemicals of concern and possible health or safety effects of emergencies involving these chemicals.

14.2 Spills

Accidental releases of fuels or hydraulic fluids could occur at the site. Reportable spills are not expected as the amounts of material used at the site will not be present in amounts that would require reporting. Fueling operations will take place on secondary containment. In the event of a release, it will be reported to the SSHO who will assess the hazard and determine the appropriate response action. Releases to soil will be excavated. The excavated materials will be drummed and appropriately disposed. Fuel spills to the containment area will be remediated with sorbent material and appropriately disposed.

14.3 Fires

In the event of a fire at one of the active job sites:

Field staff will immediately stop work, evacuate the area, and report the emergency via verbal communication to the field leader or SSHO, whoever is more accessible. Reporting processes will be reviewed during the Daily Tailgate Meeting so that all staff are aware of who to communicate with at any given time during the work day. The fire department and the facility responders shall be alerted. Emergency contact numbers will be placed in the field vehicles, so all field personnel will have access to them.

Because portable fire extinguishers are made available for general employee use at the site, an employee who elects but is not designated to extinguish an incipient fire, may do so if it can be done safely and if the fire is not blocking the evacuation route from the area. If the evacuation route is not blocked, the employee will place themselves between the fire and the evacuation point in the event the fire situation changes requiring evacuation. All Arcadis field staff have fire extinguisher training.

The field leader or SSHO will assess the situation and determine the need for full evacuation from the location and/or what additional response actions are required. Notifications and reporting of the emergency will following the existing procedures and will include notification of off-site emergency responders, even if an incipient fire is extinguished. If full evacuation is required due to the size of the initial fire or because conditions have changed since the ignition of an incipient fire, all staff will move to the designated meeting point agreed to during the Daily Tailgate Meeting. At the meeting point, the SSHO will take roll call to ensure all staff are accounted for and safe. If not, the SSHO will attempt to contact the missing staff member and will notify emergency responders of this situation. Emergency responders that are called from off-site will provide all emergency rescue as necessary. Emergency contact numbers will be placed in the field vehicles so all field personnel will have access to them.

Emergency medical assistance will be provided as appropriate by staff trained in First Aid/CPR until off-site emergency responders arrive as long as that assistance does not put the first aider in danger.. The Emergency Response Plan will be reviewed whenever any element of the Emergency Response Plan changes or those personnel with key roles in the plan change. These changes will be reviewed with all site employees as well as all appropriate emergency responders.

14.4 Medical Support

First aid kits will be available in each field vehicle and in areas most accessible to employees and in the proximity of those areas where accidents are most likely to occur. The SSHO will be responsible for keeping the first aid kits adequately supplied. First aid kits will be provided at a ratio of one for every 25 employees. The presence of fewer than 25 employees on site still warrants a first aid kit to be on site. The SSHO will inspect the first aid equipment at each location on a daily basis as part of the daily health and safety and occupational health inspections. Only those trained in rendering first aid, including CPR, will do so.

Portable eyewash bottles will be available with the first aid kit. The water in the unit will be maintained at a temperature between 60- and 100-^{0}F. Personal eyewash fluids will be visually inspected daily by the SSHO to ensure they remain sanitary with no visible sediments.

14.5 Personnel Roles, Lines of Authority, and Communication

The SSHO is the primary authority for directing operations at a property under emergency conditions. All communications both on and off the property will be directed through the SSHO. The roles and emergency contact information personnel for the project are provided below.

Cellular phones and hand signals will be used for communications and during emergency situations. Working order of the cellular phones should be verified before field tasks begin.

14.6 Emergency Recognition and Prevention

As part of the Site Orientation Training, the SSHO will address emergency recognition and prevention. Topics will include hazard recognition regarding tasks to be performed, in addition to hazards associated with property contaminants. Personnel should also read this SSHP to become familiar with other topics related to emergency recognition and prevention.

14.6.1 Adverse Weather Conditions

The SSHO will check weather reports daily; when the weather reports provide warnings or indications of impending severe weather (heavy rains, thunderstorms, damaging winds, tornados, hurricanes, floods, lightning), weather emergency notification will be monitored through the state Emergency Alert System. Emergency Alert System messages provide information during emergencies including severe weather and are disseminated via numerous radio stations in the site vicinity.

Whenever unfavorable conditions arise, the SSHO will evaluate both the safety hazards and the abilities of the employees to effectively perform given tasks under such conditions. Activities will be halted at the discretion of the SSHO who has the ultimate responsibility for these decisions.

In the event of severe weather conditions, all site personnel will report to their field vehicle immediately and remain inside the vehicle until further notice. The SSHO will decide to either secure the site for the day or go back to work. Some of the guidelines to be used in making this decision are:

- Potential for lightning strikes
- Potential for heat/cold stress
- Limited visibility
- Inclement weather-related working conditions
- Area roads becoming impassable

If lightning is observed, all work shall stop. A determination will be made as to the proximity to the operation being performed. Once lightning is seen, the number of seconds until thunder is heard will be counted. Divide number of seconds by 5 to get the distance the lightning is away. If lightning is 10-miles away or less, work should stop until 30- minutes after the last audible thunder or visible flash of lightning.

14.6.2 Fire or Explosion

Vapors at concentrations exceeding the lower explosive limits values are not anticipated in the work zone. However, if a gas odor is observed, vent and evacuate the area, and notify the local fire and police departments and other appropriate emergency response groups.

Other fire hazards may include brush fires from operation of heavy equipment over or near dry vegetation. Notify local appropriate emergency response groups by calling 911 if an actual fire or explosion has taken place. Allow the responding agencies to be responsible for public safety and notifying the public.

14.6.3 Emergency Telephone Numbers

Emergency phone numbers will be made available in the field vehicles and saved to cell phones. Emergency phone numbers are provided in Table 4.

14.6.4 Medical Support

14.6.4.1 Onsite First Aid Support

First aid kits and eyewash stations, as described in **Section 13,** will be available in each field vehicle and in areas most accessible to employees and in the proximity of those areas where accidents are most likely to occur. The SSHO will be responsible for keeping the first aid kits adequately supplied. Only those trained in rendering first aid, including cardiopulmonary resuscitation, will do so.

Arcadis has designated that at least two people (one being the SSHO) onsite to be trained in first aid/cardiopulmonary resuscitation as offsite medical providers may not be able to respond in a prompt manner (within a few minutes). The emergency medical facilities will be notified of the nature and period of performance of the work to be performed.

This notification will be completed via telephone and notes taken to document the notification will be provided to the PM, Regional Lead, TM, and SHM via e-mail. The emergency services providers will be offered an onsite orientation of the project and the associated hazards. Access procedures to the site will be determined and provided to the emergency responders for efficient access to the site in the event of an emergency.

In addition, a verbal agreement will be established between Arcadis, local emergency responders, and the servicing emergency medical facility that specifies the responsibilities of onsite personnel, emergency response personnel, and the emergency medical facility in the event of an onsite emergency. If a field employee is involved in an accident that requires medical treatment beyond first aid, field personnel will contact 911 using a cellular phone. After contacting 911, the SSHO will contact WorkCare at (888) 449-7787 to inform them of the emergency. Additionally, the SSHO will notify the PM, Regional Lead, or TM and SHM.

In case of a non-emergency related injury/illness, field personnel will contact WorkCare at (800) 455-6155. WorkCare will provide instructions to the field personnel and inform them if the injured employee must receive additional medical attention. The PM, Regional Lead, TM, or SHM and SSHO will be notified after calling WorkCare.

Emergency responders will be contacted first for transporting an injured employee to an appropriate medical support facility. In rare events, it may be necessary for a member of the project team to drive the employee to the emergency room. If this situation arises, the designated first aid responder(s) will transport the injured party.

The Yakima Valley Urgent Care (17 E Valley Mall Boulevard #2b, Union Gap, Washington 98903) is the nearest WorkCare approved non-emergency care provider for YTC; the total drive time from the project site is approximately 13 minutes. **Figure 4** provides a map of the recommended route from the project site to Yakima Valley Urgent Care.

Directions to Yakima Valley Urgent Care in Yakima from YTC are as follows:

- Get on I-82 E (0.1 mile)
- Head West on 7th Avenue/Firing Center Road toward Pomona Heights Road (0.7 mile)
- Continue onto WA-821 N (0.1 mile)
- Turn Left to merge with I-82 E towards Yakima (0.3 mile)
- Follow I-82 E to Rudkin Road in Union Gap. Take Exit 36 from I-82 E (9.4 miles)
- Drive towards your destination (0.2 mile). Your destination is on the right.

The Virginia Mason Memorial Hospital (2811 Tieton Drive, Yakima, Washington 98902) is the local hospital and emergency care provider for YTC; the total drive time from the project site is approximately 15 minutes. **Figure 5** provides a map of the recommended route from the project site to Virginia Mason Memorial Hospital.

Directions to Virginia Mason Memorial Hospital in Yakima from YTC are as follows:

- Get on I-82 E (1.2 miles)
- Merge with I-82 E (4.1 miles)
- Use right lane to exit 31 A-31 B and keep right to continue Exit 31 A, and merge with US-12 W (0.8 miles)
- Take the North 16th Avenue Exit (0.3 mile)
- Turn left onto North 16th Avenue (2.2 miles)
- Turn right onto W Tieton Drive (0.7 mile)
- Turn left (0.2 mile) on to Tieton Drive
- Your destination is on the right.

The SSHO will coordinate with the emergency responders to gain an understanding of what needs to be done in the event of an emergency and to ensure emergency medical service information is accurate. Emergency phone numbers are included in **Table 4**, below.

Table 4. Emergency Contact List

Emergency Contact	Phone
Emergency (calling from cell phone)	911
Police/Ambulance/Fire Department	911
State Police	911
Local Hospital: Virginia Mason Memorial Hospital 2811 Tieton Drive, Yakima, Washington 98902	(509)-575-8000
Local Urgent Care Clinic: Yakima Valley Urgent Care 17 E Valley Mall Boulevard #2b, Union Gap, Washington 98903	(509)-367-8733
WorkCare	(888) 449-7787
Poison Control	(800) 222-1222
National Response Center (all spills in reportable quantities)	(800) 424-8802
PM: Jesse Hemmen	(503)-449-0778 (M)
Program Manager: Rhonda Stone	(610) 563-6122 (M)
SSHO: Gabriel Hebert	(317) 694-3727 (M)
SHM/Certified Industrial Hygienist: Grey Coppi	(732) 661-3851 (O) (908) 917-6948 (M)
U.S. Army Environmental Command PM: Roger Walton	(210) 466-1063 (O)

Notes:
M = mobile
O = office

14.7 Evacuation Procedures/Safe Distances

Evacuation procedures and anticipated conditions that may require these responses are described below. If property evacuation is required, all Arcadis personnel will be notified by cellular telephone.

- *Withdrawal upwind.* Withdrawing upwind (100 feet or more, if practical) will be required when gas odor is detected (call 911 immediately, when at a safe distance). Personnel conducting PA/SI activities will observe general wind directions. The SHM, PM, and the U.S. Army Environmental Command PM will be notified of conditions and actions taken. When access to the property is restricted and escape is thereby hindered, personnel may be instructed to evacuate the property rather than move upwind, especially if withdrawal upwind moves personnel away from escape routes.

- *Property evacuation.* Property evacuation will be required when a fire or major collapse occurs; or when explosion is imminent or has occurred. After determining that evacuation is warranted, the field team will proceed upwind of the work area and call 911, then notify the SSHO of site conditions. The SSHO and the field team will remain at the designated location given on the 911 call, so they may assist the first responders to the situation. The SSHO will remain with the 911 responders until told to leave. The field team will proceed to the muster point and document their knowledge of the situation.
- The evacuation route and an upwind gathering point will be determined by the SSHO each day and communicated to all personnel prior to beginning work. Any modifications to the evacuation route or gathering point will be discussed at the daily tailgate meeting.
- *Surrounding area evacuation.* Should the area surrounding a property will be evacuated when persistent, insuppressible toxic or explosive vapors from borings are released, or air quality monitored at several points downwind indicates danger to the surrounding area, the installation and 911 will be notified. If it is determined by the installation and emergency services that conditions warrant evacuation of downwind residences and commercial operations, then the local agencies will be notified, and assistance requested, if necessary.

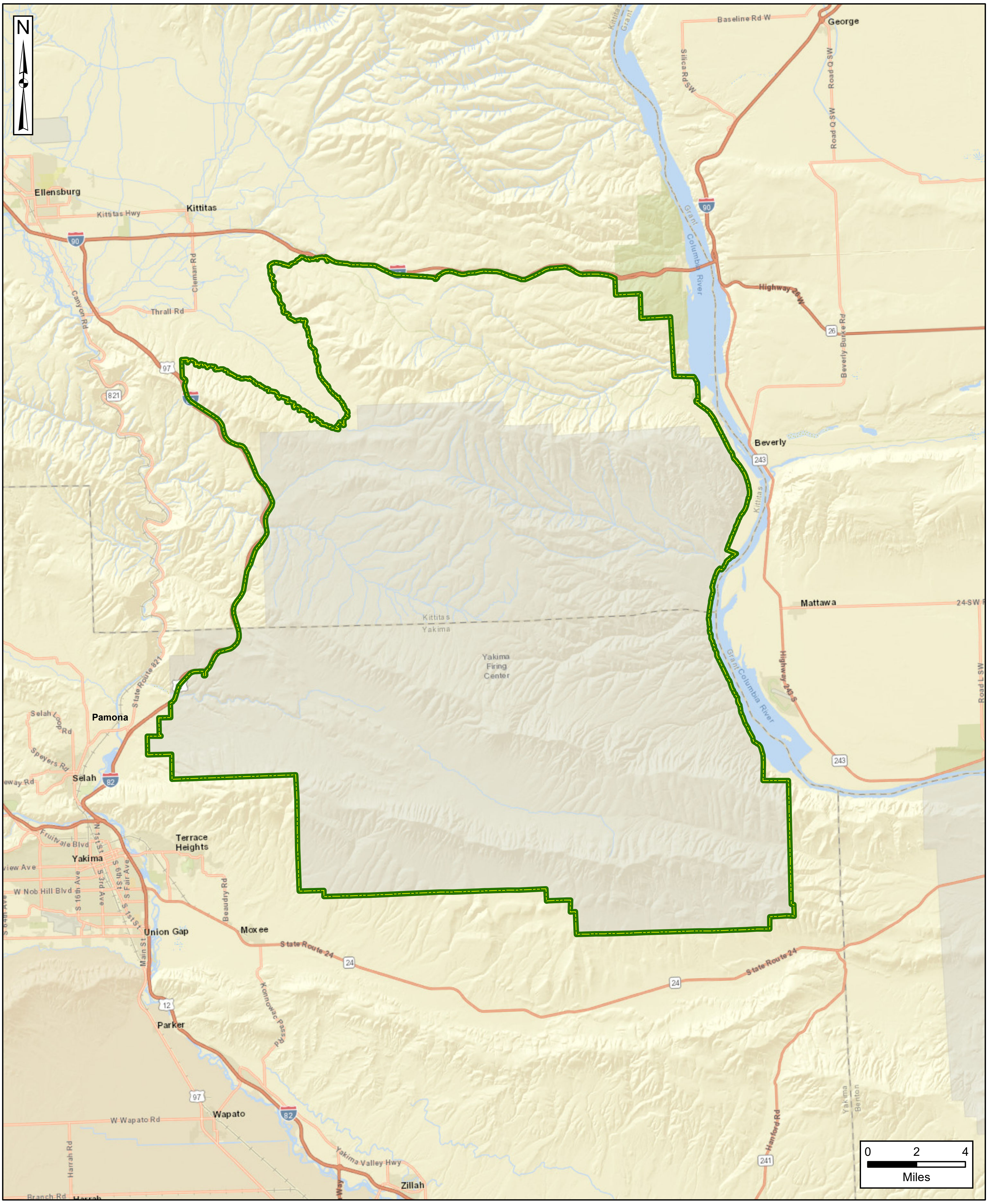
14.8 Post-Emergency Response Actions

Before field activities are resumed, personnel will be fully prepared and equipped to handle another similar emergency. The SSHO will be responsible for re-stocking emergency supplies and replacing or repairing damaged equipment and reviewing or revising the emergency response plan as appropriate.

FIGURES

Boundary Investigation Work Plan
USAEC PFAS Remedial Investigation
Yakima Training Center, WA

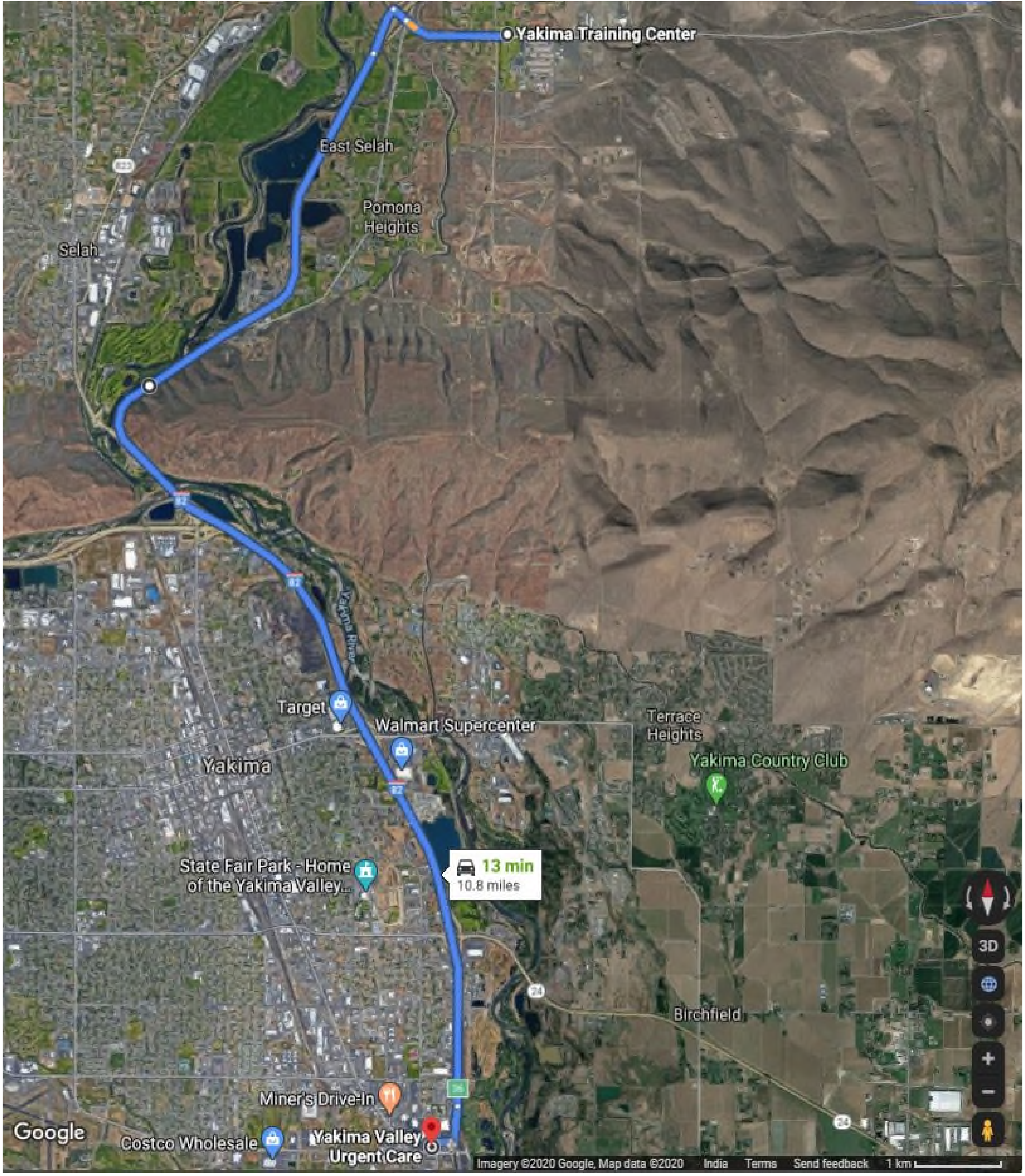
Figure 1
Site Location



▢ Installation Boundary

Data Sources:
Yakima Training Center, GIS Data, 2018
ESRI ArcGIS Online, Street Map Data

Coordinate System:
WGS 1984, UTM Zone 10 North



Notes:

1. Image obtained from Google Maps.
2. Telephone number for Yakima Valley Urgent Care - Yakima, Washington: (509)-367-8733

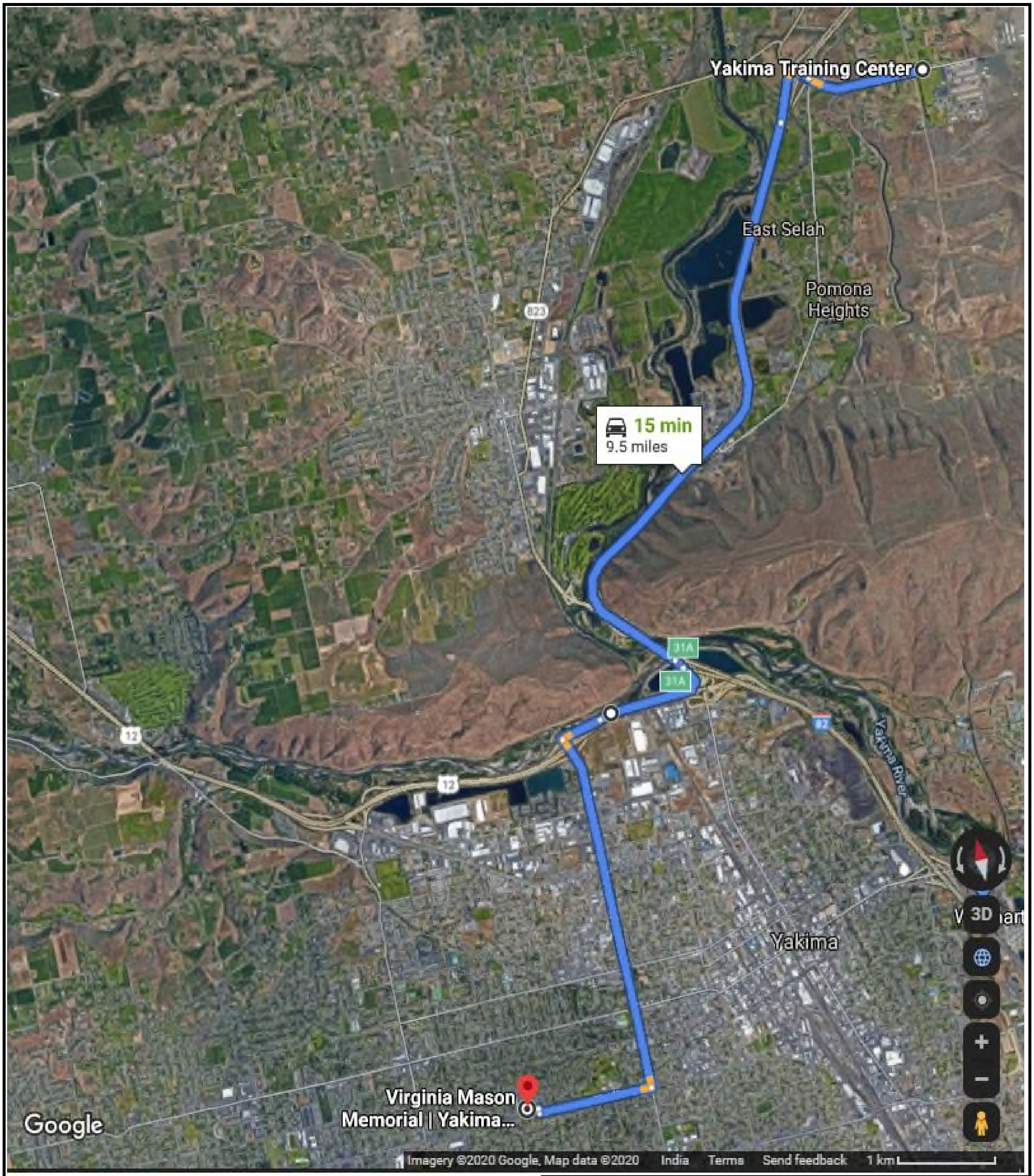
USAEC PFAS RI
YAKIMA TRAINING CENTER
YAKIMA, WASHINGTON

SITE SAFETY AND HEALTH PLAN

Route from Yakima Cantonment Area to Yakima Valley Urgent Care

ARCADIS Design & Consultancy for natural and built assets

FIGURE
4



Notes:

1. Image obtained from Google Maps.
2. Telephone number for Virginia Mason Memorial Hospital - Yakima, Yakima County, Washington: (509)-575-8000

USAEC PFAS RI
YAKIMA TRAINING CENTER
YAKIMA, WASHINGTON
SITE SAFETY AND HEALTH PLAN

Route from Yakima Cantonment Area to Virginia Mason Memorial Hospital

ARCADIS Design & Consultancy for natural and built assets

FIGURE
5

4/2/2020
https://arcadiso365.sharepoint.com/sites/USAEC_PFOS_PFOA/region2/Shared Documents/Yakima Training Center/03_Deliverables/08 - SSHP/01_Draft/02_Figures/[Figure 7 - Nearest Hospital Directions_Yakima Training Center (Region 2).xlsx]Figure 6

ATTACHMENT 1

PFAS Fact Sheet

Perfluoroalkyl and Polyfluoroalkyl Substances (PFAS)

Frequently Asked Questions

What are PFAS?

Perfluoroalkyl and polyfluoroalkyl substances (PFAS) are a large group of man-made chemicals that have been used in industry and consumer products worldwide since the 1950s.

- PFAS do not occur naturally, but are widespread in the environment.
- PFAS are found in people, wildlife and fish all over the world.
- Some PFAS can stay in people's bodies a long time.
- Some PFAS do not break down easily in the environment.

How can I be exposed to PFAS?

PFAS contamination may be in drinking water, food, indoor dust, some consumer products, and workplaces. Most non worker exposures occur through drinking contaminated water or eating food that contains PFAS.

Although some types of PFAS are no longer used, some products may still contain PFAS:

- Food packaging materials
- Nonstick cookware
- Stain resistant carpet treatments
- Water resistant clothing
- Cleaning products
- Paints, varnishes and sealants
- Firefighting foam
- Some cosmetics

How can I reduce my exposure to PFAS?

PFAS are present at low levels in some food products and in the environment (air, water, soil etc.), so you probably cannot prevent PFAS exposure altogether. However, if you live near known sources of PFAS contamination, you can take steps to reduce your risk of exposure.

- If your drinking water contains PFAS above the EPA Lifetime Health Advisory, consider using an alternative or treated water source for any activity in which you might swallow water:
  - drinking
  - food preparation
  - cooking
  - brushing teeth, and
  - preparing infant formula
- Check for fish advisories for water bodies where you fish.
  - Follow fish advisories that tell people to stop or limit eating fish from waters contaminated with PFAS or other compounds.
  - Research has shown the benefits of eating fish, so continue to eat fish from safe sources as part of your healthy diet.
- Read consumer product labels and avoid using those with PFAS.

How can PFAS affect people's health?

Some scientific studies suggest that certain PFAS may affect different systems in the body. NCEH/ATSDR is working with various partners to better understand how exposure to PFAS might affect people's health—especially how exposure to PFAS in water and food may be harmful. Although more research is needed, some studies in people have shown that certain PFAS may:

- affect growth, learning, and behavior of infants and older children
- lower a woman's chance of getting pregnant
- interfere with the body's natural hormones
- increase cholesterol levels
- affect the immune system and
- increase the risk of cancer

At this time, scientists are still learning about the health effects of exposures to mixtures of PFAS.

How can I learn more?

You can visit the following websites for more information:

- **CDC/ATSDR:**
  - CDC Info: https://www.cdc.gov/cdc-info/, or **(800) 232-4636**.
  - www.atsdr.cdc.gov/pfc/index.html
  - https://www.cdc.gov/exposurereport/index.html
- **Environmental Protection Agency (EPA):** https://www.epa.gov/chemical-research/research-and-polyfluoroalkyl-substances-pfas
- **Food and Drug Administration:** https://www.fda.gov/food/newsevents/constituentupdates/ucm479465.htm
- **National Toxicology Program:** https://ntp.niehs.nih.gov/pubhealth/hat/noms/pfoa/index.html

If you have questions about the products you use in your home, please contact the **Consumer Product Safety Commission (CPSC)** at **(800) 638-2772**.

List of Common PFAS and Their Abbreviations:

Abbreviation	Chemical name
PFOS	Perfluorooctane sulfonic acid
PFOA (or C8)	Perfluorooctanoic acid
PFNA	Perfluorononanoic acid
PFDA	Perfluorodecanoic acid
PFOSA (or FOSA)	Perfluorooctane sulfonaminde
MeFOSAA (aka Me-PFOSA-AcOH)	2-(N-Methyl-perfluorooctane sulfonamido) acetic acid
Et-FOSAA (aka Et-PFOSA-AcOH)	2-(N-Ethyl-perfluorooctane sulfonamido) acetic acid
PFHxS	Perfluorohexane sulfonic acid

ATTACHMENT 2

Activity Hazard Analysis

General Task Hazard Assessment and Risk Control (HARC)

General:	Site-Wide

The 12 hazard category HARC ratings are not available in this General THA. The mitigated and unmitigated ratings for the hazards presented are based on the Risk Assessment Matrix below. Modify hazards and ratings as necessary to meet project needs.

Risk Assessment Matrix		Likelihood Ratings			
Consequences Ratings		A	B	C	D
People	Property	0 Almost Impossible	1 Possible but Unlikely	2 Likely to Happen	3 Almost Certain to Happen
1-Slight or No Health Effect	Slight or No Damage	0-Low	1-Low	2-Low	3-Low
2-Minor Health Effect	Minor Damage	0-Low	2-Low	4-Medium	6-Medium
3-Major Health Effect	Local Damage	0-Low	3-Low	6-Medium	9-High
4-Fatalities	Major Damage	0-Low	4-Medium	8-High	12-High

Hazard #1

Driving - On road - Injury or vehicle damage from motor vehicle accident or incident

Suggested FHSHB Ref:	3.4	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	HIGH	Smith System (on line)
Mitigated Risk:	MEDIUM	JSAs

Comments: Use Smith System "5-Keys" when driving. See Driving JSA for details.

Hazard #2

Driving - Driver - Injury, death or property damage due to driver distraction, fatigue, etc.

Suggested FHSHB Ref:	3.4, 3.21	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	HIGH	Smith System (on line)
Mitigated Risk:	LOW	Driver awareness and use of stop work authority

Comments: Use route planning. Keep eyes moving while driving. See Driving JSA.

Hazard #3

Biological - skin/eye irritation or damage from poisonous plants

Suggested FHSHB Ref:	3.17.11	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	MEDIUM	See HASP Tick/Poisonous Plant Section
Mitigated Risk:	LOW	Job Briefing/Site Awareness

Comments: Use skin pre-treatment lotions when available.

Hazard #4

Biological - bites or stings from exposure to insects or arachnids

Suggested FHSHB Ref:	3.17: 2,3,7,8,9,10	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	MEDIUM	PPE (see HASP "PPE" section)
Mitigated Risk:	LOW	Job Briefing/Site Awareness

Comments: Do body check daily. For ticks see also HASP Tick/Poisonous Plant section

Hazard #5

Biological - cuts, scrapes, skin/eye puncture from exposure to physically damaging plants

Suggested FHSHB Ref:	3.17.11	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	MEDIUM	Job Briefing/Site Awareness
Mitigated Risk:	LOW	PPE (see HASP "PPE" section)

Comments:

General Task HARC (continued)

Hazard #6

Environmental - Thermal stress - Injury or illness from heat or cold

Suggested FHSHB Ref:	3.16	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	MEDIUM	Field H&S Handbook (see ref. above)
Mitigated Risk:	LOW	JSAs

Comments: Use job rotation or rest breaks. Stay hydrated and eat regularly.

Hazard #7

Environmental - Inclement weather -Injury or equipment damage from inclement weather

Suggested FHSHB Ref:	3.12	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	MEDIUM	Weather Monitoring
Mitigated Risk:	LOW	Cont./Emerg. Planning

Comments: Use 30/30 rule for lightning. See FHSHB for details.

Hazard #8

Motion - Musculoskeletal - Injury from lifting, twisting , stooping, or awkward body positions

Suggested FHSHB Ref:	3.29.1	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	MEDIUM	Engineering Controls (specify in comments)
Mitigated Risk:	LOW	Admin. Controls (specify in comments)

Comments: Use proper lifting techniques. Use job rotation when applicable. See FHSHB for details.

Hazard #9

Motion - Musculoskeletal - Injury from repeated work activity or body motion

Suggested FHSHB Ref:	3.29.2	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	MEDIUM	Engineering Controls (specify in comments)
Mitigated Risk:	LOW	Admin. Controls (specify in comments)

Comments: Use proper lifting techniques. Use job rotation when applicable. See FHSHB for details.

Hazard #10

Gravity - Falls - Injury due to slips and trips

Suggested FHSHB Ref:	3.26.4, 4.11	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	MEDIUM	Site Awareness
Mitigated Risk:	LOW	Housekeeping

Comments: Use footwear appropriate for site conditions, plan routes and do not hurry while walking.

Hazard #11

None

Suggested FHSHB Ref:	None	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	Not Ranked	Select
Mitigated Risk:	Not Ranked	Select

Comments:

Hazard #12

None

Suggested FHSHB Ref:	None	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	Not Ranked	Select
Mitigated Risk:	Not Ranked	Select

Comments:

Task Specific HARC

Task 1:	Drilling - Contractor oversight

HARC Unmitigated Hazard Types (H-High, M-Medium, L-Low): FHSHB Ref: 4.5

Biological*	L	Chemical	L	Driving*	-	Electrical	L
Environmental*	L	Gravity*	M	Mechanical	M	Motion*	M
Personal Safety	-	Pressure	L	Radiation	-	Sound	H

Hazard rating, if present, excludes General THA hazards in this category.

Hazard #1

Mechanical - Pinch point - Injury by pinching of body part in mechanical process

Suggested FHSHB Ref:	3.27.4	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	MEDIUM	Operator Competency per Standard
Mitigated Risk:	LOW	Machine Guarding

Comments: Air rotary drilling will be conducted by trained subcontractors. Arcadis will perform oversight only and keep distance from rig while operating.

Hazard #2

Motion - Process failure - Injury or equipment damage due to improper lockout/tagout

Suggested FHSHB Ref:	3.24	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	MEDIUM	Lockout/Tagout
Mitigated Risk:	LOW	H&S Standards

Comments: Arcadis will discuss safety protocols and LO/TO with subs in tailgate meeting.

Hazard #3

Pressure - Hydraulic - Injury from hydraulic process or device failure

Suggested FHSHB Ref:	2.5, 4.5, 4.6	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	MEDIUM	Specialized Training per Standard
Mitigated Risk:	LOW	PPE (see HASP "PPE" section)

Comments: Air rotary drill rig uses compressed air. Arcadis will keep safe distance from rig while operating--only subs with specialized training will operate rig. PPE such as safety glasses and cut-resistant gloves will be worn at all times around the rig.

Hazard #4

Sound - Noise - Injury or illness due to noise exposure

Suggested FHSHB Ref:	3.15	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	MEDIUM	PPE (see HASP "PPE" section)
Mitigated Risk:	LOW	H&S Standards

Comments: Hearing protection will be used an d distance from rig during operation.

General Task Hazard Assessment and Risk Control (HARC)

General: **Site-Wide**

The 12 hazard category HARC ratings are not available in this General THA. The mitigated and unmitigated ratings for the hazards presented are based on the Risk Assessment Matrix below. Modify hazards and ratings as necessary to meet project needs.

Risk Assessment Matrix		Likelihood Ratings			
Consequences Ratings		A	B	C	D
People	Property	0 Almost Impossible	1 Possible but Unlikely	2 Likely to Happen	3 Almost Certain to Happen
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3-Major Health Effect	Local Damage	0-Low	3-Low	6-Medium	9-High
4-Fatalities	Major Damage	0-Low	4-Medium	8-High	12-High

Hazard #1

Driving - On road - Injury or vehicle damage from motor vehicle accident or incident

Suggested FHSHB Ref:	3.4	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	HIGH	Smith System (on line)
Mitigated Risk:	MEDIUM	JSAs

Comments: Use Smith System "5-Keys" when driving. See Driving JSA for details.

Hazard #2

Driving - Driver - Injury, death or property damage due to driver distraction, fatigue, etc.

Suggested FHSHB Ref:	3.4, 3.21	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	HIGH	Smith System (on line)
Mitigated Risk:	LOW	Driver awareness and use of stop work authority

Comments: Use route planning. Keep eyes moving while driving. See Driving JSA.

Hazard #3

Biological - skin/eye irritation or damage from poisonous plants

Suggested FHSHB Ref:	3.17.11	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	MEDIUM	See HASP Tick/Poisonous Plant Section
Mitigated Risk:	LOW	Job Briefing/Site Awareness

Comments: Use skin pre-treatment lotions when available.

Hazard #4

Biological - bites or stings from exposure to insects or arachnids

Suggested FHSHB Ref:	3.17: 2,3,7,8,9,10	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	MEDIUM	PPE (see HASP "PPE" section)
Mitigated Risk:	LOW	Job Briefing/Site Awareness

Comments: Do body check daily. For ticks see also HASP Tick/Poisonous Plant section

Hazard #5

Biological - cuts, scrapes, skin/eye puncture from exposure to physically damaging plants

Suggested FHSHB Ref:	3.17.11	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	MEDIUM	Job Briefing/Site Awareness
Mitigated Risk:	LOW	PPE (see HASP "PPE" section)

Comments:

General Task HARC (continued)

Hazard #6		
Environmental - Thermal stress - Injury or illness from heat or cold		
Suggested FHSHB Ref:	3.16	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	MEDIUM	Field H&S Handbook (see ref. above)
Mitigated Risk:	LOW	JSAs
Comments:	Use job rotation or rest breaks. Stay hydrated and eat regularly.	
Hazard #7		
Environmental - Inclement weather -Injury or equipment damage from inclement weather		
Suggested FHSHB Ref:	3.12	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	MEDIUM	Weather Monitoring
Mitigated Risk:	LOW	Cont./Emerg. Planning
Comments:	Use 30/30 rule for lightning. See FHSHB for details.	
Hazard #8		
Motion - Musculoskeletal - Injury from lifting, twisting , stooping, or awkward body positions		
Suggested FHSHB Ref:	3.29.1	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	MEDIUM	Engineering Controls (specify in comments)
Mitigated Risk:	LOW	Admin. Controls (specify in comments)
Comments:	Use proper lifting techniques. Use job rotation when applicable. See FHSHB for details.	
Hazard #9		
Motion - Musculoskeletal - Injury from repeated work activity or body motion		
Suggested FHSHB Ref:	3.29.2	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	MEDIUM	Engineering Controls (specify in comments)
Mitigated Risk:	LOW	Admin. Controls (specify in comments)
Comments:	Use proper lifting techniques. Use job rotation when applicable. See FHSHB for details.	
Hazard #10		
Gravity - Falls - Injury due to slips and trips		
Suggested FHSHB Ref:	3.26.4, 4.11	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	MEDIUM	Site Awareness
Mitigated Risk:	LOW	Housekeeping
Comments:	Use footwear appropriate for site conditions, plan routes and do not hurry while walking.	
Hazard #11		
None		
Suggested FHSHB Ref:	None	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	Not Ranked	Select
Mitigated Risk:	Not Ranked	Select
Comments:		
Hazard #12		
None		
Suggested FHSHB Ref:	None	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	Not Ranked	Select
Mitigated Risk:	Not Ranked	Select
Comments:		

Task Specific HARC

Task 1: **Drilling - Contractor oversight**

HARC Unmitigated Hazard Types (H-High, M-Medium, L-Low): FHSHB Ref: 4.5

Biological*	L	Chemical	L	Driving*	-	Electrical	L
Environmental*	L	Gravity*	M	Mechanical	M	Motion*	M
Personal Safety	-	Pressure	L	Radiation	-	Sound	H

** Hazard rating, if present, excludes General THA hazards in this category.*

Hazard #1

Mechanical - Pinch point - Injury by pinching of body part in mechanical process

Suggested FHSHB Ref:	3.27.4	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	MEDIUM	Operator Competency per Standard
Mitigated Risk:	LOW	Machine Guarding

Comments: Air rotary drilling will be conducted by trained subcontractors. Arcadis will perform oversight only and keep distance from rig while operating.

Hazard #2

Motion - Process failure - Injury or equipment damage due to improper lockout/tagout

Suggested FHSHB Ref:	3.24	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	MEDIUM	Lockout/Tagout
Mitigated Risk:	LOW	H&S Standards

Comments: Arcadis will discuss safety protocols and LO/TO with subs in tailgate meeting.

Hazard #3

Pressure - Hydraulic - Injury from hydraulic process or device failure

Suggested FHSHB Ref:	2.5, 4.5, 4.6	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	MEDIUM	Specialized Training per Standard
Mitigated Risk:	LOW	PPE (see HASP "PPE" section)

Comments: Air rotary drill rig uses compressed air. Arcadis will keep safe distance from rig while operating--only subs with specialized training will operate rig. PPE such as safety glasses and cut-resistant gloves will be worn at all times around the rig.

Hazard #4

Sound - Noise - Injury or illness due to noise exposure

Suggested FHSHB Ref:	3.15	To mitigate this hazard, use TRACK and the following:
Overall Unmitigated Risk:	MEDIUM	PPE (see HASP "PPE" section)
Mitigated Risk:	LOW	H&S Standards

Comments: Hearing protection will be used an d distance from rig during operation.

ACTIVITY HAZARDS ANALYSIS

Date: 25-May-20 Project: PFAS Preliminary Assessment / Site Inspection

Activity: COVID19 Exposure Prevention

Activity Location: Yakima Training Center

Prepared By: Eeda Wallbank

Overall Risk Assessment Code (RAC) (Use highest code): **M**

E = Extremely High Risk
H = High Risk
M= Moderate Risk
L= Low Risk

Risk Assessment Code Matrix

		Probability				
		Frequent	Likely	Occasional	Seldom	Unlikely
Severity	Catastrophic	E	E	H	H	M
	Critical	E	H	H	M	L
	Marginal	H	M	M	L	L
	Negligible	M	L	L	L	L

	JOB STEPS	HAZARDS	ACTIONS TO ELIMINATE OR MINIMIZE HAZARDS	RAC
1	Initial Job Preparation, including cooler and equipment handling	Changing procedures or outdated information.	• Due to the rapidly changing situation associated with COVID19, check the SHM for current and updated guidance or procedures. • Check state and local ordinances for travel restrictions or Stay In Place (SIP) orders. • Check Arcadis guidance for travel to the areas where work is being conducted. • Get appropriate approval and letters if required before beginning travel.	**M**
		COVID19 virus exposure from commonly touched surfaces.	• Disinfect commonly touched surfaces after touching with appropriate antibacterial cleaner (e.g. Lysol, Clorox, etc.) or other CDC approved cleaning product. • Wash hands frequently with soap and water for at least 20 seconds. Refer to Section 11 of the SSHP. • If soap and water are not readily available, use a hand sanitizer with at least 80% alcohol. • Avoid touching your eyes, nose and mouth. • Do not share Personal Protective Equipment (PPE). Maintain and thoroughly clean PPE in accordance with manufacturer's instructions.	**L**

ACTIVITY HAZARDS ANALYSIS

Date: 25-May-20 Project: PFAS Preliminary Assessment / Site Inspection

Activity: COVID19 Exposure Prevention

Activity Location: Yakima Training Center

Prepared By: Eeda Wallbank

Overall Risk Assessment Code (RAC) (Use highest code): **M**

	JOB STEPS	HAZARDS	ACTIONS TO ELIMINATE OR MINIMIZE HAZARDS	RAC
1, cont.	Initial Job Preparation, including cooler and equipment handling, cont.	COVID19 virus exposure from packages, coolers, equipment.	• Put on gloves prior to opening or handling sample coolers. • Disinfect exterior surface of sample cooler ppropriate antibacterial cleaner (e.g. Lysol, Clorox, etc.) or other CDC approved cleaning product. placing an emphasis on high touch points such as cooler handles and the front of the lid. • Open boxes using dedicated personal tools (safety scissors etc.) rather than community tools. If the use of community tools is required, disinfect tools prior to use. • Disinfect surface of equipment with ppropriate antibacterial cleaner (e.g. Lysol, Clorox, etc.) or other CDC approved cleaning product with emphasis on high touch point surfaces such as control pads, screens, buttons, handles, or hold surfaces.	**L**
		COVID19 virus exposure from personal interaction.	• Coordinate with the Installation Point of Contact (POC). Communicate in advance of mobilization and ask if anyone is experiencing flu-like symptoms or if anyone is in mandatory or precautionary self-quarantine. Notifiy the Project Manager/SHM if the POC indicates that staff are in self-quarantine. • Share Arcadis work procedures if requested and indicate that the field team will be practicing social distancing during the work.	**L**
2	Obtaining Rental Car or Using Arcadis Fleet Vehicle	COVID19 virus exposure from other people and frequently touched surfaces.	• Practice social distancing (stay 6 feet or 2 meters away from others) where interaction is necessary. • Ask about cleaning procedures used to disinfect the vehicle. • If paper agreements are used, do not use provided pens, use your own writing device. If the agreement is digital, ask the attendant to sign on your behalf. • Prior to driving the rental vehicle, put on new disposable gloves and disinfect surfaces. ppropriate antibacterial cleaner (e.g. Lysol, Clorox, etc.) or other CDC approved cleaning product to clean high touch surfaces (steering wheel, shift lever, stereo controls, center console, seat belt buckle and latch mechanism, door handles, rear view mirror, window/door lock controls, seat adjustment controls, fuel door and fuel cap, tailgate handle and others). • Upon vehicle return, ask for an e-mail coy of the rental receipt, rather than accept a paper copy.	**L**

ACTIVITY HAZARDS ANALYSIS

Date: 25-May-20 Project: PFAS Preliminary Assessment / Site Inspection

Activity: COVID19 Exposure Prevention

Activity Location: Yakima Training Center

Prepared By: Eeda Wallbank

Overall Risk Assessment Code (RAC) (Use highest code): **M**

	JOB STEPS	HAZARDS	ACTIONS TO ELIMINATE OR MINIMIZE HAZARDS	RAC
3	Travel to/from the Site and purchasing items at stores.	COVID19 virus exposure from other people and frequently touched surfaces.	• For locations where person to person contact is potential (toll booths, fuel stations, drive through restaurants or similar) - Eliminate contact wherever possible by using non-contact payment methods such as: - Pike pass or other automated toll payment method - Pay at the pump - Self checkout - Apple pay (or similar). • Practice social distancing (stay 6 feet or 2 meters away from others) where interaction is necessary. • Put on new disposable gloves prior to touching (fuel pumps, door handles, or other frequently touched surfaces). • Carefully remove gloves without touching the outside of the gloves. Wash hands with soap and water after contact or carry hand scrubs or sanitizer (80% alcohol) to clean hands. • Minimize interactions - Purchase all necessary items at one location and buy as much as needed to complete the work rather than making multiple trips if feasible. - Fuel up only when necessary - Use self-service ice machines (Twice the Ice etc.)	**L**
4	Work on Site	Exposing others to COVID-19 and/or other illnesses.	• Complete a risk assessment: - If you are sick, stay home and notify project manager and supervisor. - Observe others (including subcontractors). If they exhibit flu-like symptoms, STOP WORK and contact project manager. • Avoid interacting with non-essential contacts (off-site residents, passers-by, etc.). Utilize caution tape and cones to create a work zone to keep the public out of work areas. • DoD Memorandum dated 5 April 2020 made mandatory that all indivuals on DoD Property, installations, and facilities wear cloth face coverings when social distancing cannot be maintained, such as public areas or work centers.	**L**
		COVID19 virus exposure from shared equipment (trucks, pens, clipboards etc.).	• Avoid sharing pens, clipboards, field books or other equipment. • At tailgate meetings, practice social distancing and have on person sign in for everyone on the tailgate form.	**L**

ACTIVITY HAZARDS ANALYSIS

Date: 25-May-20 Project: PFAS Preliminary Assessment / Site Inspection

Overall Risk Assessment Code (RAC) (Use highest code): **M**

Activity: COVID19 Exposure Prevention

Activity Location: Yakima Training Center

Prepared By: Eeda Wallbank

	JOB STEPS	HAZARDS	ACTIONS TO ELIMINATE OR MINIMIZE HAZARDS	RAC
4, cont.	Work on Site, cont.	COVID19 Virus exposure from commonly touched surfaces.	•When collecting trash, wear gloves, safety glasses and other appropriate PPE. • Once finished collecting trash, remove gloves and wash hands with soap for at least 20 seconds. If soap and water are not readily available, use a hand sanitizer with at least 80% alcohol.	**L**
5	Hotel Stays	COVID19 virus exposure from commonly touched surfaces	• Minimize contact with check in counter (do not lean or rest hands unnecessarily on countertop). - When signing hotel agreements, use your own writing device, do not use provided pens. - If a line exists at check in, practice social distancing by remaining at least 6ft from other guests or the host. - Ask about cleaning procedures and frequency. - Request rapid checkout (receipt under door) or a folio be e-mailed to you. - Leave room keys in the room rather then taking them to the front desk at checkout. - Leave baggage in the vehicle until after check in is completed (do not set bags on the floor or use luggage cart without first disinfecting). - Disinfect key cards prior to handling. • Before bringing baggage to room, visit room to understand pathway (stairs, elvevator etc.). • Minimize contact with common area high touch surfaces such as door handles elevator buttons by using a barrier such as gloves. • Use appropriate antibacterial cleaner (e.g. Lysol, Clorox, etc.) or other CDC approved cleaning product to disinfect commonly touched items in room such as: remotes, light switches, door knobs, and other high touch surfaces. • Use the “Do not Disturb” or similar door hanger prevent daily cleaning of the room. • During long hotel stays, most hotels have policies that rooms much be checked at least once a week. If you find that the room has been serviced even though the “Do not disturb” sign was hung, perform additional decontamination of the room as described above.	**L**

ACTIVITY HAZARDS ANALYSIS

Date: 25-May-20 Project: PFAS Preliminary Assessment / Site Inspection

Activity: COVID19 Exposure Prevention

Activity Location: Yakima Training Center

Prepared By: Eeda Wallbank

Overall Risk Assessment Code (RAC) (Use highest code): **M**

	JOB STEPS	HAZARDS	ACTIONS TO ELIMINATE OR MINIMIZE HAZARDS	RAC
5, cont.	Hotel Stays, cont.	COVID19 virus exposure from commonly touched surfaces, cont.	• Do not use common areas such as lobby, hall restrooms, water fountains, workout rooms, swimming pools or breakfast areas. - Most hotels will provide a "to go" or bagged breakfast if requested. Request a "to go" breakfast the night before if breakfast is desired or make other arrangements for breakfast	**L**
6	Reporting exposure to someone with COVID-19	COVID-19 exposure.	• If you learn you have been in close contact* with a worker, client ot member of the public who is COVID-19 positive: - STOP WORK. - Notify your supervisor and PM. - Notification to the Installation POC will be the responsiblity of the PM - Self-isolate and contact your personal physician for additional direction. - Notify Brian Kundert (Phone: 510-596-9646 or 510-517-4092; email: Brian.Kundert@arcadis.com). *Per the CDC, close contact is defined as a) being withing approximately 6 feet (2 meters) of a COVID-19 case for a prolonged period of time; close contact can occur while caring for, living with, visiting, or sharing a healcare waiting area or room with a COVID-19 case OR b) having direct contact with infectious secretions of a COVID-19 case (e.g. being coughed on).	**M**

ACTIVITY HAZARDS ANALYSIS

Date: 25-May-20 Project: PFAS Preliminary Assessment / Site Inspection

Overall Risk Assessment Code (RAC) (Use highest code): **M**

Activity: COVID19 Exposure Prevention

Activity Location: Yakima Training Center

Prepared By: Eeda Wallbank

	EQUIPMENT	TRAINING	INSPECTION
1	Vehicles	Site-specific training.	Perform inspection of vehicle at the start and end of each day and prior to each use.
2	Mobile phones	None	Daily to ensure in proper working order
3	Required PPE for for being in public spaces (cloth face covering and nitrile gloves)	PPE training per Hazwoper refresher.	Prior to use.
6	Required PPE for Field Efforts (cloth face covering, safety glasses, safety-toed boots, hard hat, high visibility vest (Class II or III), nitrile gloves)	PPE training per Hazwoper refresher. If ear plugs are needed, review on proper insertion and use.	Prior to use.

Involved Personnel: provide names as needed below
SSHO: Olivia Miller
Designated Representative: Not Applicable
Competent or Qualified Person: Not Applicable

Type of SSHO (drop down below):
Hazwoper - 1yr Experience at cleanup operations

Type of work (drop down below) Proof of Competency / Qualifications attached? **Yes** / No

Acceptance Authority (digital signature): Grey P. Coppi, CIH, CSP

ACTIVITY HAZARDS ANALYSIS

Date: 11-Mar-20 Project: PFAS Preliminary Assessment / Site Inspection

Overall Risk Assessment Code (RAC) (Use highest code): **L**

Activity: General Site Hazards

Activity Location: Yakima Training Center

Prepared By: Eeda Wallbank

E = Extremely High Risk
H = High Risk
M= Moderate Risk
L= Low Risk

Risk Assessment Code Matrix

		Probability				
		Frequent	Likely	Occasional	Seldom	Unlikely
Severity	Catastrophic	E	E	H	H	M
	Critical	E	H	H	M	L
	Marginal	H	M	M	L	L
	Negligible	M	L	L	L	L

	JOB STEPS	HAZARDS	ACTIONS TO ELIMINATE OR MINIMIZE HAZARDS	RAC
1	Site - General	General Hazards	• This AHA is drafted to summarize general site hazards that are applicable to all site activates and will be reviewed/updated in conjunction with activity specific AHAs.	**L**
2	Site - General	Inclement weather	• Observe work-rest scheduled (as outlined in the APP) to manage heat/cold stresses. • Locate nearest severe weather shelter/strong structure before beginning fieldwork. • Do not work in lightning, wind greater than 30 MPH, or rain more than 1 inch per hour to prevent possible weather related injuries (lightning, falls, struck by flying debris). • In accordance with EM 385-1-1 Section 01.E.01(4) (30 Nov 2014), if lightning is 10 or less miles away, work is to be stopped for 30-minutes from the last audible thunder or visible flash of lightning. • Seek shelter in nearest vehicle or permanent shelter (not equipment) until lightning delay has passed.	**L**

ACTIVITY HAZARDS ANALYSIS

Date: 11-Mar-20 Project: PFAS Preliminary Assessment / Site Inspection

Activity: General Site Hazards

Activity Location: Yakima Training Center

Prepared By: Eeda Wallbank

Overall Risk Assessment Code (RAC) (Use highest code): L

	JOB STEPS	HAZARDS	ACTIONS TO ELIMINATE OR MINIMIZE HAZARDS	RAC
2 (cont.)	Site - General (cont.)	Inclement weather (cont.)	• Avoid water, high ground, open spaces, and metal objects. Suspend fieldwork when lightning is first seen or thunder is first heard. • Do not work in areas subject to flash flooding (e.g., ditch) if rain is forecast in the immediate area or upstream of site. • Wear sunscreen to protect from sunburn. • Maintain buddy system and observe buddy for signs of heat-related illness (heat rash, heat cramps, dizziness, nausea, weakness).	L
		Biological hazard (insects, snakes, wildlife, vegetation) that could come into contact with you and cause irritation or injury	• Inspect area for hazardous plants and organism conditions. • Avoid walking through brush or rubbing against bushes and trees. • Be able to identify poisonous plants and avoid contact if possible. • When walking, be cautious of snakes. If observed, report to SSHO and others. • Do not place hands or feet into areas that cannot be seen. • Wear clothing that covers potentially affected body parts. • Tuck pant legs into socks and seal/tape pants legs against contact with plants and to prevent access by ticks/ants. • Recommend use of clothing with permethrin. • Recommend insect/tick repellant to supplement. Spray 100% DEET around ankles, wrists, and on a head covering. Spray 30% DEET on exposed skin. • Check for ticks during field activities; shower and conduct a complete body check after work; place clothing in hot dryer to kill loose ticks. • Be aware of symptoms of mosquito and tick-borne illness • Do not touch face before thoroughly washing hands with Technu if working in poison ivy/oak/sumac; wash clothing in soap and hot water to remove oils; do not reuse clothing exposed to poison ivy/oak/sumac • Review route to hospital if in snake habitat or allergic to insect/spider sting/bite.	L

ACTIVITY HAZARDS ANALYSIS

Date: 11-Mar-20 Project: PFAS Preliminary Assessment / Site Inspection

Activity: General Site Hazards

Activity Location: Yakima Training Center

Prepared By: Eeda Wallbank

Overall Risk Assessment Code (RAC) (Use highest code): L

	EQUIPMENT	TRAINING	INSPECTION
1	Vehicles	Site-specific training.	Perform inspection of vehicle at the start and end of each day and prior to each use.
2	Mobile phones	None	Daily to ensure in proper working order
3	2-way radio (optional)	Instruction on how to use and communicate to be discussed during Tailgate Safety Briefing	Daily by SSHO to ensure in proper working order
4	First Aid Kit with Eye Wash Bottle	First aid training if administering to others.	Monthly at a minimum. Daily to ensure they are in proper locations.
5	Fire Extinguisher (in vehicle)	Only those trained in the use of the fire extinguisher should use it to fight fires	Monthly at a minimum. Daily to ensure they are in proper locations.
6	Required PPE (safety glasses, safety-toed boots, hard hat, high visibility vest (Class II or III), nitrile gloves)	PPE training per Hazwoper refresher. If ear plugs are needed, review on proper insertion and use.	Prior to use.

Involved Personnel: provide names as needed below
SSHO: Olivia Miller
Designated Representative: Not Applicable
Competent or Qualified Person: Not Applicable

Type of SSHO (drop down below):
Hazwoper - 1yr Experience at cleanup operations

Type of work (drop down below) Proof of Competency / Qualifications attached? **Yes** / No

Acceptance Authority (digital signature): Grey P. Coppi, CIH, CSP Grey P. Coppi

ACTIVITY HAZARDS ANALYSIS

Date: 11-Mar-20 Project: PFAS Preliminary Assessment / Site Inspection

Activity: Site Mobilization / Preparation / Demobilization

Activity Location: Yakima Training Center

Prepared By: Eeda Wallbank

Overall Risk Assessment Code (RAC)
(Use highest code)
L

E = Extremely High Risk
H = High Risk
M= Moderate Risk
L= Low Risk

Risk Assessment Code Matrix

		Probability				
		Frequent	Likely	Occasional	Seldom	Unlikely
Severity	Catastrophic	E	E	H	H	M
	Critical	E	H	H	M	L
	Marginal	H	M	M	L	L
	Negligible	M	L	L	L	L

	JOB STEPS	HAZARDS	ACTIONS TO ELIMINATE OR MINIMIZE HAZARDS	RAC
1	Site - General	General Hazards	• Refer to General Site Hazards AHA	**L**
2	Mobilization / Demobilization	Vehicle malfunction/break down	• Perform vehicle inspection for damaged or leaking car parts and tire pressure. Correct any damages before driving to site. • Perform walk around vehicle to identify hazards before exiting parking area.	**L**
		Collisions with other vehicles or objects in travel path	• Continually scan the road for debris, potholes, pedestrians and other cars while en route to destination. • Wear seatbelt at all times when vehicle is in motion. • Adhere to speed limit and traffic signs. Maintain 4 second distance from other vehicles. Continually check mirrors. • Use both hands to steer the wheel placed at the 10 and 2 position. • Drive defensively. • Stay attentive while driving and do not get distracted by cell phone or two way radios.	**L**
		Decreased visibility and/or loss of control of vehicle due to changes in environmental conditions (rain, snow, etc.)	• Maintain a reduced speed of 5 to 10 MPH less than the posted speed limit if there has been a change in weather conditions (fog, snow, sleet, heavy rains, night driving).	**L**

ACTIVITY HAZARDS ANALYSIS

Date: 11-Mar-20 Project: PFAS Preliminary Assessment / Site Inspection

Overall Risk Assessment Code (RAC) (Use highest code): L

Activity: Site Mobilization / Preparation / Demobilization

Activity Location: Yakima Training Center

Prepared By: Eeda Wallbank

	JOB STEPS	HAZARDS	ACTIONS TO ELIMINATE OR MINIMIZE HAZARDS	RAC
3	Parking	Struck by other vehicles or equipment	• Park in designated, identified parking spots when possible (inside painted lines, in signed areas). Pull through park whenever possible to prevent backing when leaving site. • Use a traffic cone in front and behind vehicle when parking in an area without designated parking spots. • If working in parking lots and private roadways, set up cones and establish work area per Site Traffic Safety Plan in SSHP.	L
		Unintended movement of vehicle.	• Engage the emergency parking brake and remove keys before exiting the vehicle.	L
3	Unloading, staging supplies and equipment, packing and reloading supplies and equipment	Struck by equipment and/or vehicles	• Conduct unloading/offloading activities out of travel paths of traffic or equipment. Use cones to demarcate work zone. • Don high visibility safety vest and hard hat to increase your visibility to others.	L
		Strains/sprains while lifting supplies or tools.	• Never lift objects that weigh more than 50 lbs. alone. • Bend with the knees and not the back. • Avoid twisting at the waist when carrying objects. • Don't lift objects over the sides of a pickup truck. • Place heavy items where they will be easy to reach. • Use mechanical equipment whenever possible to unload.	L

ACTIVITY HAZARDS ANALYSIS

Date: 11-Mar-20 Project: PFAS Preliminary Assessment / Site Inspection
Activity: Site Mobilization / Preparation / Demobilization
Activity Location: Yakima Training Center
Prepared By: Eeda Wallbank

Overall Risk Assessment Code (RAC)
(Use highest code)
L

	EQUIPMENT	TRAINING	INSPECTION
1	Vehicles	Site-specific training	Perform inspection of vehicle at the start and end of each day and prior to each use.
2	Mobile phones	None	Daily to ensure in proper working order
3	2-way radio (optional)	Instruction on how to use and communicate to be discussed during Tailgate Safety	Daily by SSHO to ensure in proper working order
4	First Aid Kit with Eye Wash Bottle	First aid training if administering to others.	Monthly at a minimum. Daily to ensure they are in proper locations.
5	Fire Extinguisher (in vehicle)	Only those trained in the use of the fire extinguisher should use it to fight fires	Monthly at a minimum. Daily to ensure they are in proper locations.
6	Required PPE (safety glasses, safety-toed boots, hard hat, high visibility vest (Class II or III), nitrile gloves)	PPE training per Hazwoper refresher. If ear plugs are needed, review on proper insertion and use.	Prior to use.

Involved Personnel: provide names as needed below
SSHO: Olivia Miller
Designated Representative: Not Applicable
Competent or Qualified Person: Not Applicable

Type of SSHO (drop down below):
Hazwoper - 1yr Experience at cleanup operations

Type of work (drop down below) Proof of Competency / Qualifications attached? **Yes** / No

Acceptance Authority (digital signature):

Grey P. Coppi

Grey P. Coppi, CIH, CSP

ACTIVITY HAZARDS ANALYSIS

Date: 11-Mar-20 Project: PFAS Preliminary Assessment / Site Inspection

Activity: Utility Location

Activity Location: Yakima Training Center

Prepared By: Eeda Wallbank

Overall Risk Assessment Code (RAC)
(Use highest code)
M

E = Extremely High Risk
H = High Risk
M= Moderate Risk
L= Low Risk

Risk Assessment Code Matrix

		Probability				
		Frequent	Likely	Occasional	Seldom	Unlikely
Severity	Catastrophic	E	E	H	H	M
	Critical	E	H	H	M	L
	Marginal	H	M	M	L	L
	Negligible	M	L	L	L	L

	JOB STEPS	HAZARDS	ACTIONS TO ELIMINATE OR MINIMIZE HAZARDS	RAC
1	Site - General	General Hazards	• Refer to General Site Hazards AHA	**L**
2	Coordinate Subsurface Utility Survey Activities	Encountering an underground utility line resulting in property damage or severe injuries	• Follow Arcadis policy on Utility Location (ARCHFS019) • Complete One Call Notification. • Coordinate and complete private utility mark out operations. • Obtain installation dig permit prior to beginning intrusive operations.	**M**
3	Mobilization, Site Reconnaissance, and Utility Mark-Out/Survey	Slips/trips/falls	• Remove slip/trip/fall hazards or demarcate fixed hazards using marking paint or traffic cones. • Travel on established walking paths. • Scan the walking path ahead for potential slip, trip, fall hazards. Alert others in the group and use an alternate route around impediments. • Keep work area clear of hazards and debris (good housekeeping). • Wear safety toe shoes at all times. Inspect shoes before use to ensure soles have good tread.	**L**

ACTIVITY HAZARDS ANALYSIS

Date:	11-Mar-20	Project:	PFAS Preliminary Assessment / Site Inspection
Activity:	Utility Location		
Activity Location:	Yakima Training Center		
Prepared By:	Eeda Wallbank		

Overall Risk Assessment Code (RAC)
(Use highest code)
M

	JOB STEPS	HAZARDS	ACTIONS TO ELIMINATE OR MINIMIZE HAZARDS	RAC
3 (cont.)	Mobilization, Site Reconnaissance, and Utility Mark-Out/Survey (cont.)	Traffic Hazards	• Plan work to stay out of active traffic areas. • Maintain awareness of the potential for traffic at any time. • Utilize buddy system. One person focused on establishing the work zone while the second person focuses on establishing eye contact with approaching motor vehicle drivers and alerting other workers to potential imminent hazards. • Position work vehicle(s) so that field crew is protected from site traffic. • Wear DOT Class II or higher hi-visibility traffic vests/shirts. • If working in parking lots and private roadways, set up cones and establish work area per Site Traffic Safety Plan in SSHP.	**L**
		Repetitive stress from repeated bending or squatting or ergonomic injury from improper or prolonged use of carried devices that are long or bulky	• Use job rotation when hazard exists and stretch before performing work activity. • Use paint device that allows employee to stand while spraying. • Implement proper lifting and body position practices. • Use buddy system for carrying heavy devices or equipment.	**L**
		Chemical exposure from using spray paint	• Stand upwind of paint spraying activities.	**L**
		Temperature related illness	• Wear appropriate clothes for the weather. • Monitor for heat and cold stress. Employees should dress for the weather and potential weather changes (e.g., dress in layers so that clothes can be removed/added as needed for heat, cold, or moisture). • Take breaks and consume fluids as necessary.	**L**

ACTIVITY HAZARDS ANALYSIS

Date: 11-Mar-20 Project: PFAS Preliminary Assessment / Site Inspection

Overall Risk Assessment Code (RAC) (Use highest code): M

Activity: Utility Location

Activity Location: Yakima Training Center

Prepared By: Eeda Wallbank

	EQUIPMENT	TRAINING	INSPECTION
1	Vehicles	Site-specific training.	Perform inspection of vehicle at the start and end of each day and prior to each use.
2	Mobile phones	None	Daily to ensure in proper working order
3	2-way radio (optional)	Instruction on how to use and communicate to be discussed during Tailgate Safety	Daily by SSHO to ensure in proper working order
4	First Aid Kit with Eye Wash Bottle	First aid training if administering to others.	Monthly at a minimum. Daily to ensure they are in proper locations.
5	Fire Extinguisher (in vehicle)	Only those trained in the use of the fire extinguisher should use it to fight fires	Monthly at a minimum. Daily to ensure they are in proper locations.
6	Required PPE (safety glasses, safety-toed boots, hard hat, high visibility vest (Class II or III), nitrile gloves)	PPE training per Hazwoper refresher. If ear plugs are needed, review on proper insertion and use.	Prior to use.

Involved Personnel: provide names as needed below

SSHO: Olivia Miller

Designated Representative: Not Applicable

Competent or Qualified Person: Not Applicable

Type of SSHO (drop down below):

Hazwoper - 1yr Experience at cleanup operations

Type of work (drop down below) Proof of Competency / Qualifications attached? **Yes** / No

Acceptance Authority (digital signature): Grey P. Coppi, CIH, CSP Grey P. Coppi

Utilities and Structures Checklist

ARCADIS Design & Consultancy for natural and built assets

THIS FORM MUST BE COMPLETED IN ENTIRETY PRIOR TO BEGINNING ANY INTRUSIVE WORK

Project: ____________________

Project Number: ____________________

Form Completion Date: Form Expiration Date: ____________

All utility markings must be refreshed ≤15 days when work is ongoing. (15 business days post form completion date)

Pre-Field Work

Required: One Call or "811" notified 48-72 hours in advance of work? #: ____________

Ticket Expiration Date ____________ (Review State Requirements)

Utility companies notified during the One Call process ☐ See attached ticket

____________ ____________ ____________ ____________

____________ ____________ ____________ ____________

List any other utilities requiring notification: ☐ None

____________ ____________ ____________ ____________

Private Locator Contacted ☐ Yes ☐ No

Plan private utility clearance subcontractor assignments, areas, required clearance equipment, depth of clearance needed, types of utilities. When possible re-clear 811 markings to confirm utility locations.

Client provided utility maps or "as built" drawings showing utilities? ☐ Yes ☐ No

Field Work **-** This must be completed on site, by staff who have a minimum of one year of field experience in identifying utilities. Review Check list with PM or designee prior to beginning intrusive work.

Mechanized intrusive work in utility Tolerance Zone (<30-in.) requires pre-approval by Corporate H&S

List Soil Boring / Well IDs or Excavation Locations applicable to this clearance checklist:

3 Reliable Lines of Evidence Required Prior to Starting any Subsurface Intrusive Work

☐ One Call/"811" (Reliable as a line of evidence when working in public right of way or easement)

Utility Markings Present: ☐ Paint ☐ Pin flags/stakes ☐ Other ☐ None

☐ Client Provided Maps/Drawings **OR** ☐ Maps/Drawings requested but not provided

☐ Client Clearance Name(s)/Affiliation(s) ____________

☐ Interview(s): Name(s)/Affiliation(s) ____________

____

Did person(s) interviewed indicate depths of any utilities in the subsurface?

☐ Yes, depths provided: ☐ Did not know or refused to answer

Additional Comments:

☐ Site Inspection (**Complete Page 2 & Photo Document Marked Utilities & Utility Structures**)

☐ Public Records / Maps / As-Builts

☐ **Private Locator: (Name and Company)** ____________

☐ Ground Penetrating Radar (GPR)

☐ Radiofrequency (RF Loc)

☐ Electromagnetic (EM)

☐ Metal Detector

Soft Dig Methods

☐ Termination Depth _______ft. bgs

☐ Potholing / Vacuum Extraction

☐ Air knife ☐ Hydro knife

☐ Probing

☐ Hand Auguring

Tips for Successful Utility Location (H&S Standard Section 5.6):

1. Don't forget to look up (mark above grade utilities if warranted)
2. Be on-site with Private Utility Locators
3. Ask Private Locators to "confirm" other's markings
4. Select alternate/backup locations during clearance process
5. Mark out all known utilities. Leave nothing to question
6. No hammering - no pickaxes - no digging bars - no shortcutting
7. No excessive turning or downward force of hand augers/shovels
8. Utilities may run in or directly under asphalt/concrete
9. Clearing, grubbing, and heavy equipment may damage shallow utilities.
10. Is Spotter needed for Heavy Equipment near aboveground utilities?

☐ Other: ____________

☐ Marine Locator: (Name and Company) ____________

Utilities and Structures Checklist

During the site inspection look for the following: **("YES" requires additional investigation and the utility must be marked properly prior to beginning subsurface intrusive work)**:

Site Inspection	**Utility Color Codes**	**Present**	
A) Natural gas line present (evidence of a gas meter)?	Yellow	☐ Yes	☐ No
i) Feeder Lines to buildings or homes?		☐ Yes	☐ No
B) Evidence of electric lines:	Red		
i) Conduits to ground from electric meter or along wall?		☐ Yes	☐ No
ii) Conduits from power poles running into ground?		☐ Yes	☐ No
iii) Light poles, electric devices with no overhead lines?		☐ Yes	☐ No
iv) Overhead electric lines present? Marked? (See Section L)		☐ Yes	☐ No
C) Evidence of sewer drains:	Green		
i) Restrooms or kitchen on site?		☐ Yes	☐ No
ii) Sewer cleanouts present?		☐ Yes	☐ No
iii) Combined sewer /storm lines or multiple sewer lines?		☐ Yes	☐ No
D) Evidence of water lines:	Blue		
i) Water meter on site or multiple water lines?		☐ Yes	☐ No
ii) Fire hydrants in vicinity of work?		☐ Yes	☐ No
iii) Irrigation systems? (Sprinkler heads, valve boxes, controls in building)		☐ Yes	☐ No
E) Evidence of storm drains:	Green		
i) Open curbside or slotted grate storm drains		☐ Yes	☐ No
ii) Gutter down spouts going into ground		☐ Yes	☐ No
F) Evidence of telecommunication lines:	Orange		
i) Fiber optic warning signs in areas?		☐ Yes	☐ No
ii) Aboveground cable boxes or housings or wires in work area? Marked?		☐ Yes	☐ No
G) Underground storage tanks:			
i) Tank pit present, tank vent present?		☐ Yes	☐ No
ii) Product lines running to dispensers/buildings?		☐ Yes	☐ No
H) Do utilities enter or exit existing structures/buildings? If Yes, confirm the utility markings outside of structure/building match up.		☐ Yes	☐ No
I) Proposed excavation marked in white?	White	☐ Yes	☐ No
J) Unclassed utilities / anomalies marked in pink?	Pink	☐ Yes	☐ No
K) **Overhead** Utilities/Communication Lines - **Look Up and MARK**:			
i) Overhead electrical conduit, pipe chases, cable trays, product lines?		☐ Yes	☐ No
ii) Overhead fire sprinkler system?		☐ Yes	☐ No
L) **Overhead** Power lines in or near the work area:			
i) < 50 kV within 10 ft. of work area?		☐ Yes	☐ No
ii) >50 - 200 kV within 15 ft. of work area?		☐ Yes	☐ No
iii) >200-350 kV within 20 ft. of work area?		☐ Yes	☐ No
iv) >350-500 kV within 25 ft. of work area?		☐ Yes	☐ No
v) >500-750 kV within 35 ft. or work area?		☐ Yes	☐ No
vi) >750-1000 kV within 45 ft. of work area?		☐ Yes	☐ No
M) Other:			
i) Evidence of linear asphalt or concrete repair?		☐ Yes	☐ No
ii) Evidence of linear ground subsidence or change in vegetation?		☐ Yes	☐ No
iii) Unmarked manholes or valve covers in work area?		☐ Yes	☐ No
iv) Warning signs (Call Before you Dig, Look Up, etc.) on or adjacent to site?		☐ Yes	☐ No
v) Utility color markings not illustrated in this checklist?	i.e. Purple	☐ Yes	☐ No
vii) Operating heavy equipment on unpaved/unimproved ground; review equipment route for shallow utilities crossing it and modify if necessary.		☐ Yes	☐ No
O) Utilities & Structures Checklist been reviewed by the PM or Designee		Yes	No*
PM or Designee Name: ____________________		*** If no, STOP WORK, call PM**	

Name and Signature of person completing the checklist: ____________________

Date: ____________ ____________________

Do not perform mechanized intrusive work within 30 inches of a utility marking without receiving pre-approval by Corporate H&S.

ALL UTILITY STRIKES REQUIRE CORPORATE H&S NOTIFICATION (EMAIL OR CALL) WITH A CONFIRMED RESPONSE

ACTIVITY HAZARDS ANALYSIS

Date: 6-Jun-20 Project: PFAS Preliminary Assessment / Site Inspection

Activity: Sonic Drilling (soil sampling, groundwater sampling)

Activity Location: Yakima Training Center

Prepared By: Eeda Wallbank

Overall Risk Assessment Code (RAC)
(Use highest code)
M

E = Extremely High Risk
H = High Risk
M= Moderate Risk
L= Low Risk

Risk Assessment Code Matrix

		Probability				
		Frequent	Likely	Occasional	Seldom	Unlikely
Severity	Catastrophic	E	E	H	H	M
	Critical	E	H	H	M	L
	Marginal	H	M	M	L	L
	Negligible	M	L	L	L	L

	JOB STEPS	HAZARDS	ACTIONS TO ELIMINATE OR MINIMIZE HAZARDS	RAC
1	Site - General	General Hazards	• Refer to General Site Hazards AHA	**L**
2	Set up necessary traffic controls	Struck by vehicle due to improper traffic controls	• Establish work area and traffic controls in accordance with the Site Traffic Safety Plan provided as Attachment 3 to the Site Safety and Health Plan.	**L**
3	Utility Clearance	Potential to encounter overhead / underground utilities while drilling	• Underground utility clearance will be performed prior to mobilization to locate any potential utilities – complete checklist. • During utility clearance operations ensure to look up for overhead utilities. Document on the checklist. • Refer to Utility Location Activity Hazards Analysis. • Never move the drill rig with the derrick up.	**L**
4	Sonic Drill Rig Operation	Physical hazards/pinch points	• Non-operators will remain at least 5 feet away from moving parts of the drill rig. • All onsite staff will know where the rig kill switch is located and the switch will be tested to verify it is working. • Do not wear loose clothing/jewelry during drilling operations. Long hair will be tied back. • Do not overreach for materials/cores. Use good body position to move materials. • Stretch in advance of work activities.	**M**
		Flying debris	• Inspect rig and all equipment for loose or damage parts prior to use. • Wear safety glasses at all times.	**L**
		Slips/trips/falls	• Maintain good housekeeping. • Keep work area clear of core tubing and miscellaneous tooling. • Plan route and keep clear when moving cores.	**L**

ACTIVITY HAZARDS ANALYSIS

Date:	6-Jun-20	Project:	PFAS Preliminary Assessment / Site Inspection
Activity:	Sonic Drilling (soil sampling, groundwater sampling)		
Activity Location:	Yakima Training Center		
Prepared By:	Eeda Wallbank		

Overall Risk Assessment Code (RAC)
(Use highest code) **M**

	JOB STEPS	HAZARDS	ACTIONS TO ELIMINATE OR MINIMIZE HAZARDS	RAC
4 cont.	Sonic Drill Rig Operation, cont.	Exposure to dust/particulate and/or vapor/gas (VOC/SVOC) inhalation	• Conduct exposure monitoring / air monitoring with PID and particulate meter - refer to Section 7 of the SSHP. • Keep face clear of soil cores and work upwind. Report any noticeable vapors to SSHO and refer to action levesl in Section 7 of the SSHP. • Verify instruments are calibrated and functioning properly. • Work upwind. Utilize STOP WORK for noticeable dusts and/or exceedances of monitoring criteria. Report any noticeable dusts to SSHO. Implement engineering controls as necessary.	L
		Exposure to elevevated noise during drill rig operation	• All operators and Arcadis staff working near the drill rig are required to wear hearing protection while drill rig is in operation. • Non-operators will remain at least 5 feet away from the drill rig. Rule of thumb for hearing protection device (HPD) use is if voice has to be elevated to be heard within 3 feet than HPD is required.	L
		Muscle strain from lifing rods/casing and soil cores	• Use proper lifting techniques using legs and avoid bending at waist. • Use two people to move core sleeves (never lift objects that weigh more than 50 lbs. alone).	L
		Struck by hazard from pressurized water, hydraulic, and grout pump lines	• Inspect hoses and connections daily prior to use. • SSHO will determine if whip checks are required.	L
		Burns from hot surfaces and potential to volatilize VOCs/SVOCs	• Surfaces may become headed due to friction if there is a lack fo drilling fluids. Ensure that sufficent drilling fluids are available to mitigate heating. Also wear work gloves (leather) over nitrile gloves. • Conduct air monitoring according to the SSHP.	L
5	Soil Sample Collection	Soil cores may contain contaminated media	• Wear nitrile gloves and safety glasses for protection from contaminated media. • Refer to Soil Sampling Activity Hazards Analysis.	L
6	Temporary Well Installation	Monitoring well construction materials can clutter the work area	• Maintain good housekeeping.	L
7	Groundwater Sample Collection	Groundwater may contain contaminated media	• Wear nitrile gloves and safety glasses for protection from contaminated media. • Refer to Groundwater Sampling Activity Hazards Analysis.	L

ACTIVITY HAZARDS ANALYSIS

Date: 6-Jun-20 Project: PFAS Preliminary Assessment / Site Inspection

Activity: Sonic Drilling (soil sampling, groundwater sampling)

Activity Location: Yakima Training Center

Prepared By: Eeda Wallbank

Overall Risk Assessment Code (RAC) (Use highest code): **M**

	EQUIPMENT	TRAINING	INSPECTION
1	Sonic Drill Rig	Operated by a licensed driller Site-specific training for Arcadis staff working in proximity to the DPT drill rig.	Perform inspection of vehicle at the start and end of each day and prior to each use.
2	Hearing Protection (Noise Reduction Rating (NRR) of 28 or greater	PPE training per Hazwoper refresher. On site training/review of proper insertaion and use of ear plugs	Prior to use.
3	Photoionization Detector (PID)	Training on proper use of equipment to ensure appropriate exposure monitoring in accordance with Section 7 of the SSHP. Can be via the supplier of the equipment.	Prior to use. Use manufacturer instructions. Label device with calibration date and calibrator's initials.
4	Particulate Meter / Dust Monitor	Training on proper use of equipment to ensure appropriate exposure monitoring in accordance with Section 7 of the SSHP. Can be via the supplier of the equipment.	Prior to use. Use manufacturer instructions. Label device with calibration date and calibrator's initials.
5	Vehicles	Site-specific training	Perform inspection of vehicle at the start and end of each day and prior to each use.
6	Mobile phones	None	Daily to ensure in proper working order
7	2-way radio (optional)	Instruction on how to use and communicate to be discussed during Tailgate Safety Briefing	Daily by SSHO to ensure in proper working order
8	First Aid Kit with Eye Wash Bottle	First aid training if administering to others.	Monthly at a minimum. Daily to ensure they are in proper locations.
9	Fire Extinguisher (in vehicle)	Only those trained in the use of the fire extinguisher should use it to fight fires	Monthly at a minimum. Daily to ensure they are in proper locations.
10	Required PPE (safety glasses, safety-toed boots, hard hat, high visibility vest (Class II or III), nitrile gloves)	PPE training per Hazwoper refresher.	Prior to use.

ACTIVITY HAZARDS ANALYSIS

Date: 6-Jun-20 Project: PFAS Preliminary Assessment / Site Inspection

Overall Risk Assessment Code (RAC) (Use highest code): **M**

Activity: Sonic Drilling (soil sampling, groundwater sampling)

Activity Location: Yakima Training Center

Prepared By: Eeda Wallbank

Involved Personnel: provide names as needed below
SSHO: Olivia Miller
Designated Representative: Not Applicable
Competent or Qualified Person: Not Applicable

Type of SSHO (drop down below):
Hazwoper - 1yr Experience at cleanup operations

Type of work (drop down below

Proof of competency/qualifications attached? **Yes** / No

Acceptance Authority (digital signature): Grey P. Coppi, CIH, CSP

ACTIVITY HAZARDS ANALYSIS

Date: 11-Mar-20 Project: PFAS Preliminary Assessment / Site Inspection

Activity: Groundwater Sampling (Low Flow and Bailer)

Activity Location: Yakima Training Center

Prepared By: Eeda Wallbank

Overall Risk Assessment Code (RAC) (Use highest code): **L**

E = Extremely High Risk
H = High Risk
M= Moderate Risk
L= Low Risk

Risk Assessment Code Matrix

		Probability				
		Frequent	Likely	Occasional	Seldom	Unlikely
Severity	Catastrophic	E	E	H	H	M
	Critical	E	H	H	M	L
	Marginal	H	M	M	L	L
	Negligible	M	L	L	L	L

	JOB STEPS	HAZARDS	ACTIONS TO ELIMINATE OR MINIMIZE HAZARDS	RAC
1	Site - General	General Hazards	• Refer to General Site Hazards AHA	**L**
2	Assemble needed sampling equipment (i.e., pumps)	Sprain or strain from manual lifting	• Never lift objects that weigh more than 50 pounds alone. • Use good lifting techniques including having stable footing, maintaining a good grip, minimizing bending at the waist or twisting, and no sudden movements or overexertion.	**L**
		Slip/Trips/Falls over sampling equipment	• Visual check for and remove trip hazards prior to setup of sampling equipment. • Ensure good housekeeping in setting up equipment	**L**
3	Open wells to equilibrate and gauge wells	Pinch points on well vault	• Use correct tools to open well vault/cap. • Wear leather / cut resistant 2 gloves when removing well vault lids and chemical protective (nitrile) gloves while gauging.	**L**
		Pressure inside well	• Keep head away from well cap when removing. If pressure relief valves are on well use prior to opening well.	**L**
		Exposure to vapor/gas inhalation	• Keep face clear of wellhead and work upwind. Report any noticeable vapors to SSHO • Verify instruments are calibrated and functioning properly. • Conduct exposure monitoring / air monitoring with PID - refer to Section 7 of the SSHP.	**L**

ACTIVITY HAZARDS ANALYSIS

Date: 11-Mar-20 Project: PFAS Preliminary Assessment / Site Inspection

Activity: Groundwater Sampling (Low Flow and Bailer)

Activity Location: Yakima Training Center

Prepared By: Eeda Wallbank

Overall Risk Assessment Code (RAC) (Use highest code): L

	JOB STEPS	HAZARDS	ACTIONS TO ELIMINATE OR MINIMIZE HAZARDS	RAC
4	Purge Well (low flow pump or bailer)	Slip, trip and fall hazard over loose bailer twine, twine bucket, bailers, pump cables or associated tubing	• Keep loose twine, tubing, and pump cables off of ground. When pulling twine or tubing from bucket or spool determine amount needed to match depth of well to be purged and wind twine into a loop which can be easily carried. Do not place twine buckets, tubing, or pump controllers in walking path in or around work zone. • Keep bailers in bailer box when not in use.	L
		Injury due to cutting twine or pump tubing	• Do not use fixed open blades to cut twine or tubing. • Use scissors or tubing cutters to cut twine or tubing.	L
		Sprains and strains to arms and back while deploying and retrieving bailer or pump in groundwater monitoring well	• Do not bend over at waist when deploying or retrieving bailers or pumps in wells. • Stand upright with back straight. • Do not lift arms over head when retrieving bailer or pump from well. • Use both hands when dropping or pulling twine attached to bailer or tubing attached to pumps. • Deploy and retrieve bailers and pumps slowly. • Use pump to purge wells with high purge volumes to reduce sprains and strains.	L
		Slips and falls due to wet surfaces created by discharging purge water into bucket	• Pour water slowly into buckets/drums to minimize splashing. • Minimize splashing and wet areas. Set up work area to avoid wet areas and unnecessary steps.	L
		Dermal burns or abrasions to hands while deploying bailer or pump to well	• Do not allow twine, cables or tubing to slide though hands or fingers. • Use hand-over-hand technique to deploy and retrieve twine, cables, or tubing. • Wear Level 2 cut-resistant glove with nitrile liners or nitriles over Level 2 cut-resistant gloves when handling twine, bailers, pumps, tubing and cables to prevent abrasions and lacerations to hands from bailer twine.	L

ACTIVITY HAZARDS ANALYSIS

Date: 11-Mar-20 Project: PFAS Preliminary Assessment / Site Inspection

Overall Risk Assessment Code (RAC) (Use highest code): **L**

Activity: Groundwater Sampling (Low Flow and Bailer)

Activity Location: Yakima Training Center

Prepared By: Eeda Wallbank

	JOB STEPS	HAZARDS	ACTIONS TO ELIMINATE OR MINIMIZE HAZARDS	RAC
4 cont.	Purge Well (low flow pump or bailer), cont.	Abrasions and lacerations to hands by entangled bailer twine or pump cable	• Do not allow twine or pump cables to entangle hands or fingers creating loops which can potential cause pinches, abrasions and lacerations to hands. • Wear Level 2 cut-resistant glove with nitrile liners or nitriles over Level 2 cut-resistant gloves when handling twine, bailers, pumps, tubing and cables to prevent abrasions and lacerations to hands from bailer twine.	L
		DC electrical from battery	• Make sure equipment is turned off when connecting/disconnecting. • Protect equipment from liquid exposure (rain, purge water)	L
5	Collect groundwater sample	Broken sampling containers	• Inspect all containers prior to mobilizing to work area. Discard and replace any defects. • Do not over tighten vials to prevent breakage. • Use leather or cut resistant 2 gloves	L
		Constituents of Concern (COCs)	• Wear nitrile gloves when collecting samples.	L
6	Decontamination of Equipment	Contact with decontamination fluid	• Use spray bottle to apply decon fluid to equipment. Use scrub brush to clean equipment. • Spray fluid with the wind to your back. • Dispose of all garbage in correctly labeled waste containers.	L

ACTIVITY HAZARDS ANALYSIS

Date: 11-Mar-20 Project: PFAS Preliminary Assessment / Site Inspection

Overall Risk Assessment Code (RAC) (Use highest code): L

Activity: Groundwater Sampling (Low Flow and Bailer)

Activity Location: Yakima Training Center

Prepared By: Eeda Wallbank

	EQUIPMENT	TRAINING	INSPECTION
1	Vehicles	Site-specific training.	Perform inspection of vehicle at the start and end of each day and prior to each use.
2	Mobile phones	None	Daily to ensure in proper working order
3	2-way radio (optional)	Instruction on how to use and communicate to be discussed during Tailgate Safety Briefing	Daily by SSHO to ensure in proper working order
4	First Aid Kit with Eye Wash Bottle	First aid training if administering to others.	Monthly at a minimum. Daily to ensure they are in proper locations.
5	Fire Extinguisher (in vehicle)	Only those trained in the use of the fire extinguisher should use it to fight fires	Monthly at a minimum. Daily to ensure they are in proper locations.
6	Required PPE (safety glasses, safety-toed boots, hard hat, high visibility vest (Class II or III), nitrile gloves)	PPE training per Hazwoper refresher. If ear plugs are needed, review on proper insertion and use.	Prior to use.
7	Sampling Containers	Site-specific training on the collection of samples for PFAS analysis.	Containers should be inspected prior to use.
8	Pump and battery	General knowledge and site-specific training.	Inspect pump, hoses, battery and cables before use.
9	Bailer and twine	General knowledge and site-specific training.	Inspect bailer and twine prior to assembling.
10	Photoionization Detector (PID)	Training on proper use of equipment to ensure appropriate exposure monitoring in accordance with Section 7 of the SSHP. Can be via the supplier of the equipment.	Prior to use. Use manufacturer instructions. Label device with calibration date and calibrator's initials.

Involved Personnel: provide names as needed below

SSHO: Olivia Miller

Designated Representative: Not Applicable

Competent or Qualified Person: Not Applicable

Type of SSHO (drop down below):

Hazwoper - 1yr Experience at cleanup operati

Type of work (drop down below):

Proof of Competency / Qualifications attached? **Yes** / No

Acceptance Authority (digital signature): Grey P. Coppi, CIH, CSP Grey P. Coppi

ACTIVITY HAZARDS ANALYSIS

Date: 11-Mar-20 Project: PFAS Preliminary Assessment / Site Inspection

Activity: Soil Sampling - Hand Auger

Activity Location: Yakima Training Center

Prepared By: Eeda Wallbank

Overall Risk Assessment Code (RAC) (Use highest code): **L**

E = Extremely High Risk
H = High Risk
M= Moderate Risk
L= Low Risk

		Risk Assessment Code Matrix				
		Probability				
		Frequent	Likely	Occasional	Seldom	Unlikely
Severity	Catastrophic	E	E	H	H	M
	Critical	E	H	H	M	L
	Marginal	H	M	M	L	L
	Negligible	M	L	L	L	L

	JOB STEPS	HAZARDS	ACTIONS TO ELIMINATE OR MINIMIZE HAZARDS	RAC
1	Site - General	General Hazards	• This AHA is drafted to summarize general site hazards that are applicable to all site activates and will be reviewed/updated in conjunction with activity specific AHAs.	**L**
2	Assemble equipment	Sprain or strain	• Refer to General Site Hazards AHA • Use good lifting techniques including having stable footing, maintaining a good grip, minimizing bending at the waist or twisting, and no sudden movements or overexertion. • Avoid squatting for extended periods of time, allowing for breaks in between collecting samples.	**L**
		Slips/trips	• Clear path to work area and perform a walk through inspection prior to beginning work activities to eliminate or demarcate trip hazards. • Maintain good housekeeping practices in the work area.	**L**
3	Collect soil sample	Exposure to dust/particulate inhalation	• Conduct exposure monitoring / air monitoring with particulate meter - refer to Section 7 of the SSHP. • Verify instruments are calibrated and functioning properly. • Work upwind. Utilize STOP WORK for noticeable dusts and/or exceedances of monitoring criteria. Report any noticeable dusts to SSHO. Implement engineering controls as necessary.	**L**
		Broken sampling containers	• Inspect all containers prior to mobilizing to work area. Discard and replace any defective containers. • Do not over tighten vials to prevent breakage. • Use leather or cut resistant 2 gloves	**L**
		COCs	• Wear nitrile gloves when collecting samples.	**L**

ACTIVITY HAZARDS ANALYSIS

Date: 11-Mar-20 Project: PFAS Preliminary Assessment / Site Inspection

Overall Risk Assessment Code (RAC) (Use highest code): L

Activity: Soil Sampling - Hand Auger

Activity Location: Yakima Training Center

Prepared By: Eeda Wallbank

	JOB STEPS	HAZARDS	ACTIONS TO ELIMINATE OR MINIMIZE HAZARDS	RAC
4	Decontamination of Equipment	Contact with decontamination fluid	• Use spray bottle to apply decon fluid to equipment. Use scrub brush to clean equipment. • Spray fluid with the wind to your back. • Dispose of all garbage in correctly labeled waste containers.	L

	EQUIPMENT	TRAINING	INSPECTION
1	Vehicles	Site-specific training.	Perform inspection of vehicle at the start and end of each day and prior to each use.
2	Mobile phones	None	Daily to ensure in proper working order
3	2-way radio (optional)	Instruction on how to use and communicate to be discussed during Tailgate Safety Briefing	Daily by SSHO to ensure in proper working order
4	First Aid Kit with Eye Wash Bottle	First aid training if administering to others.	Monthly at a minimum. Daily to ensure they are in proper locations.
5	Fire Extinguisher (in vehicle)	Only those trained in the use of the fire extinguisher should use it to fight fires.	Monthly at a minimum. Daily to ensure they are in proper locations.
6	Required PPE (safety glasses, safety-toed boots, hard hat, high visibility vest (Class II or III), nitrile gloves)	PPE training per Hazwoper refresher. If ear plugs are needed, review on proper insertion and use.	Prior to use.
7	Sampling Containers	Site-specific training on the collection of samples for PFAS analysis.	Containers should be inspected prior to use.
8	Metal trowels and hand auger	Site-specific training on the collection of samples for PFAS analysis.	Prior to use.
9	Particulate Meter / Dust Monitor/PID	Training on proper use of equipment to ensure appropriate exposure monitoring in accordance with Section 7 of the SSHP. Can be via the supplier of the equipment	Prior to use. Use manufacturer instructions. Label device with calibration date and calibrator's initials.

ACTIVITY HAZARDS ANALYSIS

Date: 11-Mar-20
Project: PFAS Preliminary Assessment / Site Inspection
Activity: Soil Sampling - Hand Auger
Activity Location: Yakima Training Center
Prepared By: Eeda Wallbank

Overall Risk Assessment Code (RAC)
(Use highest code)
L

Involved Personnel: provide names as needed below
SSHO: Olivia Miller
Designated Representative: Not Applicable
Competent or Qualified Person: Not Applicable

Type of SSHO (drop down below):
Hazwoper - 1yr Experience at cleanup operation

Type of work (drop down below):

Proof of Competency / Qualifications attached? **Yes** / No

Acceptance Authority (digital signature): Grey P. Coppi, CIH, CSP Grey P. Coppi

ACTIVITY HAZARDS ANALYSIS

Date: 28-May-20 Project: PFAS Preliminary Assessment / Site Inspection

Activity: Surface Water and Sediment Sampling

Activity Location: Yakima Training Center

Prepared By: Eeda Wallbank

Overall Risk Assessment Code (RAC)
(Use highest code)
L

E = Extremely High Risk
H = High Risk
M= Moderate Risk
L= Low Risk

Risk Assessment Code Matrix

Probability

		Frequent	Likely	Occasional	Seldom	Unlikely
Severity	Catastrophic	E	E	H	H	M
	Critical	E	H	H	M	L
	Marginal	H	M	M	L	L
	Negligible	M	L	L	L	L

	JOB STEPS	HAZARDS	ACTIONS TO ELIMINATE OR MINIMIZE HAZARDS	RAC
1	Site - General	General Hazards	• Refer to General Site Hazards AHA	**L**
2	Assemble needed sampling equipment (i.e., battery with field water quality equipment, and pole mounted sampling cup)	Sprain or strain from manual lifting	• Never lift objects that weigh more than 50 pounds alone. • Use good lifting techniques including having stable footing, maintaining a good grip, minimizing bending at the waist or twisting, and no sudden movements or overexertion.	**L**
3	Collecting surface water sample and conducting water quality measurements	Biological Hazards	• Surface water sample collectionfrom 2 AOPIs: Selah Airstrip and the Boundary Monitoring Locations • Sample locations will be collected from the bank without wading. • Notify the SSHO and PM if biological hazards are observed in the work area.	**L**
		Slips/trips	• Place equipment into water with ease/care to minimize splashing. • Wear safety glasses and traction footing. • Avoid walking on slick, muddy or areas with growth or debris when possible.	**L**
		DC electrical from battery	• Make sure equipment is turned off when connecting/disconnecting. • Do not use in the rain or run cords through wet areas.	**L**

ACTIVITY HAZARDS ANALYSIS

Date: 28-May-20 Project: PFAS Preliminary Assessment / Site Inspection

Activity: Surface Water and Sediment Sampling

Activity Location: Yakima Training Center

Prepared By: Eeda Wallbank

Overall Risk Assessment Code (RAC)
(Use highest code)
L

	JOB STEPS	HAZARDS	ACTIONS TO ELIMINATE OR MINIMIZE HAZARDS	RAC
3 (cont.)	Collecting surface water sample and conducting water quality measurements (cont.)	Cuts from broken sampling containers	• Inspect all containers prior to mobilizing to work area. Discard and replace any defects. • Do not over tighten vials to avoid to prevent breakage. • Wear protective gloves when placing or removing bottle lid (cut resistant under nitile). Select gloves with good gripping capability on wet glass.	**L**
		Sprains and strains	• Avoid squatting for extended periods of time, allowing for breaks in between collecting samples. • Do not lift objects that are over 50 pounds without the help from someone else. Bend with the knees. Take frequent trips to mobilize the completed samples.	**L**
		Exposure to COCs	• Wear nitrile gloves when handling samples. • Work with a partner to transfer the collected sample from the collection cup into collection bottles.	**L**
		Drowning	• The SSHO shall determine if a risk of drowning exists through completion of the Water Risk Assessment Form and document by marking up this AHA. SSO wil notifiy the Arcadis Project Manager prior to escallating required PPE. • Use a USCG approved personal flotation device (PFD) if working near, over, on or in a body of water where the risk of drowning exists. • In accordance with the QAPP Addendum and SSHP, neither wading nor the use of a jon boat is to be used for surface water/sediment sample collection.	**L**
4	Conduct sediment probing and collect sediment sample	Potential to encounter underground utilities while drilling	• Underground utility clearance will be performed prior to mobilization to locate any potential utilities – complete checklist. • Refer to Utility Location Activity Hazards Analysis.	**L**
		Physical hazards	• Take turns when driving/pulling core tubes. • Lift with legs, not back. • Have proper grip on the tuber, keep upright, and avoid overexertion. • Precautions will be taken to minimize strain including moving feet and not twisting body, not overreaching for materials, stretching in advance of work activities, and avoiding awkward work positions.	**L**

ACTIVITY HAZARDS ANALYSIS

Date: 28-May-20 Project: PFAS Preliminary Assessment / Site Inspection

Activity: Surface Water and Sediment Sampling

Activity Location: Yakima Training Center

Prepared By: Eeda Wallbank

Overall Risk Assessment Code (RAC) (Use highest code): L

4 (cont.)	Conduct sediment probing and collect sediment sample (cont.)	Drowning	• The SSHO shall determine if a risk of drowning exists through completion of the Water Risk Assessment Form and document by marking up this AHA. SSO will notify the Arcadis Project Manager prior to escalating required PPE. • Use a USCG approved personal flotation device (PFD) if working near, over, on or in a body of water where the risk of drowning exists. • In accordance with the QAPP Addendum and SSHP, neither wading nor the use of a jon boat is to be used for surface water/sediment sample collection.	L
		Slips/trips	• Place equipment into water with ease/care to minimize splashing. • Wear safety glasses and traction footing. • Avoid walking on slick, muddy or areas with growth or debris when possible.	L
		Exposure to COCs	• Wear nitrile gloves when handling samples. • Work with a partner to transfer the collected sample from the collection cup into collection bottles.	L
5	Decontamination of Equipment	Contact with decontamination fluid	• Use spray bottle to apply decon fluid to equipment. Use scrub brush to clean equipment. • Spray fluid with the wind to your back. • Dispose of all garbage in correctly labeled waste containers.	L

ACTIVITY HAZARDS ANALYSIS

Date: 28-May-20 Project: PFAS Preliminary Assessment / Site Inspection

Overall Risk Assessment Code (RAC) (Use highest code): L

Activity: Surface Water and Sediment Sampling

Activity Location: Yakima Training Center

Prepared By: Eeda Wallbank

	EQUIPMENT	TRAINING	INSPECTION
1	Vehicles	Site-specific training.	each day and prior to each use.
2	Mobile phones	None	Daily to ensure in proper working order
3	2-way radio (optional)	Instruction on how to use and communicate to be discussed during Tailgate Safety Briefing	Daily by SSHO to ensure in proper working order
4	First Aid Kit with Eye Wash Bottle	First aid training if administering to others.	Monthly at a minimum. Daily to ensure they are in proper locations.
5	Fire Extinguisher (in vehicle)	Only those trained in the use of the fire extinguisher should use it to fight fires	Monthly at a minimum. Daily to ensure they are in proper locations.
6	Required PPE (safety glasses, safety-toed boots, hard hat, high visibility vest (Class II or III), nitrile gloves, PFD as determined by the SSHO)	PPE training per Hazwoper refresher.	Prior to use and in accordance with the Manufacturer Instructions.
7	Surface water collection tool (cup on pole)	Site-specific training on the collection of samples for PFAS analysis.	Containers should be inspected prior to use.
8	Sediment sample collection equipment (core, scoops, spoons, grab sampler, etc.)	Site-specific training on the collection of samples for PFAS analysis.	Containers should be inspected prior to use.
9	Battery and Field Parameter Analysis Equipment	Site-specific training on the collection of samples for PFAS analysis.	Inspect battery, cables, and field parameter anaysis equipment before use.
10	Sampling Containers	Site-specific training on the collection of samples for PFAS analysis.	Containers should be inspected prior to use.
11	Water Risk Assessment Form	PPE training per Hazwoper refresher and the Arcadis Water Operations HS Standard	Completion of Water Risk Assessment form prior to beginning operations.

Involved Personnel:
SSHO: Livi Miller
Designated Representative: Not Applicable
Competent or Qualified Person: Not Applicable

Type of SSHO:
Construction - 5yr Safety Experience

Type of work (drop down below):
COMPETENT PERSON

Proof of Competency / Qualifications attached? **Yes** / No

Acceptance Authority (digital signature): Grey P. Coppi, CIH, CSP

Water Risk Assessment Form

Project Name:	Project Location:
Project Number:	Date / Time:
Project Manager:	Evaluation Completed By:

Expiration Date:
(At a minimum the WRAF must be reviewed and update every 3 months)

1. Description of Water Operations

Scope of work:

Type or Water Body (Stream, Pond, River, Ocean, etc.):

Depth range of Water Body: _________ to _________

Typical Working Hours: __________ to ___________

Water Body Flow Rate or Current (List unit of measurement):

Water Body Temperature Range (List unit of measurement):

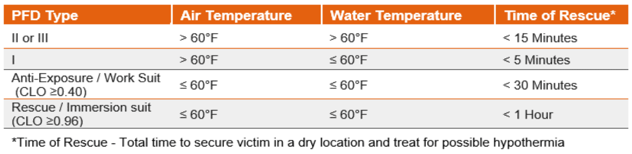
Geographic Limits of Work Area including Start/End Location:

Surrounding Topography or Site Conditions:

2. Identification & Control of Water Hazards [1,2]

(Circle Answer that Applies)

1) Will work be conducted at a height of 6ft or greater with unprotected edges? If **YES,** completion of the Elevated Work Permit is required. See Section 5.3 of Water Operations HSS	**YES**	**NO**
2) Will work be conducted when water temperature is at or below 60˚F? If **Yes**, below select type of cold water work PPE to be used : (See Section 5.6 of Water Operations HSS)	**YES**	**NO**
	Type I PFD	
	Anti-Exposure / Work Suit	
	Rescue / Immersion Suit	



PFD Type	Air Temperature	Water Temperature	Time of Rescue*
II or III	> 60°F	> 60°F	< 15 Minutes
I	> 60°F	≤ 60°F	< 5 Minutes
Anti-Exposure / Work Suit (CLO ≥0.40)	≤ 60°F	≤ 60°F	< 30 Minutes
Rescue / Immersion suit (CLO ≥0.96)	≤ 60°F	≤ 60°F	< 1 Hour

*Time of Rescue - Total time to secure victim in a dry location and treat for possible hypothermia

2) Does the Water Operations listed in Section 1. present a risk of drowning? If **YES,** select type of Inherently Buoyant PFD to be used: (See Section 5.1.1 of Water Operations HSS)	**YES**	**NO**
Worn when employees are working in or near an open ocean, rough seas, or remote water where rescue may be slow coming. See Section 2.	**Type I**	
Worn by employees when working around or on calm, inland waters, or where there is a good chance for fast rescue	**Type II**	
Worn by employees when working around or on calm, inland waters, or where there is a good chance for fast rescue	**Type III**	
4) Does the work require the use of a boat / vessel ? If **YES**, an electronic Float Plan must be completed and submitted prior to starting work. (See Section 5.5.1 of Water Operations HSS)	**YES**	**NO**
5) Will work on boat/vessel be conducted within 3,000ft of a Dam, Spillway, Similar Feature? If **YES**, completion of a communication plan is required. (See Section 5.7 of Water Operations HSS)	**YES**	**NO**

2. Identification & Control of Water Hazards [1,2]

(Circle Answer that Applies)

6) Will staff be working alone (Lone Worker)? If **YES**, the use of the buddy system is required and completion of a communication plan is required. (See Section 5.1 of Water Operations HSS)	**YES**	**NO**
7) Will work be conducted at night with out the use of a boat / vessel? If **YES**, completion of a communication plan is required. (See Section 5.1 of Water Operations HSS)	**YES**	**NO**

2) If YES is selected for any questions 3, 4, 5, and 6 must be reviewed and completed.

3.Communcition Plan

(List Minimum Requirements as required in Section 5.1 of the Water Operations Safety HSS)

1) If working in water within 3,000ft of a dam, dam overflow, water intake, or similar structure, Arcadis will notify the structure owner and discuss the appropriate safety requirements and work restrictions and document the requirements here.

4. Emergency Action / Rescue Plan

(List the Rescue Requirements as required in Section 5.5.1 & 5.7 of the Water Operations HSS)

5.Restrictions

Minimum restrictions are listed below

1) The use of Type V and non-inherently buoyant PFDs is not approved unless approved by Corporate H&S.
2) The use of PFDs classified for recreational use are prohibited for use on Arcadis projects.
3) Snorkeling or diving work is prohibited unless reviewed and approval by the Arcadis Diving Control Board (DCB)

6.Site Safety Officer (SSO) Review and Signature

The signatory has reviewed this WRAF and has reviewed the Water Operations HSS. The WRAF must be shared with all personnel performing the work, and must also be available for review in the appropriate work area. After activation of the Emergency Response Plan contact Arcadis Corporate Health and Safety

Name (Print):	Date:
Signature:	Time:

ACTIVITY HAZARDS ANALYSIS

Date: 11-Mar-20 Project: PFAS Preliminary Assessment / Site Inspection

Activity: IDW Handling

Activity Location: Yakima Training Center

Prepared By: Eeda Wallbank

Overall Risk Assessment Code (RAC)
(Use highest code)
M

E = Extremely High Risk
H = High Risk
M= Moderate Risk
L= Low Risk

Risk Assessment Code Matrix

		Probability				
		Frequent	Likely	Occasional	Seldom	Unlikely
Severity	Catastrophic	E	E	H	H	M
	Critical	E	H	H	M	L
	Marginal	H	M	M	L	L
	Negligible	M	L	L	L	L

	JOB STEPS	HAZARDS	ACTIONS TO ELIMINATE OR MINIMIZE HAZARDS	RAC
1	Site - General	General Hazards	• Refer to General Site Hazards AHA	**L**
2	Remove lids from drums to add waste (soil cores or purged groundwater)	Hand Injuries can occur from sharp edges, pinch points, and from use of hand tools	• Wear appropriate work gloves. • When removing ring from drum, fingers can get pinched between ring and drum. Keep fingers clear of this space. • Select proper tool for task.	**L**
		Use of mechanical tools to remove bolts from drum lids causes excessive noise	• Wear hearing protection if SSHO determines noise presents a risk.	**L**
		Splashing can occur if filling drum, or collecting samples	• Wear eye and face protection. • Pour liquids into drum slowly to minimize splashing.	**M**
3	Sample contents from drums for waste classification	Exposure to COCs can occur by contacting impacted contents	• Select proper dermal protection for task, at a minimum nitrile gloves should be worn. • Wear appropriate eye face and body protection as outlined in the SSHP.	**M**
		Exposure to vapor/gas inhalation	• Keep face clear and work upwind. Report any noticeable vapors to SSHO • Verify instruments are calibrated and functioning properly. • Conduct exposure monitoring / air monitoring with PID - refer to Section 7 of the SSHP.	**M**
		Sharp edges and broken sample containers can cause lacerations	• Discard any broken sample ware or glass properly. • Do not over tighten sample containers.	**M**

ACTIVITY HAZARDS ANALYSIS

Date: 11-Mar-20 Project: PFAS Preliminary Assessment / Site Inspection

Activity: IDW Handling

Activity Location: Yakima Training Center

Prepared By: Eeda Wallbank

Overall Risk Assessment Code (RAC) (Use highest code): **M**

	JOB STEPS	HAZARDS	ACTIONS TO ELIMINATE OR MINIMIZE HAZARDS	RAC
3 (cont.)	Sample contents from drums for waste classification (cont.)	Chemical burns or skin irritation can occur from contact with sample preservatives	• Wear chemical protective gloves when collecting samples, or when handling damaged sample containers.	**M**
4	Replace drum lids	Hand Injuries can occur from sharp edges, pinch points, and from use of hand tools	• See step 1 above.	**M**
5	Moving and Storing Drums	Drum storage area (near building 610) is a secure, shared drum storage area	• Calculate how many drums will be stored in new location. • Ensure that drums are clearly and appropriately labeled. • Do not store such that drums impede pedestrian or vehicular traffic.	**M**
		Muscle strain can occur when lifting/pulling/pushing drums	• Drums that are full can weigh as much as 800 lbs. Use a lift assist device whenever possible, and use a team lift approach. • When moving soil drum generated by drilling, have drillers use their equipment to move the drums. • Using dolly, slightly lift drum away from dolly to install forks under drum. Slowly let drum come back down and rest on dolly. Using hook on top of dolly, ensure it latches on top of drum correctly.	**M**
		Body parts can be pinched between lift device, or drum and the ground	• Be aware of hand and foot placement during drum staging. • Do not hurry through task.	**M**
		When moving, the drum can tip or the dolly could become unstable from uneven ground surface	• Plan travel route with drum prior to moving. • With drum secure on dolly, have one employee pull back on dolly, and other employee slowly push back on drum toward dolly. • Have second worker act as spotter for traffic, pedestrians, and any trip hazards along the way.	**M**

ACTIVITY HAZARDS ANALYSIS

Date: 11-Mar-20 Project: PFAS Preliminary Assessment / Site Inspection

Overall Risk Assessment Code (RAC) (Use highest code): **M**

Activity: IDW Handling

Activity Location: Yakima Training Center

Prepared By: Eeda Wallbank

	EQUIPMENT	TRAINING	INSPECTION
1	Vehicles	Site-specific training.	Perform inspection of vehicle at the start and end of each day and prior to each use.
2	Mobile phones	None	Daily to ensure in proper working order
3	2-way radio (optional)	Instruction on how to use and communicate to be discussed during Tailgate Safety Briefing	Daily by SSHO to ensure in proper working order
4	First Aid Kit with Eye Wash Bottle	First aid training if administering to others.	Monthly at a minimum. Daily to ensure they are in proper locations.
5	Fire Extinguisher (in vehicle)	Only those trained in the use of the fire extinguisher should use it to fight fires	Monthly at a minimum. Daily to ensure they are in proper locations.
6	Required PPE (safety glasses, safety-toed boots, hard hat, high visibility vest (Class II or III), nitrile gloves)	PPE training per Hazwoper refresher.	Prior to use and in accordance with the Manufacturer Instructions.
7	Waste containers (5-gallon bucket with lids and 55-gallon drums)	General knowledge	Containers should be inspected prior to use, and before/after moving
8	Drum dolly	Manufacturer Instructions. PPE training per Hazwoper refresher.	Prior to use and in accordance with the Manufacturer Instructions.
9	Photoionization Detector (PID)	Training on proper use of equipment to ensure appropriate exposure monitoring in accordance with Section 7 of the SSHP. Can be via the supplier of the equipment.	Prior to use. Use manufacturer instructions. Label device with calibration date and calibrator's initials.

Involved Personnel: provide names as needed below
SSHO: Olivia Miller
Designated Representative: Not Applicable
Competent or Qualified Person: Not Applicable

Type of SSHO (drop down below):
Hazwoper - 1yr Experience at cleanup operat

Type of work (drop down below): Proof of Competency / Qualifications attached? **Yes** / No

Acceptance Authority (digital signature): Grey P. Coppi, CIH, CSP Grey P. Coppi

Job Safety Analysis

General

JSA ID	17038	**Status**	(3) Completed
Job Name	Seismic Geophysical survey	**Created Date**	8/5/2019
Task Description	Geophysical Survey	**Completed Date**	09/09/2019
Template	FALSE	**Auto Closed**	TRUE

Client / Project

Client	Oxy USA Inc
Project Number	600025350000
Project Name	Occidental Chemical
PIC	MAROO, KETANKUMAR
Project Manager	BRUNT, LAWRENCE

User Roles

Role	Employee	Due Date	Completed Date	Supervisor	Active
Developer	Wiener, Matt	8/26/2019	8/5/2019	Porsche, Robert	☑
HASP Reviewer	Kirby, John Desmond	8/19/2019		Kaufman, Brian	☑

Job Steps

Job Step No.	Job Step Description		Potential Hazard	Critical Action	H&S Reference
1	Mobilization of equipment to survey area	1	Lifting hazards (heavy or bulky equipment)	Use TRACK to plan lifts and routes to work location. Use proper lifting techniques.	
		2	Delay or improper/unsafe performance of work due to improper equipment	Review HASP for required traffic control and air monitoring equipment. Review work plan and equipment prior to mobilization.	
		3	Awkward body positions and twisting	Plan activity to avoid twisting of body or awkward body positions. Use buddy system or job rotation to reduce exposure to conditions that cannot be avoided.	
		4	Trip and fall hazards from uneven ground or restricted view when carrying equipment	Break loads down to manageable size that does not obstruct view of ground. Plan route and use TRACK, wear footwear with good tread and ankle support. Use buddy system for large or bulky items when carrying.	
2	Set up survey grid and control	1	Slip trip and fall hazards from wet, uneven ground or over vegetation.	Break loads down to manageable size that does not obstruct view of ground. Plan route and use TRACK, wear footwear with good tread and ankle support. Use buddy system for large or bulky items when carrying.	
		2	Crush hazard or contact stress to hands/fingers from inserting pins or stakes.	Wear leather gloves when inserting pins, flagging, or stakes into the ground. Do not hurry task if hammering.	
		3	Struck by hazards by vehicles if working in traffic area.	Establish traffic control and wear a Class II traffic vest if in traffic area. Use vehicles to block work area when practical.	
		4	Repetitive stress from repeated bending or squatting during grid construction	Use job rotation when hazard exists, stretch before performing work activity. Use paint device that allows employee to stand up while spraying.	
		5	Chemical exposure from using spray paint	Stand up wind of paint spraying activities	
3	Performing survey	1	Slips trips and falls on wet, uneven or steep sloped surfaces	Break loads down to manageable size that does not obstruct view of ground. Plan route and use TRACK, wear footwear with good tread and ankle support. Use buddy system for large or	
		2	Pinch or injury to hand when opening/closing manhole cover.	Use proper tools to open and utilize help if available with good verbal communication. Wear work gloves.	

		3	Scrapes or cuts to hands, arms or legs from equipment or vegetation in area.	Wear leather or other suitable gloves when performing survey, wear long pants, wear heavy long sleeve shirt if arm hazard exists.	
		4	Noise hazards from survey equipment using percussion devices	Wear hearing protection, keep unnecessary workers away from devices when activated.	
		5	Theft of personal items or survey equipment	Use TRACK. If necessary, secure equipment if not close by and use second person to watch if the equipment must be left out.	
		6	Ergonomic injury form improper or prolonged use of	Use job rotation to reduce potential for injury.	
		7	Data loss and/or anomalies	Review data in secure area (field office/trailer), download and store on secure media and backup data.	
4	Demobilization and clean up	1	Muscle strain from removing pins or stakes	Use devices that maintain neutral body positions to remove pins when practical. Do not bend at waist when removing.	
		2	Pinch hazards to fingers from equipment cases	Identify hazard and avoid, pack equipment properly so that no wires or cables protrude from case requiring fingers to push into case when closing.	
		3	Lifting hazards from demobilizing equipment from work area	Use proper lifting techniques and use buddy system when necessary to assist in awkward size or heavy equipment.	
		4	Slip, trip and falls carrying equipment that obstructs view or on wet or uneven surfaces.	Break loads down to manageable size that does not obstruct view of ground. Plan route and use TRACK, wear footwear with good tread and ankle support. Use buddy system for large or bulky items when carrying.	
5	Preparation and return shipment of equipment	1	Cuts to hands and forearms from cutting strapping tape	Do not hurry during package preparation, Use TRACK, Use the right cutting tool for the task activity, use cutting tools with selfretracting blades.	
		2	Pinch hazards to fingers from equipment cases and placement of equipment in boxes	Identify hazard and avoid, pack equipment properly so that no wires or cables protrude from case requiring fingers to push into case when closing.	
		3	Lifting hazards from completed shipping packages	Break loads down to manageable size that does not obstruct view of ground. Plan route and use TRACK, wear footwear with good tread and ankle support. Use buddy system for large or bulky items when carrying.	
		4	Fire hazard form improperly packed spare batteries	Cover battery terminals or keep in original packaging when shipping, protect batteries from other metal objects in packages, perform shipping determination for number of spare batteries permitted to be shipped in package or consignment.	

PPE Personal Protective Equipment

Type	Personal Protective Equipment	Description	Required
Eye Protection	safety glasses		Required
Foot Protection	steel-toe boots		Required
Hand Protection	work gloves (specify type)	leather	Required
Head Protection	hard hat		Required
Miscellaneous PPE	other	Additional PPE as required by the HASP.	Required

Supplies

Type	Supply	Description	Required
Communication Devices	mobile phone		Required
Miscellaneous	fire extinguisher		Required
	first aid kit		Required

Personal	insect repellent		Recommended
	sunscreen		Recommended
	water/fluid replacement		Required
Traffic Control	traffic cones	cone off work zone as necessary	Recommended

Job Safety Analysis

General

JSA ID	16259	**Status**	(3) Completed
Job Name	Environment-Geophysical survey	**Created Date**	6/5/2018
Task Description	Electrical Resistivity Geophysical Survey	**Completed Date**	06/19/2018
Template	FALSE	**Auto Closed**	FALSE

Client / Project

Client	Rio Tinto
Project Number	RTKC00100001
Project Name	Rio Tinto Sweetwater
PIC	REISINGER, ROBERT
Project Manager	GILBERT, JOSEPH

User Roles

Role	Employee	Due Date	Completed Date	Supervisor	Active
Developer	Barker, Brent	6/25/2018	6/11/2018	Rice, Steve	☑
HASP Reviewer	Nannini, Thomas	6/25/2018	6/19/2018	Berry, Michael	☑
Quality Reviewer	Mayhut, John	6/22/2018	6/22/2018	Mayhut, John	☐

Job Steps

Job Step No.	Job Step Description		Potential Hazard	Critical Action	H&S Reference
1	Mobilization of equipment to survey area	1	Lifting hazards (heavy or bulky equipment)	Use TRACK to plan lifts and routes to work location. Use proper lifting techniques.	
		2	Awkward body positions and twisting	Plan activity to avoid twisting of body or awkward body positions. Use buddy system or job rotation to reduce exposure to conditions that cannot be avoided.	
		3	Trip and fall hazards from uneven ground or restricted view when carrying equipment	Break loads down to manageable size that does not obstruct view of ground. Plan route and use TRACK, wear footwear with good tread and ankle support. Use buddy system for large or	
2	Set up survey grid and control	1	Weather (lightning, rain) causing electrical shock	Stop work immediately if thunder is heard or lightning is seen. Power down equipment and take shelter in the nearest vehicle (away from survey equipment) in the event of lightning	
		2	Slip trip and fall hazards from wet, uneven ground or over vegetation.	See step one controls.	
		3	Crush hazard or contact stress to hands/fingers from inserting pins or stakes.	Wear leather gloves when inserting pins, flagging, or stakes into the ground. Do not hurry task if hammering.	
		4	Struck by hazards by vehicles if working in traffic area.	Establish traffic control and wear a Class II traffic vest if in traffic area. Use vehicles to block work area when practical.	
		5	Repetitive stress from repeated bending or squatting during grid construction	Use job rotation when hazard exists, stretch before performing work activity. Use paint device that allows employee to stand up while spraying.	
		6	Equipment inspection- faulty equipment could result in injury or equipment damage.	Conduct daily inspections of equipment and annotate on a Daily Inspection form. Inspect lines, cables, and connections for wear and insure all cable connections are tight. Repair	
		7	Chemical exposure from using spray paint	Stand up wind of paint spraying activities	
		8	Lifting equipment that is too heavy or awkward resulting in back/neck strains/sprains.	Lift with legs and not back to reduce back strain. Use two-person lift technique to lift any loads over 50 pounds. Load items using two persons to minimize awkward lifting or reaching	

3	Performing survey	1	Slips trips and falls on wet, uneven or steep sloped surfaces	See step one controls.	
		2	Scrapes or cuts to hands, arms or legs from equipment or vegetation in area.	Wear leather or other suitable gloves when performing survey, wear long pants, wear heavy long sleeve shirt if arm hazard exists.	
		3	Noise hazards from survey equipment using percussion devices.	Wear hearing protection, keep unnecessary workers away from devices when activated.	
		4	Ergonomic injury form improper or prolonged use of carried devices that are long or bulky.	Use job rotation to reduce potential for injury	
		5	Crush hazard or contact stress to hands/fingers from hammering/inserting resistivity electrode stakes into the	Wear leather gloves when drilling, inserting pins, flagging, or stakes into the ground. Do not hurry task if hammering.	
		6	Weather (lightning, rain) causing electrical shock	Stop work immediately if thunder is heard or lightning is seen. Power down equipment and take shelter in the nearest	
		7	Encountering radiation contamination	Follow site specific rules and directions. Take site specific training. Coordinate site walks with client and include site safety officer. Perform monitoring as required.	
4	Demobilization and clean up	1	Muscle strain from removing pins or stakes	Use devices that maintain neutral body positions to remove pins when practical. Do not bend at waist when removing.	
		2	Pinch hazards to fingers from equipment cases	Identify hazard and avoid, pack equipment properly so that no wires or cables protrude from case requiring fingers to push into case when closing.	
		3	Lifting hazards from demobilizing equipment from work area	See step one controls.	
		4	Slip, trip and falls carrying equipment that obstructs view or on wet or uneven surfaces.	See step one controls.	
5	Preparation and return shipment of equipment	1	Cuts to hands and forearms from cutting strapping tape	Do not hurry during package preparation, Use TRACK, Use the right cutting tool for the task activity, use cutting tools with self retracting blades	
		2	Pinch hazards to fingers from equipment cases and placement of equipment in boxes	See step 4 controls.	
		3	Lifting hazards from completed shipping packages	See step 1 controls	
		4	Fire hazard form improperly packed spare batteries	Cover battery terminals or keep in original packaging when shipping, protect batteries from other metal objects in packages, perform shipping determination for number of spare	

PPE Personal Protective Equipment

Type	Personal Protective Equipment	Description	Required
Dermal Protection	long sleeve shirt/pants		Required
Eye Protection	safety glasses		Required
Foot Protection	steel-toe boots		Required
Hand Protection	work gloves (specify type)	cut-resistant	Required
Head Protection	hard hat		Required
Hearing Protection	ear plugs		Recommended
Miscellaneous PPE	traffic vest--Class II or III	vest or shirt, class II	Required

Supplies

Type	Supply	Description	Required
Communication Devices	mobile phone		Required
	walkie talkie		Recommended
Decontamination	Decon supplies (specify type)	Alconox	Required
Miscellaneous	fire extinguisher		Required
	first aid kit		Required
Personal	eye wash (specify type)		Required
	sunscreen		Recommended
	water/fluid replacement		Required

Review Comments

Reviewer		Comments
Employee: **Role** **Review Type** **Completed Date**	Nannini, Thomas HASP Reviewer Revise 6/8/2018	Very well written JSA. Only comments are to add Weather (lighting...) to "Performing Survey" and make sure consistent with Rio Tinto standard or reference that client procedure will be followed.
Employee: **Role** **Review Type** **Completed Date**	Nannini, Thomas HASP Reviewer Approve 6/19/2018	well written and thorough
Employee: **Role** **Review Type** **Completed Date**	Mayhut, John Quality Reviewer NA 6/22/2018	Very good task analysis the safety contingencies were addressed. Two items for your consideration 1) Make sure equipment is turned off when connecting/disconnecting, and 2) Reconnaissance of the survey lines to identify potential hazards prior to the set-up or installation of equipment.

Job Safety Analysis

General

JSA ID	2796	**Status**	(3) Completed
Job Name	Construction-Oversight - excavation and construction	**Created Date**	6/14/2010
Task Description	Excavation/Trenching Oversight (Outdoors)	**Completed Date**	06/17/2010
Template	True	**Auto Closed**	False

Client / Project

Client	Arcadis AGMI
Project Number	000000100000
Project Name	GENERAL OVERHEAD
PIC	
Project Manager	

User Roles

Role	Employee	Due Date	Completed Date	Supervisor	Active
Developer	Stewart, Ian	5/21/2012	6/14/2010	Stewart, Ian	☐
HASP Reviewer	Tremblay, Tony	6/28/2010	6/17/2010	Tremblay, Tony	☐
Quality Reviewer	Crandall, James M.	6/25/2010	6/25/2010	Johnson, Gary	☐

Job Steps

Job Step No.	Job Step Description		Potential Hazard	Critical Action	H&S Reference
1	Utility Clearance	1	Contact with utilities can cause injury, property damage, and cause releases of hazardous substances to the environment.	Establish a minimum of three lines of evidence, and obtain additional lines of evidence as needed for site specific conditions. Maintain utility markings, perform detailed site inspections, and keep open and constant communication between operators, onsite staff, and project management. Always Use Stop Work Authority if there is a question or concern about the location of a utility.	ARCHSFS019 - Utility Clearance HS Standard
		2	Slip trip and falls while performing site clearance activities	Focus on task at hand and do not hurry through task. Avoid reading maps/drawings while walking, stop walking when looking up for overhead utilities.	
2	Excavation/Trenching and Backfilling Oversight	1	Slips trips and falls from poor housekeeping around trench or excavation.	Maintain work area and minimize clutter near excavation. Place excavated material properly and at least 2 feet away from the edge of excavation. Remove potential hazards when possible. Mark hazards when it cannot be removed. Create and maintain awareness of hazard. Maintain barriers, fall hazard warning signage and traffic controls properly. Do not cross over caution tape, safety fencing etc. Follow Project specific STAR Plan	FHSHB IV(D)
		2	Excavation or trench collapse trapping workers or creating falls.	Excavation/Trench greater than five (5) feet deep in which subcontractor, employees or others will be entering must be properly sloped, benched, shored or have a trench box in place. Sloping, benching, shoring or use of trench box is not required IF an excavation is less than five (5) feet in depth and examination of the ground by a competent person provides no indication of a potential cave-in. Ensure a Competent Person is on site to inspect and oversee excavation/ trenching activities. Where feasible, stay six (6) feet from edge of excavation/trench. A safe means of egress, such as a stairway, ladder, or ramp, shall be	

				located so that no more than twenty-five (25) feet of lateral travel is necessary for site workers conducting activities in trenches exceeding four (4) feet in depth.	
		3	Potential high level of dust, fumes, vapors or particulates creating visibility or inhalation/contact hazards could result in exposure above occupational exposure limit or create an IDLH atmosphere.	Visually monitor air for dust, and wet excavated soil as needed to control dust. Monitor for chemical vapors if hazard exists. The atmosphere must be tested in excavations greater than four (4) feet in depth where oxygen deficiency or toxic or flammable gases are likely to be present, before workers will be permitted to enter. Ensure downwind and perimeter monitoring also performed, if atmospheric hazards exists.	
		4	Excessive noise from excavating equipment or pumps.	Make sure all authorized personnel including subcontractors are wearing hearing protection (ear plugs/muffs) when working around noisy equipment. Increase distance from noise hazard when practical.	
		5	Potential Leaks of Petroleum Fluids and Lubricants from excavating equipment and support equipment.	Make sure all authorized personnel including subcontractors perform equipment inspections looking for leaks, cracked hoses, and loose fittings. Promptly and properly repair all leaks.	
		6	Open Excavation, Unauthorized Entry, or Property Damage	Make sure all authorized personnel including subcontractors mark open excavation with demarcation tape, orange fencing, orange cones, etc. to prevent unauthorized / accidental entry. Make sure controls are adequate for traffic protection after dark or when the site is unstaffed. Backfill excavation area as soon as possible and fence off any excavation not backfilled at the end of the work day.	
		7	Contact with potentially impacted groundwater and soil.	Conduct task in a calm, cautious manner. Wear appropriate PPE. Ensure equipment is in working conditions before start of work every day. Stop work immediately and report to the site manager, if any life threatening conditions exist.	
		8	Working Around Heavy Machinery	Where feasible, maintain distance from excavation equipment in excess of the swing radius. Maintain eye contact with operators at all time. Ensure equipment is in good working condition before work begins. Wear appropriate PPE, including safety vest. Do not wear loose clothing and pull back long hair. Be aware of and avoid standing in red zones (equipment operator "blind-spots"). No personnel are permitted to stand underneath suspended loads.	
3	Stockpile Maintenance and Sampling	1	Falls climbing on or during covering of stockpile.	Avoid climbing on stockpiles when possible, keep hands free, do not hurry trough tasks such as pulling plastic sheeting up onto or over piles.	
		2	Overexertion placing plastic sheeting, weight, and straw bales.	Use proper lifting techniques, avoid twisting of body, and forceful pulling/pushing. Do not hurry through task.	
		3	Cuts, scrapes, impalement from debris in stockpiles.	Have excavation contractor remove/isolate large chunks of concrete, exposed rebar etc. from stockpile to extent practical. Inspect areas prior to kneeling or placing hands when sampling upon stockpile.	

PPE	**Personal Protective Equipment**		
Type	**Personal Protective Equipment**	**Description**	**Required**
Dermal Protection	long sleeve shirt/pants		Required
Eye Protection	safety glasses		Required

Foot Protection	steel-toe boots		Required
Hand Protection	chemical resistant gloves (specify type)	When sampling groundwater	Required
	work gloves (specify type)	Leather when hand hazard exists; nitrile for soil/	Required
Head Protection	hard hat		Required
Hearing Protection	ear plugs	When working near heavy equipment	Required
Miscellaneous PPE	traffic vest--Class II or III		Required

Supplies

Type	Supply	Description	Required
Communication Devices	mobile phone	Remote area, check reception	Required
Decontamination	Decon supplies (specify type)		Required
Miscellaneous	fire extinguisher		Required
	first aid kit		Required
	flashlight		Required
Personal	eye wash (specify type)		Required
	insect repellent		Recommended
Traffic Control	Other	Cones/tape to delineate trenches prior to backfill	Required

Review Comments

Reviewer		Comments
Employee: **Role** **Review Type** **Completed Date**	Tremblay, Tony HASP Reviewer Approve 6/17/2010	
Employee: **Role** **Review Type** **Completed Date**	Crandall, James M. Quality Reviewer NA 6/25/2010	No additional comments. Very well done.

Job Safety Analysis

General

JSA ID	344	**Status**	(3) Completed
Job Name	Construction-Heavy equipment operation	**Created Date**	5/29/2009
Task Description	Heavy equipment operation	**Completed Date**	06/15/2009
Template	True	**Auto Closed**	False

Client / Project

Client	Arcadis AGMI
Project Number	000000100000
Project Name	GENERAL OVERHEAD
PIC	
Project Manager	

User Roles

Role	Employee	Due Date	Completed Date	Supervisor	Active
Developer	Coppola, Mija	5/21/2012	5/29/2009	Coppola, Mija	☐
HASP Reviewer	Moyers, Samuel	6/12/2009	6/15/2009	McDonald, Andrew	☑

Job Steps

Job Step No.	Job Step Description		Potential Hazard	Critical Action	H&S Reference
1	Loading and Unloading Equipment from transport vehicles.	1	Stake or impact hazards from moving equipment	Stand clear of equipment loading or unloading form transport vehicles	FHSHB Section IV (E); ARCHSF019, FHSHB Section III(MM)
		2	Equipment damage from improper removal or placement on vehicle	Ensure any ramps used are rated for weight and properly placed and secure prior to moving equipment across, ensure trailers being loaded or unloaded are properly secured against movement.	
		3	Overhead utility contact for equipment with booms or extensions	Plan position of transport vehicle to maintain safe distance (>20 ft) from all overhead lines and structures, Use spotters since operator focus may be on vehicle alignment with ramps or other ground level distractions.	
		4	Ascending/Descending equipment cab.	Do not hurry through task, wear footwear with good tread and ankle support, maintain 3 points of contact while accessing or egress equipment, no jumping off trailers or truck beds.	
2	Pre-operation inspection	1	Pinch hazards to hands	Wear gloves appropriate for hazard while maintaining dexterity. Keep hand in field of vision and watch for and keep hands clear of obvious hazards like door or cover closures. Do not hurry during the removal or placement of covers or equipment components.	
		2	Head injury from striking equipment covers or components	Wear hard hat, stay focused on surroundings, avoid standing or raising up suddenly especially if door cover is overhead.	
		3	Exposure to engine fluids or lubricants	Wear protective gloves, ensure MSDS is available for engine fluids and lubricants, promptly wash exposed skin, contact WorkCare immediately for any situation where diesel is injected under the skin.	
		4	Awkward body positions and twisting	Plan inspection activity and do not hurry through task, stretch before crawling or squatting. Avoid overreaching.	
		5	Entanglement in equipment components.	Do not circumvent protective guards or shields, ensure equipment is not operational (LOTO if necessary) when accessing engine compartment if intrusion required.	
3	Equipment operation	1	Strike or impact hazards with	Keep eyes moving and watch for	

			other workers, equipment or structures.	unanticipated worker movement. Keep workers 15 ft from any extendable area of the equipment, Maintain 360 degrees of awareness and ensure adequate communication method with other workers. All workers to know emergency STOP hand signals. Verify that all back up alarms are functional.	
		2	Utility contact (subsurface or above ground)	Follow utility clearance procedure prior to any intrusive work with equipment. Immediately stop work if any unusual or unanticipated condition encountered.	
		3	Rollovers on slopes or from improper usage	Follow equipment manufacturer instructions for use on slopes or load capacities, wear seatbelt at all times, Ensure all outriggers, if equipped are properly deployed on stable surface.	
		4	Noise from engine or work activity	Wear hearing protection as required, keep equipment well maintained.	
		5	Slips and falls from accessing or egress from equipment	Maintain 3 points of contact when access or egress equipment, keep any ladder or steps on equipment clean and dry to extent practical, ensure equipment doors, if present, are in good working order.	
		6	Exposure to tools and metal edges and damaged metal resulting in cuts lacerations to hands during maintenance	Wear protective gloves that allow for good dexterity. Mitigate sharp surfaces to extent practical.	
		7	Pinch/crush hazards to hands from doors or covers	Wear gloves appropriate for hazard while maintaining dexterity. Watch for and keep hands clear of obvious hazards like door or cover closures. Do not hurry during the removal or placement of covers or equipment components.	
		8	Contact stress to knees and hands	Use padding or knee pads if kneeling on hard surfaces for an extended period of time. Avoid placing weight on hands for extended periods of time.	
4	Maintenance	1	Awkward body positions and twisting	Plan inspection activity and do not hurry through task, stretch before crawling or squatting. Avoid overreaching.	
		2	Excessive force turning bolts or lifting heavy components.	Use automated methods to loosen tight bolts, do not use excessive force or torque when using hand tools. Do not use "cheater bars".	
		3	Contact with engine fluids or lubricants	Wear protective gloves, ensure MSDS is available for engine fluids and lubricants, promptly wash exposed skin, contact WorkCare immediately for any situation where diesel is injected under the skin.	
		4	Flying debris during decontamination or cleaning activities.	Wear adequate eye and face protection when removing soils or solid media form tracks, buckets, or other component of equipment by using a pressure washer.	
		5	Entanglement in equipment components.	Do not circumvent protective guards or shields, ensure equipment is not operational (LOTO if necessary) when accessing engine compartment if intrusion required.	
		6	Exposure of hands and arms to hot engine components	Take the time to allow the engine to cool, wear protective gloves and forearm protection.	
		7	Struck by moving equipment or boom extensions	Keep at least 15 ft from any extendable area of the equipment, if entering within 15 ft, establish and maintain contact with equipment operator, wear high visibility clothing or work vest.	
5	Working in proximity to heavy equipment	1	Equipment damage from moving equipment	Keep other equipment not required for work outside of heavy equipment work area. Flag or mark equipment with high visibility markings, cones, etc.	

		2	Noise hazards from equipment operation	Wear hearing protection and increase distance if work activity permits.	

PPE Personal Protective Equipment

Type	Personal Protective Equipment	Description	Required
Eye Protection	safety glasses		Required
Foot Protection	steel-toe boots		Required
Hand Protection	work gloves (specify type)		Required
Head Protection	hard hat		Required
Hearing Protection	ear plugs	as needed	Recommended
Miscellaneous PPE	traffic vest--Class II or III		Required

Supplies

Type	Supply	Description	Required
Miscellaneous	fire extinguisher		Required
	first aid kit		Required
Personal	eye wash (specify type)		Required

Review Comments

Reviewer		Comments
Employee: **Role** **Review Type** **Completed Date**	Moyers, Samuel HASP Reviewer Approve 6/15/2009	

ATTACHMENT 3

Site Traffic Safety Plan

Traffic Safety Plan (TSP)

1.0 General

Plan type	Non-Right of Way (Non-ROW)
Project Name:	YTC Boundary Investigation
Project Number:	
Developer Name:	Julia Vidonish Aspinall
Duration of Project (in hours or days):	8 hrs per location
Time Restrictions (Y/N, if Y describe below):	NA
Not Applicable	
Not Applicable	
Not Applicable	NA
Not Applicable	
Not Applicable	NA

☒ Working on multiple roads?

Projects with roadway work on multiple roadways must prepare a TSP for each roadway location. A map should be attached indicating which TSP applies to each roadway location.

Comments: This TCP is for surface geophysics transects performed on-post.

2.0 Work Description

Provide a brief description of scope of work:

Surface geophysics transects using seismic ground vibration equipment on-post at Yakima Training Center. Cable protectors will be laid across driveways and parking lot areas as needed.

3.0 Type and Duration

Work locations on this project will be: Intermediate work (1-8 hours per location)

Non-ROW work will be performed in: Active parking lot

Special traffic conditions may include (select most prevalent): Not applicable

4.0 Traffic Control Layout, Number of Devices Required, and Phasing

The following Non-ROW requirements in the Traffic Safety Handbook applies:

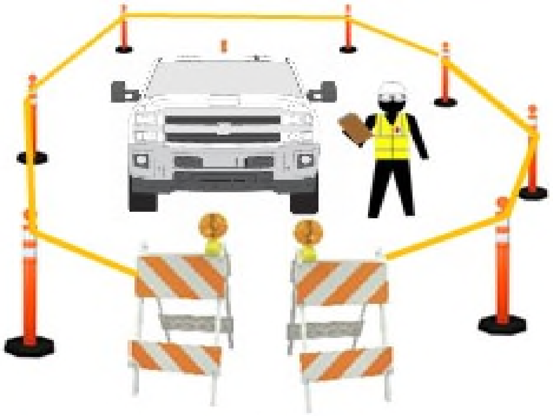
Section 7.3 Intermediate Duration Work in Parking Areas (1 to 8 Hours) (DOT Facts-302b)

The menu below will be blank and is not applicable.

The menu below will be blank and is not applicable.

Non-ROW configuration:

An example non-ROW traffic control configuration for this project is illustrated below. The actual type and number of devices required are specified below. Don't leave vehicle doors open. Don't establish controls within 25 ft of the front or rear of parked large vehicles/rolling equipment without coordinating with the vehicle/equipment operator.

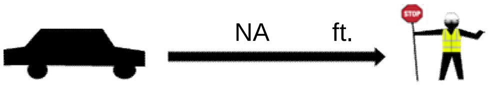


Intermediate Term (1-8 Hours)
Channelizing Cones, Caution Tape and
Type II Barricades

ROW minimum sign spacing distances for "A", "B" and "C" (as applicable) in referenced DOT Facts.

A	NA	ft.
B	NA	ft.
C	NA	ft.

ROW oncoming traffic minimum site distance required to see Flagger and properly decelerate and stop.



NA ft.

ROW Cone Calculation (Values are default. Light grey fields may be modified based on actual road conditions)

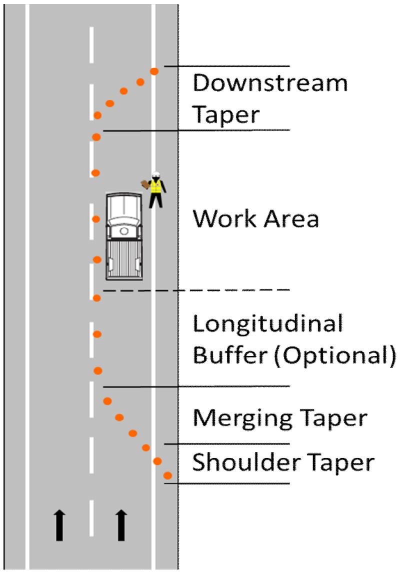
Active work area length (feet)
☐ Apply Optional Longitudinal Buffer (ft)?
Lane width of offset (feet)
Shoulder width of offset (feet)
Posted speed limit NA

☐ **Shoulder Taper**

Taper Length (feet)	NA
Cones Required	NA
Cones Spacing (max., ft)	NA

☐ **Merging Taper**

Taper Length (feet)	NA
Cones Required	NA
Cones Spacing (max., ft)	NA



☐ **Work Area**

Cone Spacing (max., ft)	NA
Cones Required	NA

Note: Review taper configuration and cone spacing after ROW implementation to ensure traffic is moving efficiently without motorist confusion in the RWZ.

☐ **Downstream Taper**

Taper Length (feet)	NA
Cones Required	NA
Cone Spacing (max., ft)	NA

Cones Required (minimum) NA

Select the traffic control devices to be used and enter number each required:

Check all that apply:		*Wording or Pictogram*	*Number:*
☐	Warning signs		
☐	Warning signs		
☐	Warning signs		
☐	Stop/Slow paddle		
☐	Red flag		
☐	Drums		
☐	Channelizer cone (42 inch height, 10 lb base)		
☒	Channelizer cone (42 inch height, 30 lb base)		7
☐	Traffic cones (≥ 18 inches tall)		
☒	Barricade: Type II		2
☐	Flags for cones		
☐	Lights (for night work)		
☐	Plastic fencing (rolls)		
☒	Caution tape (rolls)		2
☐	Other (specify):		

Non-ROW Phasing:

1) Position truck as shield, if practical

2) Deploy traffic control devices

3) Affix flags, caution tape or fencing

4) Unload project equipment

5) Commence work

6) SSO to maintain controls

7) Remove controls in reverse order

Electronic Device Use Safety

Reviewed By:

HASP Reviewer: ______________________

____

ATTACHMENT 4

COVID-19 Guidance

Arcadis Field and Embedded Staff COVID-19 Guidance

16 February 2022

Version Control

Revision No.	Date Issued	Description
1	3/17/20	Original document.
2	3/20/20	Added guidance for multiple occupants traveling in the same vehicle.
3	3/24/20	Updated introduction to include links to Orange Line information; added requirement of Arcadis COVID-19 Health Screening Self-Assessment Questionnaires; moved client questionnaire section forward in the document; and made minor updates to the social distancing, vehicle/transportation, lodging and equipment sections.
4	3/30/20	Updated social distancing section to include CDC “close contact” definition; added section for work in team settings; added AirBnB to lodging discussion.
5	4/2/20	Document template updated and sections rearranged; updated Hand Hygiene section; updated Cleaning of Frequently Touched Surfaces section; updated close contact definition; added section on PPE; added section for Traveling Between States, Provinces and Territories; added section for Construction/Construction Management; added section on Post-Shift Work
6	4/3/20	Added Appendix D – Interim Guidance for the Use of Face Coverings; Updated links, Section 2.3 added bullet to avoid sharing tools and equipment unless cleaned; Section 4.7.2 updated with a bullet for maintaining social distancing at choke points; Section 4.8 added section for Face Coverings and guidance in Appendix D.
7	4/10/20	Added Section 2.8 Other Considerations for journey and emergency action planning; Section 4.6 updated with current information regarding COVID-19 in sewage; Section 4.8 and Appendix D updated to include CDC’s recommends of wearing cloth face coverings in public settings where other social distancing measures are difficult to maintain.
8	4/13/20	Revised Section 2.6 by adding information about gloves being required in some jurisdictions; revised Section 4.8 and Appendix D with latest CDC and Health Canada guidance information.
9	4/20/20	Revised Section 2.1 to discuss both digital and hardcopy COVID-19 Health Screening Self-Assessment Questionnaires; revised Section 2.3.1 to include instructions on alcohol-based hand sanitizer use.
10	4/26/20	Revised Section 2.1 by adding the definition of fever and process for elevated temperature; revised section 2.4 by adding a reminder to understand the appropriate uses and limitations of the disinfectant; revised Section 2.6 by adding link to PPE request form and email address; Section 3.1 added link to “Locations with Travel Restrictions”

Revision No.	Date Issued	Description
		dashboard; revised Section 3.2 to consider face coverings when multiple occupants are riding in a single vehicle; revised Section 4.2 adding critical infrastructure/essential worker language; updated hyperlinks
11	5/1/20	Section 1 revised with latest symptoms of COVID-19; Section 2.5 reinforced Stop Work Authority and reporting where social distancing is not being practiced; inserted Interim Guidelines for Cardiopulmonary Resuscitation as Section 2.8 and moved “Other Considerations” to Section 2.9; added a bullet referencing Continuity Plan in Section 2.9
12	5/4/20	Revised Appendix C per jurisdictional updates.
13	6/16/20	Updated symptom list per CDC guidance; revised CDC close contact definition notes (Section 2.4); added plan for breaks bullets in Section 4.2; added Section 4.9 KN95; updated CDC’s face covering laundering recommendations in Appendix D.
14	8/14/20	Updated footnotes for “close contact” definition (Section 2.5); updated Sections 3.1 and 3.3 to reflect current travel recommendations; updated Section 4.8 and Appendix D to indicate exhalation valves or vents should NOT be worn; added links to the Face Covering Guide in Section 4.8.
15	10/23/20	Added Appendix E with additional signage that may be used; added reference to signage (Section 2.3.1); updated social distancing and close contact definitions (Section 2.5); added Yellow Guidance sub bullet (Section 2.7); updated order hyperlink (Section 3.1); added airline and other transportation (Section 3.2); added reporting requirement documentation (Section 4.3); updated Section 4.7.1 to clarify occupancy and documentation of visitors for contact tracing; added guidance to hold meetings outside (Section 4.7.2); minor edits to Section 4.8 and Appendix D.
16	11/13/20	Section 3.2 updated protocol to only one person in a vehicle; Section 3.3 updated protocol regarding room sharing and dining; Sections 4.2 through 4.7 added a face covering bullet; Section 4.8 and Appendix D added information from recent study that face coverings provide protection to the wearer.
17	12/4/20	Revised the reporting process in Section 2.7 to contact WorkCare instead of Brian Kundert. Added Section 2.7.1 describing WorkCare’s risk stratification and return to work process.
18	1/29/21	Updated all hyperlinks to new Intranet; added COVID-19 vaccine to Section 2.3; moved the Face Covering and KN95 section from 4.8 and 4.9, respectively, to Section 2.6; renumbered all sections; Section 2.9 clarified the continuity plan is required by the jurisdiction or client and is

Revision No.	Date Issued	Description
		recommended for all projects; revised poster in Appendix B; Appendix D updated with current CDC language and added CDC graphics.
19	2/25/21	Updated links in Section 2.1.2; updated Section 2.6 and Appendix D with revised face covering and KN95 guidance.
20	5/18/21	Added U.S. quarantine exemptions in Section 2.8; updated U.S. ridesharing requirements in Section 3.2; updated U.S. dining protocol in Section 3.3; updated face covering bullets in Section 4.0 work-specific situations; template update.
21	7/23/2021	Updated Section 2.1 and 2.8.1 to reflect the revised WorkCare Daily Screen and risk stratification process; removed outdated Section 2.6.1; updated U.S. vehicle sharing protocol in Section 3.2; Section 4.7 updated with guidance for vaccinated and unvaccinated employees.
22	8/13/21	Removed “Jurisdictional Social Distancing” template from Appendix C and renumber appendices; changed temperature at which individuals will not visit an office or project site to 100.0°F (37.8°C) in Section 2.1; updated face covering protocol for indoor spaces in Section 2.6 and Appendix C; updated U.S. vehicle sharing protocol in Section 3.2.
23	9/10/21	Added Section 2.3 Vaccine Policy and renumbered sections; Section 2.8 removed reference to retired “Yellow Caution Status” flowchart; Section 3.2 updated Canada ridesharing; Section 3.3 updated Canada and U.S. dining protocol; Section 4.7.1 removed reference to unvaccinated employees.
24	2/14/22	Updated vaccination terminology and definition in Section 2.9; revised U.S. ridesharing and lodging requirements for unvaccinated staff in Sections 3.2 and 3.3, respectively; added requirement that staff entering residential settings must be vaccinated in Section 4.5; updated Appendix C with latest CDC mask guidance; updated hyperlinks throughout the document.
25	2/16/22	Revised Section 4.5 recommending staff entering residential settings be vaccinated and added recommendation for an N95.

Contents

Appendices

Acronyms and Abbreviations

AED	Automated external defibrillators
CDC	U.S. Centers for Disease Control and Prevention
CPR	Cardiopulmonary resuscitation
HC	Health Canada
PPE	Personal protective equipment
SDS	Safety Data Sheet

1 Introduction

Currently Arcadis is following CDC and Health Canada guidelines, as well as applicable government directives. The health and safety of our people is of utmost importance to us. Arcadians are empowered to use TRACK to evaluate individual situations and Stop Work Authority anytime safety is at risk. Employees will not come to work if exhibiting any respiratory illness symptoms, including but not limited to COVID-19.

It is recommended that all field and embedded staff review and have access to the current version of this document. The most current version can be viewed and downloaded from the ANA H&S COVID-19 Resources intranet page. COVID-19 symptoms may appear 2-14 days after exposure to the virus. People with these symptoms or combinations of symptoms may have COVID-19:

- Fever or chills
- Cough
- Shortness of breath or difficulty breathing
- Fatigue
- Muscle or body aches
- Headache
- New loss of taste or smell
- Sore throat
- Congestion or runny nose
- Nausea or vomiting
- Diarrhea

This list is not all inclusive. Please consult your medical professional for any other symptoms that are severe or concerning to you.

2 Guidance for Project Activities

Employees will complete the following for all project activities.

2.1 Arcadis COVID-19 Health Screening Self-Assessment Questionnaires

All employees going to an Arcadis office, a project site, or a client site will be required to complete a Daily Screening through WorkCare's WorkMatters app, regardless of vaccination status. Individuals should continuously monitor for signs and symptoms of COVID-19 and, if not feeling well, complete the WorkCare Daily Screen Process again.

When individuals take their own temperature to evaluate whether they have a fever, the temperature measurements will be completed without the use of fever-reducing medicines that contains ibuprofen or acetaminophen and not within 30 minutes of exercise. The CDC defines a fever as a temperature of 100.4°F (38°C) or greater. If the individual's temperature is between 99°F (37.2°C) and 99.9°F (37.7°C) it is recommended the individual pay close attention for signs and symptoms of COVID-19 and complete the WorkCare COVID-19 Daily Screen Process more frequently. Individuals with temperatures of 100.0°F (37.8°C) or greater should not visit an office or project site. You may also contact WorkCare's COVID-19 services if you are experiencing symptoms consistent with COVID-19 and are concerned it may be COVID-19.

2.1.1 COVID-19 Daily Screen Process

All Arcadis staff will register in WorkCare's WorkMatters app. Arcadis staff can use the WorkCare WorkMatters app once a day (or multiple times a day, if appropriate) to complete their COVID-19 health screening self-assessment using the Daily Screen Survey.

Upon completion of the COVID-19 Daily Screen Process in the WorkMatters app, the user will receive a green or red completion message:

- Green – Proceed to the office or project site.
- Red – Do not proceed to the office or project site. Complete Survey 2 and follow end guidance. You and your supervisor will receive an email that you have not been cleared to work. You will need to conduct contact tracing with Corporate Health & Safety, if necessary. You must log into the URL or App to complete the Daily Symptom Tracker, each day you are Not Cleared To Return To Work.

Once you have been cleared to Return to Work by a WorkCare physician, you and your supervisor will receive an email that states you have been Cleared to Return to Work.

2.1.2 COVID-19 Health Screening Self-Assessment Questionnaire (Hardcopy)

The COVID-19 Health Screening Self-Assessment Questionnaire must be:

- Distributed to scheduled visitors, clients, and contractors before visiting Arcadis offices or sites.
- Post the self-assessment questionnaire and post Appendix A at entrances and/or field trailers.

Minimize visitors on site. All visitors (staff, subcontractors, clients, anticipated guests, unanticipated guests) to the site must be asked to review the applicable questionnaire from the following list.

Canada COVID-19 Health Screening Self-Assessment Questionnaire for Staff (English)

U.S. COVID-19 Health Screening Self-Assessment Questionnaire for Staff, Contractors and Visitors (English)

U.S. COVID-19 Health Screening Self-Assessment Questionnaire for Staff, Contractors and Visitors (Spanish)

If a client has a similar questionnaire that Arcadis staff are required to complete, the client questionnaire may be substituted for Arcadis questionnaire.

2.2 Client COVID-19 Health Screening Forms

Some clients are requiring our employees to complete their COVID-19 health screening forms.

- You are not required to share personal medical information with clients; therefore, Arcadis is not requiring you to complete any form requesting medical information. Your disclosure of personal medical information to clients is completely voluntary.
- Please understand, if you do not complete the form, you will not be allowed on the client's sites and facilities, per the client's directive.
- Also, if you complete the form, you have an ongoing duty to provide prompt notice of any changes to any of your responses. (Some clients may require periodically signing updated forms).
- If you are restricted from a client site as a result of your answers to the COVID-19 health screening form, or because you have chosen not to complete the form, Arcadis will attempt to find you alternative work that does not involve access to the client's site or facility; although, Arcadis cannot guarantee that other work will be available.

If your Project Manager is not already aware of the client COVID-19 health screening form, please alert them when you receive one from a client.

2.3 U.S. Vaccine Policy

Arcadis strongly encourages all employees to receive a COVID-19 vaccination. COVID-19 vaccines are effective at helping protect against severe disease and death from variants of the virus that causes COVID-19. In accordance with the Arcadis U.S. Vaccine Policy, all U.S. employees are encouraged to upload the vaccination details into WorkCare's WorkMatters portal.

Clients may require employees working at their sites be fully vaccinated or if unvaccinated, to complete surveillance testing. If the client requires Arcadis verification, Project Managers or Account Managers will reach out to HR Operations (HROperations.ANA@arcadis.com) with a list of names to be checked. If testing is required, contact Corporate Health & Safety.

2.4 Practice Good Hygiene

The best way to prevent illness is to avoid exposure to the virus. CDC and Health Canada recommend common flu and cold season preventative measures, including:

- Wash hands often with soap and water for at least 20 seconds. If soap and water are not readily available, use a hand sanitizer with at least 60% alcohol.
  - If hand sanitizer or soap & water are not available on site, bring your own source of water and hand soap to accommodate hand washing.
- Avoid touching your eyes, nose, and mouth.
- Cover your nose and mouth with a tissue when sneezing or coughing.
- Monitor your health daily by completing a self-assessment.
- Stay 6 feet (2 metres) away from others.
- Avoid crowds and poorly ventilated spaces.
- Do not share Personal Protective Equipment (PPE).
- Maintain and thoroughly clean PPE in accordance with manufacturer's instructions.
- Avoid sharing phones, offices, tools, and equipment. If sharing is necessary, clean and disinfect prior to use.
- Clean high touch surfaces daily.
- Get a vaccine (flu to reduce the risk of flu illness and COVID-19).

2.4.1 Hand Hygiene

Hand hygiene for infection prevention is an important part of the U.S. and Canada response to COVID-19. Washing hands with soap and water has been and will continue to be our primary method for good hand hygiene. Both CDC and HC recommend that you wash hands often with soap and water for at least 20 seconds especially after you have been in a public place, or after blowing your nose, coughing, or sneezing. Hand washing mechanically removes pathogens.

Alcohol based hand sanitizer is a flammable liquid and vapor. However, there is no evidence to suggest hand sanitizer poses a fire hazard when used according to package directions and warnings. To use hand sanitizer:

- Follow manufacturer instructions for use.
- Rub your hands together, covering all surfaces of both hands, including between your fingers and up around your fingertips and nails.
- Rub hands together for 30 seconds to allow your hands to completely absorb the product.
- Allow the hand sanitizer to completely dry.
- Do not touch food or anything until your hands are dry.
- Refer to the Safety Data Sheet (SDS) for hazards information.

If hand sanitizer is not available, Arcadis requires that project teams assess and address the need for hand washing (e.g., access to water and soap) while working on site. This can be achieved by having access to a functioning restroom, a portable hand washing station or as simple as having hand soap, bottled water and paper towels to clean hands as necessary. A handwashing sign that may be posted near handwashing stations is provided in Appendix D.

2.5 Clean Frequently Touched Surfaces

Arcadis recommends that project teams identify who is responsible for cleaning frequently touched surfaces in our workplaces (field trailers, client facilities, etc.). CDC and HC recommend that these surfaces are disinfected daily. This includes tables, doorknobs, light switches, countertops, handles, desks, phones, keyboards, toilets, faucets, and sinks. Before using a disinfectant product, understand the appropriate uses and limitations of the disinfectant, and refer to equipment/tool manufacturer care instructions to determine whether the disinfectant is compatible (e.g., using isopropyl alcohol to disinfect an iPhone).

CDC cleaning and disinfecting facilities: https://www.cdc.gov/coronavirus/2019-ncov/community/disinfecting-building-facility.html

Health Canada cleaning and disinfecting public spaces: https://www.canada.ca/en/public-health/services/publications/diseases-conditions/cleaning-disinfecting-public-spaces.html

Health Canada hard surface disinfectants: https://www.canada.ca/en/health-canada/services/drugs-health-products/disinfectants/covid-19.html

If surfaces are dirty, clean them using detergent or soap and water prior to disinfection. To disinfect, most common EPA-registered or HC-approved household disinfectants will work. Use disinfectants appropriate for the surface.

If the sourcing of disinfectant products is limited, CDC and HC have outlined an option to use a diluted household bleach solution (at least 1,000 ppm sodium hypochlorite) as a disinfectant.

Standard household bleach is typically 5.25% sodium hypochlorite (52,500 ppm), whereas ultra-strength household bleach is typically 6% sodium hypochlorite (60,000 ppm). In accordance with Hazard Communication requirements, always refer to and have a copy of the Safety Data Sheet (SDS) available and on site with you. To **make a daily bleach solution** for use as a disinfectant:

- Mix 5 tablespoons (1/3rd cup) of standard bleach per gallon of water or for a smaller spray bottle size dilution, mix 4 teaspoons bleach per quart of water.
  OR
- 1 teaspoon (5 mL) per cup (250 mL) OR 4 teaspoons (20 mL) per litre (1000mL).
  Note: Solution must be mixed daily, because the solution will lose effectiveness as a disinfectant after 24-hours.

Follow manufacturer's instructions (e.g., Clorox) for application and proper ventilation, ensuring a contact time of at least 1 minute (for specific products and contact time information, refer to the CDC and HC links above). Check to ensure the product is not past its expiration date. Never mix household bleach with ammonia or any other cleanser. According to the HC, CDC and U.S. EPA, unexpired household bleach will be effective against coronaviruses when properly diluted.

A second alternative is to use an alcohol solution. The solution must have at least 70% isopropanol.

If supplies cannot be sourced locally, email PPErequests@arcadis.com.

2.6 Practice Social (Physical) Distancing

The CDC definition of **social distancing, also called "physical distancing,"** means keeping a safe space (approximately 6 feet, 2 metres or about two arm lengths) between yourself and other people who are not from your household in both indoor and outdoor spaces. Situations where social/physical distancing should be practiced include but are not limited to tailgate and safety briefing meetings, breaks in field trailers, entering stores and workstations. Plan work activities to maximize social (physical) distancing and minimize close contact with others. Social (physical) distancing is mandatory for unvaccinated individuals and highly recommended for vaccinated individuals. If there are instances where social distancing is not being practiced where it should, Stop Work and remove yourself from the situation. Contact the Project Manager or your Supervisor and document in the H&S App as an "Close Call" or "Unsafe Behavior."

Additional information when working in teams is required is discussed in the "work specific situations" section below.

> **Note:** The CDC defines **close contact** as: a person who was within 6 feet of an infected person for a cumulative total of 15 minutes or more over a 24-hour period starting from 2 days before illness onset (or, for asymptomatic patients, 2 days prior to test specimen collection) until the time the patient is isolated.[1]

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[1] Individual exposures added together over a 24-hour period (e.g., three 5-minute exposures for a total of 15 minutes). Data are limited, making it difficult to precisely define "close contact;" however, 15 cumulative minutes of exposure at a distance of 6 feet or less can be used as an operational definition for contact investigation. Factors to consider when defining close contact include proximity (closer distance likely increases exposure risk), the duration of exposure (longer exposure time likely increases exposure risk), whether the infected individual has symptoms (the period around onset of symptoms is associated with the highest levels of viral shedding), if the infected person was likely to generate respiratory aerosols (e.g., was coughing, singing, shouting), and other environmental factors (crowding, adequacy of ventilation, whether exposure was indoors or outdoors). Because the general public has not received training on proper selection and use of respiratory PPE, such as an N95, the determination of close contact should generally be made irrespective of whether the contact was wearing respiratory PPE. At this time, differential determination of close contact for those using fabric face coverings is not recommended.

2.7 Face Coverings

Health Canada and CDC recommends wearing face coverings in public settings, like on public and mass transportation, at events and anywhere you will be around other people. In the U.S., face coverings are required on planes, buses, trains, and other forms of public transportation traveling into, within, or out of the United States and in U.S. transportation hubs such as airports and stations. When visiting Arcadis offices and project sites, face coverings will be worn when moving about the space, in common areas and during meetings. If social/physical distancing can be maintained, face coverings may be removed when sitting at individual workstations or actively eating in cafés. Some jurisdictions require face coverings to be worn at all times indoors regardless of vaccination status.

In Canada, non-surgical face coverings are mandatory when flying and travelling through airports. The wearing of face coverings is either required or recommended in all other public settings across Canada (indoors and outdoors).

Studies show that face coverings reduce the spray of droplets when worn over the nose and mouth. Studies also show face coverings can reduce wearers' exposure to infectious droplets through filtration. How well the face covering protects the wearer depends on the fabrics used and how it is made (e.g., the type of fabric, the number of layers of fabric, how well the mask fits). Health Canada and CDC still recommends that you stay at least 6 feet away from other people (social distancing), frequent hand cleaning, avoid contact with people who are sick and other everyday preventive actions. Face coverings are not a substitute for social/physical distancing. Face coverings with exhalation valves or vents should NOT be worn to help prevent the person wearing the mask from spreading COVID-19 to others. Face shields and goggles are not a substitute for face coverings.

Face coverings offering various features appropriate for different work environments, including moisture wicking and FR, are now in stock at Airgas (U.S.). The Face Covering Guide outlines several options to facilitate selection of the face covering that is appropriate for your work.

Some jurisdictional entities and clients require the use of face coverings based on Health Canada and CDC guidance. CDC guidance on selection of face coverings is included in Appendix C.

2.8 Personal Protective Equipment

Be prudent with PPE use (PPE with a purpose). Continue to work with our vendors on your PPE ordering needs and consider alternatives (e.g., N95 dust masks may not be available, but half face elastomeric respirators with P100 cartridges are available in limited supplies). If PPE and supplies cannot be sourced locally, email PPErequests@arcadis.com.

Select the appropriate glove for the task and include in the HASP, JSA and/or COVID-19 Preparedness, Response and Continuity Plan. Before using nitrile gloves as personal protective equipment (PPE), make sure to:

- Wash and dry your hands before and immediately after using gloves.
- Understand how to put nitrile gloves on and take them off (Ansell Donning & Doffing Technical Release).
- Nitrile gloves offer protection against common consumer cleaning supplies, chlorinated solvents, and offer good dexterity and sensitivity.
- Change gloves between tasks or wash gloved hands with soap and water between tasks.
- Do not touch your face.

- Inspect gloves frequently for rips, tears, etc. and replace as necessary.
- Understand limitations of nitrile gloves.

2.9 Reporting a COVID-19 Exposure

Contact WorkCare (888-449-7787, press 9) to initiate the COVID-19 Screening and Return to Work Process if you have tested positive for COVID-19, have been asked to be tested for COVID-19 by a medical professional or have received a red “Stop” screen during the COVID-19 self-assessment instructing you to call WorkCare.

If you learn you have been in **close contact** with a worker, client or member of the public who is COVID-19 positive:

- Stop work.
- Notify your Supervisor and Project Manager.
- Self-quarantine in accordance with country-specific requirements (Canada and U.S.) and contact your personal physician for additional direction.
    - If working in the U.S., the following people are exempt from self-quarantine due to close contact and are asymptomatic
        - Fully vaccinated and up-to-date on COVID-19 vaccines[2]
        - Had COVID-19 in the past 3 months

If you’ve been tested or asked to be tested for COVID-19 by a medical professional, please contact WorkCare (888-449-7787, press 9) to initiate the return to work process.

2.9.1 WorkCare COVID-19 Screening & Return to Work Process

Contact WorkCare (888-449-7787, press 9) for access to doctors and nurses who will discuss your symptoms, complete a risk stratification process, and advise on return-to-work process. If you complete the Daily Screen Process through the WorkMatters App and receive a red screen, you will be prompted to complete the risk stratification process electronically and depending on the outcome, you may receive a call from a WorkCare nurse or physician. If prompted to complete the risk stratification process, you can expect to:

- Be placed into a low, moderate or high-risk category
    - Low Risk – you may be cleared to return to work at an office or project site
    - Moderate and High Risk – you will not be cleared to return to work at an office or project site and instructed to remain at home
    - An email will be sent to you, Corporate H&S, HR, and your Supervisor indicating whether you can proceed to an office or project site (cleared) or whether you must work remotely (not cleared). If you are not cleared, this will initiate Arcadis’ internal contact tracing process.
- Moderate and High-Risk individuals will be required to complete the “Daily Symptom Tracker” during their self-isolation period.
- At the end of your self-isolation period, you will complete a Return-to-Work Survey in the WorkMatters Portal. The survey and daily symptom tracker will be reviewed by a WorkCare physician.

---

[2] People are considered fully vaccinated and up-to-date when they have received all recommended COVID-19 vaccines, including any booster dose(s) when eligible. “Fully vaccinated” two weeks after second dose in a two-dose series, such as Pfizer/Moderna vaccines, or two weeks after a single-does vaccine, such as Johnson & Johnson's Janssen vaccine.

- You will receive a written notice from WorkCare indicating whether you are cleared or not cleared to return to work at an office or project site.

If you are not cleared, you will receive additional instruction, which may include continuing daily assessments and completing another return-to-work survey at a later date.

2.10 Interim Guidelines for Cardiopulmonary Resuscitation

The American Heart Association and Hearth & Stroke Foundation of Canada have issued interim Hands-only cardiopulmonary resuscitation (CPR) guidelines to reduce the risk when helping victims of cardiac arrest with suspected or confirmed COVID-19.

CPR and the use of automated external defibrillators (AED) significantly improve the chance of survival of patients experiencing cardiac arrest. During the COVID-19 pandemic, first aid trained folks and bystanders may feel uncomfortable performing lifesaving CPR and increasing their own risk of contracting the virus.

Hands-only CPR involves performing chest compressions only at a rate of 100 to 120 compressions per minute until an ambulance arrives.

When administering CPR, consider:

- Wearing a face covering
- Laying a cloth, towel, or clothing over the person’s mouth and nose
- Perform hands-only CPR
- Use an AED, if available

2.11 Other Considerations

When planning field work, consider the following:

- Plan your journey to and from the site to manage social distancing and hand hygiene when you need to stop for gas or at a store for supplies
- Reevaluate the current field work situation as it relates to lone worker protocols
- A COVID-19 Preparation, Response and Continuity Plan template is required for all projects.

3 Travel Guidance

3.1 Traveling Between States, Provinces or Territories

Some states, provinces and territories have issued executive orders requiring self-quarantine, travel health screening questionnaires and/or COVID-19 testing for people traveling into or from certain locations. While some jurisdictions exempt essential workers, self-quarantine requirements may apply during off-work hours, confining the employee to their lodging location. Check local requirements before you travel to determine whether you can travel or if there is a need to self-quarantine at the destination. Prior to travel, it is important to have a destination plan in place and understand the steps you will take to remain safe and healthy throughout your trip. Whenever possible, use local project teams within a 4-hour drive radius.

3.2 Field Vehicles and Transportation

When using shared vehicles (fleet, rental, ride sharing services) follow the cleaning guidance above for frequently touched surfaces. Check with your rental agency before vehicle pick-up to understand their cleaning procedures, and supplement with your own cleaning, as necessary. Note: if using wipes, make sure the wipe is compatible with the surface being cleaned.

Canada: A limit of two vaccinated employees may share a vehicle. Unvaccinated individuals are not permitted to share vehicles.

U.S.: There is no limit to the number of vaccinated employees that may share a vehicle. Face coverings must be worn at all times when multiple people are in the vehicle. Unvaccinated employees are not allowed to share vehicles.

When traveling by air for business-critical travel, check with the airline to obtain their latest COVID-19 requirements. A summary of current airline COVID-19 policies can be found here.

3.3 Lodging Considerations

Most hotel chains have implemented additional cleaning, disinfection and face covering in common area procedures. Check with your hotel before check-in to understand their procedures. Consider bringing a surface cleaner or disinfecting wipes to clean frequently touched surfaces such as doorknobs, tv remote, etc.

In instances where AirBnB has been authorized and approved in writing by the Project Manager and Supervisor, consider the following:

- The entire team should not stay at the same residential facility.
- In the U.S., only vaccinated individuals may share lodging provided the configuration allows each individual to have their own dedicated living space (e.g., own bedroom). Face coverings are required in common spaces.
- Understand the AirBnB may need additional cleaning and disinfection of commonly touched surfaces upon arrival.

Lodging together is not permitted for unvaccinated employees.

Always maintain good personal hygiene and avoid crowded places such as restaurants or bars. Consider using take out or outdoor seating. If self-quarantine is required by the jurisdiction during off-work hours, plan ahead and evaluate local food and/or grocery delivery options.

Canada: Dining together outdoors and indoors without face coverings is permitted if everyone is fully vaccinated. Outdoor dining is preferable. Indoor dining should be limited, and groups kept small. Dining together is not permitted if anyone is not vaccinated.

U.S.: Dining together outdoors without face coverings is permitted if everyone is fully vaccinated. Indoor dining is permitted if everyone is fully vaccinated and face coverings are worn in public spaces. Dining together is not permitted if anyone is not vaccinated.

3.4 Rental Equipment and Sample Cooler Handling

Clean the exterior of rental equipment and sample coolers upon arrival at the job site using a cleaning product that will not impact data quality. Wear gloves and safety glasses when handling sample coolers to prevent contact with acid preservation of the bottles in coolers. Where possible, order separate sets of equipment and “assign” equipment to individuals for use through the duration of the event.

4 Work-Specific Situations

4.1 Working with Little or No Contact with Others

Follow procedures listed in Section 2.0 and Section 3.0.

4.2 Working in Project Teams

When working in project teams (paired Arcadians, embedded staff, contractors, clients, etc.):

- If feasible, prior to visiting the site, have a H&S check in to confirm all attendees are complying with CDC or Health Canada guidelines, including:
    - Confirm understanding that workers or clients should not go to the job site if they have personally tested positive for COVID-19, have been in close contact to anyone else who has tested positive for COVID-19 or are exhibiting symptoms. If a worker discloses close contact with someone COVID-19 positive and the worker is asymptomatic, instruct the employee to complete the WorkCare Daily Screen and follow the instructions provided following the survey.
- Out of respect for all, ask everyone to self-disclose if they are not feeling well (exhibiting flu-like symptoms), and request that they should go home.
- Observe person(s) for symptoms, and use Stop Work, as necessary, and contact Project Manager.
- Set visual or physical barriers to keep the public away (caution tape and cones).
- Consider if “split shifts” can be used to limit contact, or if work can be scheduled during hours of low to no facility operations.
- Arcadis staff plan work activities, continuously use TRACK and re-plan work activities to maximize social distancing and minimize “close contact”
    - Practice good hygiene and clean commonly touched surfaces
        - Clean clipboard and pen prior to use
        - Bring your own pen
        - Disinfect shared equipment (water level meters, pumps, etc.)
        - Coordinate with sanitation vendor for portable hand wash station (soap & water or hand sanitizer)
    - Use work practices and tools to minimize close contact when feasible, such as:
        - Single person operating a winch instead of a two-person manual lift
        - Tools to maximize distance
    - Use PPE in accordance with the Job Safety Analysis (face shield, safety glasses, gloves, etc.)
    - Plan for breaks to allow for hydration, nutrition and rest/prevention of heat related illness
        - Select locations where social distancing can be maintained
        - Allow time for safe doffing/donning of personal safety items
        - Communicate individual needs for breaks before beginning work.

- If social distancing or other controls are not feasible discuss this with your supervisor and PM, discuss “Is the work necessary?” or “Can the work be rescheduled for a later date?”
  - Refer to Section 2.6 for the definition of close contact. CDC has indicated short periods of time in close contact may not increase risk of exposure.
- Wear face coverings in accordance with Section 2.7 and jurisdictional requirements.
- Subcontractors need to develop and implement their own procedures to protect their workers.

4.3 Embedded Employee Working at a Client Facility

Embedded employee at a client facility should:

- Inquire whether working remotely is an option.
- If not, and Arcadis must work at the client facility:
  - Ask if arrangements can be made to practice social distancing (e.g., split shift, separate workstation, etc.)
  - Practice good hygiene, and if you do not feel the situation is safe, you can execute your stop work authority by having discussions with your Supervisor and Project Manager.
- Wear face coverings when social/physical distancing cannot be maintained or in accordance with client or jurisdictional requirements.
- If client facility cleanliness is a concern discuss concerns with Project Manager. The Project Manager will discuss with the client. If the client will not increase cleaning, Arcadis employees will be provided with the supplies to clean and disinfect frequently touched surfaces as well as supplies to clean hands.
- Discuss and document Arcadis, client and jurisdictional protocol for reporting a COVID-19 case using the template in the Arcadis COVID-19 Preparedness, Response and Continuity Plan or similar form.

4.4 Working in Contact with the Public

When working in contact with the public (mall areas, parks, outdoor residential settings):

- Set visual or physical barriers (caution tape and cones) to keep the public away and maintain social distancing.
- Wear face coverings when working indoors or in enclosed spaces. Refer to Appendix C for guidance on the appropriate face covering.
- Consider posting signs reminding the public of social distancing guidance (example in Appendix B).

4.5 Working at Indoor Residential Settings

When working at indoor residential settings, consider the following guidelines:

- It is recommended that employees entering residential settings are fully vaccinated.
- A N95 is recommended when entering residential settings.
- Call ahead to ask if the resident(s) is experiencing flu-like symptoms or if anyone in the house is in mandatory or precautionary self-quarantine. Reschedule the work if the resident is experiencing symptoms or under quarantine. Also share Arcadis work procedures and explain that Arcadis will be practicing social distancing during the work.
- Upon arrival, assess the residents for signs of flu-like symptoms. If observed, use Stop Work, exercise social distancing and contact the Project Manager.

- Where feasible, wear gloves, wipe down surfaces prior to touching them and thoroughly wash hands after completing the work (do not touch face).
- Ask if arrangements can be made to practice social distancing (meaning stay 6 feet [2 metres] away).
- Schedule your work when resident is not home, if your work area allows for access (e.g., a basement crawl space the doesn't require entry to the main living area of the home).

4.6 Projects Involving Drinking Water Systems, Recreational Water and/or Wastewater

According to the CDC, at this time, the risk of transmission of the virus that causes COVID-19 through sewerage systems is thought to be low. Although transmission of the virus that causes COVID-19 through sewage may be possible, there is no evidence to date that this has occurred.

Wastewater and sewage workers should use standard practices, practice basic hygiene precautions, and wear personal protective equipment (PPE) as prescribed for current work tasks.

When working on projects involving drinking water systems, recreational water and/or wastewater:

- The COVID-19 virus has not been detected in drinking water.
- Conventional water treatment methods that use filtration and disinfection, such as those in most municipal drinking water systems, should remove or inactivate the virus that causes COVID-19.
- Standard practices associated with wastewater treatment plant operations should be sufficient to protect wastewater workers from the virus that causes COVID-19.
- Review the project Health & Safety Plan and task-specific Job Safety Analysis for required personal protective equipment and other controls.
- Wear face coverings when working indoors. Refer to Appendix C for guidance on the appropriate face covering.

4.7 Construction Management/Construction

4.7.1 Field Trailers

Field trailers may present unique challenges for social distancing. Consider the following:

- Restrict access by posting site signage (Appendix D) requesting all visitors, including site workers. All who enter the field trailer should knock and don a face covering before entering.
    - The project team will determine the maximum occupancy based on the ability to maintain social distancing.
- Local jurisdictions may require face coverings in all indoor spaces regardless of vaccination status. In areas without jurisdictional mandates, all workers will wear face coverings in common spaces and when social/physical distancing cannot be maintained. Refer to Appendix C for guidance on the appropriate face covering.
- Maintain a log of visitors entering the trailer use the "Arcadis Contact Tracing Log" in Appendix E. Assign a person responsible for signing visitors in and out.
- Clean surfaces regularly. In the absence of professional cleaning services, occupants will develop a schedule for site personnel to complete cleaning of commonly touched surfaces.

    - When using common surfaces, each individual is responsible for wiping down the shared surface before and after use.
- Assess and address the need for the availability of hand washing (e.g., access to water and soap) while working on site. This can be achieved by:
    - Having access to a functioning restroom
    - Portable hand washing station
    - Hand soap and bottled water to clean hands as necessary.
- Plan seating arrangement so that personnel inside the trailer maintain social distancing, at least 6-feet (2 m) of separation.
- Meetings in the trailer will not exceed the maximum occupancy as determined based on the ability to maintain social distancing. Unvaccinated individuals must wear face coverings and maintain 6 feet (2 m) of physical distance.
- Consider the use of physical barriers to separate the field trailer from the public and/or site activities.

4.7.2 Other Construction Guidance

Additional guidance related to construction and construction management activities include:

- Consider use of technology (e.g., digital sign in using QR codes, virtual tailgate, or construction meetings, video camera systems to minimize the number of people on site).
- For tailgate or other meetings that are not virtual:
    - Unvaccinated individuals must wear face coverings at all times, when meeting indoors. Refer to Appendix C for guidance on the appropriate face covering.
    - Maintain 6 feet (2 m) of physical distance at all times between attendees (both seated and standing).
    - Have the person leading the meeting sign everyone in.
    - If signature is required, everyone should have their own pen.
    - Hold meetings in outdoor spaces whenever feasible.
- For work outdoors:
    - Masks are optional when working outside more than 6 feet (2 m) apart (socially distanced).
    - Determine comfort level and vaccination status of field team when deciding whether to wear face covering for work tasks that need to be completed within 6 feet (2 m) and physical distancing cannot be maintained. Unvaccinated staff must wear face coverings when physical distancing cannot be maintained.
    - Refer to Appendix C for guidance on the appropriate face covering.
- Simultaneous operations coordination to separate contractors:
    - Coordinate movements around the site
    - Set up work zones with visual barriers for specific activities with transition areas in common spaces
    - Post social distancing signage (refer to Section 4.4)
    - Maintain social distancing with at least 6-feet (2 m) of separation whenever feasible
    - Consider the following administrative controls:
        - Activity rotation - schedule work when the fewest number of people are present
        - “Split shifts” can be used to limit contact, or if work can be scheduled during hours of low to no facility operations.

- Work in teams/pairs:
    - Plan work activities, continuously use TRACK and re-plan work activities to maximize social distancing and minimize “close contact”
    - Use equipment or tools to increase distance between personnel to greater than 6-feet (2m) or eliminate the need for a second person.
- Coordinate with contractors to make sure they are following the same social distancing, hand hygiene and cleaning guidance to reduce the risk to other project personnel.

5 Post Shift Considerations

At the end of the work shift, clean the vehicle, if used throughout the day. Wash hands prior to leaving the site and after the commute.

Upon arriving home or at lodging, shower and launder clothing.

Appendix A

Site Signage – Self-Assessment Required

ARCADIS

Arcadis Employees

Have you done your “Daily Screen “ today?

Before each day, you must complete the online **“Daily Screen”.**

QR Code for daily self-assessment.

SAFE Return

Appendix B

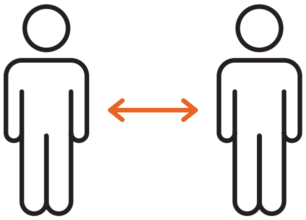
Site Signage – Social Distancing

ARCADIS

Project Sites

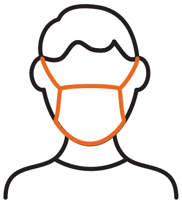
Keep Yourself and Others Working Safely

100% compliance is required by you and our subcontractors.



Maintain physical (social) distance of six feet, about two arms' length.

Need to talk? Shut equipment down if noise is interfering, use hand signals, radios, or move to another area of the site where distance can be maintained.



Face coverings must be worn when six feet of physical distance cannot be maintained.

***Stop Work** if procedures are not followed. It's mandatory!*

SAFE Return

Appendix C

Guidance for the Use of Face Coverings

ARCADIS

COVID-19 Face Covering Recommendations

Scenario	Mask Type			Respirators	
	Cloth Masks	Procedure Masks	Masks that Meet a Standard	Respirators that Meet International Standards[3]	NIOSH-Approved Respirators[3]
Working Indoors					
Entering a resident, school, or hospital	Not Recommended	Recommended	Preferred	CDC Recommended	CDC Preferred
Working indoors with coworkers[1] and physically distanced	Not Recommended	Recommended	Preferred	--	--
Working indoors in close proximity to coworkers, no physical distancing	Not Recommended	Recommended	Preferred	CDC Recommended	CDC Preferred
Working indoors with the general public and physically distanced	Not Recommended	Recommended	Preferred	CDC Recommended	CDC Preferred
Working indoors in close proximity to the general public (no physical distancing)	Not Recommended	Not Recommended	Not Recommended	CDC Recommended	CDC Preferred
Working in an Arcadis Office[2]	Not Recommended	Recommended	Preferred	CDC Recommended	CDC Preferred
Working Outdoors					
Working outdoors with coworker and physically distanced	--	--	--	--	--
Working outdoors with a coworker and not physical distancing	Not Recommended	Recommended	Preferred	--	--
Working outdoors with the general public and physically distanced	Not Recommended	Recommended	Preferred	CDC Recommended	CDC Preferred
Working outdoors with the general public and not physical distancing	Not Recommended	Not Recommended	Not Recommended	CDC Recommended	CDC Preferred
Travel					
Travel on public transportation	Not Recommended	Recommended	Preferred	CDC Recommended	CDC Preferred
Ridesharing with coworker (Fully Vaccinated Only)	Not Recommended	Recommended	Preferred	CDC Recommended	CDC Preferred
Ridesharing	Not Recommended	Recommended	Preferred	CDC Recommended	CDC Preferred
Communal lodging	Not Recommended	Recommended	Preferred	CDC Recommended	CDC Preferred

Notes:

[1] Coworkers includes Arcadis employees, Arcadis or client subcontractors, and Arcadis clients

[2] Masks must be worn when entering an office or job trailer, moving about the space and in common areas. Masks may be removed when seated at a individual workstation and physically distanced from others or alone in a enclosed space with floor to ceiling walls and door closed. Additional jurisdiction requirements may apply.

[3] Required use of a respirator meeting an international standard or NIOSH-approved respirator will need to follow the Arcadis Respiratory Protection H&S Standard.

References:

CDC Types of Masks and Respirators

Types of Masks and Respirators

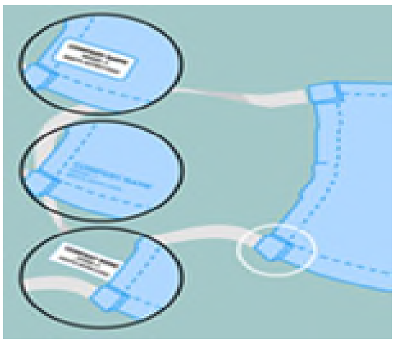
ARCADIS

Cloth masks:

- Multiple layers of tightly woven, breathable fabric
- Nose wire
- Fabric that blocks light when held up to bright light source
- Do not wear mask with exhalation valve

Procedure masks:

- Multiple layers of non-woven material
- Nose wire
- Protects others from the wearer’s respiratory emissions



Mask that meets a standard:

- Designed and tested to ensure they perform at a consistent level
- Must be labeled with the standard the mask meets
- Multiple layers of non-woven material

Respirators that meet international standards:

- Designed and tested to meet international standards
- Filters varying levels of particles in the air depending on the standard they are designed to meet
- Seals tightly to the face when fitted properly
- Medical surveillance and fit testing required if using when required under Arcadis’ Respiratory H&S Standard

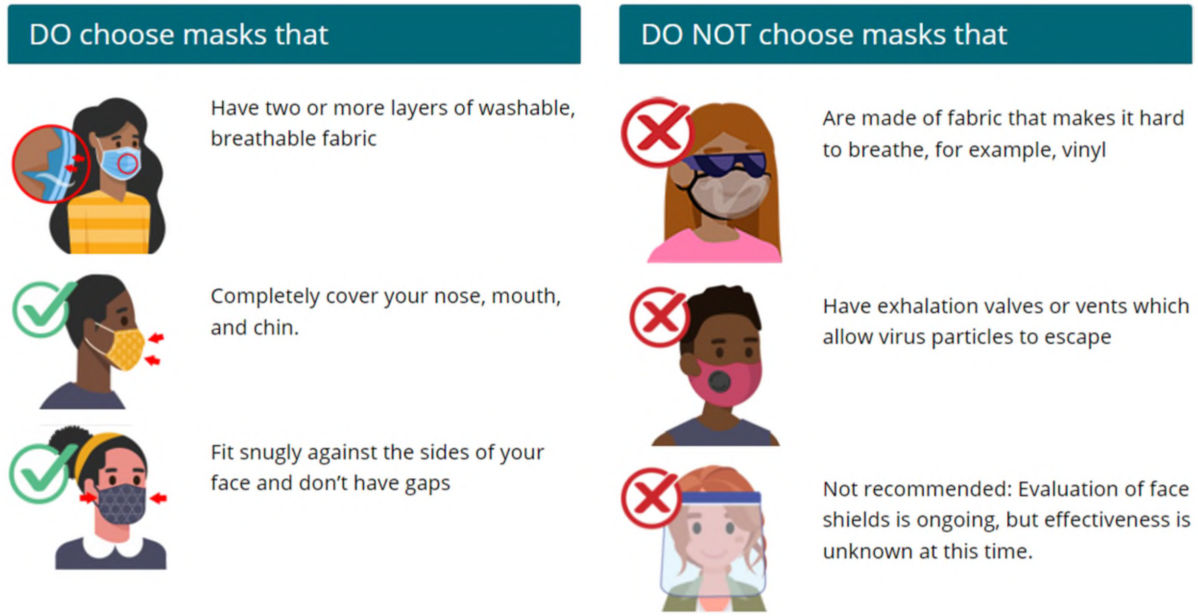
NIOSH-approved respirators:

- Respirators listed on the NIOSH-Approved Particulate Filtering Facepiece Respirators webpage
- Evaluated against a specific US standard that includes a quality requirement
- Filters at least 95% of particles in the air with proper fit
- Seals tightly on the face
- Medical surveillance and fit testing required if using when required under Arcadis’ Respiratory H&S Standard

Resource: CDC Types of Mask and Respirators

Rev. 16 February 2022

The following graphics are from the U.S. CDC:



DO choose masks that

- Have two or more layers of washable, breathable fabric
- Completely cover your nose, mouth, and chin.
- Fit snugly against the sides of your face and don't have gaps

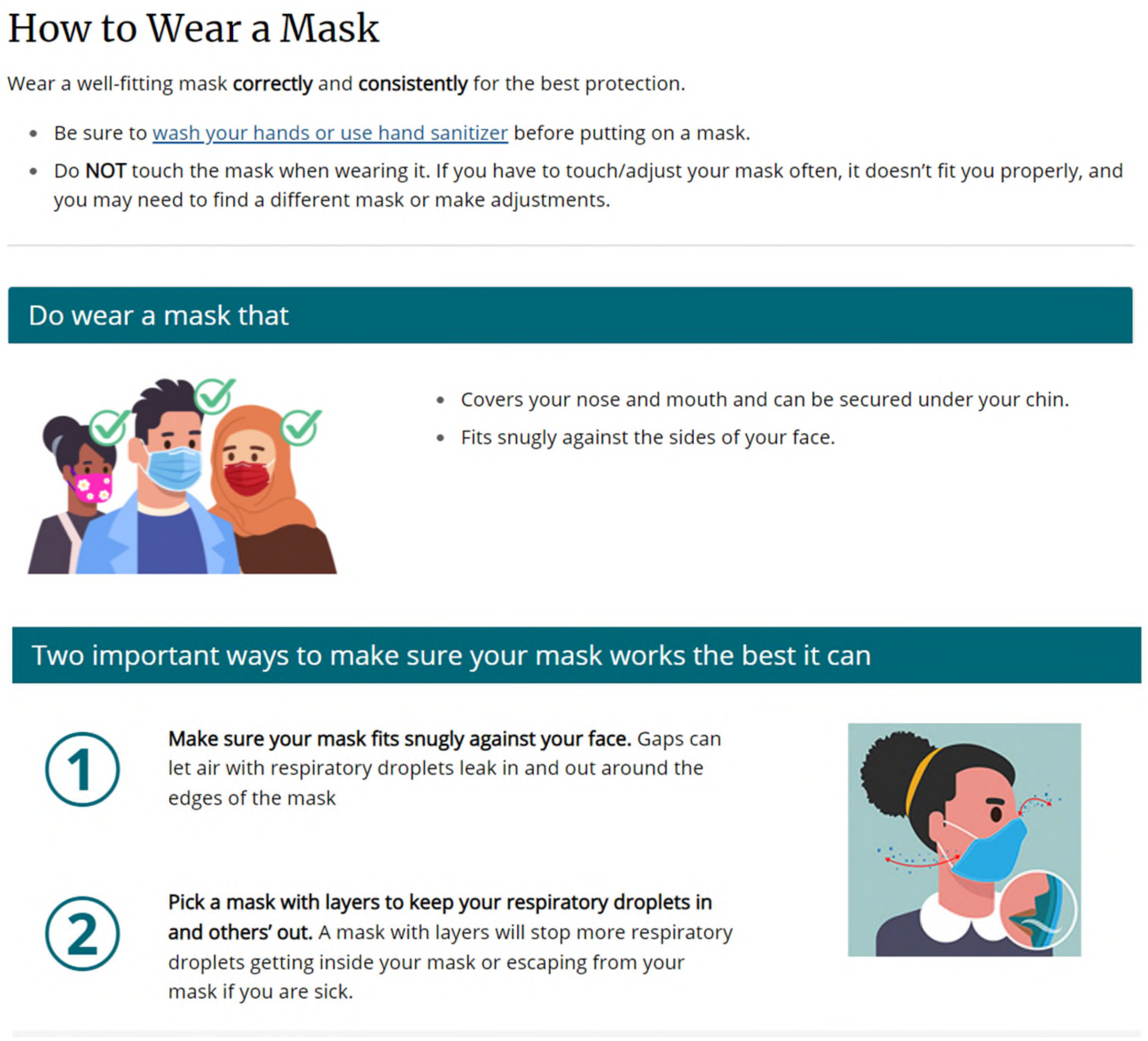
DO NOT choose masks that

- Are made of fabric that makes it hard to breathe, for example, vinyl
- Have exhalation valves or vents which allow virus particles to escape
- Not recommended: Evaluation of face shields is ongoing, but effectiveness is unknown at this time.

Cold weather gear

- Wear your scarf, ski mask or balaclava over your mask
- Scarves, ski masks and balaclavas are not substitutes for masks

Note: Some jurisdictions may not consider gaiters or bandanas acceptable face coverings.



How to Wear a Mask

Wear a well-fitting mask **correctly** and **consistently** for the best protection.

- Be sure to wash your hands or use hand sanitizer before putting on a mask.
- Do **NOT** touch the mask when wearing it. If you have to touch/adjust your mask often, it doesn't fit you properly, and you may need to find a different mask or make adjustments.

Do wear a mask that

- Covers your nose and mouth and can be secured under your chin.
- Fits snugly against the sides of your face.

Two important ways to make sure your mask works the best it can

① **Make sure your mask fits snugly against your face.** Gaps can let air with respiratory droplets leak in and out around the edges of the mask

② **Pick a mask with layers to keep your respiratory droplets in and others' out.** A mask with layers will stop more respiratory droplets getting inside your mask or escaping from your mask if you are sick.

Do

Choose a mask with a nose wire

- A nose wire is a metal strip along the top of the mask
- Nose wires prevent air from leaking out of the top of the mask.
- Bend the nose wire over your nose to fit close to your face.

Use a mask fitter or brace

- Use a mask fitter or brace over a disposable mask or a cloth mask to prevent air from leaking around the edges of the mask.

Check that it fits snugly over your nose, mouth, and chin

- Check for gaps by cupping your hands around the outside edges of the mask.
- Make sure no air is flowing from the area near your eyes or from the sides of the mask.
- If the mask has a good fit, you will feel warm air come through the front of the mask and may be able to see the mask material move in and out with each breath.

Add layers of material

2 ways to layer

- Use a cloth mask that has multiple layers of fabric.
- Wear a disposable mask underneath a cloth mask.
  - The cloth mask should push the edges of the disposable mask against your face.

Make sure you can see and breathe easily

Knot and tuck ear loops of a 3-ply mask

- Knot the ear loops of a 3-ply face mask where they join the edge of the mask
- Fold and tuck the unneeded material under the edges
- For instructions, see the following https://youtu.be/GzTAZDsNBe0 ↗ .

Other things to consider

Certain types of facial hair, like beards, can make mask fitting difficult. People with beards can do one or more of the following:

- Shave their beards.
- Trim their beards close to the face.
- Use a mask fitter or brace.
- Wear one disposable mask underneath a cloth mask that has multiple layers of fabric. The second mask should push the edges of the inner mask snugly against the face and beard.

Masks designed for people with beards are being evaluated, and information will be provided when it becomes available.

Do NOT

Combine two disposable masks

- Disposable masks are not designed to fit tightly and wearing more than one will not improve fit.

Combine a N95 or KN95 mask with any other mask.

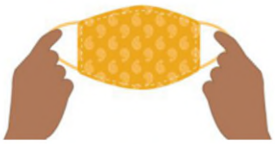
- Only use one N95 or KN95 mask at a time.

How NOT to Wear a Mask

How to take off a mask

①

Carefully, untie the strings behind your head or stretch the ear loops



②

Handle only by the ear loops or ties

③

Fold the outside corners together

④

Be careful not to touch your eyes, nose, and mouth when removing and wash hands immediately after removing

Appendix D

Additional Signage

ARCADIS

Best Practices

Wash your hands.

Wash in hot water for 40 seconds: 20 seconds with soap, 20 seconds to rinse.

Wipe surfaces with disinfectant wipes after you are finished.

Maintain proper social distancing.

Stand back 6 feet from others who may be washing their hands, or waiting in line to wash.

SAFE Return

Best Practices

You touch it, you clean it.

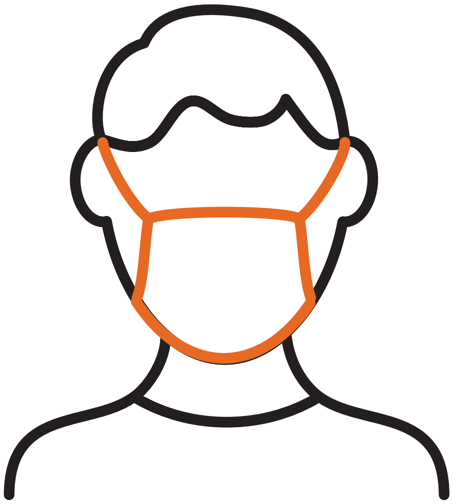
Remember to clean any surface you touch with the provided disinfectant spray.

SAFE Return

ARCADIS

Arcadis Staff, Visitors & Deliveries

Wear face cover.



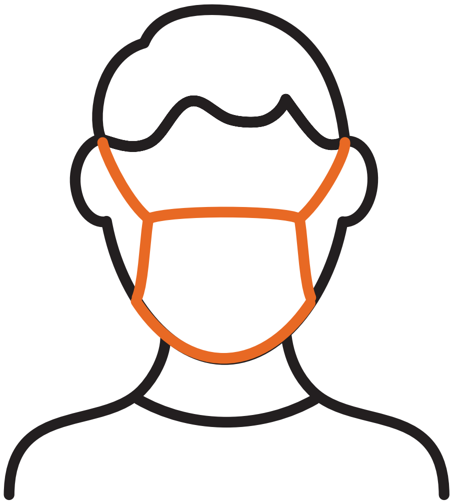
Face covering must be worn at
all times.

SAFE Return

ARCADIS

Arcadis Staff, Visitors & Deliveries

Wear face cover.



Please wear face covering when moving about the space. Face coverings can be removed while seated at workstation.

SAFE Return

ARCADIS

Visitors & Deliveries

All staff, visitors or deliveries must use the main entrance.

Located: Main lobby front door

Firstname Lastname: 123 555 1212
Firstname Lastname: 123 555 1212

SAFE Return

ARCADIS

Restricted

Authorized Staff Only

In order to maintain proper social distancing, this area is restricted to authorized staff.

Need something?

Contact: Firstname Lastname 123 555 1218

SAFE Return

ARCADIS

Restricted

Maximum Occupancy

2

In order to maintain proper social distancing, the number of people allowed in this area is limited.

SAFE Return

ARCADIS

Closure

Room Closed

In order to maintain proper social distancing guidelines, this room is temporarily closed.

SAFE Return

Off limits

CUT

Do not use

CUT

Restricted

Appendix E

Arcadis Contact Tracing Log

ARCADIS

Arcadis Contact Tracing Log

Printed Name	Company	Cell phone or email	Date/Time On Site	Date/Time Off Site

Arcadis U.S., Inc.
1 Executive Drive, Suite 303
Chelmsford
Massachusetts 01824
Phone: 978 937 9999
Fax:
www.arcadis.com

ATTACHMENT 5

Biological Hazards Descriptions, Photos and Fact Sheets

SNAKES

Pacific Rattlesnake

(Crotalus oreganus)

Pacific Rattle snakes can vary from being stunted in growth to becoming very large, however the average length is 36 inches. The color of their iris usually matches the ground color, which may be gold, bronze, or different shades of pink and gray. The color pattern typically appears to look dark brown or olive-brown with a series of large dark blotches containing uneven white edges. When alarmed, it may violently vibrate its tail.

Rattlesnakes have long, hollow, movable fangs connected to their venom glands, and the fangs can be replaced if broken. Young pacific rattlesnakes, have distinct patterns, but fade as they mature and have no rattle on their tail.

The pacific rattlesnake inhabits rocky hillsides, talus slopes and outcrops, rocky stream courses, rocky areas in grasslands, mixed woodlands, forests, pinyon juniper, and sagebrush. This snake is primarily nocturnal but can also be active during the daylight when the temperature is more moderate.

SPIDERS

Black Widow Spider

(Latrodectus variolus/mactans)

One of the most widely known and feared spider species, the black widow is one of the relative few spider species that can be deadly to humans. Black Widow spiders are a glossy jet-black, with a bright-red hourglass marking on the underside of their abdomen.

The hourglass of the Northern Black Widow is typically incomplete, with the bottom half and top half separated, however the Southern Blank Widow hourglass marking is complete and connected. The bottom half (farthest from the head) is typically more rounded, rather than triangular. The Northern Black Widow will typically have a row of red dots running down the top of its abdomen, with white stripes running diagonally down the sides of the abdomen. In addition to the typical hourglass marking on the underside of their abdomen, immature Black Widow spiders can vary greatly in the way they are marked on the top of their back. Typically, they have red or white spots running down the middle of their back and white stripes running diagonally down the sides of the abdomen. In the Northern Black Widow these markings are often retained as they mature. As with all widow spiders, only the female of the species is considered dangerous. The much smaller male is considered harmless.

Black widow webs are chaotically constructed without discernible pattern. Typically constructed close to the ground. Because of this location and the strength of the black widow's silk, leaves and other debris will often get tangled in the widow's web.

Northern/Southern Black Widow spiders are nocturnal, which means they are active during the nighttime. They spend most of their time hanging "upside down" in their web, which often makes the hourglass marking immediately visible. Northern/Southern Black Widow spiders are typically not aggressive, and bite as a defensive measure when they are attacked or feel threatened. They will often retreat into hiding but are more protective of their web when there are egg sacs present.

Mature females have approximately 0.50-inch bodies with 1.5 to 2.0-inch leg spans; mature males are approximately one third this size

TICKS

Brown Dog Tick

(Rhipicephalus sanguineus)

Brown dog ticks (*Rhipicephalus sanguineus*) found worldwide. Dogs and medium-sized mammals are the preferred hosts of adult dog ticks, although they feed readily on other large mammals, including humans. In the southwestern US and along the US-Mexico border, brown dog ticks transmit Rocky Mountain spotted fever.

Rocky Mountain Wood Tick

(Dermacentor andersoni)

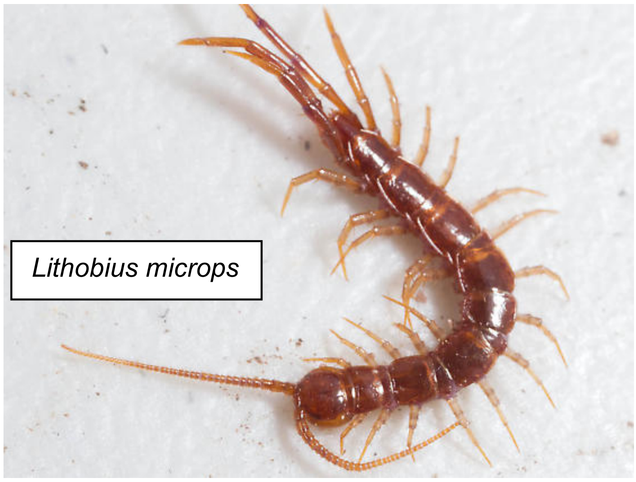
Rocky Mountain Spotted Fever

Rocky Mountain wood ticks (Dermacentor andersoni) are found in the Rocky Mountain states and in southwestern Canada. Adult ticks feed primarily on large mammals; larvae and nymphs feed on small rodents. Rocky Mountain wood ticks are distributed in the Rocky Mountain states and southwestern Canada from elevations of 4,000 to 10,500 feet. They transmit Tularemia, Colorado tick fever, and Rocky Mountain spotted fever.

OTHER ARACHNIDS AND INSECTS

Stone Centipede

(*Lithobius sp.*)



Lithobius microps

Lithobius forficatus

Centipedes have a rounded or flattened head, bearing a pair of antennae at the forward margin and a pair of elongated mandibles. The *Lithobius microps* is also known as “Delcores Centipede” and is observed in the Northeastern states (New York, Connecticut, Rhode Island, and Massachusetts). Delcore's Centipede is usually quite small, up to about 1" long, possibly to 2" long. It can appear red or orange. Typical habitat includes under stones, rocks, logs, and under buildings where possible (e.g., crawl spaces). The species tend to hibernate in colder climates, emerging in April when temperatures tend to warm.

The *Lithobius forfictus* has been imported from Europe and ranges from across the majority of the United States. This centipede is quite small, ranging in size from 0.5 to 1.5 inches. As with the *Lithobius microps* typical habitat includes under stones, rocks, logs, and under buildings where possible (e.g., crawl spaces)

POISONOUS PLANTS

Poison Ivy

(Toxicodendron radicans)

Poison Ivy is present throughout the forested areas and may occur as a climbing vine or a rooted, singular plant. It can be identified by three shiny leaves that grow outward from a thick woody vine or thin pale stem. Urushiol, an oil that causes rash on human skin, is present on the entire plant. Proper identification and avoidance are the best options when conducting field work.

Poison Oak

(Toxicodendron diversilobum)

Poison-oak is usually a shrub, though it sometimes becomes a vine several inches in diameter that grows high into the oak trees attached by air-roots. The leaves do come in threes. They are shiny, without prickers, and the middle leaf has a distinct stalk. It is harder to identify Poison Oak in the winter, when it loses its leaves and looks like erect bare sticks coming from the ground. Poison Oak is highly variable. It varies from shrub to vine. The leaves vary from red to green. It has erected stems, leaves in threes, small greenish flowers, and smooth seeds that are about 1/4 inch across. It is deciduous, and often loses its leaves in late summer, leaving it hard to recognize.

Giant Hogweed
(***Heracleum mantegazzianum***)

Giant hogweed has a stout, bright green stem often spotted with dark red and hollow red-spotted leaf stalks that produce sturdy bristles. These plants are 6.5 ft to 18 ft in height. The sap is phototoxic. When contacted skin is exposed to sunlight or UV light it develops severe skin inflammation, which develops into blisters within 48 hours. Do not try to remove this plant.

ARCADIS Design & Consultancy for natural and built assets

TRACK TO 0

BIOLOGICAL HAZARD CONTROL
PERMETHRIN – AN EFFECTIVE INSECT CONTROL TOOL

What is Permethrin?

Permethrin is a repellent and insecticide developed from dried and crushed flowerheads of two species of asters (Chrysanthemum cinerariifolium and C. coccineum). It has been used in the United States as a U.S. EPA-registered product since 1979.

Common users include park service employees, military personnel, landscapers, ecologists, forest management personnel, farmers, backpackers and hunters.

What does it do?

Permethrin both repels (mosquitos and flies) and kills crawling arthropods (ticks, chiggers, fleas and lice).

How is it used?

Permethrin is applied to clothing, hats, boots, gear, seat covers and other items. **Permethrin is not applied directly to skin.** For clothing, permethrin can be 1) self-applied using a kit available at sporting/camping supply stores, 2) purchased as manufacturer pre-treated clothing or 3) applied by a permethrin treatment service (Insect Shield® Repellent Technology) directly to your favorite field clothing. The last option takes some preplanning for the shipping, treatment and return of your clothing from the treatment company.

Permethrin is non-leachable, allowing the repellent to be effective after many washes, rains and sweating events. This non-leachable property also makes the use of permethrin safe on clothing and gear used in wetland and waterway settings. The application and use of permethrin should strictly follow manufacturer directions. Here is a video on how apply permethrin products to clothing:

https://www.youtube.com/watch?v=9Ezb1uSgGSs

An Effective Control

Permethrin is highly effective for the control of biting/stinging insects and ticks, which can be carriers of disease including West Nile virus, Zika, malaria and many tick-borne illnesses such as Lyme disease, Rocky Mountain Spotted Fever and babesiosis. The risks posed by these insects is high in some areas of the country.

When it comes to insect control, permethrin is in a class by itself when compared to other repellents. It has been demonstrated to be a safe insect control method. It is important to read the permethrin product label and follow all directions for application and use. Permethrin is compatible with flame-resistant (FR) clothing.

Permethrin does not provide protection to exposed skin adjacent to treated clothing. Therefore, protection is most effective when combined with insect protection for the skin (DEET, bug nets, etc.).

For more information:

Centers for Disease Control and Prevention-Ticks

U.S. EPA Repellent-Treated Clothing

TickEncounter Resource Center

National Pesticide Information Center

Air Force Pest Management Board Technical Guide No. 36 – Personal Protective Measures Against Insects and Other Arthropods of Military Significance

Contributed By: ANA Corporate Health & Safety

ARCADIS

TICK BITE PREVENTION

Health & Safety Fact Sheet

Administrative/Engineering Controls

- Consider mowing work area and paths prior to job if heavily tick infested.
- Consider time of year when planning work. Schedule work to avoid high tick activity season – avoid warmer months.
- Is pesticide application a possibility for highly infested areas?
- Avoid walking/working in wooded, overgrown/brushy/tall grass areas.
- Walk in the middle of clearings and trails to avoid brush and tall grass.
- Plan and schedule "buddy checks" throughout day for ticks that may be present on clothing or along the hairline.
- Complete personal body checks in morning and evening.

CALL WORK CARE IF BITTEN BY TICK

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Personal Prevention Measures

- Wear light-colored clothing to detect ticks more easily.
- Wear long pants and long-sleeved shirts.
- Button up shirt near collar and end of sleeves.
- Wear light-colored hat.
- Wear boots with a high cuff (> 6-in.) for tucking in pants. Gaiters may be worn but still need to tuck pants into socks.
- Consider wearing mesh head and/or body netting in infested areas.
- Tuck shirt into pants. Tuck pant legs into socks or inside boot cuffs.
- Tape pants near boots and sleeves near wrists to seal openings.
- Wear coveralls in highly tick-infested areas. Use of coveralls may require additional hazard assessment for high heat conditions. Evaluate the use of disposable breathable white coveralls.
- Using double-sided tape or duct tape (sticky-side out) around forearms and calves to capture ticks on outside of clothing. Note: tape may be a trip hazard or collect debris.
- Use 0.5% permethrin insecticide on clothes. **DO NOT APPLY TO SKIN! DO NOT APPLY DAY OF USE! FOLLOW PRODUCT USE AND SAFETY INSTRUCTIONS.**
- Use insect repellent containing 20 - 40% DEET on exposed skin, clothes, hats, & boots. When applying to face, avoid mouth and eyes, and do not apply to any exposed skin that is irritated or abraded.
  FOLLOW PRODUCT SAFETY INSTRUCTIONS.
- Consider, for purchase, clothing pre-impregnated with permethrin.

ATTACHMENT 6

Staff Qualifications

ARCADIS

Education

MS, Environmental Health Science, City University of New York, Hunter College

BS, Health Science, City University of New York, Brooklyn College

Years of Experience

Total - 25
With Arcadis - <1

Professional Registrations

Certified Industrial Hygienist # 5279
Certified Safety Professional # 11120
OSHA 500 Course Authorized Trainer 2015

Professional Qualifications

American Industrial Hygiene Association
American Academy of Industrial Hygiene
American Conference of Governmental Industrial Hygienists
NJ Chapter of the AIHA - Director of Member Services

Grey P. Coppi, CIH, CSP

Health and Safety Lead, Federal Programs

Mr. Coppi is based out of our Edison, New Jersey office. He is a Certified Industrial Hygienist (CIH) and a Certified Safety Professional (CSP) with more than 25 years of environmental, occupational health and safety experience providing practical, cost effective loss control solutions. His work experience includes USDOL/OSHA/private sector giving him a unique perspective using proven loss control techniques to achieve best-in-class performance and interact with all levels of personnel with the goal of improving margin. Notable skills include -

- EHS program devt
- ISO 9001/14001/VPP
- RCRA/EPCRA
- staff mentoring
- training courses
- hazard recognition
- practical solutions
- site auditing
- workers comp
- time management

Mr. Coppi acted as the VP Environmental, Safety and Quality Department head for 18 months at Tetratech where he provided administrative support and annual budgetary control ($4 million) for Tetra Tech EC, Inc. leading a staff of 45 full time employees.

Project Experience

CH2M - Construction Management, Environmental Health and Safety (EHS) Manager (April 2012-October 2015)
Various NYCDEP waste water treatment facilities; New York, NY. Supported CH2M Construction Manager overseeing conformance with contract specifications, applicable environmental, health and safety regulations and DEP Environmental, Health and Safety Policies and Procedures. Also supported CH2M Construction Managers similarly for two NYCDDC infrastructure projects that involved reconstruction of Fordham Plaza in the Bronx and the replacement of gas and water mains and catch basins as part of the bus bulb build out along 34th Street, Manhattan.

Stuyvesant Environmental Contracting Inc. - CIH Consultant (September 2011-April 2012)
Provided EHS consulting service for startup and operation during excavation of 40,000 cubic yards of PCB contaminated sediment from the Passaic River, located in Newark, NJ. Developed health and safety plans (HASP), SWPP, and SPCC plans, provided employee training, and site EHS support services.

TetraTech/Foster Wheeler 1995-2011

Acting VP of Environmental, Safety and Quality, Morris Plains, NJ
Led a diversified team of 45 full time employees within the ESQ department that included quality, H&S, health physics and environmental specialists located throughout the US while reporting directly to CEO. Coordinated company recertification in 2010 under ISO 9001 and 14001 and OSHAVPP, NRC licensing, and USDOT hazardous material permit. Part of team that supported, managed and completed government and commercial projects that totaled >3/4 billion dollars. Maintained ESQ department employee certifications and licenses; improved billability. Oversaw EHS program implementation at environmental remediation, restoration projects, and for all east coast office based personnel.

East Coast EHS Services Manager/Program Health and Safety Manager, U.S. Navy, NORTHDIV RAC throughout New England, Mid-Atlantic States (September 1995-June 2011)
Provided successful H&S management of EHS program at shipyards, landfills, reserve centers, and naval air stations. Remedial methods included soil stabilization and disposal, drum removal, and lead, mercury, mold and asbestos abatement. Managed all worker compensation claims including medical management and follow-up with insurance carrier, risk management, and corporate medical consultant. Conducted and issued site audits and tracked responses to closure. Program received the 1999 and 2004 TtEC, Inc. President's Award for Health and Safety Performance. In addition, worker compensation loss from 1999-2011 amounted to only $8,500. The last lost time injury occurred in August 1998 representing over 1.3 million hours worked. Personally received the TtEC, Inc. CSQ Star for the first quarter of 2001 and March 2008 for outstanding leadership and teamwork on the RAC and ACOE New England TERC, respectively.

Program Health and Safety Manager, USEPA RAC Region II; PADEP, GTAC-2/3 (April 1998-December 2008)
Successfully implemented the H&S program for all task orders, developed and peer-reviewed all HASPs, provided advice and counsel to project managers. Project activities included soil gas surveys, collecting groundwater and soil samples, installing wells, managing air sparging technology, and test pit excavations. Potential occupational contaminants included VOCs, metals, PCBs and PNAs. The EPARAC program worked 500,000 hours from 1998 – 2009 with only a single recordable injury.

Program Health and Safety Manager, New England TERC/Army Corps of Engineers (January 2005-December 2009)
Successfully implemented the H&S program for all task orders, developed and peer-reviewed all HASPs, provided advice and counsel to project managers. Project activities included structural demolition, sorting debris and backfilling, grinding of vegetative cover, rock crushing, and transportation and disposal of wastes. Received the Army Corps of Engineer NY District Commander's Certificate of Appreciation in December 2008 for "Outstanding dedication and lasting contribution to safety and occupational health". This program worked 140,000 hours with only a single recordable injury.

Program Health and Safety Manager, New York City Housing Authority (NYCHA) (March 2006-March 2009)
Oversaw EHS implementation for this 36 month, $90M renovation of 600 tenant apartments and 61 elevators. Scope of work included modernizing apartments and the associated electrical/mechanical/plumbing systems in each apartment. Elevator renovation included demolition and replacement of existing elevator penthouses with 18 feet of new steel, concrete block and bricks and new electrical and mechanical systems. Hazard control included physical/health hazards such as the fall prevention from eight story buildings, scaffold assembly and use, use of cranes to hoist and place steel, welding, painting, cement mixing and silica

exposure prevention. Reviewed HASPs, performed weekly/monthly site visits to assess subcontractor compliance with plans, regulations and initiatives; report inspection findings and develop corrective actions; and developed and offered training to subcontractor workers. Project worked 275,000 hours with only two recordable injuries.

Program Health and Safety Manager, Fox River Restoration, Green Bay, WI (June 2008-June 2011)
EHS implementation for this 10 year $700M remediation of river sediments contaminated with PCB's. Activities include construction of a 250,000 square foot treatment and processing building, parking lots, hydraulic dredging of river sediments, and physical treatment and disposal of waste materials. This project worked 550,000 hours without a lost time case and only a single recordable injury.

Other Work Experience

Dames & Moore (D&M) Consulting Certified Industrial Hygienist, Cranford, NJ
NJ Turnpike Widening Program
Provided technical, managerial and leadership oversight to the New Jersey Turnpike Authority (NJTA) during their $500M roadway-widening program that involved the excavation, segregation and replacement of soil contaminated with lead and VOCs. Approved all on-site health and safety personnel (25) employed by the construction contractors, performed site audits and assessments, developed an audit checklist, and communicated results and recommendations to contractors and the NJTA; acted as a liaison to NJTA, environmental firms, contractor and section engineers, evaluated air monitoring data, and maintained training records.

D&M-Wards Island WPC Plant Upgrade, Wards Island, New York, NY
Provided project EHS support to Slattery Construction, Inc. for a $10M plus addition to an existing NYC wastewater pollution control plant located on Wards Island, New York City. Contaminants of concern were VOCs and fuel oils. Developed the site-specific HASP, supervised on-site health and safety officers and performed bi-weekly site audits to assess compliance with the contract specifications/HASP.

ENSR/R&C, Pompton Lakes, NJ, Health and Safety Officer
Responsible for daily onsite EHS compliance for a $15M residential remediation located in northern New Jersey. Project involved excavation, transportation and disposal of 100,000 tons of soil contaminated with lead and mercury from a nearby explosives manufacturing plant, backfilling and restoring lawns, walkways, garages, and decks. Duties involved ensuring adherence with the HASP, maintaining training, air, medical and biological monitoring records; provided training to all personnel; and supervised and implemented perimeter and personal air monitoring strategies for dust, lead, and mercury. Collaborated with client, NJDEP, and oversight engineer.

Chemical Waste Management, Princeton, NJ, Industrial Hygienist and Eastern Division Manager
Responsible for health and safety oversight and staff supervision for a hazardous waste remediation firm. Projects included the remediation of PCB contaminated soils for three New Jersey compressor stations; remediation of soil containing mercury and lead at a New Jersey explosives facility; and remediation of ponds and lagoons containing VOCs at a fragrance manufacturer located in New Jersey.

U.S. Department of Labor/OSHA, Senior Industrial Hygienist, Parsippany, NJ
Enforced the Occupational Safety and Health Act throughout manufacturing, construction, and maritime. Evaluated worker exposure through the use of a variety of sampling instruments and supervised up to four compliance officers.

The

American Board of Industrial Hygiene®

ABIH®

organized to improve the practice of Industrial Hygiene
proclaims that

Grey Peter Coppi

having met all requirements through
education, experience, and examination,
is hereby certified in the

COMPREHENSIVE PRACTICE
of
INDUSTRIAL HYGIENE

and has the right to use the designations

CERTIFIED INDUSTRIAL HYGIENIST

CIH

December 9, 1991
date

Kenneth M. Wallington
Chair ABIH

5279
certificate
number

CMorley Herr
Secretary ABIH

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Grey P. Coppi

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CERTIFIED SAFETY PROFESSIONAL

IN

MANAGEMENT ASPECTS

SO LONG AS THIS CERTIFICATE OF QUALIFICATION IS RENEWED ANNUALLY AND NOT REVOKED

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R E McClay

PRESIDENT

John Alden

SECRETARY

SERIAL NO. 11120

GABRIEL HEBERT

Senior Geophysicist

EDUCATION

BS, Physics, Louisiana Tech University, 2003

MS, Geophysics, Georgia Institute of Technology-Main Campus, 2005

YEARS OF EXPERIENCE

Total – 17

With Arcadis – 8

CERTIFICATIONS

- OSHA 40-hour HAZWOPER
- OSHA 10-hour Construction
- OSHA 8-hour HAZWOPER Supervisor
- MSHA 24-hour New Miner
- AT Level 1 Awareness
- OPSEC Awareness
- CSX/NS Roadway Worker Protection
- E-Rail Certification - E-Rail US
- DOT HAZMAT#1 – DOT/IATA
- Chevron 101
- Chevron Human Performance
- CPR/BBP and First Aid

PROFESSIONAL ASSOCIATIONS

- Environmental and Engineering Geophysics Society
- Society of Exploration Geophysicists

Mr. Hebert has over 17 years of technical and project management experience in the environmental and engineering consulting industry. His specialty consists of characterizing the subsurface using surface and borehole geophysical methods such as electromagnetic conductivity, electrical resistivity, gravity, magnetics, seismic reflection and refraction, seismic shear wave analysis, and ground-penetrating radar. He continuously demonstrates expertise in the areas of geophysical method selection, survey design, field data acquisition, site mapping, data processing, interpretation, and presentation of results. Additionally, he regularly acts as the Site Safety and Health Officer (SSHO) for the majority of surface/borehole geophysical field events, where he creates and implements Site Safety and Health Plans (SSHPs) and Job Safety Analyses (JSA) / Activity Hazard Analyses (AHA), as well as leads daily tailgate safety meetings.

In addition to geophysics, Mr. Hebert has abundant experience in a variety of tasks related to soil, groundwater, and air assessment and remediation. This experience includes drilling/excavation/underground storage tank (UST) removal oversight, monitoring well/soil boring installation, quarterly sampling and reporting, and remediation system design and installation, where he also typically acts as the SSHO for field events. As part of ongoing site monitoring and closure activities, Mr. Hebert has also helped develop/revise/implement health and safety (H&S) documents including SSHPs and JSAs, as well as create various other regulatory reports including Initial Site Characterization (ISC) Reports, Phase I and II Reports, Remediation Work Plans (RWPs), Corrective Action Plans (CAPs), and Corrective Action Progress Reports (CAPRs). Finally, he has experience with Emergency Response (ER) activities and H&S oversight associated with pipeline leaks and derailment remediation.

Prior to joining Arcadis, Mr. Hebert worked as the Project Geophysicist for Mundell and Associates, a small environmental and engineering consulting firm based out of Indianapolis, IN. During his time in that role, he was responsible for the entirety of geophysical operations.

Project Experience

Various Geophysical Surveys

Various Private and Public Clients and State Environmental Agencies, Various States

Contributed to Arcadis' H&S culture by preparing and implementing numerous SSHPs and JSAs while operating as a project geophysicist and SSHO on various surface/borehole geophysical projects. A variety of geophysical techniques (seismic, electromagnetic (EM) conductivity, electromagnetic induction (EMI), electrical resistivity tomography (ERT), etc.) were utilized to characterize dozens of environmental and engineering sites for the purposes of delineating chemical source areas and preferential soil and/or groundwater migration pathways. [February 2014 – Present at 25% of time = 1.75 years]

Environmental Site Characterization Studies

Various State Environmental Agencies and Environmental Consultants, Midwest U.S.

Prepared numerous SSHPs while operating as SSHO and project geophysicist on various geophysical projects. Utilized a variety of geophysical techniques (seismic, gravity, EM, EMI, ERT, etc.) to characterize dozens of environmental sites for the purpose of chemical source delineation. [January 2008 – January 2014 at 25% of time = 1.5 years]

Third Party Validation Seeding at Camp Croft, SC

USACE – Huntsville District, Spartanburg, South Carolina

Participated in daily safety meetings and helped promote a culture of safety by utilizing stop work authority when unsafe work conditions arose during instrument verification strip (IVS) installation and validation seeding activities. [February 2021 at 50% of time = 0.04 years]

RI/FS Activities at Camp Roberts, CA

USACE – Baltimore District, San Louis Obispo, California

Participated in daily safety meetings and collected EM and digital geophysical mapping (DM) data as part of ongoing Remedial Investigation (RI)/Feasibility Study (FS) investigations. [May 2018 - June 2018 at 50% of time = 0.08 years]

Comparative Demonstration and Evaluation of Classification Technologies

Env Security Tech Cert Program (ESTCP), Arlington, Virginia

Contributed to daily safety culture and acted as the quality control (QC) geophysicist during a live site demonstration of munitions and explosives of concern (MEC) classification using two separate next generation EMI sensors. [July 2017 at 100% of time = 0.08 years]

Data Management

USACE - Baltimore District, Atlantic Beaches, New Jersey

Processed daily QC and digital geophysical mapping (DGM), data collected on beach property prior to a large-scale removal action. [January 2017 - February 2017 at 50% of time = 0.08 years]

GCMB & Rocket Range at Fort Lee, VA

USACE - Baltimore District, Fort Lee, Virginia

Reviewed and processed daily H&S, QC, DGM, and advanced geophysical characterization (AGC) data as part of a munitions response (MR) RI/FS of a former rocket range. Collected DGM grid data and reacquired targets prior to AGC activities. [October 2016 - November 2016 at 50% of time = 0.08 years]

Env. Remediation Field Tasks at Fort Wingate, NM
USACE - Fort Worth District, Fort Wingate, New Mexico

Processed daily QC data, as part of a MR RI. [September 2016 - October 2016 at 50% of time = 0.08 years]

On-Site H&S Support at Joppa Capline Station, KY
Marathon Petroleum Company LLC, Joppa, Kentucky

Provided H&S oversight during the night shift as part of series of maintenance activities conducted at a pipeline station. [August 2016 at 50% of time = 0.04 years]

Train Derailment Activities
Confidential Client, Falmouth, Kentucky

Assisted with a variety of H&S and ER remediation activities on an active derailment site. [August 2016 at 50% of time = 0.04 years]

H&S Oversight and Restoration Activities
Confidential Client, Willard, Ohio

Supervised on-going H&S and restoration activities at an inactive derailment site. [July 2016 at 50% of time = 0.04 years]

Environmental Activities at the Mt. Erie Pipeline Release
Marathon Petroleum Company LLC, Mt. Erie, Illinois

Managed daily H&S activities and supervised the restoration activities of a wetland area. [May 2016 at 50% of time = 0.04 years]

RI at Fort Bliss Castner Range, TX
USACE - Tulsa District, El Paso, Texas

Processed and reviewed daily H&S, QC, and DGM data as part of a MR RI. [May 2016 at 50% of time = 0.04 years]

MPC H&S Support
Marathon Petroleum Company LLC, Stoy, Illinois

Provided H&S oversight for ongoing construction activities across the entire Stoy Operations Area during a six-week period. This consisted of multiple concurrent projects at several different pipeline stations, as well as the Robinson Refinery. [November 2015 - December 2015 at 75% of time = 0.12 years]

NALEMP Laguna

USACE - Albuquerque District, Laguna, New Mexico

Assisted in the review of H&S documents, as well as the QC and data analysis of DGM data as part of a RI to detect and remove MEC from Native American lands. [August 2015 – September 2015 at 50% of time = 0.08 years]

H&S Support and Air Monitoring, Shively Release

Marathon Petroleum Company LLC, Louisville, Kentucky

Provided daily H&S and environmental management during remediation and restoration activities following a pipeline release. [March 2015 - May 2015 at 50% of time = 0.12 years]

RI and MMRP Services at National Training Center and Fort Irwin, CA

U.S. Army Corp of Engineers (USACE) - Huntsville District, San Bernardino, California

Shadowed the SSHO and provided the QC oversight of the DGM conducted within two areas of interest, including the installation of two (2) IVSs. [April 2015 at 50% of time = 0.04 years]

Peetsville Additional Project Safety Support

Marathon Petroleum Company LLC, Wesson, Mississippi

Provided H&S oversight during the night shift as part of ongoing emergency response actions taken at a pipeline station. [April 2015 at 50% of time = 0.04 years]

RI/FS MMRP at Twentynine Palms, CA

NAVFAC Atlantic, Twentynine Palms, California

Assisted in daily tailgate briefings, as well as on the data acquisition and target analysis portions of a live site demonstration of MEC classification using DGM sensors as well as next generation EMI sensors.
[October 2014 - December 2014 at 50% of time = 0.12 years]

Lower Beaumont at Fort Bliss, TX

USACE - Tulsa District, Fort Bliss, Texas

Managed the H&S efforts, as well as the EMI and magnetic data acquisition, processing, and reporting of the geophysical portion of an affected property assessment of three properties located on an active military base, which included a former landfill site, a former service station, and a former underground storage tank (UST) site. [August 2014 at 50% of time = 0.04 years]

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Gabriel Hebert

has successfully completed training and passed all testing requirements for

OSHA HAZWOPER Site Supervisor
per 29 CFR 1910.120(e) & Title 8CCR 5192(e)(3)(A)

Presented This

Friday, April 30, 2021

Compliance Solutions Occupational Trainers, Inc.

Certificate Number: ***754995632***

Jeffrey Kline
President/CEO

CERTIFICATE OF TRAINING

Gabriel Hebert

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Gabriel Hebert

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Issue Date

10/13/2022

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Instructor Name

john mitchell

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Gabriel Hebert

Heather Mardaga
Director, CDSE

September 02, 2022

DEFENSE COUNTERINTELLIGENCE AND SECURITY AGENCY

ATTACHMENT 7

Shipping Determination

SHIPPING/TRANSPORTATION DETERMINATION FORM Revision 12

Non-Regulated Shipping Determination

Date: 11/1/2022

Project Name: YTC- Boundary Investigation

Project Number:

1) Check the following to certify the sample media being transported/shipped meet non-regulated or not restricted status:

☐ Samples will not be collected on this project

OR

☒ The following samples have been reviewed and do not meet criteria of a regulated shipment under DOT or IATA:

Check applicable media that will be sampled on the project:

☐ Soil
☐ Sediment
☐ Sludge
☐ Bldg. materials
☐ Articles

☒ Groundwater
☐ Surface water
☐ Process water
☐ Waste water
☐ Potable water
☐ Product

☐ Air samples
☐ Tissue, body part, or body fluid (1)
☐ Plant tissue, part or fluid
☐ Mold
☐ Investigation derived waste (all media types)
☐ Other:

☐ The following location(s) and media are not covered by above, are considered HazMat for shipping/transportation, and are subject to an additional shipping determination:

1a

2) For sample preservatives, check the following as applicable:

☐ Sample containers will be filled and preserved in accordance with EPA SW-846 protocols (2)
☒ Sample containers will not be field preserved with acids or bases by Arcadis staff
☐ Empty but preserved sample containers will be return shipped to the laboratory or office
☐ EPA Method 5035 (TerraCore) samples will be collected and shipped

Supplemental information used to confirm section 1 and 2 conclusions: Work plan/QAPP

3) Certify the following by checking the applicable categories that will be shipped or transported on this project (at least one category must be checked):

☐ Equipment and supplies will not be transported or shipped on this project.

OR

☒ Field equipment being transported/shipped will not contain materials subject to DOT/IATA regulation
☒ Field test kits and first aid kits (with aerosols or non-unitized medicines) will not be shipped
☒ Remediation chemicals transported in quantities >440 pounds gross weight per vehicle are not DOT regulated

OR

Field equipment and supplies used on this project are:

☐ Not regulated for transport; and/or
☐ Eligible for materials of trade exception
☐ **Regulated HazMat and requirements are addressed through the Field Equipment**

Shipping/Transpot Quick Form

☐ The following equipment/supplies are not covered by above, are considered HazMat for shipping/transportation, and are subject to an additional shipping determination beyond the Field Equipment Shipping/Transport Quick Form:

3a ☐

Supplemental information used to confirm this conclusion: Generic shipping determination (attached)

Completion of the "Determination" worksheet is not required. Issue this worksheet to field staff.
Attach Field Equipment Shipping/Transport Quick Form to this determination.

3) Certification:

I certify that I am current in HazMat #1 or approved equivalent and the above determination is true and correct to the best of my knowledge.

Name : Julia Vidonish Aspinall

Signature: Julia Vidonish Aspinall

Reviewed By:

May be signed by any currently trained HazMat #1 employee

Notes:

1) This category applies to mammals, reptiles, birds, fish, insects, arachnids and all other vertebrate and invertebrate organisms.
2) This category is limited to containers preserved with ≤4 ml of preservatives and excludes containers used to preserve human or animal tissue described in footnote 1.

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APPENDIX C

Field Guidance Documents
(Technical Guidance Instructions and Standard Operating Procedures)

TGI –Collection and Logging of Bedrock Chips

Rev: 0

Rev Date: November 4, 2022

DRAFT

Version Control

Issue	Revision No.	Date Issued	Page No.	Description	Reviewed By
	0	November 4, 2022	All	New TGI	Marc Killingstad

Approval Signatures

Prepared by:

Jeremy Franz

Click or tap to enter a date.

Jeremy Franz (Preparer)

Date

Reviewed by:

Click or tap to enter a date.

Marc Killingstad (Subject Matter Expert)

Date

1 Introduction

This Technical Guidance Instruction (TGI) describes the procedures to be used to collect and describe bedrock chip samples. The approach is applicable to subsurface investigations employing standard air rotary, mud rotary and reverse circulation drilling methods.

2 Intended Use and Responsibilities

This document describes general and/or specific procedures, methods, actions, steps, and considerations to be used and observed by Arcadis staff when performing work, tasks, or actions under the scope and relevancy of this document. This document may describe expectations, requirements, guidance, recommendations, and/or instructions pertinent to the service, work task, or activity it covers.

It is the responsibility of the Arcadis Certified Project Manager (CPM) to provide this document to the persons conducting services that fall under the scope and purpose of this procedure, instruction, and/or guidance. The Arcadis CPM will also ensure that the persons conducting the work falling under this document are appropriately trained and familiar with its content. The persons conducting the work under this document are required to meet the minimum competency requirements outlined herein, and inquire to the CPM regarding any questions, misunderstanding, or discrepancy related to the work under this document.

This document is not considered to be all inclusive nor does it apply to all projects. It is the CPM's responsibility to determine the proper scope and personnel required for each project. There may be project- and/or client- and/or state-specific requirements that may be more or less stringent than what is described herein. The CPM is responsible for informing Arcadis and/or Subcontractor personnel of omissions and/or deviations from this document that may be required for the project. In turn, project staff are required to inform the CPM if or when there is a deviation or omission from work performed as compared to what is described herein.

In following this document to execute the scope of work for a project, it may be necessary for staff to make professional judgment decisions to meet the project's scope of work based upon site conditions, staffing expertise, regulation-specific requirements, health and safety concerns, etc. Staff are required to consult with the CPM when or if a deviation or omission from this document is required that has not already been previously approved by the CPM. Upon approval by the CPM, the staff can perform the deviation or omission as confirmed by the CPM.

3 Scope and Application

The bedrock ship collection and description procedures presented in this TGI are applicable for subsurface investigations where the project objectives include describing general lithology and bedrock characteristics including:

- Overburden-bedrock interface
- Top of competent/unweathered rock
- Rock type – dominant and secondary
- Depositional environment specific texture descriptions (e.g., volcanic glass, aphanitic or phaneritic textures, foliation, schistosity, gneissic banding, ect.)

- Grainsize, grain shape, etc. in clastic sediments such as sand and gravel.
- Full description of cohesive materials such as silt and clay
- Color
- Chemical alteration of rock minerals
- Veining, including nature of vein filling materials
- Secondary mineralization

The approach and level of detail presented is appropriate for most environmental-site subsurface investigations. Given the diverse nature of bedrock, and variety of potential project objectives, the project team will review site-specific data needs prior to starting work and, if needed, adapt the field procedures.

The scope of this TGI is specific to bedrock chip collection and description; it does not encompass the broader suite of tasks associated with bedrock drilling or well construction (see relevant SOP and TGIs, as needed). Note that bedrock drilling is often combined with related bedrock characterization techniques, including packer-testing, geophysical logging, FLUTe^{TM} profiling and whole-core rock sampling. These tasks are outside of the scope of this TGI; however, if such additional work is part of the project scope, planning and sequencing of drilling tasks will consider the requirements of auxiliary tasks.

4 Personnel Qualifications

Arcadis field personnel will have completed or are in the process of completing site-specific training as well as having current health and safety training as required by Arcadis, client, or regulations, such as 40- hour HAZWOPER training and/or OSHA HAZWOPER site supervisor training. Arcadis personnel will also have current training as specified in the Health and Safety Plan (HASP) which may include first aid, cardiopulmonary resuscitation (CPR), Blood Borne Pathogens (BBP) as needed.

In addition, Arcadis field personnel will be knowledgeable in the relevant processes, procedures, and TGIs and possess the demonstrated required skills and experience necessary to successfully complete the desired field work. The HASP and other documents will identify other training requirements or access control requirements.

Bedrock chip logging will only be performed by Arcadis personnel or authorized subcontractors with a bachelor’s degree in geology or a geology-related discipline. Field personnel will complete training on this TGI in the office and/or in the field under the guidance of an experienced field geologist with at least 2 years of prior experience with bedrock core description.

Note that this TGI is written specifically for site characterization and remediation projects. When bedrock core samples are to be used for engineering purposes (e.g., foundation design, rock mechanics, design of excavation support), field staff will work under the direction of a geotechnical engineer.

5 Equipment List

Typically Provided by Geologist:

- Approved site-specific Health and Safety Plan (HASP)

- Approved site-specific field implementation plan (FIP)/work plan which will include boring location map and drilling plan
- Required PPE (see site-specific HASP)
- Handheld sieve
- Field logbook and/or boring logs
- Camera and/or smart device (phone or tablet)
- Pen knife (to test rock hardness)
- Munsell rock color chart
- Rock hammer
- Photoionization detector (PID) or Flame ionization detector (FID) (as appropriate, depending on site-specific
- constituents of concern)
- Air monitoring equipment (as required)
- Hand lens (optional)
- 10% Hydrochloric acid solution (appropriately labeled eyedropper for carbonate identification [optional])

6 Cautions

- **Review relevant guidance:** Utility avoidance, drilling, decontamination, management of investigation derived waste and related tasks will be completed in accordance with a project- specific FIP/work plan and/or applicable SOPs or TGIs.
- **Use a trusted, experienced driller:** The quality of bedrock borings often depends on the skill of the driller (e.g., at selecting the correct tooling, down-pressure and spin-rate for the type of rock and depth). An experienced driller is less likely to drill a borehole that is smooth, straight, and true. A quality borehole will result in better data quality if bedrock drilling tasks are combined with other related bedrock characterization techniques (e.g., downhole geophysics, packer testing, ect.)
- **Choose a clean water supply for drilling fluid:** Whether for mixing mud or used as dust suppression during air rotary drilling, water used for drilling will be of sufficient quality to meet project objectives. Testing of water supply will be considered.
- **Understand your driller's plans for recirculation of drilling fluids:** Recirculation is common practice in when using mud rotary drilling methods, to limit generation of large quantities of investigation-derived waste (IDW). A mud mixture is pumped down the inside of the core barrel (or outer rods if using reverse circulation methods) to cool the bit and carry rock cuttings back to the surface. The cuttings and drilling fluids spill into a mud tub, often designed with several baffles to help cuttings fall out of suspension. This drilling fluids are then pumped back down the drill tooling, or recirculated, until the sediment load is too great, then drilling fluids must be replaced. Additionally, an inline desander/cyclone may be put in place upstream to the mud tub. The desander will help reduce sediment load significantly and cuttings can be deposited directly into a roll-off container. Recirculation can increase the risk of cross-contamination, so caution is needed. However, drilling without recirculation can quickly generate very large quantities of IDW and is often not practicable.

- **Avoid cross-contamination:** Bedrock drilling often involves creating long open boreholes that may, at least temporarily, penetrate confining beds or create artificial connections between fracture zones at different depths. If cross-contamination is a concern at a site, work will be planned to limit the length of open sections (e.g., by telescoping casing), and limit the duration that a borehole stands open. Field crews will stop-work if dense-non-aqueous phase liquid (DNAPL) is encountered (e.g., if sheens are observed on drilling return water).

7 Health and Safety Considerations

Conduct drilling and related tasks in accordance with a site-specific Health and Safety Plan (HASP). Review all site-specific and procedural hazards as they are provided in the HASP, and review Job Safety Analysis (JSA) documents in the field each day prior to beginning work. Appropriate personal protective equipment (PPE) will be worn at all times in line with the task and the site-specific HASP.

Use appropriate hand protection when conducting carbonate-rock test (using dilute acid) and hardness tests (using a penknife). If site- or client-specific health and safety requirements prohibit use of fixed/folding-blade knives, an alternative steel object (e.g., nail) may be substituted.

8 Procedure

Rotary drilling methods, including air rotary, mud rotary, and reverse circulation, are some of the most common methods for installation of bedrock monitoring wells. The nature of these drilling methods pulverizes the formation under the drill string resulting in drill cuttings consisting of fine pieces (i.e., chips) of the formation. Adequate characterization of drill cuttings ensures data quality objectives (e.g., accurate well placement) of the project are maintained. The procedures for collecting and characterizing chips samples are outlined below.

8.1 Chip Collection

Accurate chip logging requires the supervising geologist be at the rig at all times during drilling. Often, changes in lithology result in corresponding changes in drilling characteristics (e.g., drilling rate, feed pressure, and audible feedback from the drills string). Additionally, time lag for cuttings to reach the surface is typically minimal unless drilling to significant depths. Therefore, accurate formation logging (e.g., fracture sets resulting in secondary mineralization or changes in rock type) requires immediate access to cuttings in order to correlate variations in drilling characteristics with formation changes.

Chips will be collected as close to the discharge near the drill string (e.g., at the cyclone outlet, if applicable, or prior to drilling fluids entering the mud tub) as safely possible. Depending on the rig setup the driller may need to collect the sample. Chip collection will be done using a handheld sieve/strainer.

8.2 Chip Description

It is recommended that geological cross-sections, including surface geophysical results, be made available while drilling and geological interpretation be commenced while at the rig. Also, field staff will consult interpreted logs from adjacent boreholes, including borehole geophysical logs, if available.

In addition to the visual description of chip samples discussed below, the following details will be recorded in the geological log as the drilling progresses being sure to note both time of day and depth drill string at noted events:

- rate of penetration during full down force based on regular notation of depth and time of day at beginning and end of drill rod as well as several intermediate locations, particularly if conditions change rapidly;
- audible changes in drilling tone and audible volume;
- notable jumps or rapid increases in downward movement of drill string which may be indicative of voids, fractures, faults, flow tops, geologic contacts, etc.;
- indications of rock falls evidenced by ejection of rock samples of unusual size (not chips)
- dampness on samples,
- water inflows including an estimate of water produced – if significant inflow is found, stop drilling and have the driller conduct a test of the volume of water ejected by air lift after a pause of a noted amount of time under quiet conditions.
- odors and visual discolorations of samples
- PID/FID readings
- drilling problems

Perform geological logging on at least a one meter by one meter basis and record in the log as such. As a minimum, the following features must be logged:

What to Record	**How to Describe**
Depth	Note top of an interval being described, relative to ground surface. Avoid referencing depths relative to the position in the drill string run.
Rock type	Describe based on observation. Use terminology consistent with local mapping, if available. If the specific type cannot be determined in the field, use a more general descriptor (e.g., metamorphic).
Color	Reference Munsell rock color chart. Describe matrix color and major clast color separately, if applicable.
Weathering state	General weathering descriptors (e.g., fresh or weathered) may be applicable based geologic environment. Small chip size can make weathering determination difficult

Other observations may also be made, if appropriate to the rock type. Common supplemental observations include:

- Overburden-bedrock interface
- Top of competent/unweathered rock
- Depositional environment specific texture descriptions (e.g., volcanic glass, aphanitic or phaneritic textures, foliation, schistosity, gneissic banding, ect.)
- Grainsize, grain shape, etc. in clastic sediments such as sand and gravel.
- Full description of cohesive materials such as silt and clay

- Color
- Chemical alteration of rock minerals
- Veining, including nature of vein filling materials
- Secondary mineralization
- Evidence of any structural features such as slickensides, breccia, styolites, and folds
- Effervesce, e.g., if testing for limestone or dolomite using a hydrochloric acid solution
- Observations of porosity, pitting, vugs, or cavities

Take photographs of chips regularly during drilling and as geologic conditions change. For clarity, it is recommended that chips be deposited on a clean white background with identifying descriptors (locations, depth, date, time, ect) written above the sample.

8.3 Contaminant Screening

Methods for screening for contamination while drilling depend on the nature of impacts suspected. As noted above, air-monitoring at the ground surface of the borehole, and continuous visual observation of the return water while drilling generally provide the first indication of an impact.

Specific procedures for screening chips will be identified in the project FIP/work plan. Common approaches include the following:

- Though field staff will NOT intentionally sniff the cuttings, obvious odors are sometimes useful indicators. Field descriptions of odors will be general, and not attempt to specify what contaminant it smells like.
- If screening core for volatile organic compounds (VOCs) with a photo-ionization detector (PID), focus stained cuttings.
- If NAPL is suspected (e.g., based on high PID hits, or sheens in the return water), one of several commercially available NAPL-detection kits (using hydrophobic dye) may be applied to the cuttings as a supplemental test.

As noted above, when NAPL is observed in a borehole, drilling will almost always stop to avoid dragging the impacts down—drilling deeper will occur ONLY when necessitated by the project objectives, and ONLY after consulting project leadership.

9 Waste Management

Bedrock drilling may generate several types of investigation derived waste (IDW):

- Bedrock drilling typically generates substantial quantities of drilling fluid. It is typically a mixture of water and suspended fine sediment. In most cases, this is drummed. For large jobs, roll-off or “sludge” boxes may be more economical.
- Solid rock cuttings also accumulate in the mud tub. These are typically shoveled into drums.
- Other waste streams include decontamination liquids, and disposable materials (well material packages, personal protective equipment [PPE], etc.).

Waste will be managed in accordance with the TGI – Investigation-Derived Waste Handling and Storage, the procedures identified in the FIP or QAPP as well as state-, federal- or client-specific requirements. Be certain that all IDW will be placed in clearly labeled, appropriate containers and documented in the field logbook.

10 Data Recording and Management

Digital data collection is the Arcadis standard using available FieldNow® applications that enable real-time, paperless data collection, entry, and automated reporting. Paper forms should only be used as backup to FieldNow® digital data collection and/or as necessary to collect data not captured by available FieldNow® applications. The Field Now® digital form applications follow a standardized approach, correlate to most TGIs and are available to all projects accessible with a PC or capable mobile device. Once the digital forms are saved within FieldNow®, the data is instantly available for review on a web interface. This facilitates review by project management team members and SMEs enabling error or anomalous data detection for correction while the staff are still in the field. Continual improvements of FieldNow® applications are ongoing, and revisions are made as necessary in response to feedback from users and subject matter experts.

Records generated as a result of this TGI will be controlled and maintained in the project record files in accordance with project requirements as outlined in the FIP/work plan and/or QAPP.

Field forms, logs/notes (including daily field and relevant calibration logs), and digital records will be maintained by the field team lead.

Records will be transmitted to the Arcadis Project Manager and/or Task Manager, as appropriate, at the end of each day or as specified in the FIP/work plan.

Electronic data files will be sent to the project team and uploaded to the electronic project folder daily or as specified in the FIP/work plan.

Management of the original documents from the field will be completed in accordance with the site-specific QAPP

11 Quality Assurance

Bedrock chip descriptions will be completed only by appropriately trained personnel, and descriptions will be reviewed by an experienced field geologist for content, format and consistency. Edited boring logs should be reviewed by the original author to assure that content has not changed.

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GEOPHYSICAL INVESTIGATION TECHNICAL GUIDANCE INSTRUCTIONS FOR INVESTIGATING FRACTURED BEDROCK

October 25, 2022

ARCADIS

Design & Consultancy
for natural and
built assets

1 INTRODUCTION

This document provides technical guidance instructions (TGI) for geophysical methods that will be used for conducting surface geophysical surveys to investigate bedrock conditions. The broad objective of the geophysical surveys will be to provide subsurface information about the nature of the geologic conditions in the soil and bedrock in support of groundwater investigation and remediation activities. The types of information that are germane to this work include: 1) determination of the depth to the bedrock surface, 2) characterization of the nature and variability of the of the soil and weathered and competent bedrock, 3) identification of relatively permeable and porous fracture zones in the bedrock to a depth of approximately 300 feet or less in depth.

The geophysical methods selected for addressing project objectives include: 1) electrical resistivity imaging (ERI) and 2) two complementary types of seismic methods, refraction and multichannel analysis of surface waves (MASW)/refraction microtremor (ReMi). The ERI and seismic data are gathered along co-located transects approximately perpendicular to groundwater flow pathways.

2 SCOPE AND APPLICATION

This TGI is intended to be used in conjunction with the field sampling plan (FSP), quality assurance project plan (QAPP), and other quality documents developed for this project. This TGI describes equipment, field procedures, and data reduction necessary to perform surface geophysical surveys.

3 PERSONNEL QUALIFICATIONS

A register senior level geologist/engineer with in depth knowledge and experience in the proposed geophysical surveying methods will oversee the performance of the geophysical surveys. Field data collection will be performed by experienced geophysical staff and supported by properly trained technicians.

4 EQUIPMENT LIST

Several types of equipment and supporting materials will be needed for geophysical surveying. The geophysical survey instruments will include:

- Advanced Geosciences, Inc. (AGI) Super Sting R8 electrical resistivity meter and switch boxes, specialized electrical resistivity cables with up to 112 individual electrodes with maximum spacing of 6 meters, and stainless steel electrode stakes for making ground contact;
- Geometrics Geode Seismograph with 48 channels, specialized seismic cable with 48 take-outs at a spacing of 20 feet (approximately 6 meters), and 48 4.5-Hz geophones;

Other supporting equipment and materials

- Deep cycle lead acid batteries to operate seismic and resistivity systems
- Rock salt for electrode contact
- Sprayers for dispensing of salt water

- Sledge hammer or other percussive source and HDPE strike plate for seismic data collection
- Differentially Corrected Global Positioning System (DGPS)
- Survey flagging (multiple colors)
- Pin flags (multiple colors)
- Wooden Stakes
- Field logbook
- Waterproof and permanent marking pens
- Multiple tape measures (300 feet minimum)

5 CAUTIONS

This TGI is intended to be used in conjunction with the field sampling plan (FSP), quality assurance project plan (QAPP), Health and Safety Plan (HASP) and other quality documents developed for this project. This TGI describes equipment, field procedures, and data reduction necessary to perform surface geophysical surveys. Since the collection of surface geophysical data generally does not expose workers to soils below the ground surface, the risk of chemical exposure is low. However, because there may be vehicles or heavy equipment in use at the site, the field personnel should participate in tail gate meetings and safety briefings.

6 HEALTH AND SAFETY CONSIDERATIONS

Adherence to the site-specific HASP and task-specific JSAs in performance of the geophysical surveys is required. In general, PPE should be assigned by the CPM and TM in adherence with Arcadis and client requirements. However, exceptions related to the specific task will be noted in the applicable JSA. For example, collection of magnetics data requires that the worker be free of metallic objects, particularly those made of iron or other magnetic materials. As a result, the worker must wear safety shoes with composite materials.

7 PROCEDURES

Electrical Resistivity

The electrical resistivity method is highly effective in the delineation of materials or interfaces that have a contrast in electrical resistivity across a vertical or horizontal boundary. Examples of types of materials with contrasting electrical resistivity are: overlying soils vs. bedrock, fresh-water sand vs. clay, and highly contaminated soils vs. background soils. The electrical resistivity method is expected to be useful at the site for the delineation of the overlying soils/bedrock interface, significant zones of fractured bedrock, and potentially chemical impacts where the groundwater has an elevated total dissolved solid signature.

The apparent resistivity for each pair of surface or borehole current/potential electrodes will be recorded using the “SuperSting.” The SuperSting is a multi-channel portable memory earth resistivity meter with memory storage of readings and user defined measure cycles. By varying the spacing between both individual and pairs of electrodes within certain types of geometrical arrays, a vertical 2D grid (X versus Z) of apparent resistivity data is obtained for each deployment. Increasing the distance between current and potential electrode pairs allows the current to travel deeper into the ground and "sample" to greater depths. These grids of data points are then interpreted for the optimal resistivity earth model that would generate the apparent measurements obtained along a given established transect.

The SuperSting has a fully automated measuring system, which allows a full suite of measurements to be taken once the electrode array has been placed in the ground. The ability to collect 2D data (i.e., at several different fixed depths and several different lateral locations) allows an interpretation of vertical changes in resistivity with depth and thus will provided an image of these changes. In addition, by collecting two parallel lines of data separated by approximately 100 feet, it is also possible to estimate the plan-view orientation of various linear features such as vertical fractures, troughs in the top of competent bedrock, and cross-cutting geologic bodies such as igneous intrusives.

Initial Layout

Prior to any data acquisition, available site maps will be reviewed to identify the locations of all utilities and subsurface features that may affect the resistivity readings. The layout of the transect locations will be initially established with engineering tapes. Each transect will be marked at a predetermined interval along its entire length with labeled pin flags. Any utilities within 30 feet of these transects will be marked on the ground so that resistivity anomalies from utilities can be identified in the data collected. Because well casings tend to create an especially strong anomaly, layout of the resistivity transects will avoid well casings by at least 30 to 50 feet if possible.

Stainless steel electrode stakes will then be placed in the ground at each station. There will be a total of up to 112 stations. The stakes will be pushed in by gloved hand if possible, otherwise as small mallet will be used to drive the stake. If there is pavement present, it will be necessary to drill a ¾-inch diameter hole through the pavement and into the underlying soil. Once stakes are emplaced, the electrode cables will be laid out and attached to the stakes. Once the cables are attached to the stakes and the SuperSting, the manufacturer-recommended tests will be performed, including a contact resistance test. DC resistivity data will then be acquired along the transect using the appropriate array type(s) as determined by the senior professional - dipole-dipole, inverse schlumberger, and strong gradient are some of the more commonly used arrays.

Guidance on Collection and Verification of Resistivity Data

Data Collection Programming

Prior to collection of data, the decision about the which array(s) will be made. Common array types include:

- Dipole-Dipole
- Pole-Dipole
- Pole-Pole

- Schlumberger
- Inverse Schlumberger
- Strong Gradient
- Wenner

Selection of array type is primarily governed by project objectives and geologic conditions. The schlumberger, inverse schlumberger, wenner, and strong gradient arrays are sensitive to horizontal features, but are fair to poor for characterizing vertical features and have relatively sparse data sets. Dipole-dipole, pole-dipole, and pole-pole arrays are more sensitive to vertical features and also have the advantage of higher data density. In addition, these arrays take better advantage of the multichannel nature of the 8-channel SuperSting. Probably the most commonly used array type for geologic work is the dipole-dipole array, possibly supplemented with the strong gradient or inverse schlumberger array. A command file will be created using an application which generates a sequence of commands for the SuperSting. The command file contains instructions regarding which electrodes are to be switched on, and whether they are current or potential electrodes, number of measurement cycles (repeat measurements), and duration of the measurement time in seconds.

The SuperSting will record the results of the contact resistance test(s) which is conducted prior to data collection. During data collection a number of parameters are stored for each command line including: electrode positions, input current, measured voltage, apparent resistivity, measurement error, time, and date.

Contact Resistance Testing

Resistance checks should be run on the electrodes prior to data collection to assure that contact resistances are not too large. It is common practice to add saltwater around electrodes to improve contact resistance. Lowering of contact resistance improves the ability to inject current. Arcadis generally uses a cutoff 20 kΩ for surface data. Higher values may indicate that limited current can be injected for that electrode pair. It is important to witness the contact resistances and record them manually to determine the quality of contact. Note that the SuperSting automatically records the contact resistance for later use, but it is not easily reviewed in the field. Contact resistance values can provide a basis for editing data associated with particular electrodes that are malfunctioning or in poor contact with the formation.

Data Stacking

It is common practice to collect each reading several times and average the results. This procedure is referred to as “stacking.” Although collection of repeat measurements increases duration of the survey, this extra time is well worthwhile.

Stacking serves to improve the signal-to-noise ratio because random noise is averaged out. In addition, the standard deviation of the repeat measurements (i.e., the stacking error) provides a means to quantify error and define data weights for inversion. Stacking errors are useful in QA/QC and form another basis for editing datasets prior to inversion.

Pulse Duration

On the SuperSting, the duration of the current injection can be selected. Pulse duration varies from 200 ms to 14.4 seconds. Lower pulse duration results in shorter data acquisition time. Pulses on the order of 200 ms may be acceptable in conductive, low-clay media; in the presence of clays, however, longer durations may be required to achieve equilibrium voltages. The length of the pulse duration can be varied, and surveys repeated, to determine the minimum duration necessary to achieve good data. By default, Arcadis generally uses a pulse duration of 1.2 seconds.

Electrical Resistivity Data Processing and Interpretation

Once the data are collected, the resistance data are inverted to make electrical resistivity images. EarthImager 2D and/or Res2DInv software packages will be used to QC, process and interpret the surface data acquired. Depending on selection of modeling and inversion parameters, these programs can be made to produce similar results; default values differ greatly, however. Selection of many of these parameters can be somewhat subjective, and guided by the geophysicist's intuition or prior knowledge of the site geology or the nature of the targets. For example, in a layered system, one might choose to apply anisotropic smoothing, which will result in a tomogram that has a layered character. For results to be reproducible, it is critical to (1) report all parameter selections and default values; (2) document the algorithm used by the software; and (3) archive a copy of the software code or executable. Justifications of parameter choices should also be documented.

Tomographic inversion results are strongly affected by selected inversion parameters and regularization criteria, especially in the presence of large measurement errors. It is instructive, therefore, to run multiple inversions in order to gain insight into the effects of different software settings. Rarely are default inversion settings appropriate. The process for selecting inversion settings should be guided by available site-specific geologic information or other geophysical data. Such information could include past geophysical results, geologic maps, and drillers logs. If inverted resistivity cross sections are inconsistent with such prior information (e.g., values from electromagnetic logs), this could indicate that settings are sub-optimal or that assumptions (e.g., 2-D heterogeneity) are violated.

An interactive graphic display of the data readings will be used to remove invalid data points or groups of readings, as necessary. One master color scheme will be chosen for all transects acquired that represents the full range of data values interpreted, such that a 2-D section acquired along one transect can be compared to a section acquired along another transect.

References

1. Day-Lewis, Frederick D., Carole D. Johnson, Kamini Singha, and John W. Lane, Jr., 2008, Best Practices in Electrical Resistivity Imaging: Data Collection and Processing, and Application to Data from Corinna, Maine: An Administrative Report for EPA Region.
2. Keller, G. V. and Frischknecht, F.C., 1966, Electrical methods in geophysical prospecting: Oxford, Pergamon Press, 523 p.
3. Loke, M.H., 2016, Tutorial: 2-D and 3-D electrical imaging surveys.

4. Tripp, A.C., Hohmann, G.W., and Swift, C.M., Jr., 1984, Two-dimensional resistivity inversion: Geophysics, v. 49, no. 10, p. 1708-1717.
5. Zohdy, A.A.R., Eaton, G.P., and Mabey, D.R., 1974, Application of surface geophysics to ground-water investigations: U.S. Geological Survey Techniques of Water-Resources Investigations, book 2, chap. D1, 86 p.

Seismic Methods

The combined seismic methods of refraction, MASW and ReMi will be performed concurrently with the same equipment. It is anticipated that the same transect locations will be used for both seismic and electrical resistivity.

Seismic Refraction

Background

This procedure describes a method for measuring shear and compressional wave velocities in soil and rock. The Seismic Refraction Method is applied by generating compressional waves (P) (and sometimes shear (SH)) on the land surface and measuring the travel time of the corresponding waves from the source to one or more geophones. These measurements are used to interpret subsurface conditions and materials. This travel time, along with distance between source and geophone(s), can also be interpreted to yield depth to refracting layer(s). The calculated seismic velocities can often be used to characterize some of the properties of natural and man-made subsurface materials.

This is a general procedure and does not address all the details and components of a seismic refraction survey. Please refer to the references provided for additional information.

Environmental Conditions

Seismic refraction data are affected by ground vibrations from a variety of sources. These include ambient sources such wind, water movement (such as waves breaking on a nearby beach), natural seismic activity, and rainfall on the geophones. They also include cultural sources such as vehicular traffic, construction equipment, nearby motors, aircraft, or blasting. Frozen ground can contribute a high-velocity near-surface path that will obscure the contribution of deeper layers.

Such sources should be minimized as much as possible. Where possible, refraction data should not be collected during high winds or rain, or while vehicles are passing.

Measurement Procedure

The specific procedure varies according to the objective for the survey, the design of the survey, and the method used to define the planar refractors. These are described in more detail in other references (1 through 6).

The most important considerations are:

- Location of seismic refraction lines
- Length and orientation of lines
- Geophone spacing
- Location of shots (sources)
- Approach or interpretation method. These can include:
    - Intercept-time or crossover method
    - Delay-time methods and variations thereof
    - Reciprocal methods, including:
        - Common Reciprocal Method
        - Generalized Reciprocal Method
- Ray-tracing methods
- Tomographic methods

Of these approaches, the two methods most commonly used by for detailed refraction surveys are the Generalized Reciprocal Method (GRM) and the Tomographic Method. GRM is acknowledged to be superior to many other methods for modeling irregular dipping refractors and lateral velocity changes. Tomographic Methods are commonly used to image gradual velocity contacts and weathering profiles.

The general field procedures are as follows:

- Check for adequate space to lay out a straight line in accordance with the survey design
- Locate and position first geophone according to design and such that the location can be repeated or identified independently (the line should be referenced to absolute fiducials at several locations).
- Mark geophone locations between endpoints and available intermediate fiducials at the design spacing. Locations must be surveyed to within 5% of the geophone interval (3” for 5ft spacing, and 6” for 10ft spacing). Elevations of geophone locations may be obtained from client-provided survey or from a level survey referenced to available site reference points. A level survey, if performed, shall be closed back to the available site reference points within 0.25ft.
- Lay out geophone cable.
- Place geophones at marked locations. Geophones must be vertical and well-coupled to the ground using the spike provided. Where rock is exposed the spike may be replaced with a tripod base or rock plate.
- Test geophones and cables for shorts or open circuits.
- Set up source(s) at design locations. Shot locations must also be surveyed to within 5% of the geophone interval (3” for 5ft spacing, and 6” for 10ft spacing).
- Place trigger cable.
- Test seismic source and trigger cable.

- Input survey geometry into seismograph.
- Test noise level and set gains and filters.
- Proceed with refraction measurements. Perform forward and reverse and off-end shots as required by the interpretation method selected.

Required Field Records

- Field log for each refraction measurement describing:
  - Location of each geophone.
  - Date and time of test.
  - Tester or data recorder.
  - Description of source (location, amplitude, number of stacks).
  - Any gain or filtering by channel during recording.
  - Any deviations from test plan and action taken as a result.
  - File name as recorded on disk.
  - QA Review

Much of the above information will be automatically recorded in the seismograph header at the time of recording (gains, filtering, and survey geometry) and need not be recorded on the paper log.

Daily backup of the raw field data to a dedicated, labeled flash drive or external hard drive should be performed prior to leaving the work site.

Analysis and Interpretation

Following completion of field work, the recorded digital records are processed by computer and interactively analyzed by an experienced geophysicist to produce plots and tables of P wave velocity versus depth.

Again, the specific procedure varies according to the objective for the survey, the design of the survey, and the method used to define the planar refractors.

Arcadis uses *Geogiga Refractor* to analyze seismic refraction data (Geogiga Technology Corp., Calgary, Alberta, Canada). *Refractor* provides the intercept time method, delay time method, ABC method, and generalized reciprocal method (GRM) for seismic refraction surveys. In general, Arcadis refraction data is processed with the Generalized Reciprocal Method (GRM), one of the most advanced modeling methods currently available for seismic refraction data. Processing steps consist of loading field records into a computer, picking the travel times of first arrivals, entering shot and spread geometry, phantoming data from all shots on a line to obtain one set of forward and reverse travel time curves for each refractor, and applying the GRM to obtain a depth section (model showing different geologic units and their velocities). Preliminary interpretations are carefully verified using available geologic and drilling data and other geophysical results such as MASW and electrical resistivity.

References:

1. ASTM D5777 - 00(2006) “Standard Guide for Using the Seismic Refraction Method for Subsurface Investigation”
2. Redpath, Bruce B. “Seismic Refraction Exploration for Engineering Site Investigations”, Explosive Excavation Research Laboratory, Livermore, CA, distributed by NTIS, US Dept. of Commerce, Springfield, VA 1973
3. “Geophysical Exploration for Engineering and Environmental Investigations”, Technical Engineering and Design Guides as adapted from the US Army Corps of Engineers, No.23, published by ASCE Press, Reston, VA 1998
4. Dobrin, M.B. 1960 Introduction to Geophysical Prospecting. 2nd Edition. McGraw- Hill Book Co. Inc, New York
5. Telford, W.M., et al, 1976 Applied Geophysics Cambridge University Press
6. Milsom, J. 1989 Field Geophysics Open University Press, Milton Keynes

Multichannel Analysis of Surface Waves (MASW) and Refraction Microtremor (ReMi)

Background

This procedure describes a method for determining shear wave velocity (V_S) profiles, based on surface wave dispersion measurements made on the ground surface. The MASW Method consists of collecting multi-channel seismic data in the field using an active seismic source and ReMi is collected using ambient noise as the energy source. A wavefield transform is applied to the recorded seismic data to obtain the dispersion curve, followed by using iterative forward or inverse modelling to back-calculate the variation of V_S with depth.

This is a general procedure and does not address all the details and components of MASW and ReMi testing. A detailed description of the MASW and ReMi methods is given by Park, 1999a and 1999b.

Environmental Conditions

For MASW, ground vibrations from a variety of sources affect surface wave velocity measurements. These include ambient sources such as water movement (such as waves breaking on a nearby beach) and wind. Cultural noise sources such as vehicular traffic, construction equipment, rotating machinery, or blasting may also degrade data quality. When possible, MASW testing should be conducted when cultural noise levels are at a minimum. ReMi is included since it is common, especially in or near urban areas, to experience some level of ambient noise.

MASW Field Procedure

The specific procedure varies according to the objective for the survey. The most important consideration is the depth investigation. This determines the frequency range of the seismic source and length of array required. The length of the geophone array should be, at a minimum, 2 to 3 times the desired depth of the investigation.

The MASW field layout is similar to that of the seismic refraction technique. From 24 to 48 geophones are laid out in a linear array with and connected to a multi-channel seismograph (generally the same layout as refraction is used). This technique is ideally suited to 2D V_S imaging, with data collected in a roll-along manner similar to that of the seismic reflection technique. The source is offset at a predetermined distance from the near geophone usually determined by field testing. Following are the basic steps:

- The MASW technique typically uses 24 to 48 4.5Hz geophones arranged in a linear array
- Avoid concrete slabs, utility corridors, and sewer lines, as possible
- Layout survey ropes and mark stationing as necessary. If necessary, a deviation off line up to 5% is tolerable (10m of 200m line). Optionally a total station may be used to survey sensor locations. Geophone spacing should be such that the length of the receiver array is, at a minimum, 2 to 3 times the desired depth of investigation.
- Setup seismograph. Select digitizing rate and record length to match depth/frequency desired. Be sure to turn off or minimize any filtering, except antialiasing filters.
- Acquire sample data and adjust input levels if necessary.
- Activate source for measurements. For impact sources, such as a sledgehammer, several averages are usually required - 5 to 10 is typical. Multiple source locations may be occupied for a 1-D sounding.
- Download and visually confirm data on laptop. Check every channel for bad connections, and excess noise. Store in separate files or directories with unique names. Beware of overwriting files.
- Record required information on field log or in field notebook. This includes file name, location and orientation of array, location of each sensor within the array, and any other comments.
- Stake and mark center or ends of MASW array if necessary for later surveying. Measure and record azimuth of array line if necessary.
- For ReMi data, once the MASW data collection is complete, record a long-duration record(s) using all geophones. Record length is typically at least 5 minutes in duration (at least 1 repeat is desirable).
- Backup data to a dedicated, labeled flash drive or external hard drive on a daily basis.

Data Analysis and Interpretation

The Rayleigh wave dispersion curve is obtained by a wavefield transformation of the seismic record such as the f-k or τ-p transforms. These transforms are very effective at isolating surface wave energy from that of body waves. The dispersion curve is picked as the peak of the surface wave energy in slowness (or velocity) – frequency space as shown. One advantage of the MASW/ReMi technique is that the wavefield transformation may not only identify the fundamental mode but also higher modes of surface waves. At some sites, particularly those with large velocity inversions, higher surface wave modes may contain more energy than the fundamental mode. 2-D images of V_S versus depth along a profile are constructed by combining 1-D inversions of dispersion data collected at regular intervals along the profile. Arcadis uses

Geogiga Surface Plus to analyze active and passive surface wave data (Geogiga Technology Corp., Calgary, Alberta, Canada).

Required Field Records

Field log/notebook for MASW array/profiles showing:

- Location and orientation of array
- Date of test
- Field personnel
- Instrumentation
- Data acquisition parameters including record length, sample rate, receiver spacing
- For each seismic record document file name, receiver array location, source location, source type, number of source averages
- Any deviations from test plan and action taken as a result

References

1. Park, C.B., Miller, R.D. and Xia, J., 1999a, “Multimodal analysis of high frequency surface waves”, Proceedings of the Symposium on the Application of Geophysics to Engineering and Environmental Problems ’99, 115-121.
2. Park, C.B., Miller, R.D. and Xia, J., 1999b, “Multichannel analysis of surface waves”, Geophysics, Vol 64, No. 3, 800-808.

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APPENDIX D

Laboratory Standard Operating Procedures

Title: Analysis of Per- and Polyfluoroalkyl Substances (PFAS) in Water, Solid, Biosolids and Tissue

[Method 1633]

Approvals (Signature/Date):

08/12/2022
Robert Hrabak Date
Technical Manager

08/12/2022
Joe Schairer Date
Health & Safety Manager / Coordinator

08/17/2022
Lisa Stafford Date
Quality Assurance Manager

08/16/2022
Chris Williams Date
Laboratory Manager

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1. SCOPE AND APPLICATION

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

Table 1.1
PFAS Supported

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

Table 1.1
PFAS Supported

Compound Name	**Abbreviations**	**CAS #**
Perfluorinated sulfonamidoacetic acids (FOSAAs)		
N-ethylperfluoro-1-octanesulfonamidoacetic acid	NEtFOSAA (EtFOSAA)	2991-50-6
N-methylperfluoro-1-octanesulfonamidoacetic acid	NMeFOSAA (MeFOSAA)	2355-31-9
Fluorotelomer sulfonic acids (FTS)		
1H,1H,2H,2H-perfluorohexane sulfonic acid *(4:2)*	4:2 FTS	757124-72-4
1H,1H,2H,2H-perfluorooctane sulfonic acid *(6:2)*	6:2 FTS	27619-97-2
1H,1H,2H,2H-perfluorodecane sulfonic acid *(8:2)*	8:2 FTS	39108-34-4
Fluorotelomer carboxylic acids (FTCAs)		
3-Perfluoropropylpropanoic acid	3:3 FTCA	356-02-5
3-Perfluoropentylpropanoic acid	5:3 FTCA	914637-49-3
3-Perfluoroheptylpropanoic acid	7:3 FTCA	812-70-4
Per-and Polyfluoroether carboxylic acids		
Perfluoro(2-propoxypropanoic) acid or Hexafluoropropylene oxide dimer acid	HFPO-DA, GenX	13252-13-6
4,8-dioxa-3H-perfluorononanoic acid	ADONA(1) (DONA)	919005-14-4
Perfluoro-3-methoxypropanoic acid (PFMPA)	PFMPA, (PFECA F)	377-73-1
Perfluoro-4-methoxybutanoic acid (PFMBA)	PFMBA,(PFECA A)	863090-89-5
Nonafluoro-3,6-dioxaheptanoic acid (NFDHA)	NFDHA (PFECA B)	151772-58-6
Ether sulfonic acids		
9-Chlorohexadecafluoro-3-oxanonane-1-sulfonic acid	9Cl-PF3ONS	756426-58-1
11-Chloroeicosafluoro-3-oxaundecane-1-sulfonic acid	11Cl-PF3OUdS	763051-92-9
Perfluoro(2-ethoxyethane) sulfonic acid	PFEESA (PES)	113507-82-7

***Note**: Abbreviations in parenthesis are the abbreviations used by the laboratory's LIMS where they differ from the abbreviation listed in Method 1633.*

(1) In some literature, the acronym ADONA refers to the ammonium salt, CAS 958445-44-8, and DONA refers to the parent acid. In Method 1633, ADONA refers to the parent acid. DONA is the acronym present on the laboratory raw data. This analyte should be reported as ADONA for the MLVS.

1.2. The working range of the method is listed below. The linear range can be extended by diluting the extracts. Note that all compounds are reported in their acid form.

Reporting limits and Method Detection Limits for individual compounds are stored in the laboratory's LIMS.

Table 1.2
Reporting Limits and Working Range

Matrix	Nominal Sample Size	Reporting Limit	Working Range
Water	500 mL	1.6 ng/L – 40 ng/L	1.6 ng/L - 1560 ng/L
Leachate	100 mL	8 ng/L – 200 ng/L	8 ng/L – 7800 ng/L
Solid	5 g	0.2 ng/g – 5.0 ng/g	0.2 ng/g - 156 ng/g
Biosolids	0.5 g	2 ng/g – 50 ng/g	2 ng/g – 1560 ng/g
Tissue	2 g	0.5 ng/g – 12.5 ng/g	0.4 ng/g – 625 ng/g

2. SUMMARY OF METHOD

2.1. Water samples are extracted using a solid phase extraction (SPE) cartridge. PFAS are eluted from the cartridge with an ammonium hydroxide (NH4OH)/methanol solution.

2.2. Solid/biosolids samples are extracted with a NH4OH/methanol solution using agitation for 1 hour. The mixture is centrifuged and the solvent filtered.

2.3. Tissue samples are extracted with a potassium hydroxide (KOH)/methanol and acetonitrile solutions using agitation for 16 hours and sonication for 30 minutes. The mixture is centrifuged and the solvent filtered.

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

2.5. An isotope dilution technique is employed with this method for the compounds of interest. The isotope dilution analytes (IDA) consist of carbon-13 labeled analogs or deuterated analogs of the compounds of interest, and they are fortified into the samples at the time of extraction. This technique allows for the correction for analytical bias encountered when analyzing more chemically complex environmental samples. The isotopically labeled compounds are chemically similar to the compounds of concern and are therefore affected by sample-related interferences to the same extent as the compounds of concern. Compounds that do not have an identically labeled analog are quantitated by the IDA method using a closely related labeled analog.

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

3. DEFINITIONS

3.1. PFCAs: Perfluorocarboxylic acids

3.2. PFSAs: Perfluorinated sulfonic acids

3.3. FOSA: Perfluorinated sulfonamide

3.4. PFOA: Perfluorooctanoic acid

3.5. PFOS: Perfluorooctane sulfonic acid

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

3.7. SPE: Solid phase extraction

3.8. PP: Polypropylene

3.9. PE: Polyethylene

3.10. HDPE: High density polyethylene

3.11. AFFF: Aqueous Film Forming Foam

3.12. TDCA: Taurodeoxycholic acid

3.13. TCDA: Taurochenodeoxycholic acid

3.14. TUDCA: Tauroursodeoxycholic acid

3.15. IDA: Isotope dilution analyte (equivalent to EIS in reference method)

3.16. IS: Internal Standard (equivalent to NIS in reference method)

3.17. LCS: Laboratory control sample (equivalent to OPR in reference method)

3.18. MLVS: Multi-Laboratory Validation Study

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

4. INTERFERENCES

4.1. PFAS have been used in a wide variety of manufacturing processes, and laboratory supplies should be considered potentially contaminated until they have been tested and shown to be otherwise. The materials and supplies used during the method validation process have been tested and shown to be clean (i.e., no contribution greater than ½ the quantitation (reporting) limit. These items are listed below in Section 6.

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

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

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

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

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

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

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

As of this writing, only PFOS, PFOA, PFHxS, Et-FOSAA and Me-FOSAA are commercially available as technical mixtures. These reference standards of the technical mixtures for these specific PFAS are used to ensure that all appropriate peaks are included during peak integration.

4.6. In an attempt to reduce PFOS bias, it is required that m/z 499>80 transition be used as the quantitation transition.

4.7. Aluminum foil should not be used for this analysis due to the potential interferences from the PFAS used as release agents.

5. SAFETY

Employees must abide by the policies and procedures in the NDSC Safety Manual, Sacramento Supplement to the HSEM, and this document. All work must be stopped in the event of a known or potential compromise to the health or safety of an associate. The situation must be reported **immediately** to a supervisor, the EH&S Staff, or a senior manager.

5.1. Specific Safety Concerns

5.1.1. Preliminary toxicity studies indicate that PFAS could have significant toxic effects. In the interest of keeping exposure levels as low as reasonably achievable, PFAS and PFAS samples must be handled in the laboratory as hazardous and toxic chemicals.

5.1.2. The use of a filtering syringe with the SPE cartridge, if and when needed, presents an extreme risk of ergonomic injury due to the force needed to push the sample through the cartridge, and the set-up and body geometry of the individual using the syringe/SPE cartridge. Use step boxes to position yourself above the syringe and manifold so that your body weight can be carefully applied to pushing the syringe plunger down, rather than just using your arm and shoulder muscles. Ensure that this task is rotated amongst staff members so that no one has to do it repeatedly for weeks or months. Ensure that routine breaks are taken, and that muscles and joints involved with this task are routinely stretched to offset this hazard.

5.1.3. Exercise caution when using syringes with attached filter disc assemblies. Application of excessive force has, upon occasion, caused a filter disc to burst during the process.

5.1.4. Laboratory procedures such as repetitive use of pipets, repetitive transferring of extracts and manipulation of filled separatory funnels and other glassware represent a significant potential for repetitive motion or other ergonomic injuries. Laboratory associates performing these procedures are in the best position to realize when they are at risk for these types of injuries. Whenever a situation is found in which an employee is performing the same repetitive motion, the employee shall immediately bring this to the attention of their supervisor, manager, or the EH&S staff. The task will be analyzed to determine a better means of accomplishing it.

5.1.5. Eye protection that satisfies ANSI Z87.1 (as per the NDSC Safety Manual), laboratory coat, and nitrile gloves must be worn while handling samples, standards, solvents, and reagents. Disposable gloves that have been contaminated will be removed and discarded; other gloves will be cleaned immediately.

5.1.6. Perfluorocarboxylic acids are acids and are not compatible with strong bases.

5.1.7. The use of vacuum systems presents the risk of imploding glassware. All glassware used during vacuum operations must be thoroughly inspected prior to each use. Glass that is chipped, scratched, cracked, rubbed, or marred in any manner must not be used under vacuum. It must be removed from service and replaced.

5.2. Primary Materials Used

The following is a list of the materials used in this method, which have a serious or significant hazard rating. NOTE: This list does not include all materials used in the method. The table contains a summary of the primary hazards listed in the SDS for each of the materials listed in the table. A complete list of materials used in the method can be found in the reagents and materials section. Employees must review the information in the SDS for each material before using it for the first time or when there are major changes to the SDS.

Material(1)	**Hazards**	**Exposure Limit(2)**	**Signs and Symptoms of Exposure**
Acetic Acid (3-2-1)	Corrosive Poison Flammable	10 ppm-TWA 15 ppm-STEL	Contact with concentrated solution may cause serious damage to the skin and eyes. Inhalation of concentrated vapors may cause serious damage to the lining of the nose, throat, and lungs. Breathing difficulties may occur.
Acetonitrile (2-3-0)	Flammable Poison	20 ppm-TWA	Early symptoms may include nose and throat irritation, flushing of the face, and chest tightness. Prolonged exposure to high levels of vapors may cause formation of cyanide anions in the body.
Ammonium Hydroxide (3-1-0)	Corrosive Poison	50 ppm-TWA	Severe irritant. Effects from inhalation of dust or mist vary from mild irritation to serious damage to the upper respiratory tract. Symptoms may include sneezing, sore throat or runny nose. Contact with skin can cause irritation or severe burns and scarring with greater exposures. Causes irritation of eyes, and with greater exposures it can cause burns that may result in permanent damage, including blindness. Brief exposure to 5000 PPM can be fatal.
Formic Acid (3-2-1)	Flammable Corrosive Toxic Irritant	5 ppm TWA 10 ppm STEL	Extremely destructive on contact with skin, mucous membranes, eyes, upper respiratory tract. Inhalation may result in spasms, inflammation and edema. Symptoms include burning sensation, coughing, wheezing, shortness of breath, headache, nausea, vomiting, and depression.

Material(1)	Hazards	Exposure Limit(2)	Signs and Symptoms of Exposure
Methanol (2-3-0)	Flammable Poison Irritant	200 ppm PEL 250 ppm STEL	Harmful if swallowed, or absorbed through the skin. Causes eye, skin and respiratory tract irritation, and may cause central nervous system depression. A slight irritant to the mucous membranes. Toxic effects exerted upon nervous system, particularly the optic nerve. Symptoms of overexposure may include headache, drowsiness and dizziness. Methyl alcohol is a defatting agent and may cause skin to become dry and cracked. Skin absorption can occur; symptoms may parallel inhalation exposure. Irritant to the eyes.
Potassium Hydroxide (3-0-1)	Corrosive Poison	2 mg/m^3 (Ceiling)	Symptoms of inhalation may include coughing, sneezing, damage to the nasal or respiratory tract. High concentrations can cause lung damage. Contact with skin can cause irritation or severe burns and scarring with greater exposures. Causes irritation of eyes with tearing, redness, and swelling.
(1) Always add acid to water to prevent violent reactions. (2) Exposure limit refers to the OSHA regulatory exposure limit.			

6. EQUIPMENT AND SUPPLIES

Due to the ubiquitous nature of PFAS, all disposable equipment (including, but not limited to vials, pipet tips, and SPE manifold parts) that directly contacts a sample or extract is subject to QC checks on a by-lot basis prior to use. At a minimum, the QC checks include either a rinse with DI water or an extraction with basic methanol to mimic the usage encountered during sample preparation. QC check data is kept on file for reference as needed. Processes for cleaning extraction manifolds and associated components are described in WS-OP-0011, “Glassware Cleaning”.

6.1. 15 mL polypropylene test tubes with polypropylene screw caps.

6.2. 50 mL graduated plastic centrifuge tubes.

6.3. 500, 250 and HDPE bottles with HDPE screw caps. The average weight of the HDPE bottles with HDPE screw caps are calibrated once per year. The calibration is performed by weighing 10 bottles with caps and dividing by 10 to get the average weight. The average weight is used in Section 11.3.6.1 Step 4.

6.3.1. The MLVS requires 500 mL aliquots for water and Section 11.3.6.1 is not applicable to the MLVS.

6.4. Analytical balance capable of accurately weighing to the nearest 0.0001g, and checked for accuracy each day it is used in accordance with WS-QA-0041.

6.5. Extract concentrator or nitrogen manifold with water bath heating to 65°C.

6.6. Syringe filter, PALL/Acrodisc 0.2 um Nylon membrane, 25 mm, or equivalent. Do not use PTFE type filters.

6.7. 300 µL autosampler vials, polypropylene, with polypropylene screw caps, Waters PN 1860004112, or equivalent.

6.8. SPE columns

  6.8.1. Waters Oasis WAX 150 mg/6 cc (PN 186002493) or equivalent for DoD/DOE QSM and MLVS samples.

  6.8.2. Phenomenex Strata PFAS WAX/GCB, 500mg/50mg/6cc (PN DZPRO-SPE) or equivalent. This cartridge incorporates a graphitized carbon.

6.9. Graphitized carbon (Envi-Carb^{TM} or equivalent) for DoD/DOE QSM and MLVS samples.

6.10. Silanized glass wool, Sigma-Aldrich PN 20411. Rinse with methanol 2 times and store in clean glass jar prior to use. Pack to half the high of WAX SPE cartridge barrel.

6.11. Vacuum manifold for Solid Phase Extraction (SPE).

6.12. Miscellaneous laboratory apparatus (beakers, test tubes, volumetric flasks, pipettes, etc.). These should be disposable where possible, or marked and segregated for high-level versus low-level use.

6.13. pH indicator paper, JT Baker Baker-pHIX pH 2.0-9.0, or equivalent.

6.14. Centrifuge (Thermo Scientific Sorvall Legend X1, or equivalent), capable of reaching at least 4500 rpm.

6.15. Vortex Mixer (Scientific Industries model SI-0236 or equivalent)

6.16. Shaker table (Eberbach model 6010, or equivalent) for soil extractions

6.17. Desiccator, part # B002VBW9XW or equivalent

6.18. Drierite desiccant, part # 23005-UOM-EA or equivalent

6.19. Oven, capable of maintaining a temperature of 110°C (+ 5°C), Symphony part # 15-103-0503, or equivalent

6.20. Pre-weighed 47 mm filters, Environmental Express part # F93447MM or equivalent

6.21. Vacuum pump, CPS Products VP2D Pro-set 2 State, part # UX-07164-83 or equivalent

6.22. Liquid Chromatography/Tandem Mass Spectrometer (LC/MS/MS) –The instrument described below, or equivalent, may be used for this method. The HPLC is equipped with a refrigerated autosampler, an injection valve, and a pump capable of variable flow rate. The use of a column heater is required to maintain a stable temperature throughout the analytical run. Data is processed using Chrom Peak Review, version 2.3 or equivalent. The MS/MS is capable of running in the NI-ESI mode at the recommended flow rate with a minimum of 10 scans per peak.

6.22.1. SCIEX LC/MS/MS

This system consists of a Shimadzu HPLC interfaced with a SCIEX 5500 Triple Quad MS, or equivalent. The instrument control and data acquisition software is SCIEX Analyst, version 1.6.3 or equivalent.

6.22.1.1. Shimadzu CTO-20AC HPLC equipped with 3 LC-20AD pumps and one DGU-20 degassing unit or equivalent.

6.22.1.2. Phenomenex Gemini C_{18} 3 µm, 3.0 mm x 100 mm, Part No. 00D-4439-Y0, or equivalent.

6.22.1.3. PFAS Isolator column, Phenomenex Luna C_{18} 5 µm, 50 mm x 4.6 mm, part no. 00B-4252-E0 or equivalent. This is plumbed between the UPLC pumps and autosampler valve to minimize PFAS background from the UPLC solvent lines and filters.

6.23. Preventive and routine maintenance is described in the table below

Table 6.23
HPLC/MS/MS Preventative Maintenance

<u>**As Needed:**</u>	<u>**Daily (When in use)**</u>
Change pump seals. Change in-line filters in autosampler (HPLC). Check/replace in-line frit if excessive pressure or poor performance. Replace column if no change following in-line frit change. Clean corona needle. Replace sample inlet tube in APCI (10.1 cm). Replace fused silica tube in ESI interface. Clean lenses. Clean skimmer. Ballast rough pump 30 minutes. Create all eluents in Reagent module, label eluent containers with TALS label and place 2nd label into maintenance log when put into use.	Check solvent reservoirs for sufficient level of solvent. Verify that pump is primed, operating pulse free. Check needle wash reservoir for sufficient solvent. Verify capillary heater temperature functioning. Verify vaporizer heater temperature. Verify rough pump oil levels. Verify turbo-pump functioning. Verify nitrogen pressure for auxiliary and sheath gasses. Verify that corona and multiplier are functioning.
<u>**Semi-Annually**</u>	<u>**Annually**</u>

Table 6.23 **HPLC/MS/MS Preventative Maintenance**	
Replace rough-pump oil (4-6 months). Replace oil mist and odor elements. Replace activated alumina filter if applicable	Vacuum system components including fans and fan covers. Clean/replace fan filters, if applicable.

7. REAGENTS AND STANDARDS

7.1. Reagent grade chemicals shall be used in all tests whenever available. Unless otherwise indicated, it is intended that all reagents shall conform to the specifications of the Committee on the Analytical Reagents of the American Chemical Society, where such specifications are available. Other grades may be used, provided it is first ascertained that the reagent is of sufficiently high purity to permit its use without lessening the accuracy of the determination.

7.1.1. Acetic acid, glacial

7.1.2. Acetonitrile, HPLC Grade

7.1.3. Ammonium acetate (solid salt).

7.1.4. Ammonium acetate (20 mM in water): Prepared by weighing 1.54 g of ammonium acetate and dissolving in 1 L of water. This solution has volatile components, thus it should be replaced every 7 days or sooner.

7.1.5. Ammonium hydroxide (NH_4OH), 30% in water, ACS reagent grade

7.1.6. Ammonium hydroxide (NH_4OH), 3% in water: Prepared by diluting 10 mL of ammonium hydroxide (30%) with 90 mL of reagent water for a total volume of 100 mL. Replace after 3 months.

7.1.7. Ammonium hydroxide (NH_4OH), 0.3% in methanol (v/v): Prepared by diluting 10 mL of ammonium hydroxide (30%) into 990 mL of methanol for a total of 1 L.

7.1.8. Ammonium hydroxide (NH4OH), 1% in methanol (v/v): Prepared by diluting 33 mL of ammonium hydroxide into 967 mL of methanol for a total of 1 L.

7.1.9. Formic Acid, greater than 96% purity or equivalent, ACS reagent grade

7.1.10. Formic Acid, 0.1 M, in water: Prepared by dissolving 4.6 g of formic acid into 1 L of reagent water. Replace after 2 years.

7.1.11. Formic Acid, 0.3 M, in water: Prepared by dissolving 13.8 g of formic acid into 1 L of reagent water. Replace after 2 years.

7.1.12. Formic Acid, 5% in water(v/v): Prepared by diluting 5 mL of formic acid with 95 mL of reagent water for a total volume of 100 mL. Replace after 2 years.

7.1.13. Formic Acid, 50% in water(v/v): Prepared by diluting 50 mL of formic acid with 50 mL of reagent water for a total volume of 100 mL. Replace after 2 years.

7.1.14. 1:1 0.1 M formic acid:methanol (v/v); Prepared by mixing equal volumes of methanol and 0.1 M formic acid. Replace after 2 years.

7.1.15. Methanol (MeOH)

7.1.16. Potassium Hydroxide (KOH) (solid, reagent grade).

7.1.17. Potassium hydroxide, 0.4% in methanol (w/v): Prepared by weighing 16 g of potassium hydroxide and dissolving in 4 L of methanol.

7.1.18. Ottawa Sand (blank matrix for solid samples)

7.1.19. Store bought chicken breast or tilapia (blank matrix for tissue samples)

7.1.20. Water, Nanopure or Millipore, must be free of interference and target analytes.

7.1.21. Nitrogen, Ultra High Purity, used for the ESI interface, collision cell, and concentration of extracts.

7.1.22. Air, Ultra-Pure, used for vacuum and source gas.

7.1.23. 30:70 methanol:water (v/v), prepared by diluting 30 mL methanol with 70 mL HPLC reagent water or equivalent volume in respect to the ratio.

7.1.24. Instrument Blanks solution (94.375% MeOH, 4% H2O, 1% NH_4OH, 0.625% acetic acid): Prepare by combining 18.848 mL of MeOH, 0.348 mL reagent water, 0.128 mL glacial acetic acid and 0.676 mL 30% Ammonium Hydroxide in water.

7.2. Standards

7.2.1. PFAS are purchased as high purity solids (96% or greater) or as certified solutions. Standard materials are verified compared to a second source material at the time of initial calibration. The solid stock material is stored at room temperature or as specified by the manufacturer or vendor.

7.2.2. As of this writing, only PFOS, PFOA, PFHxS, NEtFOSAA and NMeFOSAA are commercially available as technical mixtures. These reference standards of the technical mixtures for these specific PFAS are used to ensure that all appropriate peaks are included during peak integration.

7.2.3. If solid material is used for preparing a standard, stock standard solutions are prepared from the solids and are stored at 0 - 6°C. Stock standard solutions should be brought to room temperature before using. Standards are monitored for signs of degradation or evaporation. Standard solutions must be replaced at least annually from the date of preparation.

7.2.4. PFBS, PFHxS, PFHpS, PFOS, PFDS, and many other PFAS are not available in the acid form, but rather as their corresponding salts, such as sodium or potassium. The standards are prepared and corrected for their salt content according to the equation below.

$$\text{Mass}_{\text{acid}} = \text{Measured Mass}_{\text{salt}} \times \text{MW}_{\text{acid}} / \text{MW}_{\text{salt}}$$

Where: MW_{acid} is the molecular weight of PFAA

MW_{salt} is the molecular weight of the purchased salt.

For example, the molecular weight of PFOS is 500.1295 and the molecular weight of NaPFOS is 523.1193. Therefore, the amount of NaPFOS used must be adjusted by a factor of 0.956.

7.2.5. For the primary source calibration solutions, individual solutions for each PFAS (both native and isotopically labelled) are purchased from Wellington Laboratories, or other reputable vendors, and are predominantly at a concentration of 50 ug/mL in basic methanol. In the case of the sulfonic compounds, the concentration is 50ug/mL of the alkali (potassium or sodium) salt. The laboratory uses the concentration of the acid form when determining the concentration of individual sulfonic acids in solution (See Section 7.2.4 above).

7.2.6. While PFAS standards commercially purchased are supplied in glass ampoules, all subsequent transfers or dilutions performed by the analyst must be prepared and stored in polypropylene or HDPE containers. Vortex all standard solutions prior to removing aliquots.

7.3. 1633 /LCS (LCS/Matrix PFC Spike Solution), 14-400 ng/mL (nominal) in

250 ml of a mixed stock solution in methanol at a nominal concentration listed below. This mixed stock is used as the spiking solution during sample preparation, as well an intermediate for the calibration curve, using the recipe below:

Table 7.3
1633 IM/LCS Solution Recipe
The solutions below are combined and diluted to 250 mL in methanol

Analyte	Stock Conc. (µg/mL)	Aliquot (mL)	1633 IM/LCS Conc. (µg/mL)	Analyte	Stock Conc. (µg/mL)	Aliquot (mL)	1633 IM/LCS Conc. (µg/mL)
PFBA	50	0.320	0.064	6:2 FTS	47.4	0.320	0.061
PFPeA	50	0.160	0.032	8:2 FTS	47.9	0.320	0.061
PFHxA	50	0.080	0.016	FOSA	50	0.080	0.016
PFHpA	50	0.080	0.016	Me-FOSA	50	0.080	0.016
PFOA	50	0.080	0.016	Et-FOSA	50	0.080	0.016
PFNA	50	0.080	0.016	Me-FOSAA	50	0.080	0.016
PFDA	50	0.080	0.016	Et-FOSAA	50	0.080	0.016
PFUdA	50	0.080	0.016	Me-FOSE	50	0.080	0.016
PFDoA	50	0.080	0.016	Et-FOSE	50	0.080	0.016
PFTrDA	50	0.080	0.016	HFPO-DA	50	0.320	0.064
PFTeDA	50	0.080	0.016	4,8-dioxa-3H-PFNA (DONA)	47.1	0.320	0.060
PFBS	44.2	0.080	0.014	PFMPA (PFECA F)	50	0.160	0.032
PFPeS	46.9	0.080	0.015	PFMPA (PFECA A)	50	0.160	0.032
PFHxS	45.5	0.080	0.015	NFDHA (PFECA B)	50	0.160	0.032
PFHpS	47.6	0.080	0.015	9Cl-PF3ONS	46.6	0.320	0.060
PFOS	46.6	0.080	0.015	11Cl-PF3OUdS	47.1	0.320	0.060
PFNS	48	0.080	0.015	PFEESA (PES)	44.5	0.160	0.028
PFDS	48.2	0.080	0.015	3:3 FTCA	50	0.400	0.080
PFDoS	48.4	0.080	0.015	5:3 FTCA	50	2.000	0.400
4:2 FTS	46.7	0.320	0.015	7:3 FTCA	50	2.000	0.400

7.4. 1633 Isotope Dilution Analyte Solution (Extracted Internal Standards), 25-500 ng/mL

The 1633-IDA solution is added to all samples prior to extraction and used as an intermediate solution for preparation of the instrument calibration standards. 200 mL of the solution at a nominal concentration of 0.025-0.5 ug/mL (25-500 ng/mL) is prepared from the individual solutions described in Section 7.2.5. using the recipe below:

Table 7.4
1633-IDA Recipe
The solutions below are combined and diluted to 200 mL with Methanol.

IDA	Stock Conc. (µg/mL)	Aliquot (mL)	IDA Mix Conc. (µg/mL)	IDA	Stock Conc. (µg/mL)	Aliquot (mL)	IDA Mix Conc. (µg/mL)
13C4-PFBA	50	1.200	0.20	13C8-PFOS	47.8	0.300	0.0478
13C5-PFPeA	50	0.600	0.10	13C2-4:2FTS	46.7	0.600	0.0934
13C5-PFHxA	50	0.300	0.050	13C2-6:2FTS	47.5	0.600	0.0950
13C4-PFHpA	50	0.300	0.050	13C2-8:2FTS	47.9	0.600	0.0958
13C8-PFOA	50	0.300	0.050	13C8-FOSA	50	0.300	0.050
13C9-PFNA	50	0.150	0.025	d3-MeFOSA	50	0.300	0.050
13C6-PFDA	50	0.150	0.025	d5-EtFOSA	50	0.300	0.050
13C7-PFUdA	50	0.150	0.025	d3-MeFOSAA	50	0.600	0.10
13C2-PFDoA	50	0.150	0.025	d5-EtFOSAA	50	0.600	0.10
13C2-PFTeDA	50	0.150	0.025	d7-Me-FOSE	50	3.000	0.50
13C3-PFBS	46.5	0.300	0.0465	d9-Et-FOSE	50	3.000	0.50
13C3-PFHxS	50	0.300	0.050	13C3-HFPO-DA	50	1.200	0.20

7.5. 1633 Internal Standard Solution, 100-400 ng/mL

The 1633 IS solution is added to all extracts prior to analysis and used as an intermediate solution for preparation of the instrument calibration standards. 20 mL of the solution at a nominal concentration of 0.1-0.4 ug/mL (100-400 ng/mL) is prepared from the individual solutions described in Section 7.2.5 using the recipe below.

Table 7.5
1633-IS Recipe
The solutions below are combined and diluted to 60 mL with Methanol.

IDA	Stock Conc. (µg/mL)	Aliquot (mL)	IDA Mix Conc. (ug/mL)	IDA	Stock Conc. (µg/mL)	Aliquot (mL)	IDA Mix Conc. (ug/mL)
13C3-PFBA	50	0.48	0.400	13C2-PFDA	50	0.12	0.100
13C2-PFHxA	50	0.24	0.200	18O2-PFHxS	47.3	0.24	0.189
13C4-PFOA	50	0.24	0.200	13C4-PFOS	47.8	0.24	0.191
13C5-PFNA	50	0.12	0.100				

7.6. Calibration Standards

Calibration solutions are prepared from the standards described in Sections 7.3, 7.4, and 7.5, above. For each level, a 100 mL volumetric flask is filled with 4 mL of water, and methanol added. The appropriate amount (see table below) of the solutions are added, and then the flask is filled to the mark with methanol to achieve the ratio of 96% methanol to 4% water, v/v.

Table 7.6
1633 Calibration Solution Recipe

PFAS Standards	**Volume (mL) to add in 100 mL FV**							
	CS-1	**CS-2**	**CS-3**	**CS-4**	**CS-5**	**CS-6**	**CS-7**	**CS-8**
1633 IM/LCS (0.02 µg/mL)	0.125	0.25	1.25	5	12.5	25	50	250
1633 IDA Mix (0.025µg/mL)	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
1633 IS Mix (0.1-0.4 µg/mL)	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5

7.6.1. Initial Calibration (ICAL) Levels (ng/mL)

Table 7.6.1
Initial Calibration Solution Concentrations (ng/mL)

Compound	**CS-1**	**CS-2**	**CS-3**	**CS-4**	**CS-5**	**CS-6**	**CS-7**	**CS-8**
PFBA	0.32	0.8	2	5	10	20	50	250
PFPeA	0.16	0.4	1	2.5	5	10	25	125
PFHxA	0.08	0.2	0.5	1.25	2.5	5	12.5	62.5
PFHpA	0.08	0.2	0.5	1.25	2.5	5	12.5	62.5
PFOA	0.08	0.2	0.5	1.25	2.5	5	12.5	62.5
PFNA	0.08	0.2	0.5	1.25	2.5	5	12.5	62.5
PFDA	0.08	0.2	0.5	1.25	2.5	5	12.5	62.5
PFUdA	0.08	0.2	0.5	1.25	2.5	5	12.5	62.5
PFDoA	0.08	0.2	0.5	1.25	2.5	5	12.5	62.5
PFTrDA	0.08	0.2	0.5	1.25	2.5	5	12.5	62.5
PFTeDA	0.08	0.2	0.5	1.25	2.5	5	12.5	62.5
PFBS	0.07072	0.1768	0.442	1.105	2.21	4.42	11.05	55.25
PFPeS	0.07504	0.1876	0.469	1.1725	2.345	4.69	11.725	58.625
PFHxS*	0.0728	0.182	0.455	1.1375	2.275	4.55	11.375	56.875
PFHpS	0.07616	0.1904	0.476	1.19	2.38	4.76	11.9	59.5
PFOS*	0.07424	0.1856	0.464	1.16	2.32	4.64	11.6	58
PFNS	0.0768	0.192	0.48	1.2	2.4	4.8	12	60
PFDS	0.07712	0.1928	0.482	1.205	2.41	4.82	12.05	60.25
PFDoS	0.07744	0.1936	0.484	1.21	2.42	4.84	12.1	60.5
4:2 FTS	0.29888	0.7472	1.868	4.67	9.34	18.68	46.7	233.5
6:2 FTS	0.30336	0.7584	1.896	4.74	9.48	18.96	47.4	237
8:2 FTS	0.30656	0.7664	1.916	4.79	9.58	19.16	47.9	239.5
FOSA	0.08	0.2	0.5	1.25	2.5	5	12.5	62.5
Me-FOSA	0.08	0.2	0.5	1.25	2.5	5	12.5	62.5
Et-FOSA	0.08	0.2	0.5	1.25	2.5	5	12.5	62.5
MeFOSAA*	0.08	0.2	0.5	1.25	2.5	5	12.5	62.5
EtFOSAA*	0.08	0.2	0.5	1.25	2.5	5	12.5	62.5
Me-FOSE	0.08	0.2	0.5	1.25	2.5	5	12.5	62.5
Et-FOSE	0.08	0.2	0.5	1.25	2.5	5	12.5	62.5
HFPO-DA	0.32	0.8	2	5	10	20	50	250

Table 7.6.1
Initial Calibration Solution Concentrations (ng/mL)

Compound	**CS-1**	**CS-2**	**CS-3**	**CS-4**	**CS-5**	**CS-6**	**CS-7**	**CS-8**
DONA	0.30144	0.7536	1.884	4.71	9.42	18.84	47.1	235.5
PFMPA (PFECA F)	0.16	0.4	1	2.5	5	10	25	125
PFMBA (PFECA A)	0.16	0.4	1	2.5	5	10	25	125
NFDHA (PFECA B)	0.16	0.4	1	2.5	5	10	25	125
9Cl-PF3ONS	0.29824	0.7456	1.864	4.66	9.32	18.64	46.6	233
11Cl-PF3OUdS	0.30144	0.7536	1.884	4.71	9.42	18.84	47.1	235.5
PFEESA (PES)	0.1424	0.356	0.89	2.225	4.45	8.9	22.25	111.25
3:3 FTCA	0.399	0.9984	2.496	6.24	12.48	24.96	62.4	312
5:3 FTCA	1.9968	4.992	12.48	31.2	62.4	124.8	312	1560
7:3 FTCA	1.9968	4.992	12.48	31.2	62.4	124.8	312	1560
Labeled Isotope Dilution Analytes (IDA)								
13C4-PFBA	10	10	10	10	10	10	10	10
13C5-PFPeA	5	5	5	5	5	5	5	5
13C5-PFHxA	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
13C4-PFHpA	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
13C8-PFOA	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
13C9-PFNA	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25
13C6-PFDA	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25
13C7-PFUdA	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25
13C2-PFDoA	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25
13C2-PFTeDA	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25
13C3-PFBS	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
13C3-PFHxS	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
13C8-PFOS	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
13C2-4:2 FTS	5	5	5	5	5	5	5	5
13C2-6:2FTS	5	5	5	5	5	5	5	5
13C2-8:2FTS	5	5	5	5	5	5	5	5
13C8-FOSA	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
d3-MeFOSA	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
d5-EtFOSA	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
d3-MeFOSAA	5	5	5	5	5	5	5	5
d5-EtFOSAA	5	5	5	5	5	5	5	5
d7-Me-FOSE	25	25	25	25	25	25	25	25
d9-Et-FOSE	25	25	25	25	25	25	25	25
13C3-HFPO-DA	10	10	10	10	10	10	10	10
Internal Standard (IS)								
13C3-PFBA	5	5	5	5	5	5	5	5
13C2-PFHxA	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
13C4-PFOA	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
13C5-PFNA	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25
13C2-PFDA	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25
18O2-PFHxS	2.365	2.365	2.365	2.365	2.365	2.365	2.365	2.365
13C4-PFOS	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5

** Both branched and linear isomers are used.*

***Note**: Sample extracts are in 80% MeOH/H_2O.*

***Note**: The above calibration limits are provided only as an example. The actual ICAL level used for each analytical batch will depend upon the LOQ requirements of the program. The MLVS only allows the use of a 500 mL aliquot for aqueous samples.*

7.6.2. A technical (qualitative) grade standard which contains both linear and branched isomers for PFOA, PFNA, FOSA, Me/Et-FOSE and Me/Et-FOSA is used as a retention time (RT) marker. This is used to integrate the total response for both linear and branched isomers of these analytes in environmental samples while relying on the initial calibration with the linear isomer quantitative standard. This technical (qualitative) grade standard is analyzed with every initial calibration and at the beginning of a daily sequence.

7.6.2.1. Additionally, standards of the bile acids (TDCA, {TUDCA and TCDA, only if eluent is not acetonitrile}) at 1.0 ug/mL are to be analyzed, after the qualitative standard for the initial calibration, on days when tissue samples are analyzed and any time when DoD samples are analyzed. Be certain to attach those three chromatograms to the document listed in Section 7.6.2.2.

7.6.2.1.1 The analysis of these standards are required daily for the MLVS.

7.6.2.2. Attach this document to the ICV from the associated ICAL by scanning the document and associating it to the file as a single document type of High Res MS Tune in TALS and to the CCVL on non-CAL days. Use the following naming convention: "_TSTD_Instrument_Date." Example: _TSTD_A10_15Mar2019.

7.6.2.3. The daily checks are attached to the initial CCV of the sequence.

7.7. Initial Calibration Verification Standard (ICV)

7.7.1. The ICV is prepared from commercially available mixed solutions (the PFC-MXB mixture from Wellington) augmented by individual stock solutions for those components not present in the commercial mixture. When available, individual stock solutions are purchased from a vendor other than Wellington laboratories. If not available, a second lot from Wellington is sourced, and if that is not available, a second laboratory chemist will prepare the intermediate mixed solution for the ICV. Currently, the commercially available mixture contains the following compounds at the listed concentrations in methanol:

Table 7.7.1
PFC-MXB composition

Analyte	Stock Conc. (µg/mL)	Analyte	Stock Conc. (µg/mL)
PFHxA	2	PFBS	2
PFHpA	2	PFHxS	2
PFOA	2	PFOS	2
PFNA	2	EtFOSAA	2
PFDA	2	MeFOSAA	2
PFUdA	2	HFPO-DA	2
PFDoA	2	9Cl-PF3ONS	2
PFTrDA	2	11Cl-PF3OUdS	2
PFTeDA	2	4,8-dioxa-3H- PFNA (DONA)	2

7.7.2. ICV-IM: 10 mL of a combined stock for the analytes listed below is created, using the recipe below, and methanol as the final solvent:

Table 7.7.2
ICV-IM Recipe

Analyte	Stock Conc. (µg/mL)	Aliquot (mL)	ICV-IM Conc. (µg/mL)	Analyte	Stock Conc. (µg/mL)	Aliquot (mL)	ICV-IM Conc. (µg/mL)
PFBA	50	0.1	0.5	FOSA	50	0.1	0.5
PFPeA	50	0.1	0.5	Et-FOSA	50	0.1	0.5
PFPeS	46.9	0.1	0.469	Me-FOSA	50	0.1	0.5
PFHpS	47.6	0.1	0.476	Et-FOSE	50	0.1	0.5
PFNS	48	0.1	0.480	Me-FOSE	50	0.1	0.5
PFDS	48.2	0.1	0.482	4:2 FTS	46.7	0.1	0.467
PFDoS	48.4	0.1	0.484	6:2 FTS	47.4	0.1	0.474
				8:2 FTS	47.9	0.1	0.479

7.7.3. ICV-IM2: 10 mL of a combined stock for the analytes listed below is created, using the recipe below, and methanol as the final solvent:

Table 7.7.3
ICV-IM2 Recipe

Analyte	Stock Conc. (µg/mL)	Aliquot (mL)	ICV-IM Conc. (µg/mL)	Analyte	Stock Conc. (µg/mL)	Aliquot (mL)	ICV-IM Conc. (µg/mL)
3:3 FTCA	50	0.1	0.5	PFEESA (PES)	44.5	0.1	0.445

Table 7.7.3
ICV-IM2 Recipe

Analyte	Stock Conc. (µg/mL)	Aliquot (mL)	ICV-IM Conc. (µg/mL)	Analyte	Stock Conc. (µg/mL)	Aliquot (mL)	ICV-IM Conc. (µg/mL)
5:3 FTCA	50	0.1	0.5	PFMPA (PFECA F)	50	0.1	0.5
7:3 FTCA	50	0.1	0.5	PFMBA (PFECA A)	50	0.1	0.5
				NFDHA (PFECA B)	50	0.1	0.5

7.7.4. Finally, the ICV solution is created, at a nominal concentration of 2.5 ng/mL for target analytes (sulfonic acids slightly less), and the same concentrations as the calibration solutions for IS and IDA, by filling a 100 mL flask with 20 mL of water, then adding methanol. After adding the solutions below, the contents are diluted to the mark with methanol:

Table 7.7.4
1633 ICV Recipe

PFAS Standards	Volume (mL) to add in 100 mL FV
Commercial PFAS Mix	0.1
1633 ICV_IM	0.40
1633 ICV_IM2	1.0
1633 IDA Mix	2.5
1633 IS Mix	0.250

8. SAMPLE COLLECTION, PRESERVATION, AND STORAGE

Laboratory default requirements for sample containers, sample size, preservation and holding time are detailed in the table below.

Table 8
Sample Collection, Preservation, and Storage Requirements

Matrix	Sample Container	Minimum Sample Size	Preservation	Holding Time[1]
Water	500 mL HDPE Bottle	500	0-6°C	28 days if 0-6°C or 90 days if stored at ≤ -20°C[2]
Soil/Sediment	4 oz. HDPE wide-mouth container	100 g	0-6°C	90 days
Tissue	4 oz. HDPE wide-mouth container	50 g	≤ -20 °C	90 days

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[1] Extraction holding time is calculated from date of collection. Analytical holding time is determined from date of extraction.

[2] By default, aqueous samples for Draft Method 1633 are stored at 0-6 Centigrade and held for up to 28 days prior to extraction. During initial development of Draft Method 1633, potential issues were observed with NMeFOSE, NEtFOSE, NMeFOSAA, and NEtFOSAA, after 7 days of storage at 0-6 C. These issues are more likely to elevate the

observed concentrations of other PFAS compounds via the transformation of these precursors if they are present in the sample.

8.1. Extracts are stored at 0 - 6°C and must be analyzed within 28 days of extraction.

8.2. Unless otherwise specified by client or regulatory program, after analysis, samples and extracts are retained for a minimum of 30 days after provision of the project report and then disposed of in accordance with applicable regulations.

8.3. Biphasic samples

8.3.1. Samples denoted as aqueous (groundwaters, surface waters, and wastewaters) with less than 50 mg of solids content are prepared and handled as a liquid sample (Section 11.2). Compare the sample to a reference container with 50 mg solid content. If the sample contains more than 50 mg solids, contact the client for authorization to extract the sample at a smaller aliquot or as a solid. Detailed descriptions of any deviations from the procedure must be documented in the LIMS NCM program.

8.3.1.1. For DOD aqueous samples determine the percent suspended solids prior to extraction using the following procedure.

8.3.1.1.1. Use a pre-weighed filter (Pro Weigh filter). Enter the documented weight into the TALS batch as the initial weight.

8.3.1.1.2. Assemble the needed filtering apparatus

8.3.1.1.3. Insert the preweighed filter into the apparatus

8.3.1.1.4. Filter 10.0 + 0.02 mL of well mixed sample through the filter.

8.3.1.1.5. Carefully transfer filter from the filtering apparatus to its preweighed dish.

8.3.1.1.6. Dry the filter a minimum of 12 hours at 110 ± 5°C.

8.3.1.1.7. Transfer the filter to a desiccator for 1 hour or until cool.

8.3.1.1.8. Weigh the filter and residue. Enter this value into TALS batch as the final wieght.

8.3.1.1.9. Calculate the percernt solids as follows:

8.3.1.1.10. % solids = (Weight after drying (g) – weight of filter (g)) / 10g X 100

8.3.1.1.11. If the percent solids is > 0.01% (50 mg/500 mL or 1 mg/10 mL), then extract the sample as a solid.

8.3.2. Samples considered solids (including aqueous samples with more than 50 mg solids, biosolids, sediments, and soils) are prepared and handled as solid samples following appropriate homogenization as per Section 11.6. Correction for moisture content is provided through the LIMS when required by the client.

8.3.3. In the event that results are required individually for the solid and aqueous phases of a sample, the phases are separated via centrifugation, and extracted separately using the appropriate preparation (Section 11.2 for the aqueous phase and Section 11.6 for the solid phase). The extracts are analyzed, and results reported for each phase separately.

9. QUALITY CONTROL

9.1. Initial Demonstration of Capability (IDOC)

The initial demonstration and method detection limit (MDL) studies described in Section 13 must be acceptable before analysis of samples may begin.

9.2. Batches are defined at the sample preparation step. Batches should be kept together through the whole analytical process as far as possible, but it is not mandatory to analyze prepared extracts on the same instrument or in the same sequence. Refer to the QC program document (WS-PQA-003) for further details of the batch definition.

9.2.1. The quality control batch is a set of up to 20 samples of the same matrix processed using the same procedure and reagents within the same time period. The quality control batch must contain a low level laboratory control sample (LLCS), a laboratory control sample (LCS) and a method blank. Laboratory generated QC samples (Blank, LLCS, LCS,) do not count toward the maximum 20 samples in a batch. Field QC samples are included in the batch count. In some cases, at client request, a matrix spike/matrix spike duplicate (MS/MSD) may be included in the batch. In the event that multiple MS/MSDs are run with a batch due to client requirements, the additional MS/MSDs do not count toward the maximum 20 samples in a batch.

9.3. One method blank (MB, laboratory reagent blank) must be extracted with every process batch of similar matrix, not to exceed twenty (20) samples. For aqueous samples, the method blank is an aliquot of laboratory reagent water. For solid samples, the method blank is an aliquot of Ottawa sand wetted with reagent water. For tissue samples the method blank is an aliquot of stored purchased chicken breast or tilapia. The method blank is processed in the same manner and at the same time as the associated samples. Corrective actions must be documented on a Non-Conformance memo, and then implemented when target analytes are detected in the method blank above the reporting limit or when IDA recoveries are outside of the control limits. Re-extraction of the blank, other batch QC and the affected samples are required when the method blank is deemed unacceptable. See policy WS-PQA-003 for specific acceptance criteria.

9.3.1. If the MB produces a peak within the retention time window of any of the analytes, determine the source of the contamination and eliminate the interference before processing samples.

9.3.2. The method blank must not contain any analyte at or above the reporting limit, greater than 1/3 the regulatory compliance limit or at or above 10% of the measured concentration of that analyte in the associated samples, whichever is higher.

9.3.2.1. DoD/DOE QSM: in addition to the above criteria, the method blank must not contain any analyte at or above ½ the reporting limit. The MLVS uses the same acceptance criteria as DoD.

9.3.3. If there is no target analyte greater than the RL in the samples associated with an unacceptable method blank, the data may be reported with qualifiers. Such action should be taken in consultation with the client.

9.3.4. Re-extraction and reanalysis of samples associated with an unacceptable method blank is required when reportable concentrations are determined in the samples.

9.3.5. Refer to WS-PQA-003 for further details of the corrective actions.

9.3.6. The position of the method blank in the SPE manifold during SPE extraction is rotated across batches.

9.4. A laboratory control sample (LCS), defined as OPR (on-going precision and recovery) in Method 1633, must be extracted with every process batch of similar matrix, not to exceed twenty (20) samples. The LCS is an aliquot of laboratory matrix (e.g. water for aqueous samples and Ottawa sand for solids) spiked with analytes of known identity and concentration. The LCS must be processed in the same manner and at the same time as the associated samples. Corrective actions must be documented on a Non-Conformance memo, then implemented when recoveries of any spiked analyte is outside of the control limits. Re-extraction of the blank, other batch QC, and all associated samples are required if the LCS is deemed unacceptable. See WS-PQA-0003 for specific acceptance criteria.

9.4.1. The control limits for the LCS are stored in TALS. Once sufficient data has been gathered, limits based on historical recoveries are generated and implemented.

9.4.2. For DoD/DOE QSM, the lower recovery limits based on historical values must be greater than or equal to 40%. The MLVS uses the same acceptance criteria as DoD.

9.5. Low level LCS (LLCS), defined as LLOPR (low-level on-going precision and recovery) in Method 1633, must be extracted with every process batch of similar matrix, not to exceed twenty (20) samples. The LLCS is an aliquot of laboratory matrix (e.g. water for aqueous samples and Ottawa sand for solids) spiked with analytes of known identity and at a concentration of twice the RL. The LLCS must be processed in the same manner and at the same time as the associated samples. Corrective actions must be documented on a Non-Conformance memo, then implemented when recoveries of any spiked analyte is outside of the control limits. Re-extraction of the blank, other batch QC, and all associated samples are required if the LLCS is deemed unacceptable. See WS-PQA-0003 for specific acceptance criteria.

9.5.1. The control limits for the LLCS are stored in TALS. Once sufficient data has been gathered, limits based on historical recoveries are generated and implemented.

9.5.2. For DoD/DOE QSM, the lower recovery limits based on historical values must be greater than or equal to 40%. The MLVS uses the same acceptance criteria as DoD.

9.6. Matrix spikes are not required for this method because any deleterious effect of the matrix is evident in the recoveries of the IDA. A matrix spike/matrix spike duplicate (MS/MSD or MS/SD) can be processed per client request. An MS/MSD pair is aliquots of a selected field sample spiked with analytes of known identity and concentration. The MS/MSD pair must be processed in the same manner and at the same time as the associated samples. Spiked analytes with recoveries or precision outside of the control limits must be within the control limits in the LCS. Corrective actions must be documented on a nonconformance memo, and then implemented when recoveries of any spiked analyte are outside of the control limits provided by TALS or by the client. Recovery limits for MS/MSD are the same as those used for the LCS.

9.6.1. For DoD/DOE QSM, the RPD limit for the MS/MSD pair is less than or equal to 30%. No MS/MSD samples are to be prepared for the MLVS.

9.7. Instrument blanks (RB or CCB) are required at the beginning of an analytical sequence, after high level samples (>UCL) and every CCV. The blank should contain IDA and IS to quantitate results. The blank should not contain any analyte > RL. See WS-PQA-003 for specific acceptance criteria.

9.8. Initial calibration verification (ICV) –A second source standard is analyzed with the initial calibration curve. The concentration should be at the mid-range of the curve.

Corrective actions for the ICV include:

- Rerun the ICV.
- Remake or acquire a new ICV.
- Evaluate the instrument conditions.
- Evaluate the initial calibration standards.
- Rerun the initial calibration.

9.9. Isotope Dilution Analytes

9.9.1. The IDA solution is added to each field and QC sample at the time of extraction, as described in Section 11. As described in Section 7, this solution consists of isotopically labeled analogs of the analytes of interest.

9.9.2. IDA recoveries are flagged if they are outside of the acceptance limits stored in TALS. If IDA recoveries are outside of these limits, additional clean-up is needed. If the recoveries cannot be met after clean up then re-extract a smaller aliquot.

9.9.2.1. If the IDA recovery is just outside of the control limits, re-analyze the extract at 1X prior to re-extraction. If in control, report the data.

9.9.3. Once sufficient data has been gathered, limits based on historical recoveries may be generated and implemented.

9.9.4. For DoD/DOE QSM, limits based on historical recoveries are required. The lower recovery limit must be greater than or equal to 20%. The MLVS uses the same acceptance criteria as DoD.

9.10. Ion Ratio

9.10.1. Compare the quantifier/qualifier SRM transition ratio in the sample to the SRM transition ratio in the standard.

Equation 1

$$Ion\ Ratio = \frac{Area\ Quantitation\ Ion\ (1^{\circ}\ Transition)}{Area\ Qualitative\ Ion\ (2^{\circ}\ Transition)}$$

9.10.2. The quantifier/qualifier SRM ion ratio should be within ±50% of the quantifier/qualifier SRM ion ratios calculated from the mid-level ICAL point.

9.10.2.1. If data is reported to the MDL the ratio should also be within ±50% of the quantifier/qualifier SRM ion ratios calculated from the initial daily CCV.

9.10.3. If the ion ratio does not meet criteria after corrective actions, (extract clean-up, sample dilution, etc.), then data should be qualified “I” if the ratio is not met.

9.10.3.1. Ion ratios must be in control in calibration solutions. If they are outside of limits, stop the analysis and correct the issues.

9.11. Internal Standards

Internal standards (IS) are spiked into every field sample, QC sample, standard, and instrument blank. They are used for quantitation of the IDA.

9.11.1. The area of the IS in field and QC samples should be within 50-200% of the average area of the calibration standards.

9.11.2. For DoD/DOE QSM, the following instances are required to be greater than the 30% of the average area of the calibration standards: The MLVS uses the same acceptance criteria as DoD.

- the internal standard areas in undiluted extracts
- the internal standard areas in sample extracts where additional IS was added post-dilution.
- the internal standard areas in diluted extracts, once corrected for the dilution factor, when additional IS was not added post-dilution.

10. CALIBRATION

10.1. For details of the calculations used to generate the regression equations, and how to use the factors generated by these equations, refer to SOP CA-Q-P-003 “Calibration Curves and Selection of Calibration Points”.

10.2. Routine instrument operating conditions are listed in the table in Section 11.12.

10.3. Instrument Tuning & Mass Calibration

10.3.1. Mass Calibration is performed by instrument manufacturer service representatives in accordance with the manufacturer’s procedures during installation, and annually thereafter.

10.3.2. Instrument tuning is done initially when the method is first developed and thereafter as needed during troubleshooting. Tuning is done by infusing each individual compound (native and/or IDA) into the mobile phase using a tee fitting at a point just before the entrance to the electrospray probe. The responses for the parent and daughter ions for each compound are observed and optimized for sensitivity and resolution. Mass assignments are reviewed and updated as needed. The mass assignments must be within ± 0.5 amu of the values shown in the table in Section 11.12.

10.3.3. Once the optimal mass assignments (within ±0.5 amu of true) are made immediately following the initial tune, the lowest level standard from the initial calibration curve is assessed to ensure that a signal to noise ratio greater than 10 to 1 (S/N > 10:1) is achieved for each PFAS analyte. The first level standard from the initial calibration curve is used to evaluate the tune stability on an ongoing basis. The instrument mass windows are set initially at ± 0.5 amu of the true value; therefore, continued detection of the analyte transition with S/N > 10:1 serves as verification that the assigned mass remains within ± 0.5 amu of the true value, which meets the tune criterion.

10.3.3.1. The instrument must have a valid mass calibration prior to sample analysis. This is verified through the acquisition of a full scan continuum mass spectrum of a PFAS stock standard. All masses must be verified to be within ± 0.5 amu of true value.

10.4. A new calibration curve must be generated after major changes to the system or when the continuing calibration criteria cannot be met. Major changes include, but are not limited to, new columns or pump seals. A new calibration is not required after minor maintenance.

10.5. With the exception of the circumstances delineated in policy CA-Q-P-003, it is not acceptable to remove points from a calibration curve. In any event, at least five points must be included in the calibration curve. Average Response Factor and linear fit calibrations require five points, whereas Quadratic (second order) calibrations require six points.

10.6. A fixed injection volume is used for quantitation purposes and is to be the same for both the sample and standards.

10.7. All units used in the calculations must be consistently uniform, such as concentration in ng/mL.

10.8. Initial Calibration

Refer to Section 12.4.3 for details relating to setting retention times and evaluating retention times.

10.8.1. A number of analytical standards of different analyte concentrations are used to generate the curve. Each standard is injected once to obtain the peak response for each analyte at each concentration. These standards define the working range of the analysis.

10.8.1.1. A minimum of six analytical standards is used when using average response factor and/or linear calibration fits, five of which must be ≥ RL.

10.8.1.2. A minimum of seven analytical standards is used when a quadratic fit is used to generate the curve, six of which must be ≥ RL.

10.8.2. Calibration is by average response factor, linear fit, or by quadratic fit. Quadratic fit is used for the analyte if the response is non-linear.

10.8.2.1. For average response factor (RFa), the relative standard deviation (RSD) for all compounds must be ≤ 20% for the curve to be valid.

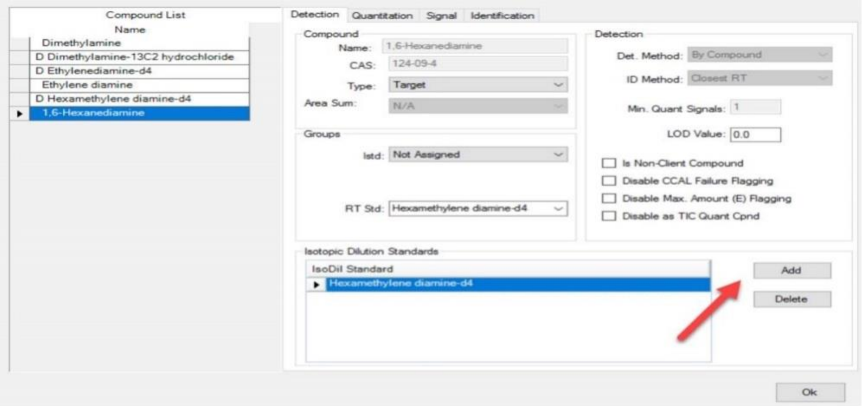
10.8.2.2. Alternatively, for average response factor (RFa), the relative standard error (RSE) for all compounds must be ≤ 20% for the curve to be valid.

10.8.2.3. For linear fits, the intercept of the line must be less than ½ the reporting limit, and the relative standard error (RSE) must be ≤ 20%.

10.8.2.4. For quadratic fits, the intercept of the line must be less than ½ the reporting limit, and the relative standard error (RSE) must be ≤ 20%.

10.8.2.5. Please note for this method PFTrDA is quantitated against the average areas of the IDA 13C2-PFTeDA and 13C2-PFDoA. In order to set this quantitation up correctly in Chrom be certain to update the analyte PFTrDA per the example below (Figure 10.8.2.5).

Figure 10.8.2.5



Compound List

Name
Dimethylamine
D Dimethylamine-13C2 hydrochloride
D Ethylenediamine-d4
Ethylene diamine
D Hexamethylene diamine-d4
▸ 1,6-Hexanediamine

Compound

Name: 1,6-Hexanediamine
CAS: 124-09-4
Type: Target
Area Sum: N/A

Groups

Istd: Not Assigned
RT Std: Hexamethylene diamine-d4

Detection

Det. Method: By Compound
ID Method: Closest RT
Min. Quant Signals: 1
LOD Value: 0.0
☐ Is Non-Client Compound
☐ Disable CCAL Failure Flagging
☐ Disable Max. Amount (E) Flagging
☐ Disable as TIC Quant Cpnd

Isotopic Dilution Standards

IsoDil Standard
▸ Hexamethylene diamine-d4

10.9. Calibration Curve Fits

10.9.1. Linear regression or quadratic curves may be used to fit the data to a calibration function. Detailed descriptions and formulas for each fitting type can be found in SOP CA-Q-P-003, “Calibration Curves and Selection of Calibration Points”.

10.9.2. The Chrom data system is programmed to complement the calibration evaluation guidelines in policy CA-Q-P-003 by evaluating calibration curve fits in the order listed below. An optimal fit is recommended to the analyst, who may override based on evaluation of the residuals for each calibration level, as per policy CA-Q-P-003.

- Average Response Factor
- Linear, 1/concentration^2 weighting
- Linear, 1/concentration weighting, forced through zero
- Quadratic, 1/concentration^2 weighting

10.9.3. The linear curve uses the following function:

Equation 2

$$y = bx + c$$

Where:

$y = \frac{Area\ (Analyte)}{Area\ (IDA)} \times Concentration(IDA)$
x = concentration
b = slope
c = intercept

10.9.4. The quadratic curve uses the following function:

Equation 3

$$y = ax^2 + bx + c$$

Where y, x, b, and c are the same as above, and a = curvature.

10.9.5. Evaluation of Calibration Curves

The following requirements must be met for any calibration to be used:

- The signal to noise ratio for each component must be greater than or equal to 3:1 in the lowest calibration standard for that component.
- Response must increase with increasing concentration.
- The absolute value of the intercept of a regression line (linear or non-linear) at zero response must be less than the reporting limit.
- There should be no carryover at or above 1/2 MRL after a high CAL standard.

If these criteria are not met, instrument conditions and standards will be checked, and the ICAL successfully repeated before continuing.

10.9.6. Weighting of Calibration Points

In linear and quadratic calibration fits, the points at the lower end of the calibration curve have less absolute variance than points at the high concentration end of the curve. This can cause severe errors in quantitation at the low end of the calibration. Because accuracy at the low end of the curve is very important for this analysis, it is preferable to increase the weighting of the lower concentration points. 1/concentration or 1/x weighting is encouraged. Visual inspection of the line fitted to the data is important in selecting the best fit.

10.9.7. Bile Salts Interference Check

The laboratory must analyze a bile salts standard (TDCA, {TCDA and TUDCA only if the eluent is not acetonitrile}) after the initial calibration, prior to the analysis of tissue samples, to check for interferences caused by bile salts. If an interference is present, the chromatographic conditions must be modified to eliminate the interference of TDCA (e.g. changing the retention time of TDCA such that it falls outside the retention time window for PFOS by more than 15 seconds with baseline resolution), and the initial calibration is repeated. If tissue samples are not being analyzed this check can be skipped.

10.9.7.1. The check is required daily for all matrices when analyzing DoD/DOE QSM and MLVS samples.

10.10. Initial Calibration Blank (ICB)

10.10.1. Immediately following the ICAL, a calibration blank is analyzed that consists of an injection of final extract solvent containing both IDA and IS.

10.10.2. The result for the calibration blank must be less than the reporting limit.

10.10.3. If the ICB is greater than the reporting limit then the source of contamination must be identified and any necessary cleaning completed, and then the instrument should be recalibrated.

10.11. Initial Calibration Verification (ICV)

10.11.1. Following the ICAL and the ICB, an ICV standard obtained from a different source or vendor than the ICAL standards is analyzed. This ICV standard is a mid-range standard.

10.11.2. The recovery for the ICV must be equal to or within 70-130% for all natives and IDA.

10.11.3. See Section 9.8 for corrective actions in the event that the ICV does not meet the criteria above.

10.12. Continuing Calibration Verification (CCV)

Analyze a CCV at the beginning of a run, the end of a run, and after every 10 samples to determine if the calibration is still valid. The exception is after an acceptable curve and ICV are run 10 samples can be analyzed before a CCV is required. The CCVs are at the mid-level range of the curve. The curve and ICV do not need to be run every day. To start an analytical sequence on days when an ICAL is not performed, a CCVL (low standard at the RL) is analyzed and if it meet acceptance criteria a run can be started.

10.12.1. The recovery for the CCV standards must be equal to or within 70-130% for all natives and IDA.

10.12.2. If this is not achieved, the instrument has drifted outside the calibration limits. The instrument must be recalibrated.

11. PROCEDURE

11.1. One-time procedural variations are allowed only if deemed necessary in the professional judgment of a supervisor to accommodate variation in sample matrix, chemistry, sample size, or other parameters. Any variation in procedure shall be completely documented using a non-conformance memo (NCM). The NCM process is described in more detail in SOP WS-QA-0023. The NCM shall be filed in the project file and addressed in the case narrative.

Any deviations from this procedure identified after the work has been completed must be documented in an NCM, with a cause and corrective action described.

Differences for samples run in accordance with the DoD/DOE QSM version 5.4 or higher and MLVS are called out as needed in the procedures below, in particular the choice of SPE column and the use of loose Envi-carb.

11.2. Water Sample Preparation

11.2.1. Visually inspect samples for the presence of settled and/or suspended sediment/particulates. Samples >50 mg solids should be processed as a solid sample. See Section 8.3.1.1 for TSS procedure. Compare sample to comparison/reference bottle. If the sample should be processed as a solid or biphasic or reduced volume contact the client for guidance prior to such action. Invert samples to homogenize prior to adding any spiking solutions.

Warning: The use of a vacuum system creates the risk of glassware implosion. Inspect all glassware prior to use. Glassware with chips, scratches, rub marks or cracks must not be used.

11.2.2. Unknown samples may be screened prior to extraction using the following:

11.2.2.1. Weigh out 10 (+ 0.10) g of sample into a 50 mL centrifuge tube.

11.2.2.2. Add 0.625 mL of IDA and 62.5 uL of IS. Vortex.

11.2.2.3. Filter 1 mL of sample through a 0.2 um filter into an injection vial.

11.2.2.4. Submit for analysis.

11.2.2.5. The screening analysis is to follow the same analytical specifications as the definitive analysis, i.e. ICAL, CCV and all analytes.

11.2.2.6. Evaluate the screening results to determine an appropriate volume to extract:

- If <0.25 ng/mL (on-column) = 1X (500 mL)
- If >0.25 ng/mL but < 2.5 ng/mL = 10 X (50 mL)
- If >2.5 ng/mL but <25 ng/mL = 100X (5 mL)
- If >25 ng/mL but < 250 ng/mL = 1000X (0.5 mL)

11.2.3. Weigh the sample container prior to extraction and then weigh the sample container after extraction to determine the initial volume. Unless otherwise directed by client, use the entire sample volume, and spike directly into the sample container.

11.2.3.1. If the sample is identified as a leachate please prep at 100 mL. The sample should be collected in an appropriately sized container, i.e. 100-125 mL. If not, please document such and that a 100 mL aliquot was used for the analysis.

11.2.4. Prepare additional aliquots of a field sample for the MS/MSD, if requested.

11.2.5. Prepare three 500 mL aliquots of HPLC-grade water for the method blank, LLCS and LCS, dependent upon container type submitted by the client.

11.2.6. Vortex the LCS/Matrix PFC Spike and IDA PFC solutions prior to use.

11.2.7. Add 0.625 mL of the IDA PFC solution (Section 7.4) into each sample and QC sample, for a fixed concentration of 1.25-25 ng/mL in the final sample vial.

11.2.8. Spike the LCS and MS/MSD (if requested) with 1.0 mL of the LCS/Matrix PFC Spike solution (Section 7.3), for a fixed concentration of 3.2 - 80 ng/mL in the final sample vial.

11.2.9. Spike the LLCS with the 100 uL of the LCS/Matrix PFS Spike solution (Section 7.3), for a fixed concentration of 0.32-80 ng/mL in the final sample vial.

11.2.10. Swirl or vortex all samples after adding spike solutions.

11.2.11. Check that the pH is 6.5 ± 0.5 using narrow range pH paper (Section 6.13). If necessary, adjust pH with 50% formic acid and 3% ammonium hydroxide.

11.3. Solid Phase Extraction (SPE) of Aqueous Samples

The automated Zymark Auto-Trace Workstation can be used as long as the program follows these conditions and passes the background check.

11.3.1. Pack clean silanized glass wool to half the height of the WAX SPE cartridge barrel.

11.3.2. Condition the SPE cartridges (Section 6.8.2, Phenomenex Strata PFAS WAX/GCB, 500mg/50mg/6cc or equivalent) by passing the following without drying the column.

11.3.2.1. For DOD/DOE and MLVS samples, use the Oasis Wax Cartridges (Section 6.8.1).

Note: *The cartridges should not be allowed to go dry until the final elution step with methanol. At all of the other transition steps, the solvent/sample level should be stopped at the top of the column before the next liquid is added.*

WARNING: The use of a vacuum system creates the risk of glassware implosion. Inspect all glassware prior to use. Glassware with chips, scratches, rub marks or cracks must not be used.

11.3.3. Wash with 15.0 mL of 1.0% NH_4OH/methanol.

11.3.4. Wash with 5.0 mL of 0.3M formic acid. Close valve when ~ 200 uL remains on top to keep column wet. After this step, the columns cannot go dry until the completion of loading and rinsing samples.

11.3.5. Appropriately label the columns and add the reservoir to the column. Be certain to rotate method blank samples through each sample port on the SPE manifold, such that each new batch uses a different port for the MB.

11.3.6. Pour the samples into the reservoirs attached to the SPE columns and with vacuum, pull the entire sample volume (500 mL) through the cartridge at a rate of approximately 2 to 5 drops per second.

11.3.6.1. If the SPE column should plug (flow rate <1 drop per minute) prior to the entire content of the sample container passing through the column do the following:

1. Stop adding sample to the reservoir.
2. Return any remaining sample volume back to the original container.

3. Weigh the original container and record this weight into the worksheet notes field within the TALS extraction batch.
4. Determine the full volume of sample fortified by using the "Gross Weight" – (remaining sample volume – default tare weight of a sample container (26.1 g)).
5. Enter this value into the "Initial Amount" field in the TALS extraction batch.
6. Proceed to Section 11.4, noting that additional vacuum or pressure might be needed to elute the SPE column.

11.3.6.2. Section 11.3.6.1 is not allowed for the MLVS. Should the SPE column plug then use a second pre-conditioned SPE column and continue loading the sample. Elute both columns individually per Section 11.4.1. Then proceed to Sections 11.5.1-11.5.6, being certain to filter both columns into the same centrifuge tube. Transfer 350 uL of extract into a microvial and mark the level. Add another 350 uL aliquot to the microvial and reduce the volume to 350 uL using a stream of nitrogen (water bath at 40^{o}C). Submit for analysis. Should this occur be certain to document this via the NCM program.

11.3.7. After the entire sample has been loaded onto the column, rinse the sample bottle with two 5 mL aliquots of reagent water and pour into the column reservoir.

11.3.8. After the final loading of the sample but before completely passed through the column, rinse the SPE column with 5 mL of 1:1 0.1 M formic acid/MeOH.

11.3.9. After the sample and water rinse have completely passed through the cartridge, allow the column to dry with vacuum for 15 seconds.

11.3.10. Discard the rinses.

11.4. SPE Elution of Aqueous Samples – using 15 mL polypropylene test tubes as receiving tubes in the SPE manifold.

11.4.1. Add the collection tubes to the manifold. Rinse sample bottles with 5 mL of 1.0% NH_4OH/methanol and transfer to the column reservoir onto the cartridge. Elute the analytes from the cartridge by pulling the 1% NH_4OH/methanol through using low vacuum such that the solvent exits the cartridge in a dropwise fashion.

11.4.2. Air dry and weigh the bottles (record as the tare weight in TALS) to get the sample volume extracted.

11.4.3. Proceed to Section 11.5 for final volume. For DOD/DOE/MLVS samples proceed to Section 11.11.1

11.5. Final volume for Aqueous Sample extracts

11.5.1. Add 25 uL of concentrated acetic acid to each sample. Cap, vortex, and set the samples aside.

11.5.2. Vortex the IS solution prior to use.

11.5.3. Add 62.5 uL of IS (Section 7.5) at 100-400 ng/mL concentration, into a new centrifuge tube.

11.5.4. Place a syringe filter (25 mm filter, 0.2 um nylon membrane) on a polypropylene syringe.

11.5.5. Decant the sample extract from section 11.5.1 into the polypropylene syringe fitted with a syringe filter.

11.5.6. Filter into the centrifuge tube that contains IS from section 11.5.3.

WARNING: Ongoing, regular use of a filtering syringe with the SPE cartridge presents an extreme risk of ergonomic injury due to the force needed to push the sample through the cartridge, Use step boxes to position yourself above the syringe and manifold so that your body weight can be carefully applied to pushing the syringe plunger down. Ensure that this task is rotated amongst staff members. Ensure that routine breaks are taken, and that muscles involved with this task are routinely stretched to offset this hazard.

11.5.7. The final volume is 5 mL. Do not adjust the volume. Cap and vortex.

11.5.8. Transfer a portion of the extract to a 1 mL polypropylene micro vial. Archive the rest of the extract in a refrigerator for re-injection and dilution.

11.5.9. Seal the vial with a polypropylene snap top cap. Note: Teflon lined caps cannot be used due to detection of low level concentration of PFAS.

11.6. Solid and Biosolids Sample Preparation and Extraction

11.6.1. Visually inspect soil samples. Homogenize the entire sample in accordance with SOP WS-QA-0018. If the sample cannot be mixed in the container, pour into a larger QC’d PFAS-free container and mix thoroughly. Transfer the sample label to the new container.

11.6.2. All solid and biosolids samples must have their default mass increased by the percent moisture content prior to extraction.

11.6.2.1. Review TALS for the percent moisture results. Use the following equation to determine what adjustment is needed to the default masses listed in Section 11.7.3.

11.6.2.1.1. Dry wt. adjusted mass = default mass X (1+ percent moisture as a decimal)

11.6.2.1.2. Do not add more that 2X the default mass, regardlesss of percent moisture value.

11.6.3. Weigh a representative dry weight adjusted 5 g aliquot of sample (0.5g for biosolids) into a 50 mL centrifuge tube. Weigh additional sample amounts for the matrix spike and matrix spike duplicate analyses if they are requested.

11.6.3.1. Do not batch solid sample and biosolids samples together due to the different masses.

11.6.4. For the method blank, LLCS and LCS matrix, use 5 g each of Ottawa sand wetted with 2.5g of DI water or 0.5 g of Ottawa sand wetted with 0.25g of DI water for biosolids.

11.6.5. Vortex the LCS/Matrix Spike and 1633 IDA solutions prior to use.

11.6.6. Add 0.625 mL of the 1633 IDA solution (Section 7.4) into each sample and QC sample, for a fixed concentration of 1.25-25 ng/mL in the final sample vial.

11.6.7. Spike the LCS and MS/MSD (if requested) with 1.0 mL of the LCS/Matrix Spike solution (Section 7.3), for a fixed concentration of 3.2 - 80 ng/mL in the final sample vial.

11.6.8. Spike the LLCS with 100 uL of the LCS/Matrix Spike solution (Section 7.3), for a fixed concentration of 0.32-8 ng/mL in the final sample vial.

11.6.9. Cap the tubes, vortex samples and allow the spike to settle into the sample matrix for at least 30 minutes.

11.6.10. Add 10 mL of 0.3% NH_4OH/methanol to each sample. Cap and vortex.

11.6.11. Shake each sample on an orbital shaker at room temperature for 30 minutes.

11.6.12. Centrifuge each sample at 2800 rpm for 10 minutes.

11.6.13. Collect and decant the solvent into a new container.

11.6.14. Add 15 mL of 0.3% NH_4OH/methanol solution to the residue and vortex.

11.6.15. Shake each sample again on an orbital shaker at room temperature for 30 minutes.

11.6.16. Centrifuge each sample at 2800 rpm for 10 minutes.

11.6.17. Collect/decant the solvent into the new centrifuge tube from Section 11.6.13.

11.6.18. Add 5 mL of 0.3% NH_4OH/methanol solution to the residue and vortex.

11.6.19. Centrifuge each sample at 2800 rpm for 10 minutes.

11.6.20. Collect/decant the solvent into the new centrifuge tube from Section 11.6.13. *Note All DOD/DOE/MLVS samples proceed to Section 11.11, prior to Section 11.6.21.*

11.6.21. Bring the volume up to 250 mL with reagent water for each sample. Check that the pH is 6.5 ± 0.5 using narrow range pH paper (Section 6.13). If necessary, adjust pH with 50% formic acid and 3% ammonium hydroxide.

11.6.22. Proceed to Section 11.7.

11.7. Solid Phase Extraction (SPE) of Solid, Biosolids and Tissue Samples

The automated Zymark Auto-Trace Workstation can be used as long as the program follows these conditions and passes the background check.

11.7.1. Pack clean silanized glass wool to half the height of the WAX SPE cartridge barrel.

11.7.2. Condition the SPE cartridges (Section 6.8.2, Phenomenex Strata PFAS WAX/GCB, 200mg/50mg/6mL or equivalent) by passing the following without drying the column.

11.7.2.1. For DOD/DOE/MLVS samples, use the Oasis Wax Cartridges (Section 6.8.1)

Note: *The cartridges should not be allowed to go dry until the final elution step with methanol. At all of the other transition steps, the solvent/sample level should be stopped at the top of the column before the next liquid is added.*

WARNING: The use of a vacuum system creates the risk of glassware implosion. Inspect all glassware prior to use. Glassware with chips, scratches, rub marks or cracks must not be used.

11.7.3. Wash with 15.0 mL of 1% NH_4OH/methanol.

11.7.4. Wash with 5.0 mL of 0.3M formic acid. Close valve when ~ 200 uL remains on top to keep column wet. After this step, the columns cannot go dry until the completion of loading and rinsing samples.

11.7.5. Appropriately label the columns and add the reservoir to the column. Be certain to rotate method blank samples through each sample port on the SPE manifold, such that each new batch uses a different port for the MB.

11.7.6. Add samples to the columns and with vacuum, pull the entire 50 mL aliquot of the sample through the cartridge at a rate of approximately 2 to 5 drops per second.

11.7.7. After the entire sample has been loaded onto the column, rinse the centrifuge tube with two 5 mL aliquots of reagent water and pour into the column reservoir.

11.7.8. After the final loading of the sample but before completely passed through the column, rinse the SPE column with 5 mL of 1:1 0.1M formic acid/methanol.

11.7.9. After the sample and water rinse have completely passed through the cartridge, allow the column to dry with vacuum for 15 seconds. Discard the rinses.

11.8. SPE Elution of Solid, Biosolids and Tissue Samples – using 15 mL polypropylene test tubes as receiving tubes in the SPE manifold.

11.8.1. Vortex the 1633 IS solution prior to use.

11.8.2. Add 62.5 uL of 1633 IS (Section 7.5) at 100-400 ng/mL concentration into a new centrifuge tube.

11.8.3. Place the centrifuge tubes containing the IS in the manifold.

11.8.4. Rinse centrifuge tubes with 5 mL of 1% NH_4OH/methanol and transfer to the column reservoir onto the cartridge. Elute the analytes from the cartridge by pulling the 1% NH_4OH/methanol through using low vacuum such that the solvent exits the cartridge in a dropwise fashion.

11.8.5. Proceed to Section 11.9 for final volume.

11.9. Final volume for Solid, Biosolids and Tissue Sample extracts

11.9.1. Add 25 uL of concentrated acetic acid to each sample. Cap, vortex, and set the samples aside.

11.9.2. The final volume is 5 mL. Do not adjust volume.

11.9.3. Place a syringe filter (25 mm filter, 0.2 um nylon membrane) on a polypropylene syringe.

11.9.4. Decant the sample extract into the polypropylene syringe fitted with a syringe filter.

11.9.5. Filter the eluted sample.

<u>WARNING: Ongoing, regular use of a filtering syringe with the SPE cartridge presents an extreme risk of ergonomic injury due to the force needed to push the sample through the cartridge, Use step boxes to position yourself above the syringe and manifold so that your body weight can be carefully applied to pushing the syringe plunger down. Ensure that this task is rotated amongst staff members. Ensure that routine breaks are taken, and that muscles involved with this task are routinely stretched to offset this hazard.</u>

11.9.6. Transfer a portion of the extract to a 1 mL polypropylene microvial. Archive the rest of the extracts for re-injection and dilution.

11.9.7. Seal the vial with a polypropylene snap top cap. Note: Teflon lined caps cannot be used due to detection of low level concentration of PFAS.

11.10. Tissue Sample Preparation and Extraction

Prior to subsampling tissue matrices, ensure that they have been appropriately homogenized in accordance with SOP WS-WI-0018, Tissue Handling and Extraction.

11.10.1. Weigh a representative 2 g aliquot of sample into a 50 mL centrifuge tube. Weigh additional sample amounts for the matrix spike and matrix spike duplicate analyses if they are requested.

11.10.2. For the method blank, LLCS and LCS matrix, use 2 g each of tissue reference material (chicken breast or fish).

11.10.3. Vortex the LCS/Matrix Spike and 1633 IDA solutions prior to use.

11.10.4. Add 0.625 mL of the 1633 IDA solution (Section 7.4) into each sample and QC sample, for a fixed concentration of 1.25-25 ng/mL in the final sample vial.

11.10.5. Spike the LCS and MS/MSD (if requested) with 1.0 mL of the LCS/Matrix Spike solution (Section 7.3), for a fixed concentration of 3.2 - 80 ng/mL in the final sample vial.

11.10.6. Spike the LLCS with 100 uL of the LCS/Matrix Spike solution (Section 7.3) for a fixed concentration of 0.32- 8 ng/mL in the final sample vial.

11.10.7. Cap the tubes, vortex samples and allow the spike to settle into the sample matrix for at least 30 minutes.

11.10.8. Add 10 mL of 0.05M KOH/methanol to each sample. Cap and vortex.

11.10.9. Shake each sample on an orbital shaker at room temperature for at least 16 hours.

11.10.10. Centrifuge each sample at 2800 rpm for 10 minutes.

11.10.11. Collect and decant the solvent into a new container.

11.10.12. Add 10 mL of acetonitrile (ACN) to the residue. Cap and vortex.

11.10.13. Sonicate each sample for 30 minutes.

11.10.14. Centrifuge each sample at 2800 rpm for 10 minutes.

11.10.15. Collect/decant the solvent into the new centrifuge tube from Section 11.10.11.

11.10.16. Add 5 mL of 0.05M KOH/methanol to the residue. Cap and vortex.

11.10.17. Centrifuge each sample at 2800 rpm for 10 minutes.

11.10.18. Collect/decant the solvent into the new centrifuge tube from Section 11.10.11. *Note: All DOD/DOE/MLVS samples proceed to Section 11.11, prior to Section 11.10.19.*

11.10.19. [redacted]

11.10.20. Proceed to Section 11.7 SPE for Solid, Biosolids, and Tissue Samples, followed by Section 11.8 SPE Elution of Solid, Biosolids, and Tissue Samples, and Section 11.9 Final volume for Solid, Biosolids, and Tissue Samples

11.11. Use of Loose Graphitized Carbon (Envi-Carb)

Analyses performed in accordance with the DOD/DOE QSM Table B-24 and MLVS require the use of loose graphitized carbon in place of pre-packed cartridges for cleanups. Instructions for performing this cleanup are provided below:

11.11.1. **Water** Samples: Immediately following Section 11.4 (SPE elution) add 25 uL of acetic acid to each sample eluted in the collection tubes and vortex to mix. Add 10 mg of carbon to each sample and batch QC extract. Proceed to 11.11.4.

11.11.2. **Solid/Biosolids** Samples: Immediately following Section 11.6.20 add 10 mg of carbon to each sample and batch QC extract. Proceed to 11.11.4.

11.11.3. **Tissue** Samples: Immediately following Section 11.10.18 add 10 mg of carbon to each sample and batch QC extract. Proceed to 11.11.4.

11.11.4. Hand-shake occasionally for no more than 5 minutes. It is important to minimize the time the sample extract is in contact with the carbon.

11.11.5. Immediately vortex for 30 seconds and centrifuge at 2800 rpm for 10 minutes.

11.11.6. **Water** Samples: Proceed to Section 11.5.2.

11.11.7. **Solid/Biosolid** Samples: Immediately decant into a new centrifuge tube. Proceed to Section 11.6.21

11.11.8. **Tissue** Samples: Immediately decant into a new centrifuge tube. Proceed to Section 11.10.19.

11.12. Instrument Analysis

Suggested operating conditions are listed in Tables 11.12-1 through 11.12--4 for the SCIEX LCMS systems:

Table 11.12 - 1 **Recommended Instrument Operating Conditions**				
HPLC Conditions (Shimadzu HPLC)				
Column (Column temp = 45°C)	Phenomenex Gemini 3 µm C18 110Å, 50 X 2 mm			
Mobile Phase Composition	A = 20 mM Ammonium Acetate in Water	B = Methanol		
Gradient Program	**Time**	**%A**	**%B**	**Flow Rate - mL/min**
	0	90	10	0.60
	0.1	45	55	0.60
	4.5	1	99	0.60
	5.9	1	99	0.60
	5.95	90	10	0.60
	Maximum pressure limit = 5,000 psi			
Injection Size	20 µL (fixed amount throughout the sequence).			
Run Time	~6.6 minutes			
Mass Spectrometer Interface Settings (SCIEX 5500)				
MS Interface Mode	ESI Negative Ion. Minimum of 10 scans/peak.			
Ion Spray Voltage (kV)	4.5			
Entrance Potential (V)	5			
Declustering Potential (V)	25			
Desolvation Temp	600ºC			
Curtain Gas	35 psi			
Collision Gas	8 psi			

Table 11.12 - 2
Masses/Transitions Utilized

ID	Comments	Q1	Q3	RT
11Cl-PF3OUdS	Native Analyte	630.9	450.9	8.31
11Cl-PF3OUdS_2	Native Analyte	632.9	452.9	8.31
13C2_PFDA	Internal Standard	515.1	470.1	6.95
13C2_PFDoA	Isotope Dilution Analyte	615.1	570	7.86
13C2_PFHxA	Internal Standard	315.1	270	4.5
13C2_PFHXA_2	Internal Standard	315.1	119.4	4.5
13C2_PFTeDA	Isotope Dilution Analyte	715.2	670	8.68
13C3_HFPO-DA	Isotope Dilution Analyte	286.9	168.9	4.78
13C3_HFPO-DA_2	Isotope Dilution Analyte	286.9	184.9	4.78
13C3_PFBA	Internal Standard	216	172	1.87
13C3_PFBS	Isotope Dilution Analyte	302.1	79.9	4.36
13C3_PFBS_2	Isotope Dilution Analyte	302.1	98.9	4.36
13C3_PFHxS	Isotope Dilution Analyte	402.1	79.9	5.96
13C3_PFHxS_2	Isotope Dilution Analyte	402.1	98.8	5.96
13C4_PFBA	Isotope Dilution Analyte	216.8	171.9	1.87
13C4_PFHpA	Isotope Dilution Analyte	367.1	322	5.25
13C4_PFOA	Internal Standard	417.1	172	5.89
13C4_PFOS	Internal Standard	502.8	79.9	7.06
13C4_PFOS_2	Internal Standard	502.8	98.9	7.06
13C5_PFHxA	Isotope Dilution Analyte	318	273	4.5
13C5_PFHxA_2	Isotope Dilution Analyte	318	120.3	4.5
13C5_PFNA	Internal Standard	468	423	6.44
13C5_PFPeA	Isotope Dilution Analyte	268.3	223	3.51
13C6_PFDA	Isotope Dilution Analyte	519.1	474.1	6.95
13C7_PFUdA	Isotope Dilution Analyte	570	525.1	7.41
13C8_PFOA	Isotope Dilution Analyte	421.1	376	5.89
13C8_PFOS	Isotope Dilution Analyte	507.1	79.9	7.06
13C8_PFOS_2	Isotope Dilution Analyte	507.1	98.9	7.06
13C8_PFOSA	Isotope Dilution Analyte	506.1	77.8	7.91
13C9_PFNA	Isotope Dilution Analyte	472.1	427	6.44
18O2_PFHxS	Internal Standard	403	83.9	5.96
3:3 FTCA	Native Analyte	241	177	2.96
3:3 FTCA_2	Native Analyte	241	117	2.96
4.2FTS_2	Native Analyte	327.1	80.9	4.22
4:2 FTS	Native Analyte	327.1	307	4.22
5:3 FTCA	Native Analyte	341	237.1	4.85
5:3 FTCA_2	Native Analyte	341	217	4.85
6:2 FTS	Native Analyte	427.1	407	5.67

Table 11.12 - 2
Masses/Transitions Utilized

ID	Comments	Q1	Q3	RT
6:2 FTS_2	Native Analyte	427.1	80.9	5.67
7:3 FTCA	Native Analyte	441	316.9	6.14
7:3 FTCA_2	Native Analyte	441	336.9	6.14
8:2 FTS	Native Analyte	527.1	507	6.74
8:2 FTS_2	Native Analyte	527.1	80.8	6.74
9Cl-PF3ONS	Native Analyte	530.8	351	7.4
9Cl-PF3ONS_2	Native Analyte	532.8	353	7.4
d3MeFOSA	Isotope Dilution Analyte	515	219	9.45
d3-MeFOSAA	Isotope Dilution Analyte	573.2	419	6.98
d5EtFOSA	Isotope Dilution Analyte	531.1	219	9.77
d5-EtFOSAA	Isotope Dilution Analyte	589.2	419	7.17
d7N-MeFOSE	Isotope Dilution Analyte	623.2	58.9	9.32
d9N-EtFOSE	Isotope Dilution Analyte	639.2	58.9	9.64
DONA	Native Analyte	376.9	250.9	5.5
DONA_2	Native Analyte	376.9	84.8	5.5
EtFOSA	Native Analyte	526	219	9.79
EtFOSA_2	Native Analyte	526	169	9.79
HFPO-DA	Native Analyte	284.9	168.9	4.78
HFPO-DA_2	Native Analyte	284.9	184.9	4.78
M2-4:2FTS	Isotope Dilution Analyte	329.1	80.9	4.22
M2-4:2FTS_2	Isotope Dilution Analyte	329.1	309	4.22
M2-6:2FTS	Isotope Dilution Analyte	429.1	80.9	5.67
M2-6:2FTS_2	Isotope Dilution Analyte	429.1	409	5.67
M2-8:2FTS	Isotope Dilution Analyte	529.1	80.9	6.74
M2-8:2FTS_2	Isotope Dilution Analyte	529.1	509	6.74
MeFOSA	Native Analyte	511.9	219	9.45
MeFOSA_2	Native Analyte	511.9	169	9.45
N-EtFOSAA	Native Analyte	584.2	419.1	7.17
N-EtFOSAA_2	Native Analyte	584.2	526	7.17
N-EtFOSE	Native Analyte	630	58.9	9.66
NFDHA (PFECA B)	Native Analyte	295	201	4.36
NFDHA_2 (PFECA B_2)	Native Analyte	295	84.9	4.36
N-MeFOSAA	Native Analyte	570.1	419	6.98
N-MeFOSAA_2	Native Analyte	570.1	483	6.98
N-MeFOSE	Native Analyte	616.1	58.9	9.32
PFBA	Native Analyte	212.8	168.9	1.87
PFBS	Native Analyte	298.7	79.9	4.36
PFBS_2	Native Analyte	298.7	98.8	4.36

Table 11.12 - 2
Masses/Transitions Utilized

ID	Comments	Q1	Q3	RT
PFDA	Native Analyte	512.9	469	6.95
PFDA_2	Native Analyte	512.9	219	6.95
PFDoA	Native Analyte	613.1	569	7.86
PFDoA_2	Native Analyte	613.1	319	7.86
PFDoS	Native Analyte	699.1	79.9	8.83
PFDoS_2	Native Analyte	699.1	98.8	8.83
PFDS	Native Analyte	599	79.9	8
PFDS_2	Native Analyte	599	98.8	8
PFEESA (PES)	Native Analyte	314.8	134.9	4.8
PFEESA_2 (PES_2)	Native Analyte	314.8	82.9	4.8
PFHpA	Native Analyte	363.1	319	5.25
PFHpA_2	Native Analyte	363.1	169	5.25
PFHpS	Native Analyte	449	79.9	6.54
PFHpS_2	Native Analyte	449	98.8	6.54
PFHxA	Native Analyte	313	269	4.5
PFHxA_2	Native Analyte	313	118.9	4.5
PFHxS	Native Analyte	398.7	79.9	5.96
PFHxS_2	Native Analyte	398.7	98.9	5.96
PFMBA (PFECA A)	Native Analyte	279	85.1	3.85
PFMPA (PFECA F)	Native Analyte	229	84.9	2.65
PFNA	Native Analyte	463	419	6.44
PFNA_2	Native Analyte	463	219	6.44
PFNS	Native Analyte	548.8	79.9	7.55
PFNS_2	Native Analyte	548.8	98.8	7.55
PFOA	Native Analyte	413	369	5.89
PFOA_2	Native Analyte	413	169	5.89
PFOS	Native Analyte	498.9	79.9	7.06
PFOS_2	Native Analyte	498.9	98.8	7.06
PFOSA	Native Analyte	498.1	77.9	7.93
PFOSA_2	Native Analyte	498.1	478	7.93
PFPeA	Native Analyte	263	219	3.51
PFPeA_2	Native Analyte	263	68.9	3.51
PFPeS	Native Analyte	349.1	79.9	5.27
PFPeS_2	Native Analyte	349.1	98.9	5.27
PFTeDA	Native Analyte	713.1	669	8.68
PFTeDA_2	Native Analyte	713.1	168.9	8.68
PFTrDA	Native Analyte	663	619	8.29
PFTrDA_2	Native Analyte	663	168.9	8.29

Table 11.12 - 2
Masses/Transitions Utilized

ID	**Comments**	**Q1**	**Q3**	**RT**
PFUdA	Native Analyte	563.1	519	7.41
PFUdA_2	Native Analyte	563.1	269.1	7.41
TCDA_1	Native Analyte	498.29	106.98	0
TCDA_2	Native Analyte	498.29	123.9	0
TCDA_3	Native Analyte	499.29	106.98	0
TCDA_4	Native Analyte	499.29	123.9	0
TCDCA	Native Analyte	464.21	126	0
TUDCA	Native Analyte	464.2	126	0

Table 11.12 – 3
Recommended Instrument Operating Conditions
Mass Spectrometer Scan Settings (SCIEX 5500)

RT	ID	MRM (win)	Dwell Weight	DP (volts)	EP (volts)	CE (volts)	CXP (volts)
0	TCDA_1	70	1	-65	-5	-58	-12
0	TCDA_2	70	1	-65	-5	-58	-12
0	TCDA_3	90	1	-65	-5	-58	-12
0	TCDA_4	90	1	-65	-5	-58	-12
0	TCDCA	120	1	-65	-5	-58	-12
0	TUDCA	120	1	-65	-5	-58	-12
1.87	13C3_PFBA	90	1	-25	-5	-12	-31
1.87	13C4_PFBA	90	1	-25	-5	-12	-31
1.87	PFBA	90	1	-25	-5	-12	-31
2.65	PFMPA (PFECA F)	70	1	-23	-10	-10	-16
2.96	3:3 FTCA	70	1	-46	-10	-11	-13
2.96	3:3 FTCA_2	70	1	-33	-10	-44	-15
3.51	13C5_PFPeA	80	1	-55	-7	-12	-13
3.51	PFPeA	80	1	-55	-7	-12	-13
3.51	PFPeA_2	80	1	-55	-7	-62	-15
3.85	PFMBA (PFECA A)	70	1	-5	-10	-16	-9
4.22	4.2FTS_2	70	1	-60	-10	-50	-12
4.22	4:2 FTS	70	1	-50	-7	-32	-10
4.22	M2-4:2FTS	70	1	-50	-7	-80	-10
4.22	M2-4:2FTS_2	70	1	-50	-7	-32	-10
4.36	13C3_PFBS	70	1	-55	-6	-58	-37
4.36	13C3_PFBS_2	70	1	-55	-6	-58	-37

Table 11.12 – 3
Recommended Instrument Operating Conditions
Mass Spectrometer Scan Settings (SCIEX 5500)

RT	ID	MRM (win)	Dwell Weight	DP (volts)	EP (volts)	CE (volts)	CXP (volts)
4.36	NFDHA (PFECA B)	70	1	-35	-10	-14	-17
4.36	NFDHA_2 (PFECA B_2)	70	1	-35	-10	-34	-5
4.36	PFBS	70	1	-55	-6	-58	-37
4.36	PFBS_2	70	1	-55	-5	-40	-12
4.5	13C2_PFHxA	50	1	-55	-5	-14	-13
4.5	13C2_PFHXA_2	50	1	-55	-5	-26	-7
4.5	13C5_PFHxA	50	1	-60	-5	-12	-15
4.5	13C5_PFHxA_2	50	1	-60	-5	-30	-9
4.5	PFHxA	50	1	-55	-5	-14	-13
4.5	PFHxA_2	50	1	-55	-5	-26	-7
4.78	13C3_HFPO-DA	70	1	-15	-10	-5	-17
4.78	13C3_HFPO-DA_2	70	1	-75	-10	-18	-15
4.78	HFPO-DA	70	1	-15	-10	-5	-17
4.78	HFPO-DA_2	70	1	-75	-10	-18	-15
4.8	PFEESA (PES)	70	1	-98	-12	-28	-12
4.8	PFEESA_2 (PES_2)	70	1	-98	-12	-28	-12
4.85	5:3 FTCA	70	1	-10	-10	-18	-13
4.85	5:3 FTCA_2	70	1	-10	-10	-38	-11
5.25	13C4_PFHpA	70	1	-25	-6	-12	-41
5.25	PFHpA	70	1	-25	-6	-12	-41
5.25	PFHpA_2	70	1	-25	-6	-20	-10
5.27	PFPeS	70	1	-57	-9	-66	-40
5.27	PFPeS_2	70	1	-57	-9	-45	-12
5.5	DONA	70	1	-55	-10	-16	-17
5.5	DONA_2	70	1	-55	-10	-35	-17
5.67	6:2 FTS	70	1	-50	-7	-32	-10
5.67	6:2 FTS_2	70	1	-80	-10	-72	-12
5.67	M2-6:2FTS	70	1	-50	-7	-90	-10
5.67	M2-6:2FTS_2	70	1	-50	-7	-32	-10
5.89	13C4_PFOA	70	1	-110	-6	-24	-20
5.89	13C8_PFOA	70	1	-110	-6	-18	-20
5.89	PFOA	70	1	-110	-6	-18	-20
5.89	PFOA_2	70	1	-110	-6	-24	-20

Table 11.12 – 3
Recommended Instrument Operating Conditions
Mass Spectrometer Scan Settings (SCIEX 5500)

RT	ID	MRM (win)	Dwell Weight	DP (volts)	EP (volts)	CE (volts)	CXP (volts)
5.96	13C3_PFHxS	65	1	-145	-12	-88	-11
5.96	13C3_PFHxS_2	65	1	-145	-12	-80	-13
5.96	18O2_PFHxS	65	1	-145	-12	-88	-11
5.96	PFHxS	65	1	-145	-12	-88	-11
5.96	PFHxS_2	65	1	-145	-12	-80	-13
6.14	7:3 FTCA	70	1	-27	-12	-18	-10
6.14	7:3 FTCA_2	70	1	-22	-12	-31	-35
6.44	13C5_PFNA	70	1	-25	-6	-14	-48
6.44	13C9_PFNA	70	1	-25	-6	-14	-48
6.44	PFNA	70	1	-25	-6	-14	-47
6.44	PFNA_2	70	1	-25	-6	-24	-47
6.54	PFHpS	70	1	-65	-11	-88	-46
6.54	PFHpS_2	70	1	-65	-11	-50	-12
6.74	8:2 FTS	70	1	-50	-7	-40	-15
6.74	8:2 FTS_2	70	1	-60	-10	-82	-9
6.74	M2-8:2FTS	70	1	-50	-7	-90	-15
6.74	M2-8:2FTS_2	70	1	-50	-7	-40	-15
6.95	13C2_PFDA	70	1	-25	-6	-16	-51
6.95	13C6_PFDA	70	1	-25	-6	-16	-51
6.95	PFDA	70	1	-25	-6	-16	-51
6.95	PFDA_2	70	1	-25	-6	-26	-12
6.98	d3-MeFOSAA	90	1	-40	-7	-36	-15
6.98	N-MeFOSAA	90	1	-40	-7	-36	-15
6.98	N-MeFOSAA_2	90	1	-75	-10	-22	-12
7.06	13C4_PFOS	90	1	-140	-9	-130	-13
7.06	13C4_PFOS_2	90	1	-140	-9	-98	-5
7.06	13C8_PFOS	90	1	-205	-9	-112	-11
7.06	13C8_PFOS_2	90	1	-205	-9	-112	-11
7.06	PFOS	90	1	-140	-9	-130	-13
7.06	PFOS_2	90	1	-140	-9	-98	-5
7.17	d5-EtFOSAA	90	1	-50	-7	-36	-15
7.17	N-EtFOSAA	90	1	-50	-7	-36	-15
7.17	N-EtFOSAA_2	90	1	-90	-10	-28	-12
7.4	9Cl-PF3ONS	70	1	-120	-10	-30	-17

Table 11.12 – 3
Recommended Instrument Operating Conditions
Mass Spectrometer Scan Settings (SCIEX 5500)

RT	ID	MRM (win)	Dwell Weight	DP (volts)	EP (volts)	CE (volts)	CXP (volts)
7.4	9Cl-PF3ONS_2	70	1	-120	-10	-30	-15
7.41	13C7_PFUdA	70	1	-25	-7	-18	-54
7.41	PFUdA	70	1	-25	-7	-18	-54
7.41	PFUdA_2	70	1	-25	-7	-28	-12
7.55	PFNS	70	1	-75	-10	-113	-52
7.55	PFNS_2	70	1	-75	-8	-71	-12
7.86	13C2_PFDoA	70	1	-25	-5	-18	-54
7.86	PFDoA	70	1	-25	-5	-18	-54
7.86	PFDoA_2	70	1	-25	-5	-30	-12
7.91	13C8_PFOSA	75	1	-90	-8	-92	-11
7.93	PFOSA	75	1	-90	-8	-92	-11
7.93	PFOSA_2	75	1	-60	-10	-40	-8
8	PFDS	70	1	-30	-11	-130	-11
8	PFDS_2	70	1	-30	-11	-110	-17
8.29	PFTrDA	90	1	-25	-7	-20	-54
8.29	PFTrDA_2	90	1	-25	-7	-36	-12
8.31	11Cl-PF3OUdS	70	1	-160	-10	-40	-17
8.31	11Cl-PF3OUdS_2	70	1	-160	-10	-40	-15
8.68	13C2_PFTeDA	120	1	-25	-7	-22	-54
8.68	PFTeDA	120	1	-25	-7	-22	-10
8.68	PFTeDA_2	120	1	-25	-7	-36	-30
8.83	PFDoS	90	1	-10	-11	-76	-11
8.83	PFDoS_2	90	1	-10	-11	-130	-5
9.32	d7N-MeFOSE	70	1	-20	-5	-70	-10
9.32	N-MeFOSE	70	1	-20	-5	-70	-10
9.45	d3MeFOSA	70	1	-75	-7	-37	-15
9.45	MeFOSA	70	1	-75	-7	-37	-15
9.45	MeFOSA_2	70	1	-50	-2	-40	-6
9.64	d9N-EtFOSE	70	1	-20	-5	-70	-10
9.66	N-EtFOSE	70	1	-20	-5	-70	-10
9.77	d5EtFOSA	70	1	-75	-7	-37	-15
9.79	EtFOSA	70	1	-75	-7	-37	-15
9.79	EtFOSA_2	70	1	-50	-8	-40	-6

Table 11.12 – 4
Retention Times & Quantitation

Native Compounds	Typical Native RT (minutes)	IDA analog	Typical IDA RT (minutes)	Quantitation Method
PFBA	2.54	13C4_PFBA	2.54	Isotope Dilution

Table 11.12 – 4
Retention Times & Quantitation

Native Compounds	Typical Native RT (minutes)	IDA analog	Typical IDA RT (minutes)	Quantitation Method
3:3 FTCA	2.9	13C5_PFPeA	2.98	Isotope Dilution
PFPeA	2.97	13C5_PFPeA	2.97	Isotope Dilution
PFBS	2.98	13C3-PFBS	2.98	Isotope Dilution
PFECA A (PFMBA)	3	13C5_PFPeA	2.97	Isotope Dilution
PES (PFEESA)	3.09	13C5_PFHxA	2.98	Isotope Dilution
PFECA B (NFDHA)	3.21	13C5_PFHxA	3.35	Isotope Dilution
4:2 FTS	3.28	13C2-4:2FTS	3.28	Isotope Dilution
PFHxA	3.35	13C5_PFHxA	3.35	Isotope Dilution
PFPeS	3.45	13C3_PFHxS	2.98	Isotope Dilution
HFPO-DA	3.46	13C3_HFPO-DA	3.46	Isotope Dilution
5:3 FTCA	3.7	13C5_PFHxA	3.77	Isotope Dilution
PFECA_F (PFMPA)	3.08	13C5_PFPeA	3.77	Isotope Dilution
PFHpA	3.74	13C4_PFHpA	3.74	Isotope Dilution
PFHxS	3.74	13C3_PFHxS	3.74	Isotope Dilution
DONA	3.79	13C3_HFPO-DA	4.5	Isotope Dilution
6:2 FTS	4.12	13C2-6:2FTS	4.12	Isotope Dilution
PFOA	4.14	13C8_PFOA	4.14	Isotope Dilution
PFHpS	4.14	13C8_PFOS	4.5	Isotope Dilution
7:3 FTCA	4.5	13C5_PFHxA	4.55	Isotope Dilution
PFOS	4.5	13C8_PFOS	4.5	Isotope Dilution
PFNA	4.52	13C9_PFNA	4.52	Isotope Dilution
9Cl-PF3ONS	4.69	13C3_HFPO-DA	4.5	Isotope Dilution
PFOSA	4.82	13C8_PFOSA	4.82	Isotope Dilution
PFNS	4.83	13C8_PFOS	4.5	Isotope Dilution
PFDA	4.86	13C6_PFDA	4.86	Isotope Dilution
8:2 FTS	4.86	13C2-8:2FTS	4.86	Isotope Dilution
N-MeFOSAA	5.03	d3-MeFOSAA	5.03	Isotope Dilution
PFDS	5.16	13C8_PFOS	4.5	Isotope Dilution
PFUdA (PFUnA)	5.19	13C7_PFUdA	5.19	Isotope Dilution
N-EtFOSAA	5.19	d5-EtFOSAA	5.19	Isotope Dilution
N-MeFOSE	5.25	d7N-MeFOSE	5.25	Isotope Dilution
MeFOSA	5.26	d3MeFOSA	5.26	Isotope Dilution
11Cl-PF3OUdS	5.31	13C3_HFPO-DA	4.5	Isotope Dilution
N-EtFOSE	5.4	d9N-EtFOSE	5.4	Isotope Dilution
EtFOSA	5.44	d5EtFOSA	5.44	Isotope Dilution
PFDoA	5.47	13C2_PFDoA	5.47	Isotope Dilution
PFDoS	5.72	13C8_PFOS	4.5	Isotope Dilution
PFTrDA	5.75	13C2_PFDoA	5.47	Isotope Dilution
PFTeDA	5.99	13C2_PFTeDA	5.99	Isotope Dilution

11.12.1. Tune and calibrate the instrument as described in Section 10.

11.12.2. A typical run sequence is as follows:

- Rinse Blank (RB, not linked to anything)
- CCVL (referred to as an ISC in Method 1633)
- Qualitative verification standard
- Rinse Blank (RB, not linked to anything)
- Method blank
- LLCS
- LCS
- Bile salt interference check (TDCA, when analyzing tissues, DOD or MLVS samples)
- 10 samples: link to midpoint of ICAL
- CCV: link to midpoint of ICAL
- CCB
- 10 more samples: link to midpoint of ICAL
- CCV: link to midpoint of ICAL
- CCB
- Etc.

11.13. Vortex all sample aliquots and standards prior to placing on the autosampler.

11.14. Samples analyzed subsequent to any sample with results at or above the upper calibration limit must be evaluated for potential carryover, and corrective actions taken, as detailed below.

11.14.1. If carryover is suspected, those samples are to be re-analyzed from a fresh extract aliquot (i.e. go the archive of the extract).

11.14.2. Should there be instrument contamination, as evident by sample carryover, any sample >5X the UCL or instrument blanks with detections > RL:

- Analyze 20 blanks alternating between 1% formic acid/methanol and 1% formic acid/water.
- Then analyze 3 methanol only blanks.
- If the system is clean resume analyses. Proceed to 11.14.4. If not clean, proceed as directed below.

11.14.3. If the system is still contaminated the following items might need to be cleaned or replaced:

- Reverse flush the analytical column
- Reverse flush the isolation column

- Replace the column (isolation, analytical or both)
- Clean the cones/entry port
- Replace the PEEK tubing in the sample pathway
- Then, repeat 11.14.2.

11.14.4. Should a high level sample be analyzed that triggers these steps then detections for those analytes over the next 2-3 days require additional evaluation (are all instrument blanks from the sequence < ½ RL) and possible re-analysis. If sample results replicate and the associated instrument blanks from the sequences are <1/2 RL then one can assume the system is under control and confirmation of positive detections can stop.

12. CALCULATIONS / DATA REDUCTION

12.1. If the concentration of the analyte ions exceeds the working range as defined by the calibration standards, then the sample might require to be diluted and reanalyzed, based upon client need. It may be necessary to dilute samples due to matrix.

12.2. Extracts can be diluted up to no more than 10X without diluting out the IDA, in most cases, and thus preserving quantitation via isotope dilution. IDA recovery must be >5% in the dilution. Use the IDA recoveries in the undiluted analysis to select the dilution factor, with the objective of keeping the IDA recoveries in the dilution above the 5% lower limit.

12.2.1. For example, if the IDA recovery for the affected analyte in the undiluted analysis is 50%, then the extract cannot be diluted more than 10X. If the IDA recovery of the affected analyte in the undiluted analysis is 30%, then the extract cannot be diluted more than 6X.

12.2.2. If the IDA response in the dilution is < 10:1 signal to noise or RT is off then the sample is to be re-extracted at a smaller aliquot.

12.2.3. If a dilution greater than 10X is needed, then the sample should be re-extracted at a smaller aliquot.

12.2.4. If a dilution is required, report the 1X data, including IDA, as primary data, and analyte of interest and associated IDA only from the dilution as secondary data.

12.3. Results less than the reporting limit are flagged in the client report as estimated. Generally, the “J” flag is used to denote ≥ MDL and ≤ RL, but the specific flag may change based on client requirements.

12.4. Qualitative Identification

12.4.1. The retention times of PFAS with labeled standards should be the same as that of the labeled IDA's to within 0.1 min. For PFAS with no labeled standards, the RT must be within ± 0.4 minutes of the ICAL or the most recent CCV standard.

Note: The IDA RT and native RT may be offset by 0.02 to 0.04 minutes.

12.4.2. PFBS, PFHxS, PFOS, NMeFOSAA, and NEtFOSAA have multiple chromatographic peaks using the LC conditions specified in the method due to the linear and branch isomers of these compounds. Most PFAS compounds are produced by one of two processes. One gives rise to linear PFAS only while the other process produces both linear and branched isomers. Both branched and linear PFAS compounds can potentially be found in the environment. For the aforementioned compounds that give rise to more than one peak, all chromatographic peaks observed in the standard must be integrated and the areas totaled. Chromatographic peaks in the sample must be integrated in the same way as the calibration standard and concentrations reported as a total for each of these analytes.

12.4.3. The expected retention times (RT) are established in the Chrom data processing module during the processing of the ICAL by selecting Edit>Method>Update RT. Once the retention times are established Chrom will look for a peak within ± 0.25 minutes of the RT. The analyst confirms that the branched isomers present in the quantitative calibration standards for PFOS, PFHxS, NEtFOSAA and NMeFOSAA are within the ± 0.25 minute window. If they are not, an adjustment to the RT window is made. The analyst confirms the presence of the branched isomers in the technical (qualitative) standard as well, and adjusts the RT window for an analyte if it is not present within the ± 0.25 minute window.

12.4.3.1. If a peak is detected within this window of ±0.25 minutes, Chrom will assign the absolute retention time at the apex of the peak. Chrom assigns the RT to the most predominant peak within this window. As the linear peak is the predominant peak in calibration solutions for those PFAS that are calibrated with the combination of both branched and linear isomers, those PFAS require additional evaluation in the event that the branched isomer is the predominant peak in a field sample and Chrom has not positively identified the peak due to the RT shift, as the apex may now be the branched isomer.

12.4.3.2. Additional evaluation is required if the field samples contain branched isomers not present in the quantitative or qualitative standards. The analyst confirms that only the peaks present in the calibration standards are included in the peak integration, or adjusts the peak integration to assure that only the peaks present in the standards are identified and quantitated.

12.4.3.3. RT are updated as needed based upon evaluation of the daily CCV.

12.4.4. The signal to noise ratio for both quantitative and qualitative ions/transitions must be ≥ 3:1 for a baseline deflection to be considered a peak. If this criterion is not met, the analyte is not considered and reported as “non-detect”.

12.5. The ICAL established in Section 10 is used to calculate concentrations for the extracts.

12.6. Extract concentrations are calculated as below. The first equation applies Average Response Factor model, the second to a linear fit, and the third to the quadratic line fit.

Equation 4

$$Concentration\ (ng/mL) = \frac{y}{A_{IDA}RRF}$$

Equation 5

$$Concentration\ (ng/mL) = \frac{y-c}{b}$$

Equation 6

$$Concentration\ (ng/mL) = \frac{-b \pm \sqrt{b^2-4ac-y}}{2a}$$

Where:

y = $\frac{Area_{Target}}{Area_{IDA}} \times Concentration(IDA)$
RRF = Relative Response Factor
x = concentration
a = curvature
b = slope
c = intercept

12.7. Water Sample Result Calculation:

Equation 7

$$Concentration\ (ng/L) = \frac{C_{ex}V_t}{V_0}$$

Where:

C_{ex} = Concentration measured in sample extract (ng/mL)
V_t = Volume of total extract (mL)
V_o = Volume of water extracted (L), i.e. total volume fortified with IDA

12.8. Soil Sample Result Calculation:

Equation 8 $$Concentration\ (ng/g) = \frac{C_{ex}V_t}{W_s D}$$

Where ng/g = µg/kg and:

C_{ex} = Concentration measured in sample extract (ng/mL)
V_t = Volume of total extract (mL)
W_s = Weight of sample extracted (g)
D = Fraction of dry solids, which is calculated as follows:

$$\frac{100 - \%\ moisture\ in\ sample}{100}$$ (for dry weight result)

12.9. IDA Recovery Calculation:

Equation 9 $$\%\ Recovery = \frac{A_{IDA}Q_{IS}}{A_{IS}Q_{IDA}RRF_{IDA}} \times 100$$

Where:

RRF_{IDA} = Response Factor for IDA compound
A_{IDA} = Area response for IDA compound
A_{IS} = Area Response for IS compound
Q_{IS} = Amount of IS added
Q_{IDA} = Amount of IDA added

12.10. Raw data, calibration summaries, QC data, and sample results are reviewed by the analyst. These must also be reviewed thoroughly by a second qualified person. See the Data Review Policy (WS-PQA-0012). These reviews are documented in TALS.

13. METHOD PERFORMANCE

13.1. The group/team leader has the responsibility to ensure that this procedure is performed by an associate who has been properly trained in its use and has the required expertise.

13.2. Method Detection Limit

The laboratory must generate a valid method detection limit for each analyte of interest. The MDL must be below the reporting limit for each analyte. The procedure for determination of the method detection limit is given in 40 CFR Part 136, Appendix B, and further defined in SOP WS-QA-0006 and policy WS-PQA-003. MDLs are available in the Quality Assurance Department.

13.3. Initial Demonstration of Capability (IDOC)

13.3.1. The method initial demonstration of capability is performed by processing 4 LCS samples and a method blank. Compare the average recovery and RSD to the IPR limits in Table 5 of the reference method.

13.3.2. Each analyst performing this procedure must successfully analyze four LCS QC samples using current laboratory LCS control limits in the LIMS. IDOCs are approved by the Quality Assurance Manager and the Technical

Director. IDOC records are maintained by the QA staff in the central training files.

14. POLLUTION PREVENTION

14.1. All waste will be disposed of in accordance with Federal, State and Local regulations.

14.2. Solid phase extraction used for water samples greatly reduces the amount of solvent used compared to liquid-liquid extraction.

14.3. Standards and reagents are purchased and prepared in volumes consistent with laboratory use to minimize the volume of expired standards and reagents requiring disposal.

14.4. Where reasonably feasible, technological changes have been implemented to minimize the potential for pollution of the environment. Employees will abide by this method and the policies in Section 13 of the NDSC Safety Manual for “Waste Management and Pollution Prevention.”

14.5. Do not allow waste solvent to vent into the hoods. All solvent waste is stored in capped containers unless waste is being transferred.

14.6. Transfer waste solvent from collection cups (tri-pour and similar containers) to jugs and/or carboys as quickly as possible to minimize evaporation.

15. WASTE MANAGEMENT

The following waste streams are produced when this method is carried out:

15.1. Assorted test tubes, autovials, syringes, filter discs and cartridges. Dump the dry solid waste into a yellow contaminated lab trash bucket. When the bucket is full or after no more than one year, tie the plastic bag liner shut and put the lab trash into the hazardous waste – landfill steel collection drum in the H3 closet. When the drum is full or after no more than 75 days, move it to the waste collection area for shipment.

15.2. Extracted soil samples, used sodium sulfate, paper funnel filters, glass wool, thimbles, and extracted solids saturated with solvents. Dump these materials into an orange contaminated lab trash bucket. When the bucket is full or after no more than one year, tie the plastic bag liner shut and put the lab trash into the incineration steel collection drum in the H3 closet. When the drum is full or after no more than 75 days, move it to the waste collection area for shipment.

15.3. Waste Methanol. Collect the waste solvents in tripours during use. Empty the tripours into a 1-liter to 4-liter carboy at the fume hood. When the carboy is full, or at the end of your shift, whichever comes first, empty the carboy into the steel flammable solvent drum in the H3 closet. When the drum is full to between four and six inches of the top, or after no more than 75 days, move the steel flammable solvent drum to the waste collection area for shipment.

15.4. Mixed water/methanol waste from soil extraction. Collect the waste in the HPLC waste carboy. When full, or after no more than one year, dump into the blue plastic HPLC collection drum in the H3 closet. When the drum is full to between four and six inches of the top or after no more than 75 days, move it to the waste collection area for shipment.

15.5. Aqueous acidic waste from the LCMS instrument contaminated with methanol. This is collected in a 1-gallon carboy at the instrument. When the carboy is full, or after no more than one year, it is emptied into the blue plastic HPLC collection drum in the H3 closet. When the drum is full to between four and six inches of the top or after no more than 75 days, move it to the waste collection area for shipment.

15.6. Autovials contaminated with methanol. As the autovials are removed from the instrument after analysis, they are collected in open containers at the instrument. After all autovials are removed, the open container must be dumped into a closed satellite collection container in a fume hood, as the punctured septa in the autovial can allow methanol and other contaminants to evaporate into the atmosphere. The satellite collection containers are transferred to the waste disposal area when full or after no more than one year, where they are disposed through the vial eater or by consolidation into 55-gallon open top plastic drum, which is shipped after no more than 90 days.

16. REFERENCES

16.1. Draft Method 1633 – Analysis of Per- and Polyfluroalkyl Substances (PFAS) in Aqueous, Solid, Biosolids and Tissue Samples by LC-MS/MS, August 2021.

16.2. 2nd Draft Method 1633 – Analysis of Per- and Polyfluroalkyl Substances (PFAS) in Aqueous, Solid, Biosolids and Tissue Samples by LC-MS/MS, June 2022.

17. METHOD MODIFICATIONS

17.1. Modifications from Method 1633 are detailed below: Note that only items 17.1.3 and 17.1.5 are applicable to the MLVS. All other items can not be used in the MLVS.

17.1.1. Percent solids in aqueous samples is determined by visual comparison to a reference sample that contains 50 mg of solid material (carbon). If samples are more turbid the extracted volume is reduced or the sample is processed as a solid based upon consultation with the client.

17.1.2. An SPE cartridge with 500 mg of WAX and 50 mg of carbon is used for water extraction and solid matrices clean up. As a result solvents and elution procedures are different.

17.1.3. The TDCA separation window is changed from 60 seconds to less than 15 seconds and baseline resolution.

17.1.4. The CCVL (ISC) will be used to start the analytical sequence on non-ICAL days and is to meet both S/N (3:1) and CCV acceptance criteria.

17.1.5. The corrective action to be taken in the event of clogging occurring in the SPE columns that is described in Section 11.3.6.1 is in lieu of using a second SPE cartridge as described in the reference method.

17.1.6. Immediately following the loading of aqueous samples onto the SPE columns, sample bottles are rinsed with reagent water, and the reagent water added to the column reservoir. This step is addition to the basic methanol rinse as part of the SPE elution step.

18. ATTACHMENTS

There are no attachments to this SOP.

19. REVISION HISTORY

19.1. WS-LC-0039, Revision 1.1, Effective 08/19/22

19.1.1. Section 5.1.2 inserted, filtering warnings added throughout.

19.1.2. Sections 7.6.2.1 and 10.9.7 had “only if eluent is not acetonitrile” added.

19.1.3. Section 8.3.1.1 was added.

19.1.4. Section 9.11.1 was added.

19.1.5. Section 11.2.2.1 was added.

19.1.6. Section 11.2.3.1 was added.

19.1.7. Section 12.2 was completely revised.

19.1.8. Section 17.1.1 was added.

19.1.9. Table 11.12-2, 13C8_PFOS, changed Q3 to 79.9, 13C8_PFOC_2, changed Q3 to 98.9.

19.1.10. Section 11.2.10, added, “using narrow range pH paper (Section 6.13).”

19.1.11. Section 11.6.21, added, “Check that the pH is 6.5 ± 0.5 using narrow range pH paper (Section 6.13). If necessary, adjust pH with 50% formic acid and 3% ammonium hydroxide.”

19.1.12. [redacted]

[redacted]

19.1.13. Section 16, added reference to 2nd Draft Method 1633, June 2022.

19.1.14. Removed references to 250 mL sample volume for aqueous samples throughout the document.

19.1.15. Editorial Revisions.

19.2. WS-LC-0039, Revision 1.0, Effective 04/08/22.

19.2.1. MLVS and its definition was added to Section 3.

19.2.2. MLVS requirements were delineated where needed: Sections 6.3, 6.8.1, 6.9, 7.6.2.1, 9.3.2.1, 9.4.2, 9.5.2, 9.6.1, 9.9.4, 9.11.1, 10.9.7.1, 11.1, 11.3.2.1, 11.4.3, 11.7.21, 11.6.20.2, 11.10.18.2 and 17.

19.2.3. Added Sections 6.3.1, 11.2.4.1, 11.3.6.2, 11.6.20.1 and 11.10.18.1.

19.2.4. Deleted Sections 11.6.21 through 11.6.24.

19.2.5. Deleted Sections 11.10.21 through 11.10.23.

19.2.6. Section 11.12.2 revised run sequence order.

19.2.7. Editorial changes.

19.3. WS-LC-0039, Revision 0, Effective 03/08/2022

19.3.1. This is the initial version of this SOP.

APPENDIX 1

1. The SPE used for DOD/DOE/MLVS samples is the standard 150 mg OASIS WAX SPE without carbon and manually packed with rinsed glass wool. All other SPE parameters: solvents, elution procedures, etc. are identical to those outlined in Section 11.

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METHOD 537. DETERMINATION OF SELECTED PERFLUORINATED ALKYL ACIDS IN DRINKING WATER BY SOLID PHASE EXTRACTION AND LIQUID CHROMATOGRAPHY/TANDEM MASS SPECTROMETRY (LC/MS/MS)

Version 1.1
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METHOD 537

DETERMINATION OF SELECTED PERFLUORINATED ALKYL ACIDS IN DRINKING WATER BY SOLID PHASE EXTRACTION AND LIQUID CHROMATOGRAPHY/TANDEM MASS SPECTROMETRY (LC/MS/MS)

1. SCOPE AND APPLICATION

1.1 This is a liquid chromatography/tandem mass spectrometry (LC/MS/MS) method for the determination of selected perfluorinated alkyl acids (PFAAs) in drinking water. Accuracy and precision data have been generated in reagent water, and finished ground and surface waters for the compounds listed in the table below.

Analyte	**Acronym**	**Chemical Abstract Services Registry Number (CASRN)**
N-ethyl perfluorooctanesulfonamidoacetic acid	NEtFOSAA	–
N-methyl perfluorooctanesulfonamidoacetic acid	NMeFOSAA	–
Perfluorobutanesulfonic acid	PFBS	375-73-5
Perfluorodecanoic acid	PFDA	335-76-2
Perfluorododecanoic acid	PFDoA	307-55-1
Perfluoroheptanoic acid	PFHpA	375-85-9
Perfluorohexanesulfonic acid	PFHxS	355-46-4
Perfluorohexanoic acid	PFHxA	307-24-4
Perfluorononanoic acid	PFNA	375-95-1
Perfluorooctanesulfonic acid	PFOS	1763-23-1
Perfluorooctanoic acid	PFOA	335-67-1
Perfluorotetradecanoic acid	PFTA	376-06-7
Perfluorotridecanoic acid	PFTrDA	72629-94-8
Perfluoroundecanoic acid	PFUnA	2058-94-8

1.2 The Minimum Reporting Level (MRL) is the lowest analyte concentration that meets Data Quality Objectives (DQOs) that are developed based on the intended use of this method. The single laboratory lowest concentration MRL (LCMRL) is the lowest true concentration for which the future recovery is predicted to fall, with high confidence (99%), between 50 and 150% recovery. Single laboratory LCMRLs for analytes in this method range from 2.9-14 ng/L, and are listed in Table 5. The procedure used to determine the LCMRL is described elsewhere.[1]

1.3 Laboratories using this method will not be required to determine the LCMRL for this method, but will need to demonstrate that their laboratory MRL for this method meets the requirements described in Section 9.2.5.

1.4 Determining the Detection Limit (DL) for analytes in this method is optional (Sect. 9.2.7). Detection limit is defined as the statistically calculated minimum concentration that can be measured with 99% confidence that the reported value is greater than zero.[2] The DL is compound dependent and is dependent on extraction efficiency, sample matrix, fortification concentration, and instrument performance.

1.5 This method is intended for use by analysts skilled in solid phase extractions, the operation of LC/MS/MS instruments, and the interpretation of the associated data.

1.6 METHOD FLEXIBILITY – In recognition of technological advances in analytical systems and techniques, the laboratory is permitted to modify the evaporation technique, separation technique, LC column, mobile phase composition, LC conditions and MS and MS/MS conditions (Sect. 6.12, 9.1.1, 10.2, and 12.1). Changes may not be made to sample collection and preservation (Sect. 8), the sample extraction steps (Sect. 11), or to the quality control requirements (Sect. 9). Method modifications should be considered only to improve method performance. Modifications that are introduced in the interest of reducing cost or sample processing time, but result in poorer method performance, should not be used. <u>Analytes must be adequately resolved chromatographically in order to permit the mass spectrometer to dwell on a minimum number of compounds eluting within a retention time window. Instrumental sensitivity (or signal-to-noise) will decrease if too many compounds are permitted to elute within a retention time window.</u> In all cases where method modifications are proposed, the analyst must perform the procedures outlined in the initial demonstration of capability (IDC, Sect. 9.2), verify that all Quality Control (QC) acceptance criteria in this method (Sect. 9) are met, and that acceptable method performance can be verified in a real sample matrix (Sect. 9.3.6).

NOTE: The above method flexibility section is intended as an abbreviated summation of method flexibility. Sections 4-12 provide detailed information of specific portions of the method that may be modified. If there is any perceived conflict between the general method flexibility statement in Section 1.6 and specific information in Sections 4-12, Sections 4-12 supersede Section 1.6.

2. SUMMARY OF METHOD

2.1 A 250-mL water sample is fortified with surrogates and passed through a solid phase extraction (SPE) cartridge containing polystyrenedivinylbenzene (SDVB) to extract the method analytes and surrogates. The compounds are eluted from the solid phase with a small amount of methanol. The extract is concentrated to dryness with nitrogen in a heated water bath, and then adjusted to a 1-mL volume with 96:4% (vol/vol) methanol:water after adding the IS(s). A 10-µL injection is made into an LC equipped with a C_{18} column that is interfaced to an MS/MS. The analytes are separated and identified by comparing the acquired mass spectra and retention times to reference spectra and retention times for calibration standards acquired under identical LC/MS/MS conditions. The concentration of each analyte is determined by using the internal standard technique. Surrogate analytes are added to all Field and QC Samples to monitor the extraction efficiency of the method analytes.

3. DEFINITIONS

3.1 ANALYSIS BATCH – A set of samples that is analyzed on the same instrument during a 24-hour period, including no more than 20 Field Samples, that begins and ends with the analysis of the appropriate Continuing Calibration Check (CCC) standards. Additional CCCs may be required depending on the length of the analysis batch and/or the number of Field Samples.

3.2 CALIBRATION STANDARD (CAL) – A solution prepared from the primary dilution standard solution and/or stock standard solution, internal standard(s), and the surrogate(s). The CAL solutions are used to calibrate the instrument response with respect to analyte concentration.

3.3 COLLISIONALLY ACTIVATED DISSOCIATION (CAD) – The process of converting the precursor ion's translational energy into internal energy by collisions with neutral gas molecules to bring about dissociation into product ions.

3.4 CONTINUING CALIBRATION CHECK (CCC) – A calibration standard containing the method analytes, internal standard(s) and surrogate(s). The CCC is analyzed periodically to verify the accuracy of the existing calibration for those analytes.

3.5 DETECTION LIMIT (DL) – The minimum concentration of an analyte that can be identified, measured, and reported with 99% confidence that the analyte concentration is greater than zero. This is a statistical determination of precision (Sect. 9.2.7), and accurate quantitation is not expected at this level.[2]

3.6 EXTRACTION BATCH – A set of up to 20 Field Samples (not including QC samples) extracted together by the same person(s) during a work day using the same lot of SPE devices, solvents, surrogate, internal standard and fortifying solutions. Required QC samples include Laboratory Reagent Blank, Laboratory Fortified Blank, Laboratory Fortified Sample Matrix, and either a Field Duplicate or Laboratory Fortified Sample Matrix Duplicate.

3.7 FIELD DUPLICATES (FD1 and FD2) – Two separate samples collected at the same time and place under identical circumstances, and treated exactly the same throughout field and laboratory procedures. Analyses of FD1 and FD2 give a measure of the precision associated with sample collection, preservation, and storage, as well as laboratory procedures.

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

3.9 INTERNAL STANDARD (IS) – A pure chemical added to an extract or standard solution in a known amount(s) and used to measure the relative response of other method analytes and surrogates that are components of the same solution. The internal standard must be a chemical that is structurally similar to the method analytes, has no potential to be present in water samples, and is not a method analyte.

3.10 LABORATORY FORTIFIED BLANK (LFB) – A volume of reagent water or other blank matrix to which known quantities of the method analytes and all the preservation compounds are added in the laboratory. The LFB is analyzed exactly like a sample, and its purpose is to determine whether the methodology is in control, and whether the laboratory is capable of making accurate and precise measurements.

3.11 LABORATORY FORTIFIED SAMPLE MATRIX (LFSM) – A preserved field sample to which known quantities of the method analytes are added in the laboratory. The LFSM is processed and analyzed exactly like a sample, and its purpose is to determine whether the sample matrix contributes bias to the analytical results. The background concentrations of the analytes in the sample matrix must be determined in a separate sample extraction and the measured values in the LFSM corrected for background concentrations.

3.12 LABORATORY FORTIFIED SAMPLE MATRIX DUPLICATE (LFSMD) – A duplicate of the Field Sample used to prepare the LFSM. The LFSMD is fortified, extracted, and analyzed identically to the LFSM. The LFSMD is used instead of the Field Duplicate to assess method precision when the occurrence of method analytes is low.

3.13 LABORATORY REAGENT BLANK (LRB) – An aliquot of reagent water or other blank matrix that is treated exactly as a sample including exposure to all glassware, equipment, solvents and reagents, sample preservatives, internal standard, and surrogates that are used in the analysis batch. The LRB is used to determine if method analytes or other interferences are present in the laboratory environment, the reagents, or the apparatus.

3.14 LOWEST CONCENTRATION MINIMUM REPORTING LEVEL (LCMRL) – The single laboratory LCMRL is the lowest true concentration for which a future recovery is expected, with 99% confidence, to be between 50 and 150% recovery.[1]

3.15 MATERIAL SAFETY DATA SHEET (MSDS) – Written information provided by vendors concerning a chemical's toxicity, health hazards, physical properties, fire, and reactivity data including storage, spill, and handling precautions.

3.16 MINIMUM REPORTING LEVEL (MRL) – The minimum concentration that can be reported as a quantitated value for a method analyte in a sample following analysis. This defined concentration can be no lower than the concentration of the lowest calibration standard for that analyte and can only be used if acceptable QC criteria for this standard are met. A procedure for verifying a laboratory's MRL is provided in Section 9.2.5.

3.17 PRECURSOR ION – For the purpose of this method, the precursor ion is the deprotonated molecule ($[M-H]^-$) of the method analyte. In MS/MS, the precursor ion is mass selected and fragmented by collisionally activated dissociation to produce distinctive product ions of smaller *m/z*.

3.18 PRIMARY DILUTION STANDARD (PDS) SOLUTION – A solution containing the analytes prepared in the laboratory from stock standard solutions and diluted as needed to prepare calibration solutions and other needed analyte solutions.

3.19 PRODUCT ION – For the purpose of this method, a product ion is one of the fragment ions produced in MS/MS by collisionally activated dissociation of the precursor ion.

3.20 QUALITY CONTROL SAMPLE (QCS) – A solution of method analytes of known concentrations that is obtained from a source external to the laboratory and different from the source of calibration standards. The second source SSS is used to fortify the QCS at a known concentration. The QCS is used to check calibration standard integrity.

3.21 STOCK STANDARD SOLUTION (SSS) – A concentrated solution containing one or more method analytes prepared in the laboratory using assayed reference materials or purchased from a reputable commercial source.

3.22 SURROGATE ANALYTE (SUR) – A pure chemical which chemically resembles method analytes and is extremely unlikely to be found in any sample. This chemical is added to a sample aliquot in known amount(s) before processing and is measured with the same procedures used to measure other method analytes. The purpose of the SUR is to monitor method performance with each sample.

4. INTERFERENCES

4.1 All glassware must be meticulously cleaned. Wash glassware with detergent and tap water, rinse with tap water, followed by a reagent water rinse. Non-volumetric glassware can be heated in a muffle furnace at 400 °C for 2 h or solvent rinsed. Volumetric glassware should be solvent rinsed and not be heated in an oven above 120 °C. Store clean glassware inverted or capped. Do not cover with aluminum foil because PFAAs can be potentially transferred from the aluminum foil to the glassware.

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

4.2 Method interferences may be caused by contaminants in solvents, reagents (including reagent water), sample bottles and caps, and other sample processing hardware that lead to discrete artifacts and/or elevated baselines in the chromatograms. The method analytes in this method can also be found in many common laboratory supplies and equipment, such as PTFE (polytetrafluoroethylene) products, LC solvent lines, methanol, aluminum foil, SPE sample transfer lines, etc.[3] All items such as these must be routinely demonstrated to be free from interferences (less than 1/3 the MRL for each method analyte) under the conditions of the analysis by analyzing laboratory reagent blanks as described in Section 9.3.1. **Subtracting blank values from sample results is not permitted.**

4.3 Matrix interferences may be caused by contaminants that are co-extracted from the sample. The extent of matrix interferences will vary considerably from source to source, depending upon the nature of the water. Humic and/or fulvic material can be co-extracted during SPE and high levels can cause enhancement and/or suppression in the electrospray ionization source or low recoveries on the SPE sorbent.[4-5] Total organic carbon (TOC) is a good indicator of humic content of the sample. Under the LC conditions used during method development, matrix effects due to total organic carbon (TOC) were not observed.

4.4 Relatively large quantities of the preservative (Sect. 8.1.2) are added to sample bottles. The potential exists for trace-level organic contaminants in these reagents. Interferences from these sources should be monitored by analysis of laboratory reagent blanks (Sect. 9.3.1), particularly when new lots of reagents are acquired.

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

5. SAFETY

5.1 The toxicity or carcinogenicity of each reagent used in this method has not been precisely defined. Each chemical should be treated as a potential health hazard, and exposure to these chemicals should be minimized. Each laboratory is responsible for maintaining an awareness of OSHA regulations regarding safe handling of chemicals used in this method. A reference file of MSDSs should be made available to all personnel involved in the chemical analysis. Additional references to laboratory safety are available.[6-8]

5.2 PFOA has been described as “likely to be carcinogenic to humans.”[9] Pure standard materials and stock standard solutions of these method analytes should be handled with suitable protection to skin and eyes, and care should be taken not to breathe the vapors or ingest the materials.

6. EQUIPMENT AND SUPPLIES

(Brand names and/or catalog numbers are included for illustration only, and do not imply endorsement of the product.) Due to potential adsorption of analytes onto glass, polypropylene containers were used for all standard, sample and extraction preparations. Other plastic materials (e.g., polyethylene) which meet the QC requirements of Section 9 may be substituted.

6.1 SAMPLE CONTAINERS – 250-mL polypropylene bottles fitted with polypropylene screw caps. Sample bottles must be discarded after use.

6.2 POLYPROPYLENE BOTTLES – 4-mL narrow-mouth polypropylene bottles (VWR Cat. No.: 16066-960 or equivalent).

6.3 CENTRIFUGE TUBES – 15-mL conical polypropylene tubes with polypropylene screw caps for storing standard solutions and for collection of the extracts (Thomas Scientific Cat. No.: 2602A10 or equivalent).

6.4 AUTOSAMPLER VIALS – Polypropylene 0.3-mL autosampler vials (SUN SRi Cat. No.: 501-354) with polypropylene caps (SUN SRi Cat. No.: 501-357 or equivalent).

NOTE: Polypropylene vials and caps are necessary to prevent contamination of the sample from PTFE coated septa. However, polypropylene caps do not reseal, so evaporation occurs after injection. Thus, multiple injections from the same vial are not possible.

6.5 POLYPROPYLENE GRADUATED CYLINDERS – Suggested sizes include 25, 50, 100 and 1000-mL cylinders.

6.6 MICRO SYRINGES – Suggested sizes include 5, 10, 25, 50, 100, 250, 500 and 1000-µL syringes.

6.7 PLASTIC PIPETS – Polypropylene or polyethylene disposable pipets (Fisher Cat. No.: 13-711-7 or equivalent).

6.8 ANALYTICAL BALANCE – Capable of weighing to the nearest 0.0001 g.

6.9 SOLID PHASE EXTRACTION (SPE) APPARATUS FOR USING CARTRIDGES

6.9.1 SPE CARTRIDGES – 0.5 g, 6-mL SPE cartridges containing styrenedivinylbenzene (SDVB) sorbent phase (Varian Cat. No.: 1225-5021 or equivalent).

6.9.2 VACUUM EXTRACTION MANIFOLD – A manual vacuum manifold with Visiprep™ large volume sampler (Supelco Cat. No. 57030 and 57275 or equivalent) for cartridge extractions, or an automatic/robotic sample preparation system designed for use with SPE cartridges, may be used if all QC requirements discussed in Section 9 are met. Extraction and/or elution steps may not be changed or omitted to accommodate the use of an automated system. Care must be taken with automated SPE systems to ensure the PTFE commonly used in these systems does not contribute to unacceptable analyte concentrations in the LRB (Sect. 9.3.1).

6.9.3 SAMPLE DELIVERY SYSTEM – Use of a polypropylene transfer tube system, which transfers the sample directly from the sample container to the SPE cartridge, is recommended, but not mandatory. Standard extraction manifolds come equipped with PTFE transfer tube systems. These can be replaced with 1/8" O.D. x 1/16" I.D. polypropylene or polyethylene tubing (Hudson Extrusions LLDPE or equivalent) cut to an appropriate length to ensure no sample contamination from the sample transfer lines. Other types of non-PTFE tubing may be used provided it meets the LRB (Sect. 9.3.1) and LFB (Sect. 9.3.3) QC requirements. The PTFE transfer tubes may be used, but an LRB must be run on each PFTE transfer tube and the QC requirements in Section 9.2.1 must be met. In the case of automated SPE, the removal of PTFE lines may not be feasible; therefore, LRBs will need to be rotated among the ports and must meet the QC requirements of Sections 9.2.1 and 9.3.1.

6.10 EXTRACT CONCENTRATION SYSTEM – Extracts are concentrated by evaporation with nitrogen using a water bath set no higher than 65 °C (Meyer N-Evap, Model 111, Organomation Associates, Inc. or equivalent).

6.11 LABORATORY OR ASPIRATOR VACUUM SYSTEM – Sufficient capacity to maintain a vacuum of approximately 10 to 15 inches of mercury for extraction cartridges.

6.12 LIQUID CHROMATOGRAPHY (LC)/TANDEM MASS SPECTROMETER (MS/MS) WITH DATA SYSTEM

6.12.1 LC SYSTEM – Instrument capable of reproducibly injecting up to 10-µL aliquots, and performing binary linear gradients at a constant flow rate near the flow rate used for development of this method (0.3 mL/min). The LC must be capable of pumping the water/methanol mobile phase without the use of a degasser which pulls vacuum on the mobile phase **bottle** (other types of degassers are acceptable). Degassers which pull vacuum on the mobile phase **bottle** will volatilize the ammonium acetate mobile phase causing the analyte peaks to shift to earlier retention times over the course of the analysis batch. The usage of a column heater is optional.

NOTE: During the course of method development, it was discovered that while idle for more than one day, PFAAs built up in the PTFE solvent transfer lines. To prevent long delays in purging high levels of PFAAs from the LC solvent lines, they were replaced with PEEK™ tubing and the PTFE solvent frits were replaced with stainless steel frits. It is not possible to remove all PFAA background contamination, but these measures help to minimize their background levels.

6.12.2 LC/TANDEM MASS SPECTROMETER – The LC/MS/MS must be capable of negative ion electrospray ionization (ESI) near the suggested LC flow rate of 0.3 mL/min. The system must be capable of performing MS/MS to produce unique product ions (Sect. 3.19) for the method analytes within specified retention time segments. A minimum of 10 scans across the chromatographic peak is required to ensure adequate precision. Data are demonstrated in Tables 5-9 using a triple quadrupole mass spectrometer (Waters Micromass Quattro Premier).

6.12.3 DATA SYSTEM – An interfaced data system is required to acquire, store, reduce, and output mass spectral data. The computer software should have the capability of processing stored LC/MS/MS data by recognizing an LC peak within any given retention time window. The software must allow integration of the ion abundance of any specific ion within specified time or scan number limits. The software must be able to calculate relative response factors, construct linear regressions or quadratic calibration curves, and calculate analyte concentrations.

6.12.4 ANALYTICAL COLUMN – An LC C_{18} column (2.1 x 150 mm) packed with 5 µm d_p C_{18} solid phase particles (Waters #: 186001301 or equivalent) was used. Any column that provides adequate resolution, peak shape, capacity, accuracy, and precision (Sect. 9) may be used.

7. REAGENTS AND STANDARDS

7.1 GASES, REAGENTS, AND SOLVENTS – Reagent grade or better chemicals should be used. Unless otherwise indicated, it is intended that all reagents shall conform to the specifications of the Committee on Analytical Reagents of the American Chemical Society, where such specifications are available. Other grades may be used, provided it is first determined that the reagent is of sufficiently high purity to permit its use without lessening the quality of the determination.

7.1.1 REAGENT WATER – Purified water which does not contain any measurable quantities of any method analytes or interfering compounds greater than 1/3 the MRL for each method analyte of interest. Prior to daily use, at least 3 L of reagent water should be flushed from the purification system to rinse out any build-up of analytes in the system's tubing.

7.1.2 METHANOL (CH_3OH, CAS#: 67-56-1) – High purity, demonstrated to be free of analytes and interferences (Tedia Absolv® grade or equivalent).

7.1.3 AMMONIUM ACETATE ($NH_4C_2H_3O_2$, CAS#: 631-61-8) – High purity, demonstrated to be free of analytes and interferences (Sigma-Aldrich ACS grade or equivalent).

7.1.4 20 mM AMMONIUM ACETATE/REAGENT WATER – To prepare 1 L, add 1.54 g ammonium acetate to 1 L of reagent water. This solution is prone to volatility losses and should be replaced at least every 48 hours.

7.1.5 TRIZMA® PRESET CRYSTALS, pH 7.0 (Sigma cat# T-7193 or equivalent) – Reagent grade. A premixed blend of Tris [Tris(hydroxymethyl)aminomethane] and Tris HCL [Tris(hydroxymethyl)aminomethane hydrochloride]. Alternatively, a mix of the two components with a weight ratio of 15.5/1 Tris HCL/Tris may be used. These blends are targeted to produce a pH near 7.0 at 25 °C in reagent water. Trizma® functions as a buffer, and removes free chlorine in chlorinated finished waters (Sect. 8.1.2).

7.1.6 NITROGEN – Used for the following purposes:

7.1.6.1 Nitrogen aids in aerosol generation of the ESI liquid spray and is used as collision gas in some MS/MS instruments. The nitrogen used should meet or exceed instrument manufacturer's specifications.

7.1.6.2 Nitrogen is used to concentrate sample extracts (Ultra High Purity or equivalent).

7.1.7 ARGON – Used as collision gas in MS/MS instruments. Argon should meet or exceed instrument manufacturer's specifications. Nitrogen gas may be used as the collision gas provided sufficient sensitivity (product ion formation) is achieved.

7.2 STANDARD SOLUTIONS – When a compound purity is assayed to be 96% or greater, the weight can be used without correction to calculate the concentration of the stock standard. PFAA analyte, IS and SUR standards commercially purchased in glass ampoules are acceptable; however, all subsequent transfers or dilutions performed by the analyst must be prepared and stored in polypropylene containers. Solution concentrations listed in this section were used to develop this method and are included as an example. Alternate concentrations may be used as necessary depending on instrument sensitivity and the calibration range used. Standards for sample fortification generally should be prepared in the smallest volume that can be accurately measured to minimize the addition of excess organic solvent to aqueous samples. **Even though stability times for standard solutions are suggested in the following sections, laboratories should use standard QC practices to determine when their standards need to be replaced.**

NOTE: Stock standards (Sect. 7.2.1.1, 7.2.2.1 and 7.2.3.1) were stored at ≤4 °C. Primary dilution standards (Sect. 7.2.1.2, 7.2.2.2 and 7.2.3.2) were stored at room temperature to prevent adsorption of the method analytes onto the container surfaces that may occur when refrigerated. Storing the standards at room temperature will also minimize daily imprecision due to the potential of inadequate room temperature stabilization.

7.2.1 INTERNAL (IS) STOCK STANDARD SOLUTIONS – This method uses three IS compounds listed in the table below. These isotopically labeled IS(s) were carefully chosen during method development because they encompass all the functional groups of the method analytes. Although alternate IS standards may be used provided they are isotopically labeled compounds with similar functional groups as the method analytes, the analyst must have documented reasons for using alternate IS(s). Alternate IS(s) must meet the QC requirements in Section 9.3.4. Note that different isotopic labels of the same IS(s) are acceptable (e.g., $^{13}C_2$-PFOA and $^{13}C_4$-PFOA) but will require modification of the MS/MS precursor and product ions.

Internal Standards	**Acronym**
Perfluoro-[1,2-$^{13}C_2$]octanoic acid	^{13}C-PFOA
Sodium perfluoro-1-[1,2,3,4-$^{13}C_4$]octanesulfonate	^{13}C-PFOS
N-deuteriomethylperfluoro-1-octanesulfonamidoacetic acid	d_3-NMeFOSAA

7.2.1.1 IS STOCK STANDARD SOLUTIONS – These IS stocks can be obtained as individual certified stock standard solutions. During the development of this method, commercially obtained 50 µg/mL stock standard solutions in methanol were used (Wellington Labs, Perkin Elmer or equivalent). Analysis of the IS(s) is less complicated if the IS(s) purchased contains only the linear isomer. IS stock standard solutions were stable for at least 6 months when stored at 4 °C.

7.2.1.2 INTERNAL STANDARD PRIMARY DILUTION (IS PDS) STANDARD (1-4 ng/µL) – Prepare, or purchase commercially, the IS PDS at a suggested concentration of 1-4 ng/µL. If prepared from the individual stock standard solutions (Sect. 7.2.1.1), the table below can be used as a guideline for preparing the IS PDS. The IS PDS used in these studies was prepared in 96:4% (vol/vol) methanol:water. The IS PDS has been shown to be stable for at least two months when stored in polypropylene centrifuge tubes at room temperature. Use 10 µL of this 1-4 ng/µL solution to fortify the final 1-mL extracts (Sect. 11.5). This will yield a concentration of 10-40 pg/µL of each IS in the 1-mL extracts.

IS	Conc. of IS Stock (µg/mL)	Vol. Of IS Stock (µL)	Final Vol. of IS PDS (µL)	Final Conc. of IS PDS (ng/µL)
^{13}C-PFOA	1000	5.0	5000	1.0
^{13}C-PFOS	50	300.0	5000	3.0
d_3-NMeFOSAA	50	400.0	5000	4.0

7.2.2 SURROGATE (SUR) ANALYTE STANDARD SOLUTIONS – The three SUR(s) for this method are listed in the table below. These isotopically labeled SUR standards were carefully chosen during method development because they encompass most of the functional groups, as well as the water solubility range of the method analytes. Although alternate SUR standards may be used provided they are isotopically labeled compounds with similar functional groups as the method analytes, the analyst must have documented reasons for using alternate SUR standards. The alternate SUR standards chosen must still span the water solubility range of the method analytes. In addition, alternate SUR standards must meet the QC requirements in Section 9.3.5.

Surrogates	Acronym
Perfluoro-n-[1,2-$^{13}C_2$]hexanoic acid	^{13}C-PFHxA
Perfluoro-n-[1,2-$^{13}C_2$]decanoic acid	^{13}C-PFDA
N-deuterioethylperfluoro-1-octanesulfonamidoacetic acid	d_5-NEtFOSAA

7.2.2.1 SUR STOCK STANDARD SOLUTIONS – These SUR stocks can be obtained as individual certified stock standard solutions. During the development of this method, commercially obtained 50 µg/mL stock standard solutions in methanol containing 4% water (except for d_5-NEtFOSAA which was purchased in pure methanol) were used (Wellington Labs or equivalent). Analysis of the SUR(s) is less complicated if the SUR(s) purchased contains only the linear isomer. SUR stock standard solutions were stable for at least 6 months when stored at 4 °C.

7.2.2.2 SURROGATE PRIMARY DILUTION STANDARD (SUR PDS) (1-4 ng/µL) – Prepare, or purchase commercially, the SUR PDS at a suggested concentration of 1-4 ng/µL. If prepared from the individual stock standard solutions (Sect. 7.2.2.1), the table below can be used as a guideline for preparing the SUR PDS. The SUR PDS used in these studies was prepared in 96:4% (vol/vol) methanol:water. This solution is used to fortify all QC and Field Samples. The PDS has been shown to be stable for one year when stored in polypropylene centrifuge tubes at room temperature.

SUR	**Conc. Of SUR Stock (µg/mL)**	**Vol. of SUR Stock (µL)**	**Final Vol. of SUR PDS (µL)**	**Final Conc. of SUR PDS (ng/µL)**
^{13}C-PFHxA	50	100.0	5000	1.0
^{13}C-PFDA	50	100.0	5000	1.0
d_5-NEtFOSAA	50	400.0	5000	4.0

7.2.3 ANALYTE STANDARD SOLUTIONS – Analyte standards may be purchased commercially as ampoulized solutions or prepared from neat materials (see Table 3 for the analyte sources used during method development). If possible, purchase the method analytes as technical grade standards or neat materials. Standards or neat materials that contain only the linear isomer can be substituted only if technical grade (linear and branched isomers) standards or neat material cannot be purchased. PFHxS and PFOS must be purchased as technical grade (containing branched and linear isomers), as well as NEtFOSAA and NMeFOSAA (if commercially available). PFHxS and PFOS are not available as the acids listed in Section 1.1, but rather as their corresponding salts, such as Na^+ and K^+ (see Table 3). These salts are acceptable starting materials for the stock standards provided the measured mass is corrected for the salt content according to the equation below. Prepare the Analyte Stock and Primary Dilutions Standards as described below.

$$Mass_{acid} = Measured\ Mass_{salt} \times \frac{MW_{acid}}{MW_{salt}}$$

where:

MW_{acid} = the molecular weight of PFAA
MW_{salt} = the molecular weight of purchased salt

7.2.3.1 ANALYTE STOCK STANDARD SOLUTION – If preparing from neat material, accurately weigh approximately 5 mg of pure material to the nearest 0.1 mg into a 4-mL or larger polypropylene bottle (Sect. 6.2). Add 1 mL of the solvent indicated in the table below. Repeat for each method analyte. These stock standards were stable for at least 6 months when stored at -15 °C. <u>When using these stock standards to prepare a PDS, care must be taken to ensure that these standards are at room temperature and adequately vortexed.</u>

Analyte	Analyte Stock Solvent
PFHxA	96:4% (vol/vol) methanol:water
PFHpA	96:4% (vol/vol) methanol:water
PFOA	96:4% (vol/vol) methanol:water
PFNA	96:4% (vol/vol) methanol:water
PFDA	96:4% (vol/vol) methanol:water
PFUnA	96:4% (vol/vol) methanol:water
PFDoA	96:4% (vol/vol) methanol:water
PFTrDA	100% ethyl acetate
PFTA	100% ethyl acetate
PFBS	100% methanol
PFHxS	100% methanol
PFOS	100% methanol
NEtFOSAA	100% methanol
NMeFOSAA	100% methanol

7.2.3.2 ANALYTE PRIMARY DILUTION STANDARD (PDS) SOLUTION (0.5-2.5 ng/µL) – The analyte PDS contains all the method analytes of interest at various concentrations in methanol containing 4% water. The ESI and MS/MS response varies by compound; therefore, a mix of concentrations may be needed in the analyte PDS. See Tables 5-9 in Section 17 for suggested concentrations for each analyte. During method development, the analyte PDS was prepared such that approximately the same instrument response was obtained for all the analytes. The analyte PDS is prepared by dilution of the combined Analyte Stock Standard Solutions and is used to prepare the CAL standards, and fortify the LFBs, the LFSMs, the LFSMDs and FDs with the method analytes. The analyte PDS has been shown to be stable for 6 months when stored at room temperature.

7.2.4 CALIBRATION STANDARDS (CAL) – At least five calibration concentrations are required to prepare the initial calibration curve spanning a 20-fold concentration range (Sect. 10.2). Larger concentration ranges will require more calibration points. Prepare the CAL standards over the concentration range of interest from dilutions of the analyte PDS in methanol containing 4% reagent water. The suggested analyte concentrations found in Tables 5-9 can be used as a starting point for determining the calibration range. The IS and SUR are added to the CAL standards at a constant concentration. During method development, the concentrations of the SUR(s) were 10-40 pg/µL in the standard (40-160 ng/L in the sample) and the IS(s) were 10-40 pg/µL. The lowest concentration CAL standard must be at or below the MRL, which may depend on system sensitivity. The CAL standards may also be used as CCCs (Sect. 9.3.2). During method development, the CAL standards were shown to be stable for at least two weeks when stored at room temperature. Longer storage times are acceptable provided appropriate QC measures are documented demonstrating the CAL standard stability.

8. SAMPLE COLLECTION, PRESERVATION, AND STORAGE

8.1 SAMPLE BOTTLE PREPARATION

8.1.1 Samples must be collected in a 250-mL polypropylene bottle fitted with a polypropylene screw-cap.

8.1.2 The preservation reagent, listed in the table below, is added to each sample bottle as a solid prior to shipment to the field (or prior to sample collection).

Compound	Amount	Purpose
Trizma®	5.0 g/L	buffering reagent and removes free chlorine

8.2 SAMPLE COLLECTION

8.2.1 The sample handler must wash their hands before sampling and wear nitrile gloves while filling and sealing the sample bottles. PFAA contamination during sampling can occur from a number of common sources, such as food packaging and certain foods and beverages. Proper hand washing and wearing nitrile gloves will aid in minimizing this type of accidental contamination of the samples.

8.2.2 Open the tap and allow the system to flush until the water temperature has stabilized (approximately 3 to 5 min). Collect samples from the flowing system.

8.2.3 Fill sample bottles, taking care not to flush out the sample preservation reagent. Samples do not need to be collected headspace free.

8.2.4 After collecting the sample, cap the bottle and agitate by hand until preservative is dissolved. Keep the sample sealed from time of collection until extraction.

8.3 FIELD REAGENT BLANKS (FRB)

8.3.1 A FRB must be handled along with each sample set. The sample set is composed of samples collected from the same sample site and at the same time. At the laboratory, fill the field blank sample bottle with reagent water and preservatives, seal, and ship to the sampling site along with the sample bottles. For each FRB shipped, an empty sample bottle (no preservatives) must also be shipped. At the sampling site, the sampler must open the shipped FRB and pour the preserved reagent water into the empty shipped sample bottle, seal and label this bottle as the FRB. The FRB is shipped back to the laboratory along with the samples and analyzed to ensure that PFAAs were not introduced into the sample during sample collection/handling.

8.3.2 The same batch of preservative must be used for the FRBs as for the field samples.

8.3.3 The reagent water used for the FRBs must be initially analyzed for method analytes as a LRB and must meet the LRB criteria in Section 9.3.1 prior to use. This requirement will ensure samples are not being discarded due to contaminated reagent water rather than contamination during sampling.

8.4 SAMPLE SHIPMENT AND STORAGE – Samples must be chilled during shipment and must not exceed 10 °C during the first 48 hours after collection. Sample temperature must be confirmed to be at or below 10 °C when the samples are received at the laboratory. Samples stored in the lab must be held at or below 6 °C until extraction, but should not be frozen.

NOTE: Samples that are significantly above 10° C, at the time of collection, may need to be iced or refrigerated for a period of time, in order to chill them prior to shipping. This will allow them to be shipped with sufficient ice to meet the above requirements.

8.5 SAMPLE AND EXTRACT HOLDING TIMES – Results of the sample storage stability study (Table 10) indicated that all compounds listed in this method have adequate stability for 14 days when collected, preserved, shipped and stored as described in Sections 8.1, 8.2, and 8.4. Therefore, water samples should be extracted as soon as possible but must be extracted within 14 days. Extracts must be stored at room temperature and analyzed within 28 days after extraction. The extract storage stability study data are presented in Table 11.

9. QUALITY CONTROL

9.1 QC requirements include the Initial Demonstration of Capability (IDC) and ongoing QC requirements that must be met when preparing and analyzing Field Samples. This section describes the QC parameters, their required frequencies, and the performance criteria that must be met in order to meet EPA quality objectives. The QC criteria discussed in the following sections are summarized in Tables 12 and 13. These QC requirements are considered the minimum acceptable QC criteria. Laboratories are encouraged to institute additional QC practices to meet their specific needs.

9.1.1 METHOD MODIFICATIONS – The analyst is permitted to modify LC columns, LC conditions, evaporation techniques, internal standards or surrogate standards, and MS and MS/MS conditions. Each time such method modifications are made, the analyst must repeat the procedures of the IDC. **Modifications to LC conditions should still produce conditions such that co-elution of the method analytes is minimized to reduce the probability of suppression/enhancement effects.**

9.2 INITIAL DEMONSTRATION OF CAPABILITY – The IDC must be successfully performed prior to analyzing any Field Samples. Prior to conducting the IDC, the analyst must first generate an acceptable Initial Calibration following the procedure outlined in Section 10.2.

9.2.1 INITIAL DEMONSTRATION OF LOW SYSTEM BACKGROUND – Any time a new lot of SPE cartridges, solvents, centrifuge tubes, disposable pipets, and autosampler vials are used, it must be demonstrated that an LRB is reasonably free of contamination and that the criteria in Section 9.3.1 are met. If an automated extraction system is used, an LRB should be extracted on each port to ensure that all the valves and tubing are free from potential PFAA contamination.

9.2.2 INITIAL DEMONSTRATION OF PRECISION (IDP) – Prepare, extract, and analyze four to seven replicate LFBs fortified near the midrange of the initial calibration curve according to the procedure described in Section 11. Sample preservatives as described in Section 8.1.2 must be added to these samples. The relative standard deviation (RSD) of the results of the replicate analyses must be less than 20%.

9.2.3 INITIAL DEMONSTRATION OF ACCURACY (IDA) – Using the same set of replicate data generated for Section 9.2.2, calculate average recovery. The average recovery of the replicate values must be within ± 30% of the true value.

9.2.4 INITIAL DEMONSTRATION OF PEAK ASYMMETRY FACTOR – Peak asymmetry factors must be calculated using the equation in Section 9.3.9 for the first two eluting peaks (if only two analytes are being analyzed, both must be evaluated) in a mid-level CAL standard. The peak asymmetry factors must fall in the range of 0.8 to 1.5. See guidance in Section 10.2.4.1 if the calculated peak asymmetry factors do not meet the criteria.

9.2.5 MINIMUM REPORTING LEVEL (MRL) CONFIRMATION – Establish a target concentration for the MRL based on the intended use of the method. The MRL may be established by a laboratory for their specific purpose or may be set by a regulatory agency. Establish an Initial Calibration following the procedure outlined in Section 10.2. The lowest CAL standard used to establish the Initial Calibration (as well as the low-level CCC, Section 10.3) must be at or below the concentration of the MRL. Establishing the MRL concentration too low may cause repeated failure of ongoing QC requirements. Confirm the MRL following the procedure outlined below.

9.2.5.1 Fortify, extract, and analyze seven replicate LFBs at the proposed MRL concentration. These LFBs must contain all method preservatives described in Section 8.1.2. Calculate the mean measured concentration (*Mean*) and standard deviation for these replicates. Determine the Half Range for the prediction interval of results (HR_{PIR}) using the equation below

$$HR_{PIR} = 3.963s$$

where

s = the standard deviation

3.963 = a constant value for seven replicates.[1]

9.2.5.2 Confirm that the upper and lower limits for the Prediction Interval of Result ($PIR = Mean \pm HR_{PIR}$) meet the upper and lower recovery limits as shown below

The Upper PIR Limit must be ≤150% recovery.

$$\frac{Mean + HR_{PIR}}{FortifiedConcentration} \times 100\% \leq 150\%$$

The Lower PIR Limit must be ≥ 50% recovery.

$$\frac{Mean - HR_{PIR}}{FortifiedConcentration} \times 100\% \geq 50\%$$

9.2.5.3 The MRL is validated if both the Upper and Lower PIR Limits meet the criteria described above (Sect. 9.2.5.2). If these criteria are not met, the MRL has been set too low and must be determined again at a higher concentration.

9.2.6 CALIBRATION CONFIRMATION – Analyze a QCS as described in Section 9.3.10 to confirm the accuracy of the standards/calibration curve.

9.2.7 DETECTION LIMIT DETERMINATION *(optional) – While DL determination is not a specific requirement of this method, it may be required by various regulatory bodies associated with compliance monitoring. It is the responsibility of the laboratory to determine if DL determination is required based upon the intended use of the data.*

9.2.7.1 Replicate analyses for this procedure should be done over at least three days (i.e., both the sample extraction and the LC/MS/MS analyses should be done over at least three days). Prepare at least seven replicate LFBs at a concentration estimated to be near the DL. This concentration may be estimated by selecting a concentration at 2-5 times the noise level. The DLs in Table 5 were calculated from LFBs fortified at various concentrations as indicated in the table. The appropriate fortification concentrations will be dependent upon the sensitivity of the LC/MS/MS system used. All preservation reagents listed in Section 8.1.2 must also be added to these samples. Analyze the seven replicates through all steps of Section 11.

NOTE: If an MRL confirmation data set meets these requirements, a DL may be calculated from the MRL confirmation data, and no additional analyses are necessary.

Calculate the *DL* using the following equation

$$DL = s \times t_{(n-1,1-\alpha=0.99)}$$

where

s = standard deviation of replicate analyses

$t_{(n\text{-}1,\ 1\text{-}\alpha=0.99)}$ = Student's t value for the 99% confidence level with n-1 degrees of freedom

n = number of replicates.

NOTE: Do not subtract blank values when performing DL calculations. The DL is a statistical determination of precision only.[2] If the DL replicates are fortified at a low enough concentration, it is likely that they will not meet the precision and accuracy criteria for CCCs. Therefore, no precision and accuracy criteria are specified.

9.2.7.2 If a laboratory is establishing their own MRL, the calculated DLs should not be used as the MRL for analytes that commonly occur as background contaminants. Method analytes that are seen in the background should be reported as present in Field Samples, only after careful evaluation of the background levels. It is recommended that a MRL be established at the mean LRB concentrations + 3σ or 3 times the mean LRB concentration, whichever is greater. This value should be calculated over a period of time, to reflect variability in the blank measurements. It is recommended that this value be used as an MRL in order to avoid reporting false positive results.

9.3 ONGOING QC REQUIREMENTS – This section summarizes the ongoing QC criteria that must be followed when processing and analyzing Field Samples.

9.3.1 LABORATORY REAGENT BLANK (LRB) – An LRB is required with each extraction batch (Sect. 3.6) to confirm that potential background contaminants are not interfering with the identification or quantitation of method analytes. If more than 20 Field Samples are included in a batch, analyze an LRB for every 20 samples. If the LRB produces a peak within the retention time window of any analyte that would prevent the determination of that analyte, determine the source of contamination and eliminate the interference before processing samples. Background contamination must be reduced to an acceptable level before proceeding. Background from method analytes or other contaminants that interfere with the measurement of method analytes must be below 1/3 of the MRL. Blank contamination is estimated by extrapolation, if the concentration is below the lowest CAL standard. This extrapolation procedure is not allowed for sample results as it may not meet data quality objectives. If the method analytes are detected in the LRB at concentrations equal to or greater than this level, then all data for the problem analyte(s) must be considered invalid for all samples in the extraction batch. Because background contamination is a significant problem for several method analytes, it is highly recommended that the analyst maintain a historical record of LRB data.

9.3.2 CONTINUING CALIBRATION CHECK (CCC) – CCC Standards are analyzed at the beginning of each analysis batch, after every 10 Field Samples, and at the end of the analysis batch. See Section 10.3 for concentration requirements and acceptance criteria.

9.3.3 LABORATORY FORTIFIED BLANK (LFB) – An LFB is required with each extraction batch (Sect. 3.6). The fortified concentration of the LFB must be rotated between low, medium, and high concentrations from batch to batch. The low concentration LFB must be as near as practical to, but no more than two times, the MRL. Similarly, the high concentration LFB should be near the high end of the calibration range established during the initial calibration (Sect. 10.2). Results of the low-level LFB analyses must be 50-150% of the true value. Results of the medium and high-level LFB analyses must be 70-130% of the true value. If the LFB results do not meet these criteria for method analytes, then all data for the problem analyte(s) must be considered invalid for all samples in the extraction batch.

9.3.4 INTERNAL STANDARDS (IS) – The analyst must monitor the peak areas of the IS(s) in all injections during each analysis day. The IS responses (peak areas) in any chromatographic run must be within 70-140% of the response in the most recent CCC and must not deviate by more than 50% from the average area measured during initial analyte calibration. If the IS areas in a chromatographic run do not meet these criteria, inject a second aliquot of that extract aliquotted into a new capped autosampler vial. Random evaporation losses have been observed with the polypropylene caps causing high IS(s) areas.

9.3.4.1 If the reinjected aliquot produces an acceptable IS response, report results for that aliquot.

9.3.4.2 If the reinjected extract fails again, the analyst should check the calibration by reanalyzing the most recently acceptable CAL standard. If the CAL standard fails the criteria of Section 10.3, recalibration is in order per Section 10.2. If the CAL standard is acceptable, extraction of the sample may need to be repeated provided the sample is still within the holding time. Otherwise, report results obtained from the reinjected extract, but annotate as suspect. Alternatively, collect a new sample and re-analyze.

9.3.5 SURROGATE RECOVERY – The SUR standard is fortified into all samples, CCCs, LRBs, LFBs, LFSMs, LFSMDs, FD, and FRB prior to extraction. It is also added to the CAL standards. The SUR is a means of assessing method performance from extraction to final chromatographic measurement. Calculate the recovery (%R) for the SUR using the following equation

$$\%R = \left(\frac{A}{B}\right) \times 100$$

where

A = calculated SUR concentration for the QC or Field Sample

B = fortified concentration of the SUR.

9.3.5.1 SUR recovery must be in the range of 70-130%. When SUR recovery from a sample, blank, or CCC is less than 70% or greater than 130%, check 1) calculations to locate possible errors, 2) standard solutions for degradation, 3) contamination, and 4) instrument performance. Correct the problem and reanalyze the extract.

9.3.5.2 If the extract reanalysis meets the SUR recovery criterion, report only data for the reanalyzed extract.

9.3.5.3 If the extract reanalysis fails the 70-130% recovery criterion, the analyst should check the calibration by injecting the last CAL standard that passed. If the CAL standard fails the criteria of Section 10.3, recalibration is in order per Section 10.2. If the CAL standard is acceptable, extraction of the sample should be repeated provided the sample is still within the holding time. If the re-extracted sample also fails the recovery criterion, report all data for that sample as suspect/SUR recovery to inform the data user that the results are suspect due to SUR recovery. Alternatively, collect a new sample and re-analyze.

9.3.6 LABORATORY FORTIFIED SAMPLE MATRIX (LFSM) – Analysis of an LFSM is required in each extraction batch and is used to determine that the sample matrix does not adversely affect method accuracy. Assessment of method precision is accomplished by analysis of a Field Duplicate (FD) (Sect. 9.3.7); however, infrequent occurrence of method analytes would hinder this assessment. If the occurrence of method analytes in the samples is infrequent, or if historical trends are unavailable, a second LFSM, or LFSMD, must be prepared, extracted, and analyzed from a duplicate of the Field Sample. Extraction batches that contain LFSMDs will not require the extraction of a FD. If a variety of different sample matrices are analyzed regularly, for example, drinking water from groundwater and surface water sources, method performance should be established for each. Over time, LFSM data should be documented by the laboratory for all routine sample sources.

9.3.6.1 Within each extraction batch (Sect. 3.6), a minimum of one Field Sample is fortified as an LFSM for every 20 Field Samples analyzed. The LFSM is prepared by spiking a sample with an appropriate amount of the Analyte

PDS (Sect. 7.2.3.2). Select a spiking concentration that is greater than or equal to the matrix background concentration, if known. Use historical data and rotate through the low, mid and high concentrations when selecting a fortifying concentration.

9.3.6.2 Calculate the percent recovery (%*R*) for each analyte using the equation

$$\%R = \frac{(A - B)}{C} \times 100$$

where

A = measured concentration in the fortified sample
B = measured concentration in the unfortified sample
C = fortification concentration.

9.3.6.3 Analyte recoveries may exhibit matrix bias. For samples fortified at or above their native concentration, recoveries should range between 70-130%, except for low-level fortification near or at the MRL (within a factor of 2-times the MRL concentration) where 50-150% recoveries are acceptable. If the accuracy of any analyte falls outside the designated range, and the laboratory performance for that analyte is shown to be in control in the CCCs, the recovery is judged to be matrix biased. The result for that analyte in the unfortified sample is labeled suspect/matrix to inform the data user that the results are suspect due to matrix effects.

9.3.7 FIELD DUPLICATE OR LABORATORY FORTIFIED SAMPLE MATRIX DUPLICATE (FD or LFSMD) – Within each extraction batch (not to exceed 20 Field Samples, Sect. 3.6), a minimum of one FD or LFSMD must be analyzed. Duplicates check the precision associated with sample collection, preservation, storage, and laboratory procedures. If method analytes are not routinely observed in Field Samples, an LFSMD should be analyzed rather than an FD.

9.3.7.1 Calculate the relative percent difference (*RPD*) for duplicate measurements (*FD1* and *FD2*) using the equation

$$RPD = \frac{|FD1 - FD2|}{(FD1 + FD2)/2} \times 100$$

9.3.7.2 RPDs for FDs should be ≤30%. Greater variability may be observed when FDs have analyte concentrations that are within a factor of 2 of the MRL. At these concentrations, FDs should have RPDs that are ≤50%. If the RPD of any analyte falls outside the designated range, and the laboratory performance for that analyte is shown to be in control in the CCC, the recovery is judged to be matrix biased. The result for that analyte in the unfortified sample is labeled suspect/matrix to inform the data user that the results are suspect due to matrix effects.

9.3.7.3 If an LFSMD is analyzed instead of a FD, calculate the relative percent difference (RPD) for duplicate LFSMs (LFSM and LFSMD) using the equation

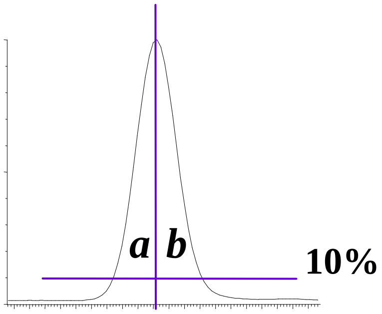
$$RPD = \frac{\left| LFSM - LFSMD \right|}{\left(LFSM + LFSMD \right)/2} \times 100$$

9.3.7.4 RPDs for duplicate LFSMs should be ≤30% for samples fortified at or above their native concentration. Greater variability may be observed when LFSMs are fortified at analyte concentrations that are within a factor of 2 of the MRL. LFSMs fortified at these concentrations should have RPDs that are ≤50% for samples fortified at or above their native concentration. If the RPD of any analyte falls outside the designated range, and the laboratory performance for that analyte is shown to be in control in the CCC, the recovery is judged to be matrix biased. The result for that analyte in the unfortified sample is labeled suspect/matrix to inform the data user that the results are suspect due to matrix effects.

9.3.8 FIELD REAGENT BLANK (FRB) – The purpose of the FRB is to ensure that PFAAs measured in the Field Samples were not inadvertently introduced into the sample during sample collection/handling. Analysis of the FRB is required only if a Field Sample contains a method analyte or analytes at or above the MRL. The FRB is processed, extracted and analyzed in exactly the same manner as a Field Sample. If the method analyte(s) found in the Field Sample is present in the FRB at a concentration greater than 1/3 the MRL, then all samples collected with that FRB are invalid and must be recollected and reanalyzed.

9.3.9 PEAK ASYMMETRY FACTOR – A peak asymmetry factor must be calculated using the equation below during the IDL and every time a calibration curve is generated. The peak asymmetry factor for the first two eluting peaks in a mid-level CAL standard (if only two analytes are being analyzed, both must be evaluated) must fall in the range of 0.8 to 1.5. Modifying the standard or extract composition to more aqueous content to prevent poor shape is not permitted. See guidance in Section 10.2.4.1 if the calculated peak asymmetry factors do not meet the criteria.

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



where:

A_s = peak asymmetry factor

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

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

9.3.10 QUALITY CONTROL SAMPLES (QCS) – As part of the IDC (Sect. 9.2), each time a new Analyte PDS (Sect. 7.2.3.2) is prepared, and at least quarterly, analyze a QCS sample from a source different from the source of the CAL standards. If a second vendor is not available, then a different lot of the standard should be used. The QCS should be prepared and analyzed just like a CCC. Acceptance criteria for the QCS are identical to the CCCs; the calculated amount for each analyte must be ± 30% of the expected value. If measured analyte concentrations are not of acceptable accuracy, check the entire analytical procedure to locate and correct the problem.

10. CALIBRATION AND STANDARDIZATION

10.1 Demonstration and documentation of acceptable initial calibration is required before any samples are analyzed. After the initial calibration is successful, a CCC is required at the beginning and end of each period in which analyses are performed, and after every tenth Field Sample.

10.2 INITIAL CALIBRATION

10.2.1 ESI-MS/MS TUNE

10.2.1.1 Calibrate the mass scale of the MS with the calibration compounds and procedures prescribed by the manufacturer.

10.2.1.2 Optimize the $[M\text{-}H]^-$ for each method analyte by infusing approximately 0.5-1.0 µg/mL of each analyte (prepared in the initial mobile phase conditions) directly into the MS at the chosen LC mobile phase flow rate (approximately 0.3 mL/min). This tune can be done on a mix of the method analytes. The MS parameters (voltages, temperatures, gas flows, etc.) are varied until optimal analyte responses are determined. The method analytes may have different optima requiring some compromise between the optima. See Table 2 for ESI-MS conditions used in method development.

10.2.1.3 Optimize the product ion (Sect. 3.19) for each analyte by infusing approximately 0.5-1.0 µg/mL of each analyte (prepared in the initial mobile phase conditions) directly into the MS at the chosen LC mobile phase flow rate (approximately 0.3 mL/min). This tune can be done on a mix of the method analytes. The MS/MS parameters (collision gas pressure, collision energy, etc.) are varied until optimal analyte responses are determined. Typically, the carboxylic acids have very similar MS/MS conditions and the sulfonic acids have similar MS/MS conditions. See Table 4 for MS/MS conditions used in method development.

10.2.2 Establish LC operating parameters that optimize resolution and peak shape. Suggested LC suggested conditions can be found in Table 1. The LC conditions listed in Table 1 may not be optimum for all LC systems and may need to be optimized by the analyst (See Sect. 10.2.4.1). <u>Modifying the standard or extract composition to more aqueous content to prevent poor shape is not permitted.</u>

Cautions: LC system components, as well as the mobile phase constituents, contain many of the method analytes in this method. Thus, these PFAAs will build up on the head of the LC column during mobile phase equilibration. To minimize the background PFAA peaks and to keep background levels constant, the time the LC column sits at initial conditions must be kept constant and as short as possible (while ensuring reproducible retention times). In addition, prior to daily use, flush the column with 100% methanol for at least 20 min before initiating a sequence. It may be necessary on some systems to flush other LC components such as wash syringes, sample needles or any other system components before daily use.

Mobile phase modifiers other than 20 mM ammonium acetate may be used at the discretion of the analyst, provided that the retention time stability criteria in Sect. 11.7.2 can be met over a period of two weeks. During method development, retention times shifted to shorter and shorter times as days progressed when mobile phases with less then 20 mM ammonium acetate were used.

10.2.3 Inject a mid-level CAL standard under LC/MS conditions to obtain the retention times of each method analyte. If analyzing for PFTA, ensure that the LC conditions are adequate to prevent co-elution of PFTA and the mobile phase interferants shown in Figure 1. These interferants have the same precursor and products ions as PFTA, and under faster LC conditions may co-elute with PFTA. Divide the chromatogram into retention time windows each of which contains one or more chromatographic peaks. During MS/MS analysis, fragment a small number of selected precursor ions ($[M-H]^-$; Sect. 3.17) for the analytes in each window and choose the most abundant product ion. The product ions (also the quantitation ions) chosen during method development are in Table 4, although these will be instrument dependent. For maximum sensitivity, small mass windows of ±0.5 daltons around the product ion mass were used for quantitation. If sufficient sensitivity exists to meet the MRL, wider mass ranges may be used to obtain more confirmation ions.

NOTE: As the NOTE in Section 10.2.4.1 indicates, PFOS has linear and branched isomers. There have been reports[10] that not all the products ions in the linear PFOS are produced in all the branched PFOS isomers. (This phenomenon probably exists for PFHxS and PFBS also, although it has not been studied to date.) Thus, in an attempt to reduce PFOS bias, it is required that the *m/z* 499 → *m/z* 80 transition be used as the quantitation transition. Some MS/MS instruments, such as conventional ion traps, may not be able to scan a product ion with such a wide mass difference from the precursor ion; therefore, they may not be used for this method if PFOS, PFBS, or PFHxS analysis is to be conducted. Literature reports[10] indicate for the most abundant PFOS isomer, which is the linear isomer, that all the products ions obtained on an ion trap have less than 10% relative abundance. In addition, there is not a single ion trap MS/MS transition that encompasses the linear isomer and the majority of the branch isomers; thus, the bias would be unacceptably high.

10.2.4 Inject a mid-level CAL standard under optimized LC/MS/MS conditions to ensure that each method analyte is observed in its MS/MS window and that there are at least 10 scans across the peak for optimum precision.

10.2.4.1 If broad, split or fronting peaks are observed for the first two eluting chromatographic peaks (if only two analytes are being analyzed, both must be evaluated), change the initial mobile phase conditions to higher aqueous content until the peak asymmetry ratio for each peak is 0.8 – 1.5. The peak asymmetry factor is calculated as described in Section 9.3.9 on a mid-level CAL standard. The peak asymmetry factor must meet the above criteria for the first two eluting peaks during the IDL and every time a new calibration curve is generated. Modifying the standard or extract composition to more aqueous content to prevent poor shape is not permitted.

NOTE: PFHxS, PFOS, NMeFOSAA, and NEtFOSAA have multiple chromatographic peaks using the LC conditions in Table 1 due to chromatographic resolution of the linear and branched isomers of these compounds. Most PFAAs are produced by two different processes. One process gives rise to linear

PFAAs only while the other process produces both linear and branched isomers. Thus, both branched and linear PFAAs can potentially be found in the environment. For the aforementioned compounds that give rise to more than one peak, all the chromatographic peaks observed in the standard must be integrated and the areas totaled. Chromatographic peaks in a sample must be integrated in the same way as the CAL standard.

10.2.5 Prepare a set of at least five CAL standards as described in Section 7.2.4. The lowest concentration CAL standard must be at or below the MRL, which may depend on system sensitivity. It is recommended that at least four of the CAL standards are at a concentration greater than or equal to the MRL.

10.2.6 The LC/MS/MS system is calibrated using the IS technique. Use the LC/MS/MS data system software to generate a linear regression or quadratic calibration curve for each of the analytes. This curve **must always** be forced through zero and may be concentration weighted, if necessary. Forcing zero allows for a better estimate of the background levels of method analytes.

10.2.6.1 The isotopically labeled IS(s) in this method may undergo suppression in the ESI source if the concentration of the co-eluting unlabeled method analyte(s) is too high. The analyte concentration at which suppression may occur can vary depending on the instrument, LC conditions, ESI conditions, IS concentration, etc. To evaluate whether suppression is occurring during calibration, calculate the relative percent difference (*RPD*) between the high (H) and low (L) areas for each IS using the equation

$$RPD = \frac{(H - L)}{(H + L)/2} \times 100$$

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

10.2.7 CALIBRATION ACCEPTANCE CRITERIA – When quantitated using the initial calibration curve, each calibration point, except the lowest point, for each analyte should calculate to be within 70-130% of its true value. The lowest CAL point should calculate to be within 50-150% of its true value. If these criteria cannot be met, the analyst will have difficulty meeting ongoing QC criteria. It is recommended that corrective action is taken to reanalyze the CAL standards, restrict the range of calibration, or select an alternate method of calibration (forcing the curve through zero is still required).

CAUTION: When acquiring MS/MS data, LC operating conditions must be carefully reproduced for each analysis to provide reproducible retention times. If this is not done, the correct ions will not be monitored at the appropriate times. As a precautionary measure, the chromatographic peaks in each window must not elute too close to the edge of the segment time window.

10.3 CONTINUING CALIBRATION CHECK (CCC) – Minimum daily calibration verification is as follows. Verify the initial calibration at the beginning and end of each group of analyses, and after every tenth sample during analyses. In this context, a "sample" is considered to be a Field Sample. LRBs, CCCs, LFBs, LFSMs, FDs FRBs and LFSMDs are not counted as samples. The beginning CCC of each analysis batch must be at or below the MRL in order to verify instrument sensitivity prior to any analyses. If standards have been prepared such that all low CAL points are not in the same CAL solution, it may be necessary to analyze two CAL standards to meet this requirement. Alternatively, the analyte concentrations in the analyte PDS may be customized to meet this criteria. Subsequent CCCs should alternate between a medium and high concentration CAL standard.

10.3.1 Inject an aliquot of the appropriate concentration CAL standard and analyze with the same conditions used during the initial calibration.

10.3.2 Determine that the absolute areas of the quantitation ions of the IS(s) are within 70-140% of the areas measured in the most recent continuing calibration check, and within 50-150% from the average areas measured during initial calibration. If any of the IS areas has changed by more than these amounts, adjustments must be made to restore system sensitivity. These adjustments may include cleaning of the MS ion source, or other maintenance as indicated in Section 10.3.4. Major instrument maintenance requires recalibration (Sect 10.2) and verification of sensitivity by analyzing a CCC at or below the MRL (Sect 10.3). Control charts are useful aids in documenting system sensitivity changes.

10.3.3 Calculate the concentration of each analyte and SUR in the CCC. The calculated amount for each analyte and SUR for medium and high level CCCs must be within ± 30% of the true value. The calculated amount for the lowest calibration point for each analyte must be within ± 50% and the SUR must be within ± 30% of the true value. If these conditions do not exist, then all data for the problem analyte must be considered invalid, and remedial action should be taken (Sect. 10.3.4) which may require recalibration. Any Field or QC Samples that have been analyzed since the last acceptable calibration verification should be reanalyzed after adequate calibration has been restored, with the following exception. **If the CCC fails because the calculated concentration is greater than 130% (150% for the low-level CCC) for a particular method analyte, and Field Sample extracts show no detection for that method analyte, non-detects may be reported without re-analysis.**

10.3.4 REMEDIAL ACTION – Failure to meet CCC QC performance criteria may require remedial action. Major maintenance, such as cleaning the electrospray probe, atmospheric pressure ionization source, cleaning the mass analyzer, replacing the LC column, etc., requires recalibration (Sect 10.2) and verification of sensitivity by analyzing a CCC at or below the MRL (Sect 10.3).

11. PROCEDURE

11.1 This procedure may be performed manually or in an automated mode using a robotic or automatic sample preparation device. The data presented in Tables 5-11 demonstrate data collected by manual extraction. If an automated system is used to prepare samples, follow the manufacturer's operating instructions, but all extraction and elution steps must be the same as in the manual procedure. Extraction and/or elution steps may not be changed or omitted to accommodate the use of an automated system. If an automated system is used, the LRBs should be rotated among the ports to ensure that all the valves and tubing meet the LRB requirements (Sect. 9.3.1).

11.2 Some of the PFAAs adsorb to surfaces, including polypropylene. Therefore, the aqueous sample bottles must be rinsed with the elution solvent (Sect 11.4.4) whether extractions are performed manually or by automation. The bottle rinse is passed through the cartridge to elute the method analytes and is then collected (Sect. 11.4.4).

NOTE: The SPE cartridges and sample bottles described in this section are designed as single use items and should be discarded after use. They may not be refurbished for reuse in subsequent analyses.

11.3 SAMPLE PREPARATION

11.3.1 Samples are preserved, collected and stored as presented in Section 8. All Field and QC Samples, including the LRB, LFB and FRB, must contain the dechlorinating agent listed in Section 8.1.2. Determine sample volume. An indirect measurement may be done in one of two ways: by marking the level of the sample on the bottle or by weighing the sample and bottle to the nearest 10 g. After extraction, proceed to Section 11.6 for final volume determination. Some of the PFAAs adsorb to surfaces, thus the sample volume may **NOT** be transferred to a graduated cylinder for volume measurement. The LRB, LFB and FRB may be prepared by measuring 250 mL of reagent water with a polypropylene graduated cylinder or filling a 250-mL sample bottle to near the top.

11.3.2 Add an aliquot of the SUR PDS (Sect. 7.2.2.2) to each sample, cap and invert to mix. During method development, a 10-µL aliquot of the 1-4 ng/µL SUR PDS (Sect. 7.2.2.2) was added to 250 mL of sample for a final concentration of 40 ng/L for ^{13}C-PFHxA and ^{13}C-PFDA and 160 ng/L for d_5-NEtFOSAA.

11.3.3 In addition to the SUR(s) and dechlorination agent, if the sample is an LFB, FD, LFSM, or LFSMD, add the necessary amount of analyte PDS (Sect. 7.2.3.2). Cap and invert each sample to mix.

11.4 CARTRIDGE SPE PROCEDURE

11.4.1 CARTRIDGE CLEAN-UP AND CONDITIONING – DO NOT allow cartridge packing material to go dry during any of the conditioning steps. Rinse each cartridge with 15 mL of methanol. Next, rinse each cartridge with 18 mL of reagent water, without allowing the water to drop below the top edge of the packing. If the cartridge goes dry during the conditioning phase, the conditioning must be started over. Add 4-5 mL of reagent water to each cartridge, attach the sample transfer tubes (Sect. 6.9.3), turn on the vacuum, and begin adding sample to the cartridge.

11.4.2 SAMPLE EXTRACTON – Adjust the vacuum so that the approximate flow rate is 10-15 mL/min. Do not allow the cartridge to go dry before all the sample has passed through.

11.4.3 SAMPLE BOTTLE AND CARTRIDGE RINSE – After the entire sample has passed through the cartridge, rinse the sample bottles with two 7.5-mL aliquots of reagent water and draw each aliquot through the sample transfer tubes and the cartridges. Draw air or nitrogen through the cartridge for 5 min at high vacuum (10-15 in. Hg).

NOTE: If empty plastic reservoirs are used in place of the sample transfer tubes to pass the samples through the cartridges, these reservoirs must be treated like the transfer tubes. After the entire sample has passed through the cartridge, the reservoirs must be rinsed to waste with reagent water.

11.4.4 SAMPLE BOTTLE AND CARTRIDGE ELUTION – Turn off and release the vacuum. Lift the extraction manifold top and insert a rack with collection tubes into the extraction tank to collect the extracts as they are eluted from the cartridges. Rinse the sample bottles with 4 mL of methanol and elute the analytes from the cartridges by pulling the 4 mL of methanol through the sample transfer tubes and the cartridges. Use a low vacuum such that the solvent exits the cartridge in a dropwise fashion. Repeat sample bottle rinse and cartridge elution with a second 4-mL aliquot of methanol.

NOTE: If empty plastic reservoirs are used in place of the sample transfer tubes to pass the samples through the cartridges, these reservoirs must be treated like the transfer tubes. After the reservoirs have been rinsed in Section 11.4.3, the elution solvent used to rinse the sample bottles must be swirled down the sides of the reservoirs while eluting the cartridge to ensure that any method analytes on the surface of the reservoirs are transferred to the extract.

11.5 EXTRACT CONCENTRATION – Concentrate the extract to dryness under a gentle stream of nitrogen in a heated water bath (60-65 °C) to remove all the water/methanol mix. Add the appropriate amount of 96:4% (vol/vol) methanol:water solution and the IS PDS (Sect. 7.2.1.2) to the collection vial to bring the volume to 1 mL and vortex. (10 µL of the 1-4 ng/µL IS PDS for extract concentrations of 10-40 pg/µL were used for method development). Transfer a small aliquot with a plastic pipet (Sect. 6.7) to a polypropylene autosampler vial.

NOTE: It is recommend that the entire 1-mL aliquot not be transferred to the autosampler vial because the polypropylene autosampler caps do not reseal after injection. Therefore, do not store the extracts in the autosampler vials as evaporation losses can occur occasionally in these autosampler vials. Extracts can be stored in 15-mL centrifuge tubes (Sect. 6.3).

11.6 SAMPLE VOLUME DETERMINATION – If the level of the sample was marked on the sample bottle, use a graduated cylinder to measure the volume of water required to fill the original sample bottle to the mark made prior to extraction. Determine to the nearest 10 mL. If using weight to determine volume, weigh the empty bottle to the nearest 10 g and determine the sample weight by subtraction of the empty bottle weight from the original sample weight (Sect. 11.3.1). Assume a sample density of 1.0 g/mL. In either case, the sample volume will be used in the final calculations of the analyte concentration (Sect. 12.2).

11.7 EXTRACT ANALYSIS

11.7.1 Establish operating conditions equivalent to those summarized in Tables 1-4 of Section 17. Instrument conditions and columns should be optimized prior to the initiation of the IDC.

11.7.2 Establish an appropriate retention time window for each analyte. This should be based on measurements of actual retention time variation for each method analyte in CAL standard solutions analyzed on the LC over the course of time. A value of plus or minus three times the standard deviation of the retention time obtained for each method analyte while establishing the initial calibration and completing the IDC can be used to calculate a suggested window size. However, the experience of the analyst should weigh heavily on the determination of the appropriate retention window size.

11.7.3 Calibrate the system by either the analysis of a calibration curve (Sect. 10.2) or by confirming the initial calibration is still valid by analyzing a CCC as described in Section 10.3. If establishing an initial calibration, complete the IDC as described in Section 9.2.

11.7.4 Begin analyzing Field Samples, including QC samples, at their appropriate frequency by injecting the same size aliquots (10 µL was used in method development), under the same conditions used to analyze the CAL standards.

11.7.5 At the conclusion of data acquisition, use the same software that was used in the calibration procedure to identify peaks of interest in predetermined retention time windows. Use the data system software to examine the ion abundances of the peaks in the chromatogram. Identify an analyte by comparison of its retention time with that of the corresponding method analyte peak in a reference standard. Comparison of the MS/MS mass spectra is not particularly useful given the limited ±0.5 dalton mass range around a single product ion for each method analyte.

11.7.6 The analyst must not extrapolate beyond the established calibration range. If an analyte peak area exceeds the range of the initial calibration curve, the extract may be diluted with 96%:4% (vol/vol) methanol:water solution and the appropriate amount of IS added to match the original concentration. Re-inject the diluted extract. Incorporate the dilution factor into the final concentration calculations. Acceptable SUR performance (Sect. 9.3.5.1) should be determined from the undiluted sample extract. The resulting data should be documented as a dilution, with an increased MRL.

12. DATA ANALYSIS AND CALCULATION

12.1. Complete chromatographic resolution is not necessary for accurate and precise measurements of analyte concentrations using MS/MS. In validating this method, concentrations were calculated by measuring the product ions listed in Table 4. Other ions may be selected at the discretion of the analyst.

12.2. Calculate analyte and SUR concentrations using the multipoint calibration established in Section 10.2. Do not use daily calibration verification data to quantitate analytes in samples. Adjust final analyte concentrations to reflect the actual sample volume determined in Section 11.6.

12.3 Prior to reporting the data, the chromatogram should be reviewed for any incorrect peak identification or poor integration.

12.4 PFHxS, PFOS, NMeFOSAA, and NEtFOSAA have multiple chromatographic peaks using the LC conditions in Table 1 due to the linear and branch isomers of these compounds (Sect. 10.2.4.1). The areas of all the linear and branched isomer peaks observed in the CAL standards for each of these analytes must be summed and the concentrations reported as a total for each of these analytes.

12.5 Calculations must utilize all available digits of precision, but final reported concentrations should be rounded to an appropriate number of significant figures (one digit of uncertainty), typically two, and not more than three significant figures.

NOTE: Some data in Section 17 of this method are reported with more than two significant figures. This is done to better illustrate the method performance.

13. METHOD PERFORMANCE

13.1 PRECISION, ACCURACY, AND MINIMUM REPORTING LEVELS – Tables for these data are presented in Section 17. LCMRLs and DLs for each method analyte are presented in Table 5. Precision and accuracy are presented for four water matrices: reagent water (Tables 6 and 7); chlorinated (finished) ground water (Table 8); high TOC chlorinated surface water (Table 9); and day zero of the aqueous holding time in chlorinated surface water (Table 10).

13.2 EVALUATION OF ADDITIONAL PERFLUORINATED ALKYL COMPOUNDS – Nine additional compounds were evaluated for inclusion in this method, but were not included for the following reasons. Due to volatility, low recoveries following evaporation were obtained for PFOSA (perfluorooctane sulfonylamide), NEtFOSE (2-N-ethylperfluorooctane sulfonamide ethanol), NMeFOSE (2-N-methylperfluorooctane sulfonamide ethanol), and NEtFOSA (N-ethylperfluorooctanesulfonamide). Poor chromatographic peak shape, which degraded with repeated injections, was obtained for PFOSAA (perfluorooctanesulfonamidoacetic acid). PFOSfn (perfluorosulfinate) degraded in aqueous samples in under 24 hours. PFOSF (perfluorooctane-1-sulfonylfluoride) had the same LC retention time as PFOS and appeared to undergo conversion in the ESI source to PFOS under method conditions. Finally, acceptable SPE recoveries were not obtained for PFBA (perfluorobutanoic acid) and PFPA (perfluoropentanoic acid).

13.3 SAMPLE STORAGE STABILITY STUDIES – An analyte storage stability study was conducted by fortifying the analytes into chlorinated surface water samples that were collected, preserved, and stored as described in Section 8. The precision and mean recovery (n=5) of analyses, conducted on Days 0, 7, and 14 are presented in Table 10.

13.4 EXTRACT STORAGE STABILITY STUDIES – Extract storage stability studies were conducted on extracts obtained from a chlorinated surface water fortified with the method analytes. The precision and mean recovery (n=5) of injections conducted on Days 0, 7, 14, 22, and 28 are reported in Table 11.

13.5 SECOND LABORATORY DEMONSTRATION – The performance of this method was demonstrated by multiple laboratories, with results similar to those reported in Section 17. The authors wish to acknowledge the work of the Suffolk County Water Authority Laboratory Hauppauge, NY and Lancaster Labs, a wholly owned subsidiary of Thermo Fisher Scientific, for their participation in the second laboratory demonstration.

14. POLLUTION PREVENTION

14.1 This method utilizes SPE to extract analytes from water. It requires the use of very small volumes of organic solvent and very small quantities of pure analytes, thereby minimizing the potential hazards to both the analyst and the environment as compared to the use of large volumes of organic solvents in conventional liquid-liquid extractions.

14.2 For information about pollution prevention that may be applicable to laboratory operations, consult "Less is Better: Laboratory Chemical Management for Waste Reduction" available from the American Chemical Society's Department of Government Relations and Science Policy, 1155 16th Street N.W., Washington, D.C., 20036 or on-line at http://membership.acs.org/c/ccs/pub_9.htm (accessed August 2008).

15. WASTE MANAGEMENT

15.1 The analytical procedures described in this method generate relatively small amounts of waste since only small amounts of reagents and solvents are used. The matrices of concern are finished drinking water or source water. However, laboratory waste management practices must be conducted consistent with all applicable rules and regulations, and that laboratories protect the air, water, and land by minimizing and controlling all releases from fume hoods and bench operations. Also, compliance is required with any sewage discharge permits and regulations, particularly the hazardous waste identification rules and land disposal restrictions.

16. REFERENCES

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17. TABLES, DIAGRAMS, FLOWCHARTS AND VALIDATION DATA

TABLE 1. LC METHOD CONDITIONS

Time (min)	% 20 mM ammonium acetate	% Methanol
Initial	60.0	40.0
1.0	60.0	40.0
25.0	10.0	90.0
32.0	10.0	90.0
32.1	60.0	40.0
37.0	60.0	40.0
Waters Atlantis® dC_{18} 2.1 x 150 mm packed with 5.0 µm C_{18} stationary phase Flow rate of 0.3 mL/min 10 µL injection		

TABLE 2. ESI-MS METHOD CONDITIONS

ESI Conditions	
Polarity	Negative ion
Capillary needle voltage	-3 kV
Cone gas flow	98 L/hr
Nitrogen desolvation gas	1100 L/hr
Desolvation gas temp.	350 °C

TABLE 3. METHOD ANALYTE SOURCE, RETENTION TIMES (RTs), AND SUGGESTED IS REFERENCES

Analyte	Method analyte Source[a]	Peak # (Fig. 1)	RT (min)	IS# Ref
PFBS	Aldrich	1	8.48	2
PFHxA	Fluka	2	11.38	1
PFHpA	Aldrich	4	14.33	1
PFHxS[b]	Fluka	5	14.48	2
PFOA	Aldrich	6	16.73	1
PFNA	Aldrich	8	18.76	1
PFOS[b]	Fluka	9	18.72	2
PFDA	Aldrich	11	20.47	1
NMeFOSAA	c	13	21.28	3
NEtFOSAA	c	15	22.01	3
PFUnA	Aldrich	17	21.95	1
PFDoA	Aldrich	18	23.20	1
PFTrDA	Exfluor	19	24.32	1
PFTA	Aldrich	20	25.27	1
^{13}C-PFHxA	Wellington Labs	3	11.38	1
^{13}C-PFDA	Wellington Labs	12	20.47	1
d_5-NEtFOSAA	Wellington Labs	16	21.99	3
^{13}C-PFOA– IS#1	PerkinElmer	7	16.73	-
^{13}C-PFOS– IS#2	Wellington Labs	10	18.71	-
d_3-NMeFOSAA–IS#3	Wellington Labs	14	21.24	-

[a] The data presented in this method were obtained using analytes purchased from these vendors. Other vendors' materials can be used provided the QC requirements in Section 9 can be met.

[b] PFHxS and PFOS neat materials were purchased as K^+ salts. The CASRN of the PFOS potassium salt is 2795-39-3 and the CASRN of the PFHxS potassium salt is 3871-99-6.

[c] These analytes were not commercially available at the time of method development as technical grade mixtures containing both linear and branched isomers.

TABLE 4. MS/MS METHOD CONDITIONS[a]

Segment[b]	Analyte	Precursor Ion [c] *(m/z)*	Product Ion[c,d] (*m/z*)	Cone Voltage (v)	Collision Energy[e] (v)
1	PFBS	299	80	40	25
2	PFHxA	313	269	15	10
3	PFHpA	363	319	12	10
3	PFHxS[f]	399	80	40	40
4	PFOA	413	369	15	10
4	PFNA	463	419	12	10
4	PFOS[f]	499	80	40	40
5	PFDA	513	469	15	10
5	NMeFOSAA[f]	570	419	25	20
5	NEtFOSAA[f]	584	419	25	20
5	PFUnA	563	519	15	10
5	PFDoA	613	569	15	10
6	PFTrDA	663	619	15	10
6	PFTA	713	669	15	10
2	^{13}C-PFHxA	315	270	15	10
5	^{13}C-PFDA	515	470	12	12
5	d_5-NEtFOSAA	589	419	25	20
4	^{13}C-PFOA	415	370	15	10
4	^{13}C-PFOS	503	80	40	40
5	d_3-NMeFOSAA	573	419	25	20

[a] An LC/MS/MS chromatogram of the analytes is shown in Figure 1.

[b] Segments are time durations in which single or multiple scan events occur.

[c] Precursor and product ions listed in this table are nominal masses. During MS and MS/MS optimization, the analyst should determine the precursor and product ion masses to one decimal place by locating the apex of the mass spectral peak place (e.g., *m/z* 498.9→79.9 for PFOS). These precursor and product ion masses (with one decimal place) should be used in the MS/MS method for all analyses.

[d] Ions used for quantitation purposes.

[e] Argon used as collision gas at a flow rate of 0.3 mL/min.

[f] Analyte has multiple resolved chromatographic peaks due to linear and branched isomers. All peaks summed for quantitation purposes.

TABLE 5. DLs AND LCMRLs IN REAGENT WATER

Analyte	Fortified Conc. (ng/L)[a]	DL[b] (ng/L)	LCMRL[c] (ng/L)
PFBS	9.1	3.1	3.7
PFHxA	5.0	1.6	2.9
PFHpA	4.1	0.5	3.8
PFHxS	11	2.0	8.0
PFOA	4.6	1.7	5.1
PFNA	4.8	0.7	5.5
PFOS	9.6	1.4	6.5
PFDA	3.7	0.7	3.8
NMeFOSAA	20	6.5	14
NEtFOSAA	21	4.2	14
PFUnA	5.4	2.8	6.9
PFDoA	3.7	1.1	3.5
PFTrDA	5.5	2.2	3.8
PFTA	4.4	1.7	4.7

[a] Spiking concentration used to determine DL.

[b] Detection limits were determined by analyzing seven replicates over three days according to Section 9.2.7.

[c] LCMRLs were calculated according to the procedure in reference 1.

TABLE 6. PRECISION AND ACCURACY OF LOW LEVEL FORTIFIED REAGENT WATER (n=7)

Analyte	Fortified Conc. (ng/L)	Mean % Recovery	% RSD
PFBS	9.1	93	12
PFHxA	5.0	108	9.3
PFHpA	8.3	111	6.2
PFHxS	11	116	4.9
PFOA	9.1	110	6.5
PFNA	9.6	121	7.5
PFOS	9.6	116	4.1
PFDA	7.3	114	4.1
NMeFOSAA	20	109	9.3
NEtFOSAA	21	113	5.5
PFUnA	11	120	5.4
PFDoA	7.3	116	4.6
PFTrDA	5.5	118	11
PFTA	8.7	117	2.4
^{13}C-PFHxA	40	89	6.1
^{13}C-PFDA	40	102	7.3
d_5-NEtFOSAA	160	100	4.9

TABLE 7. PRECISION AND ACCURACY OF HIGH LEVEL FORTIFIED REAGENT WATER (n=7)

Analyte	Fortified Conc. (ng/L)	Mean % Recovery	% RSD
PFBS	91	92	5.9
PFHxA	50	103	4.6
PFHpA	41	106	3.4
PFHxS	113	101	2.5
PFOA	46	104	3.6
PFNA	48	109	3.5
PFOS	96	101	3.8
PFDA	37	106	4.8
NMeFOSAA	202	100	3.7
NEtFOSAA	214	105	5.3
PFUnA	54	107	3.3
PFDoA	37	107	3.9
PFTrDA	55	107	1.9
PFTA	44	111	2.7
^{13}C-PFHxA	40	93	4.4
^{13}C-PFDA	40	99	3.5
d_5-NEtFOSAA	160	100	4.5

TABLE 8. PRECISION AND ACCURACY IN FORTIFIED CHLORINATED GROUND WATER[a] (n=7)

Analyte	Fortified Conc. (ng/L)	Mean % Recovery	% RSD
PFBS	91	101	3.9
PFHxA	50	112	0.9
PFHpA	41	105	1.8
PFHxS	113	103	2.2
PFOA	46	107	2.2
PFNA	48	103	2.4
PFOS	96	100[b]	2.2
PFDA	37	101	2.6
NMeFOSAA	202	96	2.6
NEtFOSAA	214	100	2.7
PFUnA	54	99	2.6
PFDoA	37	99	2.3
PFTrDA	55	96	3.4
PFTA	44	97	4.2
^{13}C-PFHxA	40	98	2.0
^{13}C-PFDA	40	98	2.1
d_5-NEtFOSAA	160	97	5.0

[a] TOC = 0.96 mg/L and hardness = 342 mg/L.

[b] Recovery is corrected for a matrix PFOS concentration of 40 ng/L.

TABLE 9. PRECISION AND ACCURACY IN FORTIFIED HIGH TOC CHLORINATED SURFACE WATER[a] (n=7)

Analyte	Fortified Conc. (ng/L)	Mean % Recovery	% RSD
PFBS	91	85	4.3
PFHxA	50	101	3.2
PFHpA	41	106	3.7
PFHxS	113	101	4.9
PFOA	46	110	3.1
PFNA	48	112	3.9
PFOS	96	104	4.0
PFDA	37	109	4.3
NMeFOSAA	202	95	4.0
NEtFOSAA	214	100	3.4
PFUnA	54	106	3.7
PFDoA	37	104	4.2
PFTrDA	55	102	4.7
PFTA	44	105	3.5
^{13}C-PFHxA	40	85	4.3
^{13}C-PFDA	40	101	3.2
d_5-NEtFOSAA	160	106	3.7

[a] TOC = 4.95 mg/L and hardness =137 mg/L.

TABLE 10. AQUEOUS SAMPLE HOLDING TIME DATA FOR SAMPLES FROM CHLORINATED SURFACE WATER[a], FORTIFIED WITH METHOD ANALYTES AND PRESERVED AND STORED ACCORDING TO SECTION 8 (n=5)

Analyte	Fortified Conc. (ng/L)	Day 0		Day 7		Day 14	
		Mean %Rec	% RSD	Mean %Rec	% RSD	Mean %Rec	% RSD
PFBS	91	83	8.5	87	3.3	90	12
PFHxA	50	99	4.3	98	3.4	104	10
PFHpA	41	105	1.1	97	4.2	102	7.0
PFHxS	113	98	2.8	98	3.8	92	9.0
PFOA[b]	46	98	2.5	94	3.2	96	7.6
PFNA	48	106	2.5	102	4.0	98	5.5
PFOS	96	103	4.9	100	3.1	104	6.7
PFDA	37	102	3.3	99	5.0	99	7.0
NMeFOSAA	202	97	3.6	95	4.0	97	5.1
NEtFOSAA	214	105	3.0	101	6.1	99	5.3
PFUnA	54	104	3.0	97	4.8	95	10
PFDoA	37	100	2.2	94	5.8	102	4.6
PFTrDA	55	102	2.8	93	3.8	104	5.3
PFTA	44	105	4.0	99	4.3	102	4.4

[a] TOC = 1.8 mg/L and hardness =205 mg/L.

[b] Recovery corrected for a native PFOA concentration of 14 ng/L in the tap water used for this study.

TABLE 11. EXTRACT HOLDING TIME DATA FOR SAMPLES FROM CHLORINATED SURFACE WATER, FORTIFIED WITH METHOD ANALYTES AND PRESERVED AND STORED ACCORDING TO SECTION 8 (n=5)

Analyte	Fortified Conc. (ng/L)	Day 0		Day 7		Day 14		Day 22		Day 28	
		Mean %Rec	RSD %	Mean %Rec	RSD %	Mean %Rec	RSD %	Mean %Rec	RSD %	Mean %Rec	RSD %
PFBS	91	83	8.5	89	10	91	8.3	92	11	90	7.5
PFHxA	50	99	4.3	101	4.7	103	5.7	105	5.2	102	4.1
PFHpA	41	105	1.1	101	3.4	109	3.5	110	2.9	108	1.7
PFHxS	113	98	2.8	101	2.1	107	3.5	106	3.1	104	2.5
PFOA[a]	46	98	2.5	100	1.4	102	2.7	101	3.4	101	2.8
PFNA	48	106	2.5	104	3.0	102	3.5	104	4.0	107	3.1
PFOS	96	103	4.9	100	1.6	109	1.4	103	3.6	105	1.9
PFDA	37	102	3.3	104	2.9	100	3.3	102	5.4	105	2.9
NMeFOSAA	202	97	3.6	96	1.8	96	2.8	102	3.4	99	3.9
NEtFOSAA	214	105	3.0	100	2.5	99	3.4	108	1.7	105	3.7
PFUnA	54	104	3.0	103	3.1	100	4.4	104	3.6	104	4.8
PFDoA	37	100	2.2	102	1.6	101	3.0	107	5.4	110	4.6
PFTrDA	55	102	2.8	95	3.8	97	2.5	104	4.1	104	2.3
PFTA	44	105	4.0	100	2.6	93	3.4	110	3.1	110	2.7

[a] Recovery corrected for a native PFOA concentration of 14 ng/L in the tap water used for this study.

TABLE 12. INITIAL DEMONSTRATION OF CAPABILITY QUALITY CONTROL REQUIREMENTS

Method Reference	Requirement	Specification and Frequency	Acceptance Criteria
Sect. 9.2.1	Initial Demonstration of Low System Background	Analyze LRB prior to any other IDC steps.	Demonstrate that all method analytes are below 1/3 the MRL and that possible interferences from extraction media do not prevent the identification and quantification of method analytes.
Sect. 9.2.2	Initial Demonstration of Precision (IDP)	Analyze four to seven replicate LFBs fortified near the midrange calibration concentration.	%RSD must be <20%
Sect. 9.2.3	Initial Demonstration of Accuracy (IDA)	Calculate average recovery for replicates used in IDP.	Mean recovery ± 30% of true value
Sect. 9.2.4	Initial Demonstration of Peak Asymmetry Factor	Calculate the peak asymmetry factor using the equation in Section 9.3.9 for the first two eluting chromatographic peaks in a mid-level CAL standard.	Peak asymmetry factor of 0.8 - 1.5
Sect. 9.2.5	Minimum Reporting Limit (MRL) Confirmation	Fortify, extract and analyze seven replicate LFBs at the proposed MRL concentration. Calculate the Mean and the Half Range (HR). Confirm that the upper and lower limits for the Prediction Interval of Result (Upper PIR, and Lower PIR, Sect. 9.2.5.2) meet the recovery criteria.	Upper PIR ≤ 150% Lower PIR ≥ 50%
Sect. 9.2.6 and 9.3.10	Quality Control Sample (QCS)	Analyze a standard from a second source, as part of IDC.	Results must be within 70-130% of true value.
Sect. 9.2.7	Detection Limit (DL) Determination (optional)	Over a period of trhee days, prepare a minimum of seven replicate LFBs fortified at a concentration estimated to be near the DL. Analyze the replicates through all steps of the analysis. Calculate the DL using the equation in Sect. 9.2.7.1.	Data from DL replicates are <u>not required</u> to meet method precision and accuracy criteria. If the DL replicates are fortified at a low enough concentration, it is likely that they will not meet precision and accuracy criteria.

NOTE: Table 12 is intended as an abbreviated summary of QC requirements provided as a convenience to the method user. Because the information has been abbreviated to fit the table format, there may be issues that need additional clarification, or areas where important additional information from the method text is needed. In all cases, the full text of the QC in Section 9 supersedes any missing or conflicting information in this table.

TABLE 13. ONGOING QUALITY CONTROL REQUIREMENTS (SUMMARY)

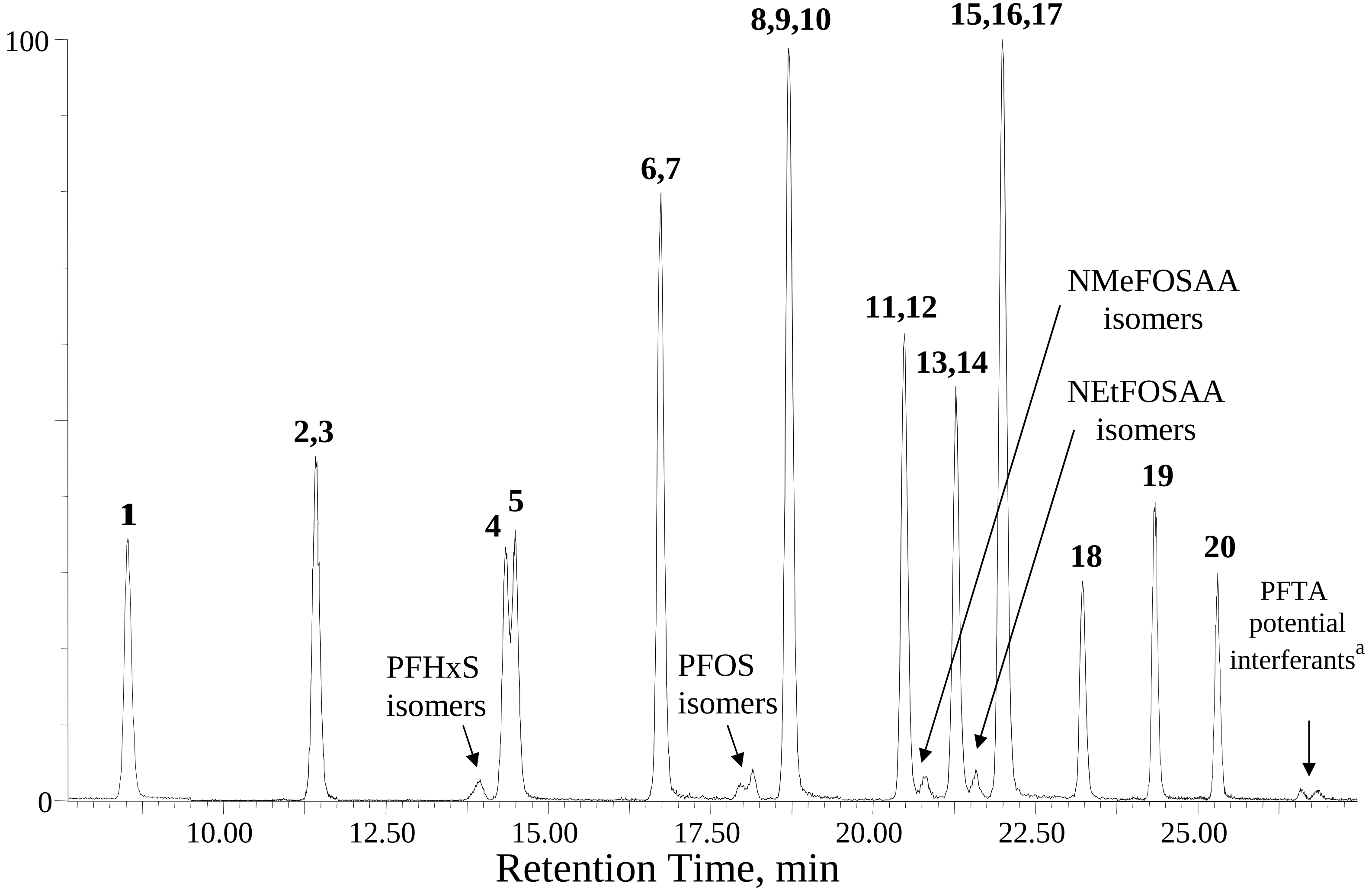
Method Reference	Requirement	Specification and Frequency	Acceptance Criteria
Sect. 8.1 - Sect. 8.5	Sample Holding Time	14 days with appropriate preservation and storage as described in Sections 8.1-8.5.	Sample results are valid only if samples are extracted within the sample holding time.
Sect. 8.5	Extract Holding Time	28 days when stored at room temperature in polypropylene centrifuge tubes.	Extract results are valid only if extracts are analyzed within the extract holding time.
Sect. 9.3.1	Laboratory Reagent Blank (LRB)	Daily, or with each extraction batch of up to 20 samples, whichever is more frequent.	Demonstrate that all method analytes are below 1/3 the MRL, and confirm that possible interferences do not prevent quantification of method analytes. If targets exceed 1/3 the MRL or if interferences are present, results for these subject analytes in the extraction batch are invalid.
Sect. 9.3.3	Laboratory Fortified Blank (LFB)	Analyze at least one LFB daily or one for each extraction batch of up to 20 Field Samples. Rotate the fortified concentrations between low, medium and high amounts.	Results of LFB analyses must be 70-130% of the true value for each method analyte for all fortified concentrations except the lowest CAL point. Results of the LFBs corresponding to the lowest CAL point for each method analyte must be 50-150% of the true value.
Sect. 9.3.4	Internal Standard (IS)	Internal standards, ^{13}C-PFOA (IS#1), ^{13}C-PFOS (IS#2), and d_3-NMeFOSAA (IS#3), are added to all standards and sample extracts, including QC samples. Compare IS areas to the average IS area in the initial calibration and to the most recent CCC.	Peak area counts for all ISs in all injections must be within ± 50% of the average peak area calculated during the initial calibration and 70-140% from the most recent CCC. If ISs do not meet this criterion, corresponding target results are invalid.
Sect. 9.3.5	Surrogate Standards (SUR)	Surrogate standards, ^{13}C-PFHxA, ^{13}C-PFDA, and d_5-NEtFOSAA, are added to all CAL standards and samples, including QC samples. Calculate SUR recoveries.	SUR recoveries must be 70-130% of the true value. If a SUR fails this criteria, report all results for sample as suspect/SUR recovery.

TABLE 13. (Continued)

Method Reference	Requirement	Specification and Frequency	Acceptance Criteria
Sect. 9.3.6	Laboratory Fortified Sample Matrix (LFSM)	Analyze one LFSM per extraction batch (20 samples or less) fortified with method analytes at a concentration close to but greater than the native concentration, if known. Calculate LFSM recoveries.	Recoveries at mid and high levels should be within 70-130% and within 50-150% at the low-level fortified amount (near the MRL). If these criteria are not met, results are labeled suspect due to matrix effects.
Sect. 9.3.7	Laboratory Fortified Sample Matrix Duplicate (LFSMD) or Field Duplicates (FD)	Extract and analyze at least one FD or LFSMD with each extraction batch (20 samples or less). A LFSMD may be substituted for a FD when the frequency of detects are low. Calculate RPDs.	Method analyte RPDs for the LFMD or FD should be ≤30% at mid and high levels of fortification and ≤50% near the MRL. If these criteria are not met, results are labeled suspect due to matrix effects.
Sect. 9.3.8	Field Reagent Blank (FRB)	Analysis of the FRB is required only if a Field Sample contains a method analyte or analytes at or above the MRL. The FRB is processed, extracted and analyzed in exactly the same manner as a Field Sample.	If the method analyte(s) found in the Field Sample is present in the FRB at a concentration greater than 1/3 the MRL, then all samples collected with that FRB are invalid and must be recollected and reanalyzed.
Sect. 9.3.9	Peak Asymmetry Factor	Calculate the peak asymmetry factor for the first two eluting chromatographic peaks in a mid-level CAL standard every time a calibration curve is generated.	Peak asymmetry factor of 0.8 - 1.5
Sect. 9.3.10	Quality Control Sample (QCS)	Analyze at least quarterly or when preparing new standards, as well as during the IDC.	Results must be within 70-130% of true value.
Sect. 10.2 and Sect. 9.3.2	Initial Calibration	Use IS calibration technique to generate a first or second order calibration curve forced through zero. Use at least five standard concentrations. Check the calibration curve as described in Sect. 10.2.7.	When each CAL standard is calculated as an unknown using the calibration curve, the analyte results should be 70-130% of the true value for all except the lowest standard, which should be 50-150% of the true value. Recalibration is recommended if these criteria are not met.
Sect. 9.3.2 and Sect. 10.3	Continuing Calibration Check (CCC)	Verify initial calibration by analyzing a low level (at the MRL or below) CCC prior to analyzing samples. CCCs are then injected after every 10 samples and after the last sample, rotating concentrations to cover the calibrated range of the instrument.	Recovery for each analyte and SUR must be within 70-130% of the true value for all but the lowest level of calibration. Recovery for each analyte in the lowest CAL level CCC must be within 50-150% of the true value and the SUR must be within 70-130% of the true value.

NOTE: Table 13 is intended as an abbreviated summary of QC requirements provided as a convenience to the method user. Because the information has been abbreviated to fit the table format, there may be issues that need additional clarification, or areas where important additional information from the method text is needed. In all cases, the full text of the QC in Section 8-10 supersedes any missing or conflicting information in this table.

FIGURE 1. EXAMPLE CHROMATOGRAM FOR REAGENT WATER FORTIFIED WITH METHOD 537 ANALYTES AT CONCENTRATION LEVELS INDICATED IN TABLE 6. NUMBERED PEAKS ARE IDENTIFIED IN TABLE 3.



[a] Abbreviated chromatographic conditions may lead to co-elution of PFTA and the potential interferants shown here. See Section 10.2.3 for more information.

STATE OF WASHINGTON
DEPARTMENT OF ECOLOGY
PO Box 488 • Manchester, WA 98353-0488 • (360) 871-8840

March 06, 2023

Heather Ann Joy Quilal-lan
Advanced Environmental Laboratories, Inc.- Jacksonville
6681 Southpoint Parkway
Jacksonville,FL 32216

Dear Heather Ann Joy Quilal-lan:

Thank you for your initial application for Washington State Environmental Laboratory Accreditation. Enclosed is a Certificate of Accreditation covering the one-year period beginning March 6, 2023 and a current Scope of Accreditation.

The following Lab requests are included in the initial Scope:
pH by SM 4500 H+B in non-potable water
pH by EPA 9045D in solid and chemical materials
Total Organic Carbon by EPA 415.1 in non-potable water. Not approved for NPDES.
Total Organic Carbon by SM 5310C in non-potable water
Total Organic carbon by EPA 9060A in solid and chemical materials
EPA 533 in drinking water
EPA 1633 2nd Draft in non-potable water
EPA 1633 2nd Draft in solid and chemical materials

Accreditation is based in part on third party recognition of the Labs Florida Department of Health NELAP accreditation.

Accreditation is based in part on review of your lab's performance over the past year as evidenced by participation in proficiency testing (PT) studies.

The following are denied accreditation, See 230306 not accredited document:
pH by EPA 9040C in non-potable water
N-Ethylperfluorooctane sulfonamide by EPA 1633 2nd Draft.

PT studies are required semi-annually. Two acceptable PT studies are required for the Labs March 2024 renewal.

As a reminder, continued participation in the Ecology Lab Accreditation Program requires the lab to:

- Submit a renewal application and fees annually.
- Report significant changes in facility, personnel, analytical methods, equipment, the lab's quality assurance (QA) manual or QA procedures as they occur.
- **Participate in proficiency testing studies semi-annually, with the following exception: For each parameter where all required PTs were analyzed and all results were**

satisfactory, you are required to submit only one PT result over this next year, and in subsequent years, as long as the results are satisfactory.

- Submit copies of current third-party Scopes of Accreditation when they are available.

If you have any questions concerning the accreditation of your lab, please contact Kamilee Ginder by e-mail at kamilee.ginder@ecy.wa.gov.

Sincerely,

Rebecca Wood

Rebecca Wood
Lab Accreditation Unit Supervisor

RW:KG:kg
Enclosures

The State of Washington
Department of Ecology

Advanced Environmental Laboratories, Inc.- Jacksonville
Jacksonville, FL

has complied with provisions set forth in Chapter 173-50 WAC and is hereby recognized by the Department of Ecology as an ACCREDITED LABORATORY for the analytical parameters listed on the accompanying Scope of Accreditation. This certificate is effective March 6, 2023 and shall expire March 5, 2024.

Witnessed under my hand on March 6, 2023

Rebecca Wood

Rebecca Wood
Lab Accreditation Unit Supervisor

Laboratory ID
C1083

WASHINGTON STATE DEPARTMENT OF ECOLOGY

ENVIRONMENTAL LABORATORY ACCREDITATION PROGRAM

SCOPE OF ACCREDITATION

Advanced Environmental Laboratories, Inc.- Jacksonville

Jacksonville, FL

is accredited for the analytes listed below using the methods indicated. Full accreditation is granted unless stated otherwise in a note. EPA is the U.S. Environmental Protection Agency. SM is "Standard Methods for the Examination of Water and Wastewater." SM refers to EPA approved method versions. ASTM is the American Society for Testing and Materials. USGS is the U.S. Geological Survey. AOAC is the Association of Official Analytical Chemists. Other references are described in notes.

Matrix/Analyte	Method	Notes
Drinking Water		
11-Chloroeicosafluoro-3-oxaundecane-1-sulfonic acid (11-Cl-PF3OUdS)	EPA 533	1
1H,1H,2H,2H,-Perfluorodecanesulfonic acid (8:2 FTS)	EPA 533	1
1H,1H,2H,2H,-Perfluorooctanesulfonic acid (6:2 FTS)	EPA 533	1
1H,1H,2H,2H-Perfluorohexanesulfonic acid (4:2 FTS)	EPA 533	1
4,8-Dioxa-3H-perfluorononanoic acid (ADONA)	EPA 533	1
9-Chlorohexadecafluoro-3-oxanonane-1-sulfonic acid (9-Cl-PF3ONS)	EPA 533	1
Hexafluoropropylene oxide dimer acid (HFPO-DA)	EPA 533	1
Nonafluoro-3,6-dioxaheptanoic acid (NFDHA)	EPA 533	1
Perfluoro(2-ethoxyethane)sulfonic acid (PFEESA)	EPA 533	1
Perfluoro-3-methoxypropanoic acid (PFMPA)	EPA 533	1
Perfluoro-4-methoxybutanoic acid (PFMBA)	EPA 533	1
Perfluorobutane sulfonic acid (PFBS)	EPA 533	1
Perfluorobutanoic acid (PFBA)	EPA 533	1
Perfluorodecanoic acid (PFDA)	EPA 533	1
Perfluorododecanoic acid (PFDoA)	EPA 533	1
Perfluoroheptane sulfonic acid (PFHpS)	EPA 533	1
Perfluoroheptanoic acid (PFHpA)	EPA 533	1
Perfluorohexane sulfonic acid (PFHxS)	EPA 533	1
Perfluorohexanoic acid (PFHxA)	EPA 533	1
Perfluorononanoic acid (PFNA)	EPA 533	1
Perfluorooctane sulfonic acid (PFOS)	EPA 533	1
Perfluorooctanoic acid (PFOA)	EPA 533	1
Perfluoropentane sulfonic acid (PFPeS)	EPA 533	1
Perfluoropentanoic acid (PFPeA)	EPA 533	1
Perfluoroundecanoic acid (PFUnA)	EPA 533	1

Matrix/Analyte	Method	Notes
Non-Potable Water		
Total Organic Carbon	EPA 415.1_1974	1,2
pH	SM 4500-H+ B-2011	1
Total Organic Carbon	SM 5310 C-2014	1
11-Chloroeicosafluoro-3-oxaundecane-1-sulfonic acid (11-Cl-PF3OUdS)	EPA 1633 2nd Draft	1
1H,1H,2H,2H,-Perfluorodecanesulfonic acid (8:2 FTS)	EPA 1633 2nd Draft	1
1H,1H,2H,2H,-Perfluorooctanesulfonic acid (6:2 FTS)	EPA 1633 2nd Draft	1
1H,1H,2H,2H-Perfluorohexanesulfonic acid (4:2 FTS)	EPA 1633 2nd Draft	1
2H,2H,3H,3H-Perfluorodecanoic Acid (7:3 FTCA)	EPA 1633 2nd Draft	1
2H,2H,3H,3H-Perfluoro-octanoic Acid (5:3 FTCA)	EPA 1633 2nd Draft	1
4,4,5,5,6,6,6-Heptafluorohexanoic Acid (3:3 FTCA)	EPA 1633 2nd Draft	1
4,8-Dioxa-3H-perfluorononanoic acid (ADONA)	EPA 1633 2nd Draft	1
9-Chlorohexadecafluoro-3-oxanonane-1-sulfonic acid (9-Cl-PF3ONS)	EPA 1633 2nd Draft	1
Hexafluoropropylene oxide dimer acid (HFPO-DA)	EPA 1633 2nd Draft	1
N-Ethylperfluorooctane sulfonamido acetic acid (NEtFOSAA)	EPA 1633 2nd Draft	1
N-Ethylperfluorooctanesulfonamidoethanol (EtFOSE)	EPA 1633 2nd Draft	1
N-Methylperfluorooctane sulfonamide (MeFOSA)	EPA 1633 2nd Draft	1
N-Methylperfluorooctane sulfonamido acetic acid (NMeFOSAA)	EPA 1633 2nd Draft	1
N-Methylperfluorooctanesulfonamidoethanol (MeFOSE)	EPA 1633 2nd Draft	1
Nonafluoro-3,6-dioxaheptanoic acid (NFDHA)	EPA 1633 2nd Draft	1
Perfluoro(2-ethoxyethane)sulfonic acid (PFEESA)	EPA 1633 2nd Draft	1
Perfluoro-3-methoxypropanoic acid (PFMPA)	EPA 1633 2nd Draft	1
Perfluoro-4-methoxybutanoic acid (PFMBA)	EPA 1633 2nd Draft	1
Perfluorobutane sulfonic acid (PFBS)	EPA 1633 2nd Draft	1
Perfluorobutanoic acid (PFBA)	EPA 1633 2nd Draft	1
Perfluorodecane sulfonic acid (PFDS)	EPA 1633 2nd Draft	1
Perfluorodecanoic acid (PFDA)	EPA 1633 2nd Draft	1
Perfluorododecane sulfonic acid (PFDoS)	EPA 1633 2nd Draft	1
Perfluorododecanoic acid (PFDoA)	EPA 1633 2nd Draft	1
Perfluoroheptane sulfonic acid (PFHpS)	EPA 1633 2nd Draft	1
Perfluoroheptanoic acid (PFHpA)	EPA 1633 2nd Draft	1
Perfluorohexane sulfonic acid (PFHxS)	EPA 1633 2nd Draft	1
Perfluorohexanoic acid (PFHxA)	EPA 1633 2nd Draft	1
Perfluorononane sulfonic acid (PFNS)	EPA 1633 2nd Draft	1
Perfluorononanoic acid (PFNA)	EPA 1633 2nd Draft	1
Perfluorooctane sulfonamide (PFOSA)	EPA 1633 2nd Draft	1
Perfluorooctane sulfonic acid (PFOS)	EPA 1633 2nd Draft	1
Perfluorooctanoic acid (PFOA)	EPA 1633 2nd Draft	1

Matrix/Analyte	Method	Notes
Non-Potable Water		
Perfluoropentane sulfonic acid (PFPeS)	EPA 1633 2nd Draft	1
Perfluoropentanoic acid (PFPeA)	EPA 1633 2nd Draft	1
Perfluorotetradecanoic acid (PFTeDA)	EPA 1633 2nd Draft	1
Perfluorotridecanoic acid (PFTrDA)	EPA 1633 2nd Draft	1
Perfluoroundecanoic acid (PFUnA)	EPA 1633 2nd Draft	1
Solid and Chemical Materials		
pH	EPA 9045 D_2004	1
Total Organic Carbon	EPA 9060A	1
11-Chloroeicosafluoro-3-oxaundecane-1-sulfonic acid (11-Cl-PF3OUdS)	EPA 1633 2nd Draft	1
1H,1H,2H,2H,-Perfluorodecanesulfonic acid (8:2 FTS)	EPA 1633 2nd Draft	1
1H,1H,2H,2H,-Perfluorooctanesulfonic acid (6:2 FTS)	EPA 1633 2nd Draft	1
1H,1H,2H,2H-Perfluorohexanesulfonic acid (4:2 FTS)	EPA 1633 2nd Draft	1
2H,2H,3H,3H-Perfluorodecanoic Acid (7:3 FTCA)	EPA 1633 2nd Draft	1
2H,2H,3H,3H-Perfluoro-octanoic Acid (5:3 FTCA)	EPA 1633 2nd Draft	1
4,4,5,5,6,6,6-Heptafluorohexanoic Acid (3:3 FTCA)	EPA 1633 2nd Draft	1
4,8-Dioxa-3H-perfluorononanoic acid (ADONA)	EPA 1633 2nd Draft	1
9-Chlorohexadecafluoro-3-oxanonane-1-sulfonic acid (9-Cl-PF3ONS)	EPA 1633 2nd Draft	1
Hexafluoropropylene oxide dimer acid (HFPO-DA)	EPA 1633 2nd Draft	1
N-Ethylperfluorooctane sulfonamide (EtFOSA)	EPA 1633 2nd Draft	1
N-Ethylperfluorooctane sulfonamido acetic acid (NEtFOSAA)	EPA 1633 2nd Draft	1
N-Ethylperfluorooctanesulfonamidoethanol (EtFOSE)	EPA 1633 2nd Draft	1
N-Methylperfluorooctane sulfonamide (MeFOSA)	EPA 1633 2nd Draft	1
N-Methylperfluorooctane sulfonamido acetic acid (NMeFOSAA)	EPA 1633 2nd Draft	1
N-Methylperfluorooctanesulfonamido ethanol (MeFOSE)	EPA 1633 2nd Draft	1
Nonafluoro-3,6-dioxaheptanoic acid (NFDHA)	EPA 1633 2nd Draft	1
Perfluoro(2-ethoxyethane)sulfonic acid (PFEESA)	EPA 1633 2nd Draft	1
Perfluoro-3-methoxypropanoic acid (PFMPA)	EPA 1633 2nd Draft	1
Perfluoro-4-methoxybutanoic acid (PFMBA)	EPA 1633 2nd Draft	1
Perfluorobutane sulfonic acid (PFBS)	EPA 1633 2nd Draft	1
Perfluorobutanoic acid (PFBA)	EPA 1633 2nd Draft	1
Perfluorodecane sulfonic acid (PFDS)	EPA 1633 2nd Draft	1
Perfluorodecanoic acid (PFDA)	EPA 1633 2nd Draft	1
Perfluorododecane sulfonic acid (PFDoS)	EPA 1633 2nd Draft	1
Perfluorododecanoic acid (PFDoA)	EPA 1633 2nd Draft	1
Perfluoroheptane sulfonic acid (PFHpS)	EPA 1633 2nd Draft	1
Perfluoroheptanoic acid (PFHpA)	EPA 1633 2nd Draft	1
Perfluorohexane sulfonic acid (PFHxS)	EPA 1633 2nd Draft	1

Matrix/Analyte	Method	Notes
Solid and Chemical Materials		
Perfluorohexanoic acid (PFHxA)	EPA 1633 2nd Draft	1
Perfluorononane sulfonic acid (PFNS)	EPA 1633 2nd Draft	1
Perfluorononanoic acid (PFNA)	EPA 1633 2nd Draft	1
Perfluorooctane sulfonamide (PFOSA)	EPA 1633 2nd Draft	1
Perfluorooctane sulfonic acid (PFOS)	EPA 1633 2nd Draft	1
Perfluorooctanoic acid (PFOA)	EPA 1633 2nd Draft	1
Perfluoropentane sulfonic acid (PFPeS)	EPA 1633 2nd Draft	1
Perfluoropentanoic acid (PFPeA)	EPA 1633 2nd Draft	1
Perfluorotetradecanoic acid (PFTeDA)	EPA 1633 2nd Draft	1
Perfluorotridecanoic acid (PFTrDA)	EPA 1633 2nd Draft	1
Perfluoroundecanoic acid (PFUnA)	EPA 1633 2nd Draft	1

Accredited Parameter Note Detail

1) Accreditation based in part on recognition of Florida NELAP accreditation. 2)Method not approved for NPDES testing.

Rebecca Wood

Authentication Signature
Rebecca Wood, Lab Accreditation Unit Supervisor

03/13/2023

Date

STATE OF WASHINGTON
DEPARTMENT OF ECOLOGY
PO Box 488 • Manchester, WA 98353-0488 • (360) 871-8840

March 22, 2023

Heather Ann Joy Quilal-lan
Advanced Environmental Laboratories, Inc.- Jacksonville
6681 Southpoint Parkway
Jacksonville,FL 32216

Dear Heather Ann Joy Quilal-lan:

Thank you for submitting the required supporting documentation for adding third party recognition accreditation N-Ethylperfluorooctane sulfonamide by EPA 1633 2nd draft in non-potable water.

The labs supporting documentation submitted was:
Passing PT WP-031523S
Current Florida NELAP Scope

Remember two acceptable PT samples are required for the Labs March 2024 renewal.

As a reminder, continued participation in the Ecology Lab Accreditation Program requires the lab to:

- Submit a renewal application and fees annually.
- Report significant changes in facility, personnel, analytical methods, equipment, the lab's quality assurance (QA) manual or QA procedures as they occur.
- **Participate in proficiency testing studies semi-annually, with the following exception: For each parameter where all required PT samples were analyzed and all results were satisfactory, you are required to submit only one PT result over this next year, and in subsequent years, as long as the results are satisfactory.**
- Submit copies of current third-party Scopes of Accreditation when they are available.

Your Right To Appeal

You have a right to appeal Ecology's decision to the Pollution Control Hearing Board (PCHB) within 30 days of the date of receipt of this decision letter. The appeal process is governed by Chapter 43.21B RCW and Chapter 371-08 WAC. "Date of receipt" is defined in RCW 43.21B.001(2).

To appeal you must do the following within 30 days of the date of receipt of this decision:

- File your appeal and a copy of this decision with the PCHB (see addresses below). Filing means actual receipt by the PCHB during regular business hours.

- Serve a copy of your appeal and this decision on Ecology in paper form - by mail or in person. (See addresses below.) E-mail is not accepted.

You must also comply with other applicable requirements in Chapter 43.21B RCW and Chapter 371-08 WAC.

Address And Location Information

Street Addresses:

Department of Ecology
Attn: Appeals Processing Desk
300 Desmond Drive SE
Lacey, WA 98503

Pollution Control Hearings Board
1111 Israel RD SW
STE 301
Tumwater, WA 98501

Mailing Addresses:

Department of Ecology
Attn: Appeals Processing Desk
PO Box 47608
Olympia, WA 98504-7608

Pollution Control Hearings Board
PO Box 40903
Olympia, WA 98504-0903

E-Mail Address:

Department of Ecology
Not currently available (see WAC 371-08)

Pollution Control Hearings Board
Pchb-shbappeals@eluho.wa.gov

If you have any questions concerning the accreditation of your lab, please contact Kamilee Ginder by e-mail at kamilee.ginder@ecy.wa.gov.

Sincerely,

Rebecca Wood
Lab Accreditation Unit Supervisor

RW:KG:kg
Enclosures

WASHINGTON STATE DEPARTMENT OF ECOLOGY

ENVIRONMENTAL LABORATORY ACCREDITATION PROGRAM

SCOPE OF ACCREDITATION

Advanced Environmental Laboratories, Inc.- Jacksonville

Jacksonville, FL

is accredited for the analytes listed below using the methods indicated. Full accreditation is granted unless stated otherwise in a note. EPA is the U.S. Environmental Protection Agency. SM is "Standard Methods for the Examination of Water and Wastewater." SM refers to EPA approved method versions. ASTM is the American Society for Testing and Materials. USGS is the U.S. Geological Survey. AOAC is the Association of Official Analytical Chemists. Other references are described in notes.

Matrix/Analyte	Method	Notes
Drinking Water		
11-Chloroeicosafluoro-3-oxaundecane-1-sulfonic acid (11-Cl-PF3OUdS)	EPA 533	1
1H,1H,2H,2H,-Perfluorodecanesulfonic acid (8:2 FTS)	EPA 533	1
1H,1H,2H,2H,-Perfluorooctanesulfonic acid (6:2 FTS)	EPA 533	1
1H,1H,2H,2H-Perfluorohexanesulfonic acid (4:2 FTS)	EPA 533	1
4,8-Dioxa-3H-perfluorononanoic acid (ADONA)	EPA 533	1
9-Chlorohexadecafluoro-3-oxanonane-1-sulfonic acid (9-Cl-PF3ONS)	EPA 533	1
Hexafluoropropylene oxide dimer acid (HFPO-DA)	EPA 533	1
Nonafluoro-3,6-dioxaheptanoic acid (NFDHA)	EPA 533	1
Perfluoro(2-ethoxyethane)sulfonic acid (PFEESA)	EPA 533	1
Perfluoro-3-methoxypropanoic acid (PFMPA)	EPA 533	1
Perfluoro-4-methoxybutanoic acid (PFMBA)	EPA 533	1
Perfluorobutane sulfonic acid (PFBS)	EPA 533	1
Perfluorobutanoic acid (PFBA)	EPA 533	1
Perfluorodecanoic acid (PFDA)	EPA 533	1
Perfluorododecanoic acid (PFDoA)	EPA 533	1
Perfluoroheptane sulfonic acid (PFHpS)	EPA 533	1
Perfluoroheptanoic acid (PFHpA)	EPA 533	1
Perfluorohexane sulfonic acid (PFHxS)	EPA 533	1
Perfluorohexanoic acid (PFHxA)	EPA 533	1
Perfluorononanoic acid (PFNA)	EPA 533	1
Perfluorooctane sulfonic acid (PFOS)	EPA 533	1
Perfluorooctanoic acid (PFOA)	EPA 533	1
Perfluoropentane sulfonic acid (PFPeS)	EPA 533	1
Perfluoropentanoic acid (PFPeA)	EPA 533	1
Perfluoroundecanoic acid (PFUnA)	EPA 533	1

Matrix/Analyte	Method	Notes
Non-Potable Water		
Total Organic Carbon	EPA 415.1_1974	1,2
pH	SM 4500-H+ B-2011	1
Total Organic Carbon	SM 5310 C-2014	1
11-Chloroeicosafluoro-3-oxaundecane-1-sulfonic acid (11-Cl-PF3OUdS)	EPA 1633 2nd Draft	1
1H,1H,2H,2H,-Perfluorodecanesulfonic acid (8:2 FTS)	EPA 1633 2nd Draft	1
1H,1H,2H,2H,-Perfluorooctanesulfonic acid (6:2 FTS)	EPA 1633 2nd Draft	1
1H,1H,2H,2H-Perfluorohexanesulfonic acid (4:2 FTS)	EPA 1633 2nd Draft	1
2H,2H,3H,3H-Perfluorodecanoic Acid (7:3 FTCA)	EPA 1633 2nd Draft	1
2H,2H,3H,3H-Perfluoro-octanoic Acid (5:3 FTCA)	EPA 1633 2nd Draft	1
4,4,5,5,6,6,6-Heptafluorohexanoic Acid (3:3 FTCA)	EPA 1633 2nd Draft	1
4,8-Dioxa-3H-perfluorononanoic acid (ADONA)	EPA 1633 2nd Draft	1
9-Chlorohexadecafluoro-3-oxanonane-1-sulfonic acid (9-Cl-PF3ONS)	EPA 1633 2nd Draft	1
Hexafluoropropylene oxide dimer acid (HFPO-DA)	EPA 1633 2nd Draft	1
N-Ethylperfluorooctane sulfonamide (EtFOSA)	EPA 1633 2nd Draft	1
N-Ethylperfluorooctane sulfonamido acetic acid (NEtFOSAA)	EPA 1633 2nd Draft	1
N-Ethylperfluorooctanesulfonamidoethanol (EtFOSE)	EPA 1633 2nd Draft	1
N-Methylperfluorooctane sulfonamide (MeFOSA)	EPA 1633 2nd Draft	1
N-Methylperfluorooctane sulfonamido acetic acid (NMeFOSAA)	EPA 1633 2nd Draft	1
N-Methylperfluorooctanesulfonamidoethanol (MeFOSE)	EPA 1633 2nd Draft	1
Nonafluoro-3,6-dioxaheptanoic acid (NFDHA)	EPA 1633 2nd Draft	1
Perfluoro(2-ethoxyethane)sulfonic acid (PFEESA)	EPA 1633 2nd Draft	1
Perfluoro-3-methoxypropanoic acid (PFMPA)	EPA 1633 2nd Draft	1
Perfluoro-4-methoxybutanoic acid (PFMBA)	EPA 1633 2nd Draft	1
Perfluorobutane sulfonic acid (PFBS)	EPA 1633 2nd Draft	1
Perfluorobutanoic acid (PFBA)	EPA 1633 2nd Draft	1
Perfluorodecane sulfonic acid (PFDS)	EPA 1633 2nd Draft	1
Perfluorodecanoic acid (PFDA)	EPA 1633 2nd Draft	1
Perfluorododecane sulfonic acid (PFDoS)	EPA 1633 2nd Draft	1
Perfluorododecanoic acid (PFDoA)	EPA 1633 2nd Draft	1
Perfluoroheptane sulfonic acid (PFHpS)	EPA 1633 2nd Draft	1
Perfluoroheptanoic acid (PFHpA)	EPA 1633 2nd Draft	1
Perfluorohexane sulfonic acid (PFHxS)	EPA 1633 2nd Draft	1
Perfluorohexanoic acid (PFHxA)	EPA 1633 2nd Draft	1
Perfluorononane sulfonic acid (PFNS)	EPA 1633 2nd Draft	1
Perfluorononanoic acid (PFNA)	EPA 1633 2nd Draft	1
Perfluorooctane sulfonamide (PFOSA)	EPA 1633 2nd Draft	1
Perfluorooctane sulfonic acid (PFOS)	EPA 1633 2nd Draft	1

Matrix/Analyte	Method	Notes
Non-Potable Water		
Perfluorooctanoic acid (PFOA)	EPA 1633 2nd Draft	1
Perfluoropentane sulfonic acid (PFPeS)	EPA 1633 2nd Draft	1
Perfluoropentanoic acid (PFPeA)	EPA 1633 2nd Draft	1
Perfluorotetradecanoic acid (PFTeDA)	EPA 1633 2nd Draft	1
Perfluorotridecanoic acid (PFTrDA)	EPA 1633 2nd Draft	1
Perfluoroundecanoic acid (PFUnA)	EPA 1633 2nd Draft	1
Solid and Chemical Materials		
pH	EPA 9045 D_2004	1
Total Organic Carbon	EPA 9060A	1
11-Chloroeicosafluoro-3-oxaundecane-1-sulfonic acid (11-Cl-PF3OUdS)	EPA 1633 2nd Draft	1
1H,1H,2H,2H,-Perfluorodecanesulfonic acid (8:2 FTS)	EPA 1633 2nd Draft	1
1H,1H,2H,2H,-Perfluorooctanesulfonic acid (6:2 FTS)	EPA 1633 2nd Draft	1
1H,1H,2H,2H-Perfluorohexanesulfonic acid (4:2 FTS)	EPA 1633 2nd Draft	1
2H,2H,3H,3H-Perfluorodecanoic Acid (7:3 FTCA)	EPA 1633 2nd Draft	1
2H,2H,3H,3H-Perfluoro-octanoic Acid (5:3 FTCA)	EPA 1633 2nd Draft	1
4,4,5,5,6,6,6-Heptafluorohexanoic Acid (3:3 FTCA)	EPA 1633 2nd Draft	1
4,8-Dioxa-3H-perfluorononanoic acid (ADONA)	EPA 1633 2nd Draft	1
9-Chlorohexadecafluoro-3-oxanonane-1-sulfonic acid (9-Cl-PF3ONS)	EPA 1633 2nd Draft	1
Hexafluoropropylene oxide dimer acid (HFPO-DA)	EPA 1633 2nd Draft	1
N-Ethylperfluorooctane sulfonamide (EtFOSA)	EPA 1633 2nd Draft	1
N-Ethylperfluorooctane sulfonamido acetic acid (NEtFOSAA)	EPA 1633 2nd Draft	1
N-Ethylperfluorooctanesulfonamidoethanol (EtFOSE)	EPA 1633 2nd Draft	1
N-Methylperfluorooctane sulfonamide (MeFOSA)	EPA 1633 2nd Draft	1
N-Methylperfluorooctane sulfonamido acetic acid (NMeFOSAA)	EPA 1633 2nd Draft	1
N-Methylperfluorooctanesulfonamido ethanol (MeFOSE)	EPA 1633 2nd Draft	1
Nonafluoro-3,6-dioxaheptanoic acid (NFDHA)	EPA 1633 2nd Draft	1
Perfluoro(2-ethoxyethane)sulfonic acid (PFEESA)	EPA 1633 2nd Draft	1
Perfluoro-3-methoxypropanoic acid (PFMPA)	EPA 1633 2nd Draft	1
Perfluoro-4-methoxybutanoic acid (PFMBA)	EPA 1633 2nd Draft	1
Perfluorobutane sulfonic acid (PFBS)	EPA 1633 2nd Draft	1
Perfluorobutanoic acid (PFBA)	EPA 1633 2nd Draft	1
Perfluorodecane sulfonic acid (PFDS)	EPA 1633 2nd Draft	1
Perfluorodecanoic acid (PFDA)	EPA 1633 2nd Draft	1
Perfluorododecane sulfonic acid (PFDoS)	EPA 1633 2nd Draft	1
Perfluorododecanoic acid (PFDoA)	EPA 1633 2nd Draft	1
Perfluoroheptane sulfonic acid (PFHpS)	EPA 1633 2nd Draft	1
Perfluoroheptanoic acid (PFHpA)	EPA 1633 2nd Draft	1

Matrix/Analyte	**Method**	**Notes**
Solid and Chemical Materials		
Perfluorohexane sulfonic acid (PFHxS)	EPA 1633 2nd Draft	1
Perfluorohexanoic acid (PFHxA)	EPA 1633 2nd Draft	1
Perfluorononane sulfonic acid (PFNS)	EPA 1633 2nd Draft	1
Perfluorononanoic acid (PFNA)	EPA 1633 2nd Draft	1
Perfluorooctane sulfonamide (PFOSA)	EPA 1633 2nd Draft	1
Perfluorooctane sulfonic acid (PFOS)	EPA 1633 2nd Draft	1
Perfluorooctanoic acid (PFOA)	EPA 1633 2nd Draft	1
Perfluoropentane sulfonic acid (PFPeS)	EPA 1633 2nd Draft	1
Perfluoropentanoic acid (PFPeA)	EPA 1633 2nd Draft	1
Perfluorotetradecanoic acid (PFTeDA)	EPA 1633 2nd Draft	1
Perfluorotridecanoic acid (PFTrDA)	EPA 1633 2nd Draft	1
Perfluoroundecanoic acid (PFUnA)	EPA 1633 2nd Draft	1

Accredited Parameter Note Detail

1) Accreditation based in part on recognition of Florida NELAP accreditation. 2)Method not approved for NPDES testing.

03/22/2023

Authentication Signature
Rebecca Wood, Lab Accreditation Unit Supervisor

Date

QAPP Worksheet #4, 7 & 8

Personnel Qualifications and Sign-off Sheet

Organization: **Advanced Environmental Laboratories, Inc.**

Name	Project Title/ Role	Education/Experience	Specialized Training/Certifications	Signature/Date
Craig Myers	Client Service Manager	AS Environmental Sciences / 28 yrs.	N/A	
Heather Quilal-lan	Quality Assurance Manager	BA Biology & Psychlology, Minor Chemistry / 15 yrs.	N/A	

QAPP Worksheet #12
Method Performance Criteria

Matrix	Ground Water & Water
Analytical Group	PFAS by EPA 1633 Draft and QSM 5.4 Tables B15 and B24
Concentration Level	Low

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)
EPA 1633 Draft & SVOA-043	Precision	RPD from Worksheet #28	Lab duplicates and LCS/LCSD	A
EPA 1633 Draft & SVOA-043	Precision	Sampling per QAP/SOP	Field duplicates and MS/MSD	S&A
EPA 1633 Draft & SVOA-043	Accuracy/Bias	% Rec. from Worksheet #28	Extracted Internal Standard (Isotop Dilution Analogues)	A
EPA 1633 Draft & SVOA-043	Accuracy/Bias	% Rec. from Worksheet #28	LCS	A
EPA 1633 Draft & SVOA-043	Accuracy/Bias (contamination)	Acceptable Blanks Levels	MB	A
EPA 1633 Draft & SVOA-043	Accuracy/Bias (contamination)	Sampling per QAP/SOP	Field Blanks and/or Equipment Blanks	S&A
EPA 1633 Draft & SVOA-043	Completeness	Laboratory Analysis	> 90%	S&A
EPA 1633 Draft & SVOA-043	Representativeness	Sampling per QAP/SOP	Field Notes	S
EPA 1633 Draft & SVOA-043	Comparability	Use of promulgated Methodology	QAPP compliance, data review	A
EPA 1633 Draft & SVOA-043	Sensitivity	PQL/EDL to meet project objectives	ICAL level acceptable, Low-Level LCS and MB acceptable	A

Matrix	Soils
Analytical Group	PFAS by EPA 1633 Draft and QSM 5.4 Tables B15 and B24
Concentration Level	Low

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)
EPA 1633 Draft & SVOA-043	Precision	RPD from Worksheet #28	Lab duplicates and LCS/LCSD	A
EPA 1633 Draft & SVOA-043	Precision	Sampling per QAP/SOP	Field duplicates and MS/MSD	S&A
EPA 1633 Draft & SVOA-043	Accuracy/Bias	% Rec. from Worksheet #28	Extracted Internal Standard (Isotop Dilution Analogues)	A
EPA 1633 Draft & SVOA-043	Accuracy/Bias	% Rec. from Worksheet #28	LCS	A
EPA 1633 Draft & SVOA-043	Accuracy/Bias (contamination)	Acceptable Blanks Levels	MB	A
EPA 1633 Draft & SVOA-043	Accuracy/Bias (contamination)	Sampling per QAP/SOP	Field Blanks and/or Equipment Blanks	S&A
EPA 1633 Draft & SVOA-043	Completeness	Laboratory Analysis	> 90%	S&A
EPA 1633 Draft & SVOA-043	Representativeness	Sampling per QAP/SOP	Field Notes	S
EPA 1633 Draft & SVOA-043	Comparability	Use of promulgated Methodology	QAPP compliance, data review	A
EPA 1633 Draft & SVOA-043	Sensitivity	PQL/EDL to meet project objectives	ICAL level acceptable, Low-Level LCS and MB acceptable	A

Matrix	Ground Water & Water
Analytical Group	Total Organic Carbon (TOC), Dissolved Organic Carbon (DOC), Total Inorganic Carbon (TIC) by SM 5310C
Concentration Level	Low

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)
SM5310C & WC-022	Precision	RPD from Worksheet #28	Lab duplicates and LCS/LCSD	A
SM5310C & WC-022	Precision	Sampling per QAP/SOP	Field duplicates and MS/MSD	S&A
SM5310C & WC-022	Accuracy/Bias	% Rec. from Worksheet #28	LCS	A
SM5310C & WC-022	Accuracy/Bias (contamination)	Acceptable Blanks Levels	MB	A
SM5310C & WC-022	Accuracy/Bias (contamination)	Sampling per QAP/SOP	Field Blanks and/or Equipment Blanks	S&A
SM5310C & WC-022	Completeness	Laboratory Analysis	> 90%	S&A
SM5310C & WC-022	Representativeness	Sampling per QAP/SOP	Field Notes	S
SM5310C & WC-022	Comparability	Use of promulgated Methodology	QAPP compliance, data review	A
SM5310C & WC-022	Sensitivity	PQL/EDL to meet project objectives	ICAL level acceptable, MB acceptable	A

Matrix	Soil
Analytical Group	Total Organic Carbon by EPA 9060A
Concentration Level	Low

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)
EPA 9060A & WC-021	Precision	RPD from Worksheet #28	Lab duplicates and LCS/LCSD	A
EPA 9060A & WC-021	Precision	Sampling per QAP/SOP	Field duplicates and MS/MSD	S&A
EPA 9060A & WC-021	Accuracy/Bias	% Rec. from Worksheet #28	LCS	A
EPA 9060A & WC-021	Accuracy/Bias (contamination)	Acceptable Blanks Levels	MB	A
EPA 9060A & WC-021	Accuracy/Bias (contamination)	Sampling per QAP/SOP	Field Blanks and/or Equipment Blanks	S&A
EPA 9060A & WC-021	Completeness	Laboratory Analysis	> 90%	S&A
EPA 9060A & WC-021	Representativeness	Sampling per QAP/SOP	Field Notes	S
EPA 9060A & WC-021	Comparability	Use of promulgated Methodology	QAPP compliance, data review	A
EPA 9060A & WC-021	Sensitivity	PQL/EDL to meet project objectives	ICAL level acceptable, MB acceptable	A

Matrix **Analytical Group** **Concentration Level**	Ground Water & Water Corrosivity (pH) by SM9040 Low

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)
SM9040, WC-002	Precision	RPD from Worksheet #28	Lab duplicates and LCS/LCSD	A
SM9040, WC-002	Precision	Sampling per QAP/SOP	Field duplicates and MS/MSD	S&A
SM9040, WC-002	Accuracy/Bias	% Rec. from Worksheet #28	LCS	A
SM9040, WC-002	Completeness	Laboratory Analysis	> 90%	S&A
SM9040, WC-002	Representativeness	Sampling per QAP/SOP	Field Notes	S
SM9040, WC-002	Comparability	Use of promulgated Methodology	QAPP compliance, data review	A

Matrix **Analytical Group** **Concentration Level**	Soil Corrosivity/pH by SW-846 Method 9045D Low

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)
SM9045D, WC-057	Precision	RPD from Worksheet #28	Lab duplicates and LCS/LCSD	A
SM9045D, WC-057	Precision	Sampling per QAP/SOP	Field duplicates and MS/MSD	S&A
SM9045D, WC-057	Accuracy/Bias	% Rec. from Worksheet #28	LCS	A
SM9045D, WC-057	Completeness	Laboratory Analysis	> 90%	S&A
SM9045D, WC-057	Representativeness	Sampling per QAP/SOP	Field Notes	S
SM9045D, WC-057	Comparability	Use of promulgated Methodology	QAPP compliance, data review	A
EPA 1030, WC-075	Comparability	Use of promulgated Methodology	QAPP compliance, data review	A

QAPP Worksheet #15
Project Action Limits and Laboratory Specific Detection/Quantitation Limits

Advanced
Environmental Laboratories, Inc.

AEL Jacksonville Limits Table Last updated 02/13/2023

DCN# QA-D043 eff
9/10/11, last rev
05/28/2021

Certification=x

											CLP	TCLP		
Matrix	**Method**	**FDOH**	**DoD/ISO**	**Cas #**	**Parameter**	**DL**	**LOD**	**LOQ**	**Units**	**Dept.**	**TAL/TCL**	**TCLP**	**Class/Type**	**SOP**
Solid	EPA 9060A	x	x	7440-44-0	Total Organic Carbon (TOC)	1620.00	5000.00	10000.00	mg/Kg	WetChem	°	°	Target	WC-021
Water	SM5310C	x	x	7440-44-0	Total Organic Carbon (TOC)	250.00	500.00	1000.00	ug/L	WetChem	°	°	Target	WC-022
Water	E9040C	x	x	PH	pH	1.000	1.000	1.000	pH units	WetChem	°	°	Target	WC-002
Soil	E9040C	x	x	PH	pH	1.000	1.000	1.000	pH units	WetChem	°	°	Target	WC-002
Soil	E9045	x	x	PH	pH	1.000	1.000	1.000	pH units	WetChem	°	°	Target	WC-057
Water	EPA Draft 1633	x	x	375-22-4	Perfluorobutanoate (PFBA, perfluorobutyric acid, Perfluorobutanoic acid)	2.50	5.00	10.00	ng/L	SemiVols	°	°	Target	SVOC-043
Water	EPA Draft 1633	x	x	377-73-1	Perfluoro-3-methoxypropanoic acid (PFMPA)	2.50	5.00	10.00	ng/L	SemiVols	°	°	Target	SVOC-043
Water	EPA Draft 1633	x	x	356-02-5	3-Perfluoropropyl propanoic acid (3:3FTCA)	10.00	20.00	40.00	ng/L	SemiVols	°	°	Target	SVOC-043
Water	EPA Draft 1633	x	x	2706-90-3	Perfluoropentanoate (PFPeA, perfluoropentanoic acid)	2.50	5.00	10.00	ng/L	SemiVols	°	°	Target	SVOC-043
Water	EPA Draft 1633	x	x	375-73-5	Perfluorobutane sulfonate (PFBS, perfluorobutane sulfonic acid)	2.50	5.00	10.00	ng/L	SemiVols	°	°	Target	SVOC-043
Water	EPA Draft 1633	x	x	863090-89-5	Perfluoro-4-methoxybutanoic acid (PFMBA)	2.50	5.00	10.00	ng/L	SemiVols	°	°	Target	SVOC-043
Water	EPA Draft 1633	x	x	113507-82-7	Perfluoro(2-ethoxyethane)sulfonic acid (PFEESA)	2.50	5.00	10.00	ng/L	SemiVols	°	°	Target	SVOC-043
Water	EPA Draft 1633	x	x	151772-58-6	Nonafluoro-3,6-dioxaheptanoic acid (NFDHA)	4.00	5.00	10.00	ng/L	SemiVols	°	°	Target	SVOC-043
Water	EPA Draft 1633	x	x	757124-72-4	1H, 1H, 2H, 2H-Perfluorohexane Sulfonate (4:2 Fluorotelomersulfonate, 4:2FTS)	2.50	5.00	10.00	ng/L	SemiVols	°	°	Target	SVOC-043
Water	EPA Draft 1633	x	x	307-24-4	Perfluorohexanoate (PFHxA, perfluorohexanoic acid)	2.50	5.00	10.00	ng/L	SemiVols	°	°	Target	SVOC-043
Water	EPA Draft 1633	x	x	2706-91-4	Perfluoropentanesulfonic acid (PFPeS)	2.50	5.00	10.00	ng/L	SemiVols	°	°	Target	SVOC-043
Water	EPA Draft 1633	x	x	13252-13-6	Hexafluoropropylene oxide dimer acid (HFPO-DA) – GenX or Propanoic acid (PFPrOPrA)	2.50	5.00	10.00	ng/L	SemiVols	°	°	Target	SVOC-043
Water	EPA Draft 1633	x	x	375-85-9	Perfluoroheptanoate (PFHpA, perfluoroheptanoic acid)	2.50	5.00	10.00	ng/L	SemiVols	°	°	Target	SVOC-043
Water	EPA Draft 1633	x	x	355-46-4	Perfluorohexane sulfonate (PFHxS, perfluorohexane sulfonic acid)	2.50	5.00	10.00	ng/L	SemiVols	°	°	Target	SVOC-043
Water	EPA Draft 1633	x	x	914637-493-3	2H,2H,3H,3H-Perfluorooctanoic acid (5:3FTCA)	50.00	100.00	200.00	ng/L	SemiVols	°	°	Target	SVOC-043
Water	EPA Draft 1633	x	x	919005-14-4	4,8-Dioxa-3H-perfluorononanoic acid (ADONA)	2.50	5.00	10.00	ng/L	SemiVols	°	°	Target	SVOC-043
Water	EPA Draft 1633	x	x	27619-97-2	1H, 1H, 2H, 2H-Perfluorooctane Sulfonate (6:2 Fluorotelomersulfonate, 6:2FTS)	2.50	5.00	10.00	ng/L	SemiVols	°	°	Target	SVOC-043
Water	EPA Draft 1633	x	x	335-67-1	Perfluorooctanoate (PFOA, perfluorooctanoic acid)	2.50	5.00	10.00	ng/L	SemiVols	°	°	Target	SVOC-043
Water	EPA Draft 1633	x	x	375-92-8	Perfluoroheptane Sulfonate (PFHpS, perfluorosulfonic acid)	2.50	5.00	10.00	ng/L	SemiVols	°	°	Target	SVOC-043
Water	EPA Draft 1633	x	x	375-95-1	Perfluorononanoate (PFNA, perfluorononanoic acid)	2.50	5.00	10.00	ng/L	SemiVols	°	°	Target	SVOC-043
Water	EPA Draft 1633	x	x	1763-23-1	Perfluorooctanesulfonic acid (PFOS)	2.50	5.00	10.00	ng/L	SemiVols	°	°	Target	SVOC-043
Water	EPA Draft 1633	x	x	812-70-4	3-Perfluoroheptyl propanoic acid (7:3FTCA)	50.00	100.00	200.00	ng/L	SemiVols	°	°	Target	SVOC-043
Water	EPA Draft 1633	x	x	7569426-58-1	9-Chlorohexadecafluoro-3-oxanonane-1-sulfonic acid (9C1-PF3ONS)	2.50	5.00	10.00	ng/L	SemiVols	°	°	Target	SVOC-043
Water	EPA Draft 1633	x	x	68259-12-1	Perfluorononanesulfonate (PFNS, Perfluorononane sulfonic acid)	2.50	5.00	10.00	ng/L	SemiVols	°	°	Target	SVOC-043
Water	EPA Draft 1633	x	x	39108-34-4	1H, 1H, 2H, 2H-Perfluorodecane Sulfonate (8:2 Fluorotelomersulfonate, 8:2FTS)	2.50	5.00	10.00	ng/L	SemiVols	°	°	Target	SVOC-043
Water	EPA Draft 1633	x	x	335-76-2	Perfluorodecanoate (PFDA, perfluorodecanoic acid)	2.50	5.00	10.00	ng/L	SemiVols	°	°	Target	SVOC-043
Water	EPA Draft 1633	x	x	2355-31-9	N-Methylperfluorooctane sulfonamido acetic acid (NMeFOSAA)	2.50	5.00	10.00	ng/L	SemiVols	°	°	Target	SVOC-043
Water	EPA Draft 1633	x	x	754-91-6	Perfluorooctane sulfonamide (PFOSA)	2.50	5.00	10.00	ng/L	SemiVols	°	°	Target	SVOC-043
Water	EPA Draft 1633	x	x	335-77-3	Perfluorodecane sulfonate (PFDS, perfluorodecane sulfonic acid)	2.50	5.00	10.00	ng/L	SemiVols	°	°	Target	SVOC-043
Water	EPA Draft 1633	x	x	2058-94-8	Perfluoroundecanoate (PFUnA, perfluoroundecanoic acid)	2.50	5.00	10.00	ng/L	SemiVols	°	°	Target	SVOC-043
Water	EPA Draft 1633	x	x	2991-50-6	N-Ethylperfluorooctane sufonamido acetic acid (NEtFOSAA)	2.50	5.00	10.00	ng/L	SemiVols	°	°	Target	SVOC-043
Water	EPA Draft 1633	x	x	763051-92-9	11-Chloroeicosafluoro-3-oxaundecane-1-sulfonic acid (11C1-PF3OUdS)	2.50	5.00	10.00	ng/L	SemiVols	°	°	Target	SVOC-043
Water	EPA Draft 1633	x	x	307-55-1	Perfluorododecanoate (PFDoA, perfluorododecanoic acid)	2.50	5.00	10.00	ng/L	SemiVols	°	°	Target	SVOC-043

Water	EPA Draft 1633	x	x	79780-39-5	Perfluorododecanesulfonic acid (PFDoS)	3.00	5.00	10.00	ng/L	SemiVols	°	°	Target	SVOC-043
Water	EPA Draft 1633	x	x	72629-94-8	Perfluorotridecanoate (PFTriA, perfluorotridecanoic acid)	2.50	5.00	10.00	ng/L	SemiVols	°	°	Target	SVOC-043
Water	EPA Draft 1633	x	x	24448-09-7	N-methyl perfluorooctanesulfonamidoethanol (N-Me-FOSE)	25.00	50.00	100.00	ng/L	SemiVols	°	°	Target	SVOC-043
Water	EPA Draft 1633	x	x	31506-32-8	N-methyl perfluorooctanesulfonamide (N-Me-FOSA)	2.50	5.00	10.00	ng/L	SemiVols	°	°	Target	SVOC-043
Water	EPA Draft 1633	x	x	376-06-7	Perfluorotetradecanoate (PFTeDA, perfluorotetradecanoic acid)	2.50	5.00	10.00	ng/L	SemiVols	°	°	Target	SVOC-043
Water	EPA Draft 1633	x	x	1691-99-2	N-ethyl perfluorooctanesulfonamidoethanol (N-Et-FOSE)	25.00	50.00	100.00	ng/L	SemiVols	°	°	Target	SVOC-043
Water	EPA Draft 1633	x	x	4151-50-2	N-ethyl perfluorooctanesulfonamide (N-Et-FOSA)	2.50	5.00	10.00	ng/L	SemiVols	°	°	Target	SVOC-043
Soil	EPA Draft 1633	x	x	375-22-4	Perfluorobutanoate (PFBA, perfluorobutyric acid, Perfluorobutanoic acid)	0.25	0.50	1.00	ug/Kg or ng/g	SemiVols	°	°	Target	SVOC-043
Soil	EPA Draft 1633	x	x	377-73-1	Perfluoro-3-methoxypropanoic acid (PFMPA)	0.25	0.50	1.00	ug/Kg or ng/g	SemiVols	°	°	Target	SVOC-043
Soil	EPA Draft 1633	x	x	356-02-5	3-Perfluoropropyl propanoic acid (3:3FTCA)	1.00	2.00	4.00	ug/Kg or ng/g	SemiVols	°	°	Target	SVOC-043
Soil	EPA Draft 1633	x	x	2706-90-3	Perfluoropentanoate (PFPeA, perfluoropentanoic acid)	0.25	0.50	1.00	ug/Kg or ng/g	SemiVols	°	°	Target	SVOC-043
Soil	EPA Draft 1633	x	x	375-73-5	Perfluorobutane sulfonate (PFBS, perfluorobutane sulfonic acid)	0.25	0.50	1.00	ug/Kg or ng/g	SemiVols	°	°	Target	SVOC-043
Soil	EPA Draft 1633	x	x	863090-89-5	Perfluoro-4-methoxybutanoic acid (PFMBA)	0.25	0.50	1.00	ug/Kg or ng/g	SemiVols	°	°	Target	SVOC-043
Soil	EPA Draft 1633	x	x	113507-82-7	Perfluoro(2-ethoxyethane)sulfonic acid (PFEESA)	0.25	0.50	1.00	ug/Kg or ng/g	SemiVols	°	°	Target	SVOC-043
Soil	EPA Draft 1633	x	x	151772-58-6	Nonafluoro-3,6-dioxaheptanoic acid (NFDHA)	0.50	1.00	2.00	ug/Kg or ng/g	SemiVols	°	°	Target	SVOC-043
Soil	EPA Draft 1633	x	x	757124-72-4	1H, 1H, 2H, 2H-Perfluorohexane Sulfonate (4:2 Fluorotelomersulfonate, 4:2FTS)	0.25	0.50	1.00	ug/Kg or ng/g	SemiVols	°	°	Target	SVOC-043
Soil	EPA Draft 1633	x	x	307-24-4	Perfluorohexanoate (PFHxA, perfluorohexanoic acid)	0.25	0.50	1.00	ug/Kg or ng/g	SemiVols	°	°	Target	SVOC-043
Soil	EPA Draft 1633	x	x	2706-91-4	Perfluoropentanesulfonic acid (PFPeS)	0.25	0.50	1.00	ug/Kg or ng/g	SemiVols	°	°	Target	SVOC-043
Soil	EPA Draft 1633	x	x	13252-13-6	Hexafluoropropylene oxide dimer acid (HFPO-DA) – GenX or Propanoic acid (PFPrOPrA)	0.25	0.50	1.00	ug/Kg or ng/g	SemiVols	°	°	Target	SVOC-043
Soil	EPA Draft 1633	x	x	375-85-9	Perfluoroheptanoate (PFHpA, perfluoroheptanoic acid)	0.25	0.50	1.00	ug/Kg or ng/g	SemiVols	°	°	Target	SVOC-043
Soil	EPA Draft 1633	x	x	355-46-4	Perfluorohexane sulfonate (PFHxS, perfluorohexane sulfonic acid)	0.25	0.50	1.00	ug/Kg or ng/g	SemiVols	°	°	Target	SVOC-043
Soil	EPA Draft 1633	x	x	914637-493-3	2H,2H,3H,3H-Perfluorooctanoic acid (5:3FTCA)	5.00	10.00	20.00	ug/Kg or ng/g	SemiVols	°	°	Target	SVOC-043
Soil	EPA Draft 1633	x	x	919005-14-4	4,8-Dioxa-3H-perfluorononanoic acid (ADONA)	0.25	0.50	1.00	ug/Kg or ng/g	SemiVols	°	°	Target	SVOC-043
Soil	EPA Draft 1633	x	x	27619-97-2	1H, 1H, 2H, 2H-Perfluorooctane Sulfonate (6:2 Fluorotelomersulfonate, 6:2FTS)	0.30	0.50	1.00	ug/Kg or ng/g	SemiVols	°	°	Target	SVOC-043
Soil	EPA Draft 1633	x	x	335-67-1	Perfluorooctanoate (PFOA, perfluorooctanoic acid)	0.25	0.50	1.00	ug/Kg or ng/g	SemiVols	°	°	Target	SVOC-043
Soil	EPA Draft 1633	x	x	375-92-8	Perfluoroheptane Sulfonate (PFHpS, perfluorosulfonic acid)	0.35	0.50	1.00	ug/Kg or ng/g	SemiVols	°	°	Target	SVOC-043
Soil	EPA Draft 1633	x	x	375-95-1	Perfluorononanoate (PFNA, perfluorononanoic acid)	0.25	0.50	1.00	ug/Kg or ng/g	SemiVols	°	°	Target	SVOC-043
Soil	EPA Draft 1633	x	x	1763-23-1	Perfluorooctanesulfonic acid (PFOS)	0.35	0.50	1.00	ug/Kg or ng/g	SemiVols	°	°	Target	SVOC-043
Soil	EPA Draft 1633	x	x	812-70-4	3-Perfluoroheptyl propanoic acid (7:3FTCA)	5.00	10.00	20.00	ug/Kg or ng/g	SemiVols	°	°	Target	SVOC-043
Soil	EPA Draft 1633	x	x	7569426-58-1	9-Chlorohexadecafluoro-3-oxanonane-1-sulfonic acid (9C1-PF3ONS)	0.25	0.50	1.00	ug/Kg or ng/g	SemiVols	°	°	Target	SVOC-043
Soil	EPA Draft 1633	x	x	68259-12-1	Perfluorononanesulfonate (PFNS, Perfluorononane sulfonic acid)	0.40	0.50	1.00	ug/Kg or ng/g	SemiVols	°	°	Target	SVOC-043
Soil	EPA Draft 1633	x	x	39108-34-4	1H, 1H, 2H, 2H-Perfluorodecane Sulfonate (8:2 Fluorotelomersulfonate, 8:2FTS)	0.25	0.50	1.00	ug/Kg or ng/g	SemiVols	°	°	Target	SVOC-043
Soil	EPA Draft 1633	x	x	335-76-2	Perfluorodecanoate (PFDA, perfluorodecanoic acid)	0.25	0.50	1.00	ug/Kg or ng/g	SemiVols	°	°	Target	SVOC-043
Soil	EPA Draft 1633	x	x	2355-31-9	N-Methylperfluorooctane sulfonamido acetic acid (NMeFOSAA)	0.25	0.50	1.00	ug/Kg or ng/g	SemiVols	°	°	Target	SVOC-043
Soil	EPA Draft 1633	x	x	754-91-6	Perfluorooctane sulfonamide (PFOSA)	0.25	0.50	1.00	ug/Kg or ng/g	SemiVols	°	°	Target	SVOC-043
Soil	EPA Draft 1633	x	x	335-77-3	Perfluorodecane sulfonate (PFDS, perfluorodecane sulfonic acid)	0.25	0.50	1.00	ug/Kg or ng/g	SemiVols	°	°	Target	SVOC-043
Soil	EPA Draft 1633	x	x	2058-94-8	Perfluoroundecanoate (PFUnA, perfluoroundecanoic acid)	0.25	0.50	1.00	ug/Kg or ng/g	SemiVols	°	°	Target	SVOC-043
Soil	EPA Draft 1633	x	x	2991-50-6	N-Ethylperfluorooctane sufonamido acetic acid (NEtFOSAA)	0.25	0.50	1.00	ug/Kg or ng/g	SemiVols	°	°	Target	SVOC-043
Soil	EPA Draft 1633	x	x	763051-92-9	11-Chloroeicosafluoro-3-oxaundecane-1-sulfonic acid (11C1-PF3OUdS)	0.25	0.50	1.00	ug/Kg or ng/g	SemiVols	°	°	Target	SVOC-043
Soil	EPA Draft 1633	x	x	307-55-1	Perfluorododecanoate (PFDoA, perfluorododecanoic acid)	0.25	0.50	1.00	ug/Kg or ng/g	SemiVols	°	°	Target	SVOC-043
Soil	EPA Draft 1633	x	x	79780-39-5	Perfluorododecanesulfonic acid (PFDoS)	0.50	1.00	2.00	ug/Kg or ng/g	SemiVols	°	°	Target	SVOC-043
Soil	EPA Draft 1633	x	x	72629-94-8	Perfluorotridecanoate (PFTriA, perfluorotridecanoic acid)	0.25	0.50	1.00	ug/Kg or ng/g	SemiVols	°	°	Target	SVOC-043
Soil	EPA Draft 1633	x	x	24448-09-7	N-methyl perfluorooctanesulfonamidoethanol (N-Me-FOSE)	2.50	5.00	10.00	ug/Kg or ng/g	SemiVols	°	°	Target	SVOC-043
Soil	EPA Draft 1633	x	x	31506-32-8	N-methyl perfluorooctanesulfonamide (N-Me-FOSA)	0.25	0.50	1.00	ug/Kg or ng/g	SemiVols	°	°	Target	SVOC-043
Soil	EPA Draft 1633	x	x	376-06-7	Perfluorotetradecanoate (PFTeDA, perfluorotetradecanoic acid)	0.25	0.50	1.00	ug/Kg or ng/g	SemiVols	°	°	Target	SVOC-043
Soil	EPA Draft 1633	x	x	1691-99-2	N-ethyl perfluorooctanesulfonamidoethanol (N-Et-FOSE)	2.50	5.00	10.00	ug/Kg or ng/g	SemiVols	°	°	Target	SVOC-043
Soil	EPA Draft 1633	x	x	4151-50-2	N-ethyl perfluorooctanesulfonamide (N-Et-FOSA)	0.25	0.50	1.00	ug/Kg or ng/g	SemiVols	°	°	Target	SVOC-043

QAPP Worksheet # 19 & 30
Sample Containers, Preservation, and Hold Times Table

Laboratory: Advanced Environmental Laboratories, Inc.
Accreditations: State of Florida FDOH E82574, ISO/IEC17025:2017, DoD ELAP PJLA 104509 L19-470-R2, State of Virgina VELAP 460296, & State of Alabama 42300
Backup Laboratory:
Sample Delivery Method: Fed Ex

Analyte Group	Matrix	Preparation Method	Analytical Method	Accreditation Expiration Date	Containers (Number, Size and Type)	Sample Volume	Preservation	Preparation Holding Time	Analysis Holding Time
Total Organic Carbon (TOC), Total Inorganic Carbon (TIC), Dissolved Organic Carbon (DOC).	Ground Water & Water	N/A	SM5310C	DoD August 4, 2023 FDOH June 30, 2023 VELAP March 14, 2023 ADEM June 30, 2023	TOC: 3 x pre-preserved phosphoric acid amber 40mL VOA vials. TIC: 3 x unpreserved amber 40mL VOA vials DOC: either 1) field filter in to 3 x pre-preserved phosphoric acid amber 40mL VOA vials or 2) Fill one unpreserved 250mL glass amber bottle and lab filter prior to analysis into a preserved 40mL VOA vial.	Approximately 40mL per preparation/analysis	TOC: Cool to >0 to < 6 degrees C, phosphoric acid preservation to pH <2. Samples needing TIC or DOC must be unpreserved and cooled to >0 to < 6 degrees C.	N/A	Preserved TOC samples must be analyzed 28 days from collection. TIC samples must be analyzed by 7 days from collection. DOC samples must be filtered and preserved by 7 days from collection, and then must be analyzed by 28 days from collection.
Total Organic Carbon (TOC), Total Inorganic Carbon (TIC).	Soil	N/A	EPA 9060A	DoD August 4, 2023 FDOH June 30, 2023 VELAP March 14, 2023 ADEM June 30, 2023	Filled 4oz glass jar with Teflon lid.	0.1g-1.0g per preparation/analysis.	As per FDEP FS1000, Thermal preservation: cooled to >0 to < 6 degrees C.	N/A	As per FDEP FS1000, 28 days from collection.
Corrosivity/pH	Ground Water & Water	N/A	EPA 9040	DoD August 4, 2023 FDOH June 30, 2023 VELAP March 14, 2023 ADEM June 30, 2023	Filled 8oz glass or plastic jar	50mL per preparation/analysis	Thermal preservation only 4 +/-2 °C	N/A	As soon as possible
Corrosivity/pH	Soil	N/A	EPA 9045D	DoD August 4, 2023 FDOH June 30, 2023 VELAP March 14, 2023 ADEM June 30, 2023	Filled 8oz glass jar with Teflon lid.	20g per preparation/analysis for Corrosivity/PH.	Thermal preservation only 4 +/-2 °C	N/A	24 hours from receipt/as soon as possible for Corrosivity/PH
PFAS	Ground Water & Water	N/A	EPA 1633 Draft and QSM 5.4 Table B-15 and B-24	DoD August 4, 2023 FDOH June 30, 2023 VELAP March 14, 2023 ADEM June 30, 2023	2 - 500mL wide mouth HDPE (3x for designated MS/MSD sample)	500mL per preparation/analysis.	None, ≤6°C	28 days	28 days
PFAS	Soil	N/A	EPA 1633 Draft and QSM 5.4 Table B-15 and B-24	DoD August 4, 2023 FDOH June 30, 2023 VELAP March 14, 2023 ADEM June 30, 2023	1-4oz HDPE	5g per preparation/analysis.	None, ≤6°C	28 days	28 days

QAPP Worksheet #23
Analytical SOP References Table

Analyte Group	Method	AEL SOP #	Title, Revision Date, and/or Number	Definitive or Screening Data	Matrix and Analytical Group	Instrument	Organization Performing Analysis	Modified for Project Work (Y/N)
Samples	Sample Reciept, handling, storage, and Log In	Admin-005	Sample Reciept, handling, storage, and Log In Rev.09, Eff. 07/27/2022	Definitive	Samples	NA	Advanced Environmental Laboratories, Inc.	N
Disposal	Sample Disposal	Admin-018	Waste Disposal and Pollution Prevention Admin-018 Rev.10 Eff 10/09/2020	Definitive	Samples	NA	Advanced Environmental Laboratories, Inc.	N
Quality Systems	Quality Systems	AEL QSM 10.4	Quality Manual, Rev. 10.4, Eff 03/31/2022	Definitive	Quality Systems	NA	Advanced Environmental Laboratories, Inc.	N
Wet Chemistry	SM9040C	WC-002	EPA Methods 150.1, 9040c, & SM 4500H+B Determination of pH (and Corrositivity) Electrometrically, Rev. 16, Eff: 2022-03-11	Definitive	Wet Chemistry Aqueous Sample Analysis	pH Meter	Advanced Environmental Laboratories, Inc.	N
Wetchemistry	EPA 9060A	WC-021	Method 9060A: Determination of Total Organic Carbon in Solid and Chemical Materials. Rev. 07, Eff. 2022-09-14	Definitive	Wetchem Solid Sample Analysis	Wet-Chemical Oxidation (Heated Persulfate Oxidation)	Advanced Environmental Laboratories, Inc.	N
Wetchemistry	SM5310C	WC-022	Method EPA 415.1 (1974)/SM5310B/C: Determination of Total Organic Carbon, Dissolved Organic Carbon, and Total Inorganic Carbon. Rev. 11, Eff. 2022-06-22	Definitive	Wetchem Aqueous Sample Analysis	Wet-Chemical Oxidation (Heated Persulfate Oxidation)	Advanced Environmental Laboratories, Inc.	N
Wet Chemistry	EPA 9045D	WC-057	Method 9045D Determinatin of pH Electrometrically in Soil and Waste, Rev 05, Eff: 2022-03-10	Definitive	Wet Chemistry Solid Sample Analysis	pH Meter	Advanced Environmental Laboratories, Inc.	N
Semi-Volatiles	EPA 1633 Draft and QSM 5.4 Tables B-15 and B-24	SVOC-043	Method EPA Draft Method 1633 and PFAS Compliant with Table B-24, DOD, QSM, Version 5.4 Requirements, Rev 01, Eff: 2022-8-26	Definitive	Semi-Volatlies Soil and Aqueous Preparation and Anaylsis	LC-MS/MS	Advanced Environmental Laboratories, Inc.	N

QAPP Worksheet #24

Analytical Instrument Calibration Table

Instrument	Calibration Procedure	Calibration Range	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference
Wet-Chemical Oxidation (Heated Persulfate Oxidation)	IC removal Check	N/A	For SM5310C: At instrument set-up a TIC standard is analyzed (25.0mg/L), prior to the ICAL and before sample analysis	Acceptable Blanks Levels for TOC (TOC concentration <1/2 MRL)	Correct problem then repeat Carry Over Check	Analyst	SVOC-022 Sections 14,16
Wet-Chemical Oxidation (Heated Persulfate Oxidation)	Carryover Check	N/A	For SM5310C: At instrument set-up a blank is analyzed after the UQL (25.0mg/L), prior to the ICAL and before sample analysis	Acceptable Blanks Levels (TOC/TIC/DOC concentration <1/2 MRL)	Correct problem then repeat Carry Over Check	Analyst	SVOC-022 Sections 14,16
Wet-Chemical Oxidation (Heated Persulfate Oxidation)	Initial Calibration	For SM 5310C: Prepare calibration standards at a maximum of 8 levels: 0 (blank), 1.0mg/L, 2.5mg/L, 5.0mg/L, 7.5mg/L, 10mg/L, 15mg/L, and 25mg/L. For EPA 9060A: Prepare calibration standards at a maximum of 6 levels: 0.5mg, 1mg, 2.5mg, 5mg, 10mg, and 20mg. External calibration is used.	At instrument set-up and after ICV or CCV failure, prior to sample analysis, every six months or as needed	Linear least squares regression for each analyte R ≥0.995	Correct problem then repeat ICAL	Analyst	For SM 5310C WC-022 Sections 13, 16 For EPA 9060A WC-023 Sections 13, 16
Wet-Chemical Oxidation (Heated Persulfate Oxidation)	Initial Calibration Verification (ICV)	At concentration level ± 25-50% of curve range	Once after ICAL	All target analytes within ± 10% of true value	Correct problem. Rerun ICV. If fails, repeat ICAL	Analyst	For SM 5310C WC-022 Sections 13, 16 For EPA 9060A WC-023 Sections 13, 16
Wet-Chemical Oxidation (Heated Persulfate Oxidation)	Initial Calibration Blank (ICB)	N/A	Once after ICV	Acceptable Blanks Levels (TOC/TIC/DOC concentration <1/2 MRL)	Correct problem then repeat ICB. If fails, perform instrument maintenance and repeat ICAL.	Analyst	For SM 5310C WC-022 Sections 13, 16 For EPA 9060A WC-023 Sections 13, 16
Wet-Chemical Oxidation (Heated Persulfate Oxidation)	Continuing Calibration Verification (CCV)	For SM 5310C: Initial CCV is low concentration (0.1mg/L), then the CCVs are varied between medium (10mg/L) and high concentration (25mg/L). For EPA 9060A: At concentration level ± 25-50% of curve range.	Daily before sample analysis, every 10 field samples, and close of analysis	For SM 5310C: All target analytes within ± 50% of true value for the low concentration CCV, and ± 15% of true value for the mid and high concentration CCV. For EPA 9060A: All target analytes within ± 10% of true value.	Immediately analyze two additional CCVs. If both pass, samples can be reported. If either fails, repair problem, rerun samples with new passing CCV. May require new ICAL. If reanalysis not possible, data must be qualified with case narration.	Analyst	For SM 5310C WC-022 Sections 12, 13, 16 For EPA 9060A WC-023 Sections 12, 13, 16
Wet-Chemical Oxidation (Heated Persulfate Oxidation)	Continuing Calibration Blank (CCB)	N/A	Analzyed after the CCV every 10 field samples, and close of analysis	Acceptable Blanks Levels (TOC/TIC/DOC concentration <1/2 MRL)	If fails, repair problem, rerun samples with new passing CCV and CCB set. May require new ICAL. If reanalysis not possible, data must be qualified with case narration.	Analyst	For SM 5310C WC-022 Sections 12, 13, 16 For EPA 9060A WC-023 Sections 12, 13, 16

pH meter	Initial Calibration	4.00, 7.00, 10.00 pH units	At instrument set-up and after ICV or CCV failure, prior to sample analysis	All levels re-analyzed after calibration, and must be within ± 5% of true value	Correct problem then repeat ICAL	Analyst	WC-002, WC-057
pH meter	Initial Calibration Verification (ICV)	7.0 pH units	Once after ICAL	Within ± 5% of true value	Correct problem. Rerun ICV. If fails, repeat ICAL	Analyst	WC-002, WC-057
pH meter	Continuing Calibration Verification (CCV)	7.0 pH units	Daily before sample analysis, and at the end of analysis.	Within ± 5% of true value	Correct problem. Rerun CCV. If fails, repeat ICAL	Analyst	WC-002, WC-057
LC-MS/MS	Mass Calibration	N/A	Instrument must have a valid mass calibration prior to any sample analysis. Mass calibration is verified after each mass calibration, prior to initial calibration (ICAL).	Calibrate the mass scale of the MS with calibration compounds and procedures described by the manufacturer. Mass calibration range must bracket the ion masses of interest. The most recent mass calibration must be used for every acquisition in an analytical run. Mass calibration must be verified to be ±0.5 amu of the true value, by acquiring a full scan continuum mass spectrum of a PFAS stock standard.	If the mass calibration fails, then recalibrate. If it fails again, consult manufacturer instructions on corrective maintenance.	Analyst	SVOC-043 Sections 12, 13, and 18
LC-MS/MS	Bile Salt Interference Check	TDCA, TCDCA and TUDCA at 1.0ug/mL	After the initial calibration as a check on the chromatographic conditions, and at the beginning of every DOD sequence.	Each bile salt must not elute within 1 minute of all PFOS isomers.	If an interference is present, the chromatographic conditions must be modified to eliminate the interference from the bile salts (e.g., changing the retention time of the bile salts such that they fall outside the retention time window for any of the linear or branched PFOS isomers in the standard by at least one minute), and the initial calibration repeated.	Analyst	SVOC-043 Sections 12 and 13
LC-MS/MS	Calibration, Calibration Verification and Spiking Standards	Mid- to high- level concentration.	All analytes. Note: Standards containing both branched and linear isomers are to be used during method validation and when re-establishing retention times, to ensure the total response is quantitated for that analyte. Technical grade standards cannot be used for quantitative analysis. Identify the retention times of the branched isomers of PFOA present in the technical-grade PFOA standard. When PFOA is chromatographed on a reversed-phase column, the branched isomers elute prior to the linear isomer. Repeat the procedure in this section for PFHxS, PFOS, N-Et-FOSA, N-Me-FOSE, and N-Et-FOSE.	Standards containing both branched and linear isomers must be used when commercially available. PFAS method analytes may consist of both branched and linear isomers, but quantitative standards that contain the linear and branched isomers do not exist for all method analytes. For PFAS that do not have a quantitative branched and linear standard, identify the branched isomers by analyzing a qualitative standard that includes both linear and branched isomers and determine retention times, transitions and transition ion ratios. Quantitate samples by integrating the total response (i.e., accounting for peaks that are identified as linear and branched isomers) and relying on the initial calibration that uses the linear isomer quantitative standard.	NA	Analyst	SVOC-043 Sections 12, 13, and 18
LC-MS/MS	Mass Spectral Acquisition Rate		Each analyte, extracted internal standard (EIS) analyte	A minimum of 10 spectra scans are acquired across each chromatographic peak.	NA	Analyst	SVOC-043 Section 24
LC-MS/MS	Ion Transitions (Precursor-> Product)		Every field sample, standard, blank, and QC sample	In order to avoid biasing results high due to known interferences for some transitions, the transitions presented in SVOC-043 Table 3 are used for quantification. If these transitions are not used, the reason must be technically justified and documented (e.g., alternate transition was used due to observed interferences).	NA	Analyst	SVOC-043 Sections 12, 13, and 24

LC-MS/MS	Initial calibration (ICAL) typically nine standards; Calibration can be linear (minimum of 6 standards) or quadratic (minimum of 7 standards); weighting is allowed. Forcing the calibration through zero is mandatory.	ICAL1 0.1 ng/mL ICAL2 0.2 ng/mL ICAL3 0.5 ng/mL ICAL4 0.8 ng/mL ICAL5 1.0 ng/mL ICAL6 1.5 ng/mL ICAL7 2.0 ng/mL ICAL8 5.0 ng/mL ICAL9 10.0 ng/mL ICV (Varied ng/mL)	At instrument set-up and after ICV or CCV failure, 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 non-linear calibrations must have r2 ≥ 0.99 for each analyte. Commercial PFAS standards available as salts are acceptable providing the measured mass is corrected to the neutral acid concentration. Results shall be reported as the neutral acid with appropriate CAS number. If a labelled analog is not commercially available, the Extracted Internal Standard Analyte with the closest retention time or chemical similarity to the analyte must be used for quantitation. (Internal Standard Quantitation).	Perform maintenance, if necessary, repeat calibration if criterion is not met. No samples shall be analyzed until ICAL has passed.	Analyst	SVOC-043 Sections 12, 13, and 18
LC-MS/MS	Instrument blank (IBLK)	N/A	Every analytical sequence, prior to sample analysis, after the high standard of the ICAL, after every CCV and after any field sample with an analyte detection above the range of the calibration curve (if observed in time to edit/update the analytical sequence) the laboratory must analyze an Instrument Blank (IB).	Concentration of each analyte must be ≤½ the LOQ. Instrument Blank must contain EIS to enable quantitation of contamination	If acceptance criteria are not met after the highest calibration standard, calibration must be performed using a lower concentration for the highest standard until acceptance criteria is met. If sample concentrations exceed the highest allowed standard and the sample(s) following exceed this acceptance criteria (>1/2 LOQ), they must be reanalyzed	Analyst	SVOC-043 Sections 12, 13, and 18
LC-MS/MS	Initial calibration verification (ICV)	Varied	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 and verify second source standard; rerun second source verification. If that fails, correct problem and repeat ICAL.	Analyst	SVOC-043 Sections 12, 13, and 18
LC-MS/MS	Non-extracted Internal Standards (NIS)	Varied	Non-extracted Internal standards are added to all standards and sample extracts.	Area recoveries must be greater than 30% of the average of the ICAL. NIS areas corrected for the dilution factor must be greater than 30% of the average area of the calibration standards in diluted samples when additional NIS was not added post dilution of the extract.	Repeat the analysis using a fresh aliquot of the extract. If failure does not confirm, report the second analysis. If the failure confirms, examine the project-specific requirements. Contact the client as to additional measures to be taken.	Analyst	SVOC-043 Sections 12, 13, and 18
LC-MS/MS	Extracted Internal Standards (EIS)	Varied	Isotope dilution analogues are added to all samples prior to extraction.	EIS recoveries must be within 20-150% until in-house limits can be created, or no project limits are provided. In-house limits cannot be lower than 20%.	Repeat the analysis using a fresh aliquot of the extract. If failure does not confirm, report the second analysis. If the failure confirms, follow the requirements listed in EPA Draft Method 1633, Section 15.3.2. If EIS recoveries still fall outside of the acceptance range, the client must be contacted for additional measures to be taken.	Analyst	SVOC-043 Sections 12, 13, and 18
LC-MS/MS	Instrument Sensitivity Check (ISC)	Varied. Concentrations of analytes at, or below, MRL/LOQ.	Daily prior to analysis and at least once every 12 hours	Analyte concentrations must be at LOQ; concentrations must be within ±30% of their true values	Correct problem, rerun ISC. If problem persists, repeat ICAL.	Analyst	SVOC-043 Sections 12, 13, and 18
LC-MS/MS	Continuing Calibration Verification (CCV)	Varied	Daily prior to sample analysis (ISC); after every 10 field samples; at end of analytical sequence	All analytes 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 samples since the last acceptable CCV.	Analyst	SVOC-043 Sections 12, 13, and 18

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

Instrument/Equipment	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action (CA)	Title/Position Responsible for CA	Reference
Wet-Chemical Oxidation (Heated Persulfate Oxidation)	Gas service Halide scrubber Heater element Dryer tube Permeation tube Reagent reservoirs Syringe pump Reaction Vessel	Initial and Continuing Calibration Verifications	• Gas service replace as needed • Replace Halide scrubber every 3,000 samples (or as needed) • Replace Heater element as needed • Replace Dryer tube as needed • Replace Permeation tube every 24,000 samples (or as needed) • Refill Reagent reservoirs as needed • Replace Syringe pump as needed • Replace Reaction Vessel as needed	As Listed with Inspection	Method blanks and instrument blanks < DL, ICAL, ICV, CCV, peak shape, & LCS, as seen on worksheet #28	Normal replacement	Analyst.	WC-022, WC-023
pH meter	Analytical Performance	Initial and Continuing Calibration Verifications	• Checked daily • Inspect probe for cleanliness, check tubing, check flow of reagents, calibrate	As Listed with Inspection	QC passing criteria	Perform necessary equipment maintenance and check calibration standards	Analyst	WC-002 and WC-057
LC-MS/MS	Mobile Phase Injection site Guard Column Analytical Column Mass Spec	Initial and Continuing Calibration Verifications	• Inspect all tubing connections at time of maintenance to assure no leaks present. • 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	As Listed with Inspection	Method blanks and instrument blanks < DL, ICAL, ICV, ICS, CCV, peak shape, & LCS, as seen on worksheet #28	Normal replacement	Analyst	SVOC-043

QAPP Worksheet #28
Laboratory QC Samples Table

Matrix: **Aqueous**
Analytical Group: **Total Organic Carbon (TOC), Dissolved Organic Carbon (DOC), and/or Total Inorganic Carbon (TIC)**
Analytical Method / SOP Reference : **SM5310C**

QC Sample:	Number / Frequency	Method / SOP QC Acceptance Limits	Corrective Action	Title of Person Responsible for Corrective Action	Project Specific Measurement Performance Criteria (MPC)
Method Blank (MB)	Once every prep/analytical batch of 10 or fewer samples	No analyte detected equal to or above the detection limit (DL) or > 1/10 the regulatory limit, whichever is greater (DoD: No analytes > ½ LOQ; common lab contaminants none detected > LOQ)	Correct problem. If required, reprep and reanalyze MB and all QC samples and field samples processed with the contaminated blank. If not enough sample volume to re-prep, data qualified with case narration.	Analyst with Department Supervisor and QA Officer review.	
Laboratory Control Spike (LCS)	Once every prep/analytical batch of 10 or fewer samples	QC limits set in QSM 5.4 LCS tables or in-house generated limits when DoD limits unavailable.	Correct problem. If required, reprep and reanalyze LCS and all QC samples and field samples processed in batch. If not enough sample volume to re-prep, data qualified with case narration.	Analyst with Department Supervisor and QA Officer review.	
Matrix Spike (MS)	Once every prep/analytical batch of 10 or fewer samples	QC limits set in QSM 5.4 LCS tables or in-house generated limits when DoD limits unavailable.	When outside limits examine project specific requirements and/or contact client. Flag data appropriately.	Analyst with Department Supervisor review.	
Matrix Spike Duplicate (MSD)	Once every prep/analytical batch of 10 or fewer samples	QC limits set in QSM 5.4 LCS tables or in-house generated limits when DoD limits unavailable. RPD of all target compounds ≤15% between MS and MSD.	When outside limits examine project specific requirements and/or contact client. Flag data appropriately.	Analyst with Department Supervisor review.	
Sample DUP (DUP)	Once every prep/analytical batch of 10 or fewer samples	RPD of all target compounds ≤15% between sample and DUP.	When outside limits examine project specific requirements and/or contact client. Flag data appropriately.	Analyst with Department Supervisor review.	

Matrix: **Solid**
Analytical Group: **Total Organic Carbon (TOC)**
Analytical Method / SOP Reference : **EPA 9060A**

QC Sample:	Number / Frequency	Method / SOP QC Acceptance Limits	Corrective Action	Title of Person Responsible for Corrective Action	Project Specific Measurement Performance Criteria (MPC)
Method Blank (MB)	Once every prep/analytical batch of 20 or fewer samples	No analyte detected equal to or above the detection limit (DL) or > 1/10 the regulatory limit, whichever is greater (DoD: No analytes > ½ LOQ; common lab contaminants none detected > LOQ)	Correct problem. If required, reprep and reanalyze MB and all QC samples and field samples processed with the contaminated blank. If not enough sample volume to re-prep, data qualified with case narration.	Analyst with Department Supervisor and QA Officer review.	
Laboratory Control Spike (LCS)	Once every prep/analytical batch of 20 or fewer samples	QC limits set in QSM 5.4 LCS tables or in-house generated limits when DoD limits unavailable.	Correct problem. If required, reprep and reanalyze LCS and all QC samples and field samples processed in batch. If not enough sample volume to re-prep, data qualified with case narration.	Analyst with Department Supervisor and QA Officer review.	
Matrix Spike (MS)	Once every prep/analytical batch of 20 or fewer samples	QC limits set in QSM 5.4 LCS tables or in-house generated limits when DoD limits unavailable.	When outside limits examine project specific requirements and/or contact client. Flag data appropriately.	Analyst with Department Supervisor review.	
Matrix Spike Duplicate (MSD)	Once every prep/analytical batch of 20 or fewer samples	QC limits set in QSM 5.4 LCS tables or in-house generated limits when DoD limits unavailable. RPD of all target compounds ≤20% between MS and MSD.	When outside limits examine project specific requirements and/or contact client. Flag data appropriately.	Analyst with Department Supervisor review.	
Sample DUP (DUP)	Once every prep/analytical batch of 20 or fewer samples	RPD of all target compounds ≤20% between sample and DUP.	When outside limits examine project specific requirements and/or contact client. Flag data appropriately.	Analyst with Department Supervisor review.	

Matrix: **Aqueous**
Analytical Group: **pH**
Analytical Method / SOP Reference : **SM9040C/WC-002**

QC Sample:	Number / Frequency	Method / SOP QC Acceptance Limits	Corrective Action	Title of Person Responsible for Corrective Action	Project Specific Measurement Performance Criteria (MPC)
Laboratory Control Spike (LCS) / Continuing Calibration Verification (CCV)	Once every prep/analytical batch of 10 or fewer samples, and at the end of the batch	QC limits set in QSM 5.4 LCS tables or in-house generated limits when DoD limits unavailable.	Correct problem. If required, reprep and reanalyze LCS/CCV and all QC samples and field samples processed in batch. If not enough sample volume to re-prep, data qualified with case narration.	Analyst with Department Supervisor and QA Officer review.	
Sample Dup	Once every prep/analytical batch of 10 or fewer samples	within 0.1 pH unit of original reading	When outside limits examine project specific requirements and/or contact client. Flag data appropriately.	Analyst with Department Supervisor review.	

Matrix: **Solid**
Analytical Group: **pH**
Analytical Method / SOP Reference : **SM9045D/WC-057**

QC Sample:	Number / Frequency	Method / SOP QC Acceptance Limits	Corrective Action	Title of Person Responsible for Corrective Action	Project Specific Measurement Performance Criteria (MPC)
Laboratory Control Spike (LCS) / Continuing Calibration Verification (CCV)	Once every prep/analytical batch of 10 or fewer samples, and at the end of the batch	QC limits set in QSM 5.4 LCS tables or in-house generated limits when DoD limits unavailable.	Correct problem. If required, reprep and reanalyze LCS/CCV and all QC samples and field samples processed in batch. If not enough sample volume to re-prep, data qualified with case narration.	Analyst with Department Supervisor and QA Officer review.	
Sample Dup	Once every prep/analytical batch of 10 or fewer samples	within 0.1 pH unit of original reading	When outside limits examine project specific requirements and/or contact client. Flag data appropriately.	Analyst with Department Supervisor review.	

Matrix: **Aqueous**
Analytical Group: **PFAS**
Analytical Method / SOP Reference : **EPA 1633 Draft and DOD QSM 5.4 B-15 and B-24 / SVOC-043**

QC Sample:	Number / Frequency	Method / SOP QC Acceptance Limits	Corrective Action	Title of Person Responsible for Corrective Action	Project Specific Measurement Performance Criteria (MPC)
Method Blank (MB)	Once every prep/analytical batch of 20 or fewer samples	Must be spiked with EIS and subjected to prep procedure. Must be 1) less than ½ the MRL/LOQ, or 2) < 1/10th the concentration found in any sample in the prep batch, or 3) < 1/10th the regulatory limit, which ever of the three concentrations is greater.	Correct problem. If required, reprep and reanalyze MB and all QC samples and field samples processed with the contaminated blank. If not enough sample volume to re-prep, data qualified with case narration.	Analyst with Department Supervisor and QA Officer review.	
Laboratory Control Sample (LCS) and Low-Level Laboratory Control Sample (LLCS). (Equivalent to as OPR and LLOPR in method 1633)	Once every prep/analytical batch of 20 or fewer samples	Fortify the LLCS with method analytes at or below the MRL. Fortify the LCS with method analytes at a concentration near the mid-point of the curve. If not enough sample is provided for MS/MSD, then a LCSD must be performed. Recovery must be within 40-150%, until in-house limits can be created, or if project limits are not provided. In-house limits cannot be lower than 40%.	Correct problem. If required, reprep and reanalyze LCS and all QC samples and field samples processed in batch. If not enough sample volume to re-prep, data qualified with case narration.	Analyst with Department Supervisor and QA Officer review.	
Matrix Spike (MS)	Once every prep/analytical batch of 20 or fewer samples	Fortify the MS with method analytes at a concentration close to but greater than the native concentrations (if known), or near the mid-point of the curve. recoveries must be within the LCS limits – 40-150% (or in-house limits), if project limits are not provided.	When outside limits examine project specific requirements and/or contact client. Flag data appropriately.	Analyst with Department Supervisor review.	
Matrix Spike Duplicate (MSD)	Once every prep/analytical batch of 20 or fewer samples	Fortify the MSD with method analytes at a concentration close to but greater than the native concentrations (if known), or near the mid-point of the curve. recoveries must be within the LCS limits – 40-150% (or in-house limits), if project limits are not provided. % RPD must be </= 30%.	When outside limits examine project specific requirements and/or contact client. Flag data appropriately.	Analyst with Department Supervisor review.	

Matrix: **Solids**
Analytical Group: **PFAS**
Analytical Method / SOP Reference : **EPA 1633 Draft and DOD QSM 5.4 B-15 and B-24 / SVOC-043**

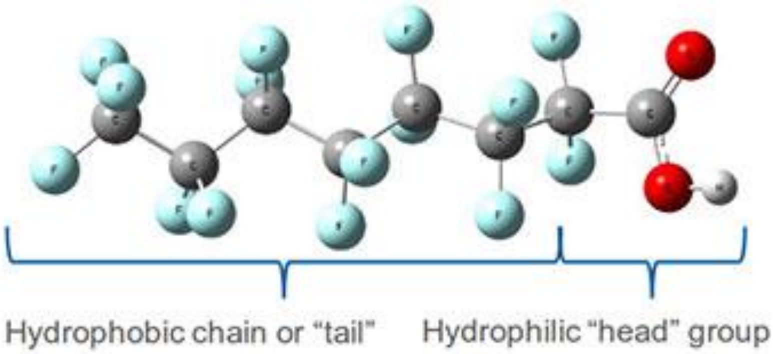
QC Sample:	Number / Frequency	Method / SOP QC Acceptance Limits	Corrective Action	Title of Person Responsible for Corrective Action	Project Specific Measurement Performance Criteria (MPC)
Method Blank (MB)	Once every prep/analytical batch of 20 or fewer samples	Must be spiked with EIS and subjected to prep procedure. Must be 1) less than ½ the MRL/LOQ, or 2) < 1/10th the concentration found in any sample in the prep batch, or 3) < 1/10th the regulatory limit, which ever of the three concentrations is greater.	Correct problem. If required, reprep and reanalyze MB and all QC samples and field samples processed with the contaminated blank. If not enough sample volume to re-prep, data qualified with case narration.	Analyst with Department Supervisor and QA Officer review.	
Laboratory Control Sample (LCS) and Low-Level Laboratory Control Sample (LLCS). (Equivalent to as OPR and LLOPR in method 1633)	Once every prep/analytical batch of 20 or fewer samples	Fortify the LLCS with method analytes at or below the MRL. Fortify the LCS with method analytes at a concentration near the mid-point of the curve. If not enough sample is provided for MS/MSD, then a LCSD must be performed. Recovery must be within 40-150%, until in-house limits can be created, or if project limits are not provided. In-house limits cannot be lower than 40%.	Correct problem. If required, reprep and reanalyze LCS and all QC samples and field samples processed in batch. If not enough sample volume to re-prep, data qualified with case narration.	Analyst with Department Supervisor and QA Officer review.	
Matrix Spike (MS)	Once every prep/analytical batch of 20 or fewer samples	Fortify the MS with method analytes at a concentration close to but greater than the native concentrations (if known), or near the mid-point of the curve. recoveries must be within the LCS limits – 40-150% (or in-house limits), if project limits are not provided.	When outside limits examine project specific requirements and/or contact client. Flag data appropriately.	Analyst with Department Supervisor review.	
Matrix Spike Duplicate (MSD)	Once every prep/analytical batch of 20 or fewer samples	Fortify the MSD with method analytes at a concentration close to but greater than the native concentrations (if known), or near the mid-point of the curve. recoveries must be within the LCS limits – 40-150% (or in-house limits), if project limits are not provided. % RPD must be </= 30%.	When outside limits examine project specific requirements and/or contact client. Flag data appropriately.	Analyst with Department Supervisor review.	

STANDARD OPERATING PROCEDURE

For

Method EPA Draft Method 1633 and PFAS Compliant with Table B-24, DOD, QSM, Version 5.4 Requirements

DETERMINATION OF PER- AND POLYFLUOROALKYL SUBSTANCES IN DRINKING WATER, WATER, OR SOILS BY ISOTOPE DILUTION ANION EXCHANGE SOLID PHASE EXTRACTION AND LIQUID CHROMATOGRAPHY/TANDEM MASS SPECTROMETRY



SOP Revision Log for AEL SOP SVOC-043

Revision Number	Revision Date	Reason for Revision	Section(s) and Page(s) Revised
Revision 00	6/01/2022	Initial Creation	All sections affected
Revision 01	8/26/2022	Revised acquisition gradient for the run method, and the analyte retention times. Minor grammatical updates throughout.	All sections affected

TABLE OF CONTENTS

1.0 Identification of Test Method

1.1 This is a solid phase extraction (SPE) liquid chromatography-tandem mass spectrometry (LC-MS/MS) method for the determination of select per- and polyfluoroalkyl substances (PFAS) in non-potable water and solids (soil, biosolids and sediment). Method 1633 requires the use of MS/MS in Multiple Reaction Monitoring (MRM) mode to enhance selectivity. Accuracy and precision data have been generated in reagent water and Ottawa sand for the compounds included in the Analyte List. Sample concentrations are determined by isotope dilution or extracted internal standard quantification using isotopically labeled compounds added to the samples before extraction. Analytes are reported in their acid form concentration.

1.2 This method is intended for use by analysts skilled in the performance of solid phase extractions, the operation of LC-MS/MS instrumentation, and the interpretation of the associated data.

1.3 This SOP deviates from the EPA 1633 referenced method in the following ways:

1.3.1 The SPE procedure for aqueous samples was modified so that instead of cartridge reservoirs, a large volume sample delivery system is used for sample filtration.

1.3.2 The hand-shake stage for the carbon clean-up is not performed for waters or soils extraction, and the centrifuge time for the carbon exposed sample has been reduced for the soil extraction. During method development, the carbon-clean-up SOP conditions for vortexing and centrifuging the samples produced the most optimal extraction efficiency.

1.3.3 The NIS solution is added to a filtered 1.0mL aliquot of each batch QC, matrix QC, and field sample extract instead of the entire 5mL eluent; this modification saves on material cost and does not interfere with the NIS quality criteria.

1.3.4 The HPLC run program was optimized for laboratory performance, efficiency, and materials cost. Including but not limited to the injection volume, columns, mobile phase, gradients, MS optimization conditions, etc. – all of which are further defined in this SOP. Note: the gradient and initial temperatures may require slight adjustments to accommodate the bile salt retention time criteria; such adjustments will not significantly affect the sensitivity or instrument performance (accuracy and precision).

Note: These deviations from the referenced test method are the best conditions for our instrumentation or client's needs and represent improved performance over the referenced test method conditions. Modifications may be made to improve performance (e.g., overcome interferences, or improve the sensitivity, accuracy, or precision of the results) provided that all performance criteria in this method are met and all modifications are well documented. Requirements for establishing equivalency are in Section 12.5 and 12.6.

2.0 Applicable Matrix or matrices

2.1 Method 1633 is applicable to non-potable water samples and solids (soil, biosolids and sediment).

3.0 Detection Limit

3.1 The method detection limit is determined in accordance with AEL SOP ADMIN-012, referencing 40CFR136, appendix B.

3.2 For the current MDLs, see the electronic version specific for the method, instrument, and matrix in the “AEL-QA” folder on the lab server.

4.0 Scope and Application, including components to be analyzed.

4.1 Both branched and linear PFAS isomers may be found in the environment. This method includes procedures for summing the contribution of multiple isomers to the final reported concentration. In those cases where standard materials containing multiple isomers are commercially available, laboratories should obtain such standards for the method analytes.

4.2 See Table 3 in Section 24 for a list of compounds and their characteristic ions that have been evaluated.

4.3 This method is restricted to use by or under the supervision of analysts experienced in the use of gas chromatograph/mass spectrometers and skilled in the interpretation of mass spectra. Each analyst must demonstrate the ability to generate acceptable results with this method.

4.4 Table 4.4 – Analyte List by Method

Analyte*	Abbreviation	CAS Number	Acid Group
1H, 1H, 2H, 2H-Perfluoro-octanesulfonic acid (6:2 Fluorotelomersulfonate)	6:2FTS	27619-97-2	Fluorotelomer sulfonic acids
Perfluorooctanesulfonic acid	PFOS	1763-23-1	Perfluoroalkyl sulfonic acids
Perfluorooctanoate (Perfluorooctanoic acid)	PFOA	335-67-1	Perfluoroalkyl carboxylic acids
Perfluoropentanoate (Perfluoropentanoic acid)	PFPeA	2706-90-3	Perfluoroalkyl carboxylic acids
Perfluoropentanesulfonic acid	PFPeS	2706-91-4	Perfluoroalkyl sulfonic acids
Perfluoroundecanoate (Perfluoroundecanoic acid)	PFUnA	2058-94-8	Perfluoroalkyl carboxylic acids
Perfluorotetradecanoate (Perfluorotetradecanoic acid)	PFTeDA (PFTA)	376-06-7	Perfluoroalkyl carboxylic acids
Perfluorotridecanoate (Perfluorotridecanoic acid)	PFTriA (PFTrDA)	72629-94-8	Perfluoroalkyl carboxylic acids
Perfluorooctane sulfonamide	FOSA (PFOSA)	754-91-6	Perfluorooctane sulfonamides
N-Methylperfluorooctane sulfonamido acetic acid	NMeFOSAA	2355-31-9	Perfluorooctane sulfonamidoacetic acids

Table 4.4 – Analyte List by Method (Continued)

Analyte*	Abbreviation	CAS Number	Acid Group
N-Ethylperfluorooctane sufonamido acetic acid	NEtFOSAA	2991-50-6	Perfluorooctane sulfonamidoacetic acids
Perfluorononanesulfonate (Perfluorononane sulfonic acid)	PFNS	68259-12-1	Perfluoroalkyl sulfonic acids
Perfluorodecane sulfonate (Perfluorodecane sulfonic acid)	PFDS	335-77-3	Perfluoroalkyl sulfonic acids
3-Perfluoropropyl propanoic acid	3:3FTCA	356-02-5	Fluorotelomer carboxylic acids
2H,2H,3H,3H-Perfluorooctanoic acid	5:3FTCA	914637-493-3	Fluorotelomer carboxylic acids
3-Perfluoroheptyl propanoic acid	7:3FTCA	812-70-4	Fluorotelomer carboxylic acids
N-ethyl perfluorooctanesulfonamide	NEtFOSA	4151-50-2	Perfluorooctane sulfonamides
N-methyl perfluorooctanesulfonamide	NMeFOSA	31506-32-8	Perfluorooctane sulfonamides
N-ethyl perfluorooctanesulfonamidoethanol	NEtFOSE	1691-99-2	Perfluorooctane sulfonamide ethanols
N-methyl perfluorooctanesulfonamidoethanol	NMeFOSE	24448-09-7	Perfluorooctane sulfonamide ethanols
Perfluorododecanesulfonic acid	PFDoS	79780-39-5	Perfluoroalkyl sulfonic acids
11-Chloroeicosafluoro-3-oxaundecane-1-sulfonic acid	11C1-PF3OUdS	763051-92-9	Ether sulfonic acids
9-Chlorohexadecafluoro-3-oxanonane-1-sulfonic acid	9Cl-PF3ONS	756426-58-1	Ether sulfonic acids
4,8-Dioxa-3H-perfluorononanoic acid	ADONA	919005-14-4	Per- & Polyfluoroether carboxylic acids
Hexafluoropropylene oxide dimer acid (GenX or Propanoic acid)	HFPO-DA (PFPrOPrA)	13252-13-6	Per- & Polyfluoroether carboxylic acids
Nonafluoro-3,6-dioxaheptanoic acid	NFDHA	151772-58-6	Per- & Polyfluoroether carboxylic acids
Perfluorobutanoate (Perfluorobutyric acid, Perfluorobutanoic acid)	PFBA	375-22-4	Perfluoroalkyl carboxylic acids
Perfluorobutane sulfonate (Perfluorobutanesulfonic acid)	PFBS	375-73-5	Perfluoroalkyl sulfonic acids
1H, 1H, 2H, 2H-Perfluorodecanesulfonic acid (8:2	8:2FTS	39108-34-4	Fluorotelomer sulfonic acids

Table 4.4 – Analyte List by Method (Continued)

Analyte*	Abbreviation	CAS Number	Acid Group
Perfluorodecanoate (Perfluorodecanoic acid)	PFDA	335-76-2	Perfluoroalkyl carboxylic acids
Perfluorododecanoate (Perfluorododecanoic acid)	PFDoA	307-55-1	Perfluoroalkyl carboxylic acids
Perfluoro(2-ethoxyethane)sulfonic acid	PFEESA	113507-82-7	Ether sulfonic acids
Perfluoroheptane Sulfonate (Perfluoroheptane sulfonic acid)	PFHpS	375-92-8	Perfluoroalkyl sulfonic acids
Perfluoroheptanoate (Perfluoroheptanoic acid)	PFHpA	375-85-9	Perfluoroalkyl carboxylic acids
1H, 1H, 2H, 2H-Perfluorohexane sulfonic acid (4:2 Fluorotelomersulfonate)	4:2FTS	757124-72-4	Fluorotelomer sulfonic acids
Perfluorohexane sulfonate (Perfluorohexanesulfonic acid)	PFHxS	355-46-4	Perfluoroalkyl sulfonic acids
Perfluorohexanoate (Perfluorohexanoic acid)	PFHxA	307-24-4	Perfluoroalkyl carboxylic acids
Perfluoro-3-methoxypropanoic acid	PFMPA	377-73-1	Per- & Polyfluoroether carboxylic acids
Perfluoro-4-methoxybutanoic acid	PFMBA	863090-89-5	Per- & Polyfluoroether carboxylic acids
Perfluorononanoate (Perfluorononanoic acid)	PFNA	375-95-1	Perfluoroalkyl carboxylic acids

*Some PFAS are commercially available as ammonium, sodium, and potassium salts. This method measures all forms of the analytes as anions while the identity of the counterion is inconsequential. Analytes may be purchased as acids or as any of the corresponding salts.

5.0 Summary of Method

5.1 For aqueous samples, a 500 mL sample is fortified with isotopically labeled analogues of the method analytes that function as isotope dilution standards. The sample is passed through an SPE cartridge containing weak anion exchange, mixed-mode polymeric sorbent that has been pre-conditioned with washes of 1% methanolic ammonium hydroxide and 0.3M formic acid, to extract the method analytes and isotope dilution analogues. The cartridge is rinsed with sequential washes of reagent water and followed by washes of 1:1 0.1M formic acid/methanol, and then the compounds are eluted from the solid phase sorbent with 1% methanolic ammonium hydroxide. Acetic acid is added to the extract and vortexed. The extract is then cleaned with carbon, centrifuged and filtered through a 0.2um syringe filter. 1.0mL of the extract is then added to a 2.0mL polyethylene autosampler vial and 10uL of the injected internal standard is added.

5.2 For solid samples, 5.0g sample is fortified with isotopically labeled analogues of the method analytes that function as isotope dilution standards. The sample is extracted on an autoshaker table with 0.3% methanolic ammonium hydroxide 3 times, decanting and collecting the supernatant in a clean 50mL centrifuge tube. The extract is then cleaned with carbon, centrifuged and decanted into another clean 50mL centrifuge tube. The extract is then concentrated using a N-Evap nitrogen blowdown to a known volume (approximately 12-19mL). The extract volume is then brought up to 50mL with reagent water and pH adjusted as needed. The extract is then extracted using a SPE column following the same procedure used for aqueous samples. The cartridge is then eluted with 1% methanolic ammonium hydroxide, acetic acid added, vortexed and filtered using a 0.2um syringe filter. 1.0 ml of the extract is added to a 2.0mL polyethylene autosampler vial and 10uL of the injected internal standard is added.

5.3 Extracts are analyzed by LC-MS/MS in the MRM detection mode. The concentration of each analyte is calculated using the isotope dilution technique. For QC purposes, the percent recoveries of the isotope dilution analogues are calculated using the integrated peak areas of isotope performance standards, which are added to the final extract and function as traditional internal standards, exclusively applied to the isotope dilution analogues.

6.0 Definitions

See also AEL ADMIN SOP-039 Laboratory Definitions

6.1 Analyte – A PFAS compound included in this method. The analytes are listed in Table 4.4.

6.2 Compound – One of many variants or configurations of a common chemical structure. Individual compounds are identified by the number of carbon atoms and functional group attached at the end of the chain.

6.3 Class A glassware – Volumetric glassware that provides the highest accuracy. Class A volumetric glassware complies with the Class A tolerances defined in ASTM E694, must be permanently labeled as Class A, and is supplied with a serialized certificate of precision.

6.4 Extraction Batch – A group of field samples with similar matrices, which are prepared at the same time in the same location using the same procedure and processed as a unit. A Method Blank, a Laboratory Control Sample, a Matrix Spike, and a Duplicate Matrix Spike must accompany each extraction batch of 20 or fewer field samples.

6.5 Continuing Calibration Verification (CCV); also known as a Continuing Calibration Check (CCC)) – A known interference free matrix spiked with a known concentration (near the mid-point of the Initial Calibration) of the target analytes. The CCV is analyzed 1) at the beginning of a 24-hour analytical run at the MRL concentration, and 2) every 10 field samples, and 3) at the end of the analytical sequence at alternating concentrations between mid and high calibration levels. The CCV is used to verify that the instrument calibration is in control before and after sample analysis.

6.6 DoD (DOD) – Acronym for Department of Defense.

6.7 Extracted internal standard (EIS) quantification – The response of the target compound is compared to the response of the labeled analog of another compound in the same LOC.

6.8 Internal standard quantitation – A means of determining the concentration of (1) a naturally occurring (native) compound by reference to a compound other than its labeled analog and (2) a labeled compound by reference to another labeled compound

6.9 Initial Calibration (ICAL) – Analysis of analytical standards at different concentrations that are used to determine and calibrate the quantitation range of the response of the analytical detector or method. The ICAL levels are solutions of the method analytes, isotope dilution analogues, and isotope performance standards prepared from the working standards and intermediate standards.

6.10 Calibration Curve – A calibration or standard curve is a set of solutions, prepared from a secondary and/or stock solution, used to calibrate the response of the LC-MS/MS instrument. The calibration curve plots known standard concentrations of an analyte versus the instrument response for that analyte.

6.11 Initial Calibration Verification (ICV); also known as a Quality Control Standard (QCS) – A known interference free matrix spiked with a known concentration (near the mid-point of the Initial Calibration) of the target analytes and isotope analogues. ICV standards are made from a stock solution that is different from the stock used to prepare calibration standards. This standard is analyzed immediately after the calibration to confirm the usability of the calibration.

6.12 Instrument Blank (IB) – An instrument blank is an aliquot of the method solvent, containing no analytes of interest. The purpose of an IB is to ensure that the analytical system is free from contamination associated with the instrument analysis. An IB also provides one way of determining the level of noise and baseline rise attributable solely to the analytical system, in the absence of any other analytes or non-analytical related contaminants. The blank should contain the internal standard.

6.13 Internal Standard (IS) – An internal standard is pure analytes added to a sample, extract, or standard solution in a known amount. The IS is used to measure the relative responses of other method analytes that are components of the same sample of solution. The internal standard must be an analyte that is not a sample component.

6.14 Field Reagent Blank (FRB) – An aliquot of reagent water that is placed in a sample container in the laboratory and treated as a sample in all respects, including shipment to the sampling site, exposure to sampling site conditions, storage, and all analytical procedures. The purpose of the FRB is to determine if method analytes or other interferences are introduced into the sample from shipping, storage, and the field environment.

6.15 Method Blank (MB); also referred to as Laboratory Reagent Blank (LRB) – An analyte-free matrix to which all reagents are added in the same volumes or proportions as used in sample processing. The method blank is fortified with the isotope dilution analytes and then carried through the complete sample preparation and analytical procedure. The method blank is used to document contamination resulting from the analytical process: the laboratory environment, the reagents, glassware, or extraction apparatus.

6.16 Laboratory Control Sample (LCS); also referred to as Laboratory Fortified Blank (LFB), and Ongoing Precision and Recovery Standard (OPR) – A known interference free matrix spiked prior to sample extraction with a known concentration of the method analytes and isotope dilution analogues. The LCS is analyzed exactly like a sample; the purpose of the LCS is to monitor analytical control for the batch. Percent recoveries are calculated for each of the analytes.

6.17 Laboratory Control Sample Duplicate (LCSD) – A second known interference free matrix spiked prior to sample extraction with a known concentration of standard. Analyses of duplicates indicate precision associated specifically with the laboratory procedures, removing any associated variables that might occur during sample collection, preservation, or storage procedures.

6.18 Sample Duplicate (DUP); also known as Field Duplicate (FD) – Separate samples collected at the same time and sampling location, shipped, and stored under identical conditions. Method precision, including the contribution from sample collection procedures, is estimated from the analysis of Field Duplicates. Field Duplicates are used to prepare Laboratory Fortified Sample Matrix and Laboratory Fortified Sample Matrix Duplicate QC samples. For the purposes of this method, Field Duplicates are collected to support potential repeat analyses (if the original field sample is lost or if there are QC failures associated with the analysis of the original field sample).

6.19 Matrix Spike/Matrix Spike Duplicate (MS/MSD); also referred to as Laboratory Fortified Matrix/ Laboratory Fortified Matrix Duplicate (LFM/LFMD) – An aliquot of a client supplied sample that is chosen at random, to which known quantities of the method analytes and isotope dilution analogues are added in the laboratory. The purpose of the matrix spike is to evaluate the effects of the sample matrix on the methods used for the analyses. The background concentrations of the analytes in the sample matrix must be determined in a separate aliquot and the values in the MS corrected for the background concentration. Matrix Spikes are analyzed with every batch or per 20 samples. The LFSMD is used instead of the Field Duplicate to assess method precision when the method analytes are rarely found at concentrations greater than the MRL.

6.20 Matrix – The substrate (e.g., water, drinking water, etc.), which may contain the analyte of interest.

6.21 Liquid Sample – A sample classified as a groundwater, surface water, wastewater or other water-soluble liquid.

6.22 Solid Sample – A sample classified as soil, solid, or sludge.

6.23 Representative Sample: A well-mixed aliquot of sample that constitutes an accurate representation of contents within the container. Methods used to achieve a representative sub-sample are described below:

6.23.1 Aqueous/Liquid samples.

6.23.1.1 Sample is shaken until homogeneous and then poured or pipetted into appropriate container.

6.23.2 Soil Samples:

6.23.2.1 If container size is sufficient, sample is mixed within until homogenous. If container size is insufficient, the entire sample is transferred to an appropriate container and mixed.

6.23.3 Miscellaneous Solid Samples:

6.23.3.1 Sample is crushed, pulverized, shaken, and stirred as appropriate to ensure the aliquot used for analysis represents the entire contents of the original sample container as accurately as possible.

6.24 PFAS – Per- and Polyfluoroalkyl substances –A group of man-made fluorinated compounds that are hydrophobic and lipophobic, manufactured and used in a variety of industries globally. These compounds are persistent in the environment as well as in the human body. This method analyzes for the PFAS listed in Table 4.4.

6.25 Isotopically labeled compound – An analog of a target analyte in the method which has been synthesized with one or more atoms in the structure replaced by a stable (non-radioactive) isotope of that atom. Common stable isotopes used are 13C (Carbon-13) or Deuterium (D or 2H). These labeled compounds do not occur in nature, so they can be used for isotope dilution quantitation or other method-specific purposes.

6.26 Isotope Dilution Technique – An analytical technique for measuring analyte concentration using the ratio of the peak area of the native analyte to that of an isotopically labeled analogue, added to the original sample in a known amount and carried through the entire analytical procedure. The isotopically enriched PFAS are spiked into each sample and allow identification and correction of the concentration of the native compounds in the analytical process.

6.27 Isotope Performance Standards (IPS); also known as Non-extracted Internal Standards (NIS) – Quality control compounds that are added to all standard solutions and extracts in a known amount and used to measure the relative response of the isotopically labelled analogues (ISA or EIS) that are components of the same solution. The isotope performance standards are indicators of instrument performance and are used to calculate the recovery of the isotope dilution analogues through the extraction procedure. In this method, the isotope performance standards are not used in the calculation of the recovery of the native analytes.

6.28 Precursor Ion – The gas-phase species corresponding to the method analyte that is produced in the electrospray ionization interface. During tandem mass spectrometry, or MS/MS, the precursor ion is mass selected and fragmented by collision-activated dissociation to produce distinctive product ions of smaller mass to charge (m/z) ratio. For this method, the precursor ion is usually the deprotonated molecule ([M – H]–) of the method analyte, except for HFPO-DA. For this analyte, the precursor ion is formed by decarboxylation of HFPO-DA.

6.29 Product Ion – One of the fragment ions that is produced in MS/MS by collision-activated dissociation of the precursor ion.

6.30 Isotope Dilution Analogues (Extracted Internal Standard (EIS) Analytes) – Isotopically labeled analogues of the method analytes that are added to the sample prior to extraction in a known amount. Note: Not all target PFAS currently have an isotopically labelled analogue. In these cases, an alternate isotopically labelled analogue is used. All listed isotope dilution analogues must be used, if available. Linear isomers are recommended to simplify peak integration. These analogues were chosen during method development because they encompass most of the functional groups, as well as the molecular weight range of the method analytes.

6.31 Stock Standards Solution, also known as Quantitative Standard – A concentrated solution of one or more target analytes at a known concentration, purchased from a reputable commercial vendor, and having Certificates of Analysis. Stock standard solutions are used to prepare working calibration standards. Stock standards once opened must be replaced after 1 year or sooner if routine QC indicates a problem.

6.32 Intermediate Standard, also known as Primary Dilution Standard (PDS) – A solution of target analytes at known concentration prepared from one or more Stock standards. The Intermediate Standard may be used to prepare the Working Calibration Standard.

6.33 Working Calibration Standard (WS) – A solution of all the target analytes at a known concentration prepared either from one or more intermediate calibration standards and/or from one or more stock standard solutions. Working standards once made must be replaced after 6 months or sooner if routine QC indicates a problem.

6.34 Technical-Grade Standard – As defined for this method, a technical-grade standard includes a mixture of the branched and linear isomers of a method analyte. For the purposes of this method, technical-grade standards are used to identify retention times of branched and linear isomers of method analytes.

6.35 Analysis Window or Analysis Batch – Samples are analyzed in a time frame referred to as a “window.” The window is initiated with the analysis of the continuing calibration verification (CCV) standard. If the CCV passes the specific criteria, then samples, bracketing CCV, and a closing CCV are analyzed until the 24-hour time limit expires.

6.36 Surrogate Analyte (Surr) – A surrogate analyte is an organic compound that is similar to the analytes of interest in chemical composition, extraction characteristics, and chromatography, but is not normally found in environmental samples. The purpose of the surrogate analyte is to evaluate the preparation and analysis of the samples. These compounds are spiked into blanks, standards, samples, and matrix spiked samples prior to analysis. Percent recoveries are calculated for each surrogate and are used to evaluate the method performance.

6.37 LC-MS/MS; also known as LC QQQ (triplequad) - used as an abbreviation for liquid chromatograph with a tandem mass spectrometer. When MS abbreviated alone, it is always defined as matrix spike, when MS used in conjunction with LC as in LC-MS/MS, it is always defined as mass spectrometer.

6.38 Multiple Reaction Monitoring (MRM) – Application of selected reaction monitoring to multiple product ions from one or more precursor ions. Method 1633 requires the use of MS/MS in Multiple Reaction Monitoring (MRM) mode to enhance selectivity.

6.39 Signal-to-noise ratio (S/N) – The height of the signal as measured from the mean (average) of the noise to the peak maximum divided by the mean height of the noise.

6.40 SPE – Solid-phase extraction; a technique in which an analyte is extracted from an aqueous solution or a solid/tissue extract by passage over or through a material capable of reversibly adsorbing the analyte. Also termed liquid-solid extraction.

6.41 Initial Demonstration of Capability (IDOC), also known as Initial precision and recovery (IPR) – four aliquots of a reference matrix spiked with the analytes of interest and labeled compounds and analyzed to establish the ability of the laboratory to generate acceptable precision and recovery. An iDOC is performed prior to the first time this method is used and any time the method or instrumentation is modified.

6.42 Case Narrative (CN) – A case narrative is simply a means of describing exactly what transpired with the samples during the analytical process. Case narratives are required for variances that occur within a project.

6.43 Non-Conformity Form (NCF) – A form which will be completed and processed for each QC failure or deviation from normal protocol that occurs outside the scope of normal operation as defined by the AEL QM Section 10, AEL SOP Admin-016, and Method SOP.

6.44 Semi-volatile department abbreviations used in sample preparation logbooks, data printouts and other Semi-volatile areas:

6.44.1 RR/RA – Rerun/Reanalyze

6.44.2 CF – Confirmation

6.44.3 NR – Not a Real Hit

6.44.4 NAP – Not a Peak

6.44.5 DNC – Does Not Confirm

6.44.6 STR – Straight/No Dilution

6.44.7 NT – Not Target

6.44.8 WRT – Wrong Retention Time

6.44.9 DNR – Do Not Report

6.44.10 BDL –Below Detection Limit

6.44.11 FH – Fails High

6.44.12 FL – Fails Low

6.44.13 DF – Dilution Factor

6.44.14 DIL – Dilution

6.44.15 STD – Standard

6.44.16 IS – Internal Standard

6.44.17 Surr – Surrogate

6.44.18 OOT – Out of Tune/CCV Window

6.44.19 WS – Working Standard

6.45 Safety Data Sheets (SDS) Safety Data Sheets (SDS) – Written information provided by vendors concerning a chemical's toxicity, health hazards, physical properties, fire, and reactivity data, including storage, spill, and handling precautions.

6.46 Limit of Detection (LOD) – The LOD is **not** synonymous with the MDL. The LOD is an estimate of the minimum amount of a substance that an analytical process can reliably detect with a high level of confidence (99% Confidence; that is a false negative rate of 1%). The LOD is at the level of the MDL. The LOD must go through all the same processes that a sample will go through and be detected above instrument noise level.

6.47 Limits of Quantitation (LOQ) – The minimum levels, concentrations, or quantities of a target variable (e.g., target analyte) that can be reported with a specific degree of confidence. It is also the lowest concentration that produces a quantitative result within specified limits of precision and bias. For DOD work the LOQ will be set at or above the concentration of the lowest initial calibration standard. For DOD work the LOQ will be the concentration at which the PQL is verified. The LOQ can equal the PQL but is not synonymous with the PQL.

6.48 Limits of Quantitation (LOQ) Verification – LOQ verifications are a spiked clean matrix sample that must go through all the same processes which regular samples will go through and be within the precision and bias acceptance criteria of the method. The LOQ verifications are spiked at the concentrations of the LOQ.

6.49 Method Detection Limit (MDL) – The MDL is an estimate of the minimum amount of a substance that an analytical process can readily detect. The MDL is the minimum concentration of an analyte that can be identified, measured, and reported with 99% confidence that the analyte concentration is greater than zero. The MDL is determined most often as 3.14 times the standard deviation of a low level, seven replicate study; however, it can be determined for some methods as the lowest increment measurable with confidence. MDLs are determined for each analyte, matrix, prep method, cleanup method, analysis method, and instrument. (See each method's requirements). The MDL is one way to establish a Detection Limit, not a Limit of Detection.

6.50 Method Detection Limit **(**MDL) Verification – MDL verifications are spiked clean matrix samples that must go through all the same processes that a regular sample will go through and be detected above instrument noise level. For labs accredited under DOD ELAP, the MDL verifications must be performed immediately after the initial MDL study and on a quarterly basis thereafter. For labs accredited under NELAC (TNI) Standards only, MDL verifications are to be performed immediately after the initial MDL study and on a yearly basis thereafter.

6.51 Minimum Reporting Level (MRL) – The minimum concentration that may be reported by a laboratory as a quantified value for a method analyte. For each method analyte, the concentration of the lowest calibration standard must be at or below the MRL and the laboratory must demonstrate its ability to meet the MRL per the criteria defined in this method.

6.52 Practical Quantitation Level (PQL); also known as the Method Reporting Limit (MRL or RL) – the lowest calibration standard or lowest quantitation level for the method and matrix. The concentration below which data is to be qualified as having less certainty. PQLs are at a concentration greater than that of the MDL.

6.53 Qualifier Codes (For Florida and FDEP work)

6.53.1 A - Value reported is the mean (average) of two or more determinations. This code shall be used if the results of two or more discrete and separate samples are averaged. These samples shall have been processed and analyzed (e.g., laboratory replicate samples, field duplicates, etc.) independently. Do not use this code if the data is the result of replicate analyses on the same sample aliquot, extract or digestate. Under most conditions, replicate values shall be reported as individual analyses.

6.53.2 I - The reported Value is between the laboratory method detection limit (MDL) and the laboratory practical quantitation limit (PQL).

6.53.3 K- Off scale low.

6.53.4 L- Off scale high. Use if reporting above the acceptable level of quantitation.

6.53.5 U- Indicates that a compound was analyzed for but not detected. The value associated with the qualifier will be the MDL.

6.53.6 V- Indicates that the analyte was detected in both the sample and the associated method blank. NOTE: The method blank value **cannot** be subtracted from the associated sample to give a result. The sample result will be reported as is with the "V" qualifier.

6.53.7 H - Value based on field kit determination; results may not be accurate. This code shall be used if a field-screening test (i.e., field gas chromatograph data, immunoassay, vendor-supplied field kit, etc.) was used to generate the value and the field kit or method has not been recognized by the Department as equivalent to laboratory methods.

6.53.8 O - Sampled, but analysis lost or not performed. NOTE: if reporting data to STORET, a numerical value must be entered. Such values are not meaningful and shall not be used.

6.53.9 Q - Sample held beyond the accepted holding time. This code shall be used if the value is derived from a sample that was prepared and/or analyzed AFTER the approved holding time restrictions for sample preparation and analysis.

6.53.10 Y - The laboratory analysis was from an unpreserved or improperly preserved sample. The data may not be accurate.

6.53.11 REJ - Data is rejected and should not be used. Some or all of the quality control data for the analyte were outside criteria, and the presence or absence of the analyte cannot be determined from the data.

6.53.12 NAI - Not analyzed due to interference.

6.53.13 J - Estimated value; value not accurate.

6.53.13.1 This code shall be used in the following instances:

6.53.13.1.1 "1" Surrogate recovery limits have been exceeded.

6.53.13.1.2 "2" No known quality control criteria exists for the component.

6.53.13.1.3 "3" The reported value failed to meet the established quality control criteria for either precision or accuracy.

6.53.13.1.4 "4" The sample matrix interfered with the ability to make any accurate determination; or

6.53.13.1.5 "5" The data is questionable because of improper laboratory or field protocols (e.g., composite sample was collected instead of a grab sample).

6.53.13.2 A "J" value shall be accompanied by justification for its use (ex. J(4)).

6.53.13.3 A "J" value shall not be used if another code applies (ex. K, L, M, T, V, Y, PQL).

6.53.14 If more than one code applies, and the data is to be entered into STORET, only one code shall be reported. The code shall be selected based on the following hierarchy: REJ, NAI, O, Y, V, H, J, B, K, L, M, PQL, T, Z, A.

7.0 Interferences

7.1 Sources of interference in this method can be grouped into three broad categories.

7.1.1 Contaminated solvents, reagents, or sample processing hardware.

7.1.2 Contaminated desolvation or collision gas, LC flow path components, column surfaces, MS source surfaces, capillary or MS/MS detector surfaces.

7.1.3 Compounds extracted from the sample matrix to which the detector will respond.

7.2 Solvents, reagents, glassware, and other sample processing hardware may yield discrete artifacts and/or elevated baselines, causing misinterpretation of the chromatograms. The analytes in this method can also be found in many common laboratory supplies and equipment, such as PTFE (polytetrafluoroethylene) products, LC solvent lines, methanol, aluminum foil, deactivated syringes, SPE sample transfer lines, etc. All of these materials must be demonstrated to be free from interferences, under the conditions of the analysis, by running method blanks. Reagents of sufficient quality are used to reduce this possibility and purchased in accordance with ADMIN-013.

7.3 Glassware must be scrupulously cleaned. Clean all glassware as soon as possible after use by rinsing with the last solvent used. Typical cleaning solvents used include water, methanol, and methanolic ammonium hydroxide. This should be followed by detergent washing with hot water, and rinsing with tap water, followed by organic-free reagent water. Drain the glassware and dry it in an oven at 130°C for several hours, or rinse with methanolic ammonium hydroxide (1%), IPA, and methanol and drain. Store dry glassware in a clean environment.

7.3.1 The residual PFAS content of disposable plasticware and filters must be verified by batch/lot number and may be used without cleaning if PFAS levels are below the Method Detection Limit (MDL).

7.4 Aqueous samples should not come in contact with any glass containers or pipettes as PFAS analytes can potentially adsorb to glass surfaces. Standards dissolved in organic solvent may be purchased in glass ampoules. These standards in organic solvent are acceptable and subsequent transfers may be performed using glass syringes and pipets. Following extraction, the eluate must be collected in a polypropylene tube prior to concentration to dryness. Concentration to dryness in glass tubes may cause poor recovery.

7.5 All parts of the SPE manifold must be cleaned between samples with methanolic ammonium hydroxide (1%) and air dried prior to use. Sonication with methanolic ammonium hydroxide (1%) may be used for components that will fit in an ultrasonic bath. Smaller parts, like the needles, adapters, reservoirs, and stopcocks associated with the manifold, require rinsing with tap water prior to manual cleaning or sonicating with methanolic ammonium hydroxide (1%) and air drying. When in use, after loading the samples but prior to elution procedures, the chamber must be rinsed with methanolic ammonium hydroxide (1%).

7.6 Solid phase extraction cartridges may be a source of interferences. The analysis of LRBs provides important information regarding the presence or absence of such interferences. Each brand and lot of SPE devices must be monitored to ensure that contamination does not preclude analyte identification and quantitation. SPE cartridges should be sealed while in storage to prevent ambient contamination of the SPE sorbent.

7.7 Each of the three telomer sulfonates in the analyte list (4:2FTS, 6:2FTS, and 8:2FTS) are referenced to their 13C2 isotope dilution analogue. The mass difference between the telomer sulfonates and the isotope dilution analogues is 2 mass units. The single sulfur atom in each of the unlabeled molecules has a naturally occurring M+2 isotope (34S) at 4.25%. Thus, the precursor ions of the 13C2 isotopically labeled analogues and the naturally occurring 34S analogues present in the native analytes have the same nominal masses. The product ions of the telomer sulfonate isotope dilution analogues listed in Table 6 would contain a small contribution from the 34S analogue of the native telomer sulfonates. At the concentrations used in this study, the contribution of the 34S analogue to the isotope dilution analogue was not greater than 2.7%. Alternate product ions may be used if there is sufficient abundance.

7.8 LC system components, as well as the mobile phase constituents, may contain many of the analytes in this method. Thus, these PFAS will build up on the head of the LC column during mobile phase equilibration. To minimize the background PFAS peaks and to keep baseline levels constant, the time the LC column sits at initial conditions must be kept constant and as short as possible (while ensuring reproducible retention times). In addition, priming the mobile phase and flushing the column with at least 90% methanol before initiating a sequence may reduce background contamination.

7.9 Matrix interferences may be caused by contaminants that are co-extracted from the sample. The extent of matrix interferences will vary considerably from source to source, depending upon the nature and diversity of the industrial complex or municipality being sampled.

7.9.1 Humic and fulvic material may be co-extracted during SPE and high levels may cause enhancement or suppression in the electrospray ionization source. Under the LC conditions used during method development, matrix effects due to co-extracted organic material enhanced the ionization of 4:2 FTS appreciably. Total organic carbon (TOC) is a good indicator of humic content of the sample.

7.9.2 The most frequently encountered interferences are fluoropolymers; however, bile salts (e.g., Taurodeoxycholic Acid [TDCA]) can interfere in the chromatography. For this reason, analysis of a standard containing TDCA is required as part of establishing the initial chromatographic conditions.

7.10 Contamination by carryover can occur whenever high-concentration and low-concentration samples are sequentially analyzed. To reduce carryover, the sample syringe is rinsed automatically with solvent between sample injections. Whenever an unusually concentrated sample (10 times the upper limit of the curve) is encountered, it should be followed by the analysis of solvent to check for cross-contamination.

8.0 Safety

8.1 The toxicity or carcinogenicity of each reagent used in this method has not been fully established. Each chemical should be regarded as a potential health hazard and exposure should be as low as reasonably achievable. Cautions are included for known extremely hazardous materials or procedures.

8.1.1 PFOA has been described as likely to be carcinogenic to humans. Pure standards should be handled by trained personnel, with suitable protection to skin and eyes, and care should be taken not to breathe the vapors or ingest the materials.

8.1.2 It is recommended that the laboratory purchase dilute standard solutions of the analytes in this method. However, if primary solutions are prepared, they must be prepared in a hood, following universal safety measures.

8.2 Each laboratory is responsible for maintaining a current awareness file of OSHA regulations regarding the safe handling of the chemicals specified in this method. A reference file of Safety Data Sheets (SDS) should be made available to all personnel involved in the chemical analysis. These are stored in the common areas of the labs.

8.3 Refer to the AEL Chemical Hygiene Plan and Safety Manual for safety precautions and for the Hygiene Plan and Emergency Response Plan.

8.4 See Standard Methods, 22nd and Online Editions, Section 1090 Laboratory Occupational Health and Safety.

9.0 Equipment and Supplies

9.1 Sample equipment, for discrete or composite sampling. Only HDPE tubing must be used.

9.2 HDPE bottles with an unlined polyethylene screw cap (for example, 250 mL bottles, Environmental Express, Cat. No. BPC1410 or equivalent).

9.3 Liquid Chromatograph (LC)- Mass Spectrometer (MS)/Mass Spectrometer (MS) system:

Note: For all labs, see the Quality Manual, Section 7, for the current listing by room location and letter designation for each piece of major equipment (by make, model, and serial number) and a full inventory of all major pieces of equipment in each lab.

9.3.1 Agilent 1260 Liquid Chromatograph coupled with an Agilent Model 6470 QQQ – An analytical system complete with liquid chromatograph; suitable for sample introduction and all required accessories, including pump, detector, column supplies, nebulizer, and collusion cell. The 1260 LC provides consistent sample injection volumes and is capable of performing binary linear gradients at a constant flow rate. All PTFE transfer lines, or components were replaced with PEEK or polypropylene components and/or bypassed by the manufacturer upon instrument installation.

9.3.1.1 Agilent 1260 Infinity II Binary Pump (Part No. G7112BR or equivalent)

9.3.1.2 Agilent 1260 Infinity II Multi-Sampler (Part No. G7167AR or equivalent)

9.3.1.3 Agilent 1260 Infinity II Multi-Column Thermostat (Part No. G7116A or equivalent)

9.3.2 Delay or Trap Column – GL Sciences, PFAS Delay column, 3.0X30mm (Part No. 5020-90005 or equivalent). The delay column is placed in the mobile phase flow path immediately before the injection valve. This direct connect column reduces the co-elution of PFAS originating from sources prior to the sample loop from the PFAS injected in the sample.

9.3.3 Analytical or Chromatographic Column – GL Sciences, InertSustain AQ-C18, 100 x 2.1mm, 1.9µm (Part No. 5020-89939, or equivalent).

9.3.4 Detector - Electrospray Ionization Tandem Mass Spectrometer (ESI-MS/MS)

9.3.4.1 Agilent

9.3.4.2 The mass spectrometer must be capable of electrospray ionization in the negative ion mode. The system must be capable of performing MS/MS to produce unique product ions for the method analytes within specified retention time segments. A minimum of 10 scans across the chromatographic peak is needed to ensure adequate precision.

9.3.4.3 Rough Pump

9.4 Data System –

9.4.1 Agilent Mass Hunter Workstation LC/MS Data Acquisition for 6400 Series Quadrupole Version 10.0 SR1 Build 10.0.142 or equivalent.

9.4.2 An interfaced data system is required to acquire, store, and output MS data. The computer software must have the capability of processing stored data by recognizing a chromatographic peak within a given retention time window. The software must allow integration of the abundance of any specific ion between specified time or scan number limits. The software must be able to construct a linear regression or quadratic regression calibration curve and calculate analyte concentrations using the internal standard technique.

9.5 Graduated Cylinders, Class A – Appropriate sizes (25mL, 100mL and 1000mL)

9.6 Polypropylene Graduated Cylinders – Appropriate sizes (1000mL, 100mL, 50mL, 25mL)

9.7 Centrifuge Tubes – Conical polypropylene centrifuge tubes (15 mL or 50mL) with polypropylene screw caps for storing standard solutions and for collection of the eluate during the extraction procedure (VWR. Part No. 21008-656 &10025-698 or equivalent).

9.8 Auto-sampler vials – Polypropylene autosampler vials (VWR, Part No. 82030-982) with polypropylene caps (VWR, Part No. 89239-430 or equivalent).

Note: Polypropylene vials and caps are necessary to prevent contamination of the sample from PTFE coated septa. However, polypropylene caps do not reseal, creating the potential for evaporation to occur after injection. Multiple injections from the same vial are not permissible unless the cap is replaced immediately after injection.

9.9 Polyethylene Disposable Pipettes – 7.7mL capacity (VWR Part No. 14670-130 or equivalent).

9.10 Repeater pipette.

9.11 Micro-Syringes –10µL, 25µL, 50µL, 100µL, 250µL, 500µL, and 1000µL.

9.12 Balance –

9.12.1 Top-loading, capable of weighing to 0.01g. For reagent (mobile phase etc.) preparation and the gravimetric determination of sample volume. (Ohaus, Model SPX2202, or equivalent).

9.12.2 Analytical, capable of weighing to 0.0001g. For percent solids determination. (VWR-220B2T, Mettler Toledo XS205, or equivalent).

9.13 Desiccator (Bel-Art Products, Secador Cat# 4207411116, or equivalent).

9.14 Glass fiber filter (Environmental Express, F93447MM-X, or equivalent).

9.15 Disposable 10mL syringe (Agilent, P/N 9301-6474, or equivalent).

9.16 Disposable syringe filter, 25-mm, 0.2uM Nylon Membrane (Agilent, P/N 5190-5110, or equivalent).

Note: EPA 1633 calls for an analytical balance capable of weighting to 0.0001g; that level of accuracy is required for weighing neat standards for preparation of calibration solutions. The balance use at AEL is only for reagent (mobile phase etc.) preparation and the gravimetric determination of sample volume.

9.17 Polystyrene Weigh Boats (VWR Part No. 76312-328 or equivalent).

9.18 Solid Phase Extraction (SPE) Apparatus

9.18.1 SPE Cartridges – For water/solids extraction: SPE cartridges containing weak anion exchange, particle size approximately 33 µm. The SPE sorbent must have a pKa above 8 so that it remains positively charged during extraction. SPE cartridges containing 150 mg sorbent (Phenomenex Cat. No. 8B-S038-SCH or equivalent). Use of 500 mg cartridges is allowed but the lab must perform demonstration of capability study to demonstrate the bed size does not negatively affect extraction and elution. The cartridges are for single use only and may not be reconditioned for subsequent analyses.

9.18.2 Vacuum Extraction Manifold – Equipped with flow and vacuum control (Restek Resprep QR-12 (Part No. 28298-VM) or equivalent system). Automated devices designed for use with SPE cartridges may be used; however, all extraction and elution steps must be the same as in the manual procedure. Care must be taken with automated SPE systems to ensure that Teflon tubing and other PTFE components commonly used in these systems, do not contribute to unacceptable analyte concentrations in LRBs.

9.18.3 Sample Delivery System – Use of large volume sampling lines, constructed with polyethylene tubing, are recommended, but not mandatory. Large volume sample transfer lines, constructed with PTFE tubing, are commercially available for standard extraction manifolds (Restek Cat. No. 26250 or equivalent). The PTFE tubing can be replaced with 1/8” o.d. x 1/16” i.d. polyethylene tubing (Freelin-Wade (McMinnville, Oregon) LLDPE or equivalent) cut to an appropriate length. This prevents potential contamination from PTFE transfer lines. Other types of non-PTFE tubing may be used provided it meets the LRB and LFB QC requirements. PTFE tubing may be used, but an LRB must be run on each individual transfer line and the QC requirements must be met. Empty 60mL SPE tubes are used during the SPE portion of the soil prep as the extract will have a 50mL volume, and transfer lines are not necessary.

9.18.4 Pump – Sufficient capacity to maintain a vacuum of approximately 15 to 20 inches of mercury for extraction cartridges.

9.19 Shaker table – for extracting the soil samples during the pre-extraction steps.

9.20 Vortex apparatus.

9.21 Centrifuge apparatus capable of centrifuging 50mL centrifuge tubes.

9.22 Extract Concentration System – Extracts are concentrated by evaporation with high-purity nitrogen using a water bath set no higher than 60°C (Organomation Associates, Meyer N-Evap, Model 11155, or equivalent).

9.23 pH paper – Used to verify the pH of the phosphate buffer and to measure the pH of the aqueous sample prior to anion exchange SPE. ColorpHastÂ® pH Strips, Narrow, one square with single indicator on each strip, 6.5-10 pH range (VWR Part No. AA35227-LQ or equivalent).

10.0 Reagents and Standards

Note: Although sources of the reagents and standards noted in this SOP may be provided, they may also change based on availability, quality, and cost. The use of a different source or concentration is acceptable without modification of the procedures, provided the products are equivalent. Reagent grade or pesticide grade chemicals shall be used in all tests. Unless otherwise indicated, it is intended that all reagents shall conform to specifications of the Committee on Analytical Reagents of the American Chemical Society, where such specifications are available. Other grades may be used, provided it is first ascertained that the reagent is of sufficiently high purity to permit its use without lessening the accuracy of the determination. If other grades are used, the reagent must be demonstrated to be free of analytes and interferences and all requirements of the IDC must be met when using these reagents.

Note: All reagents and standards must be labeled with their unique ID, the name of the material, the concentration, the date prepared, and the expiration date.

Note: Stock standard solutions are ordered from NELAC (TNI) approved vendors. Stock standards are received from the vendor in sealed amber ampoules. Once opened, store the stock standard solutions in polypropylene vials with polypropylene screw tops. All stock standards are stored at 0ºC to 6ºC and protected from light (unless otherwise instructed by the manufacturer). Check stock standards frequently for signs of degradation or evaporation, especially just prior to preparing calibration standards. Opened stock standards should be replaced after 6 months or sooner, if comparison with check standards indicates a problem.

Note: Prior to making any laboratory prepared standards, allow the stock standard to warm to room temperature. Store intermediate and working standards in screw-top vials at 0ºC to 6ºC and protect from light. Working standards should have an expiration date of six months (unless the manufacturer's expiration date is sooner). Allow working standards to warm to room temperature prior to use.

Note: Modifying the solvent composition of the standard or extract by increasing the aqueous content to better focus early eluting compounds on the column is not permitted. A decrease in methanol concentration could lead to lower or imprecise recovery of the more hydrophobic method analytes, while higher methanol concentration could lead to the precipitation of salts in some extracts.

10.1 Reagents and Standards are ordered and tracked internally in accordance with SOPs ADMIN-013 and ADMIN-031.

10.2 The mixing of reagents shall be tracked in a reagent logbook kept in the LC room. The mixing of intermediate and/or working standards shall be tracked in a standard logbook kept in the LC room. Both logbooks will contain the following information:

10.2.1 For parent material:

10.2.1.1 The manufacturer lot number.

10.2.1.2 The manufacturer name.

10.2.1.3 The chemical name and/or chemical description.

10.2.1.4 The expiration date.

10.2.1.5 The AEL receiving lot number.

10.2.2 For any laboratory prepared reagents and/or standards:

10.2.2.1 The recipe (the amount of parent material used and how the standard was mixed) is included in the logbook.

10.2.2.2 The creation date.

10.2.2.3 The expiration date.

10.2.2.4 The standard concentration.

10.3 Reagents:

10.3.1 Reference Matrices:

10.3.1.1 Organic-free reagent water — all references to water in this method refer to organic-free reagent water from the de-ionized water tap, unless ultrapure is needed then the ELGA 18mO system is utilized. Siemens Company in accordance with Admin-032 maintains our present de-ionized water system. Organic-free reagent water is defined as purified water which does not contain any measurable quantities of any method analytes or interfering compounds greater than one-third of the MRL for each method analyte. It may be necessary to flush the water purification unit to rinse out any build-up of PFAS in the system prior to collection of reagent water.

10.3.1.2 Ottawa sand – Restek, part# 26137, 20/30 mesh, 5 KG.

10.3.2 Reagent grade or HPLC grade chemicals shall be used in all tests. Unless otherwise indicated, it is intended that all reagents shall conform to specifications of the Committee on Analytical Reagents of the American Chemical Society, where such specifications are available. Other grades may be used, provided it is first ascertained that the reagent is of sufficiently high purity to permit its use without lessening the accuracy of the determination.

10.3.3 Methanol, CH3OH, CASRN 67-56-1 – HPLC grade or better in accordance with ADMIN-013 (VWR, Part No. BDH85800.100E or equivalent). LC/MS grade required for mobile phase. Purge and Trap grade used for methanolic ammonium hydroxide solutions.

10.3.4 Ammonium Acetate, NH4C2H3O2, CASRN 631-61-8, molecular weight equals 77.08 g/mole – HPLC grade or better in accordance with ADMIN-013. **LC-MS grade is required for mobile phase**.

10.3.4.1 Store at 2-8°C.

10.3.4.2 Replace two years after opening date.

10.3.5 Concentrated Ammonium Hydroxide Reagent, NH4OH, CASRN 1336-21-6, – approximately 56.6% in water as ammonium hydroxide (w/w), approximately 29% in water as ammonia, approximately 14.8 N (VWR, Part No. 470300-212, Certified ACS Plus grade, or equivalent).

10.3.6 Carbon – Supelclean ENVI-Carb SPE Bulk, part#57210-U.

10.3.7 Formic acid – 96%, or greater. Store at room temperature.

10.3.8 Salinized glass wool – Supelco, part# 20411, or equivalent. Rinsed twice with methanol prior to use.

10.3.9 LC/MS grade Acetic Acid – used to add to sample extracts.

10.3.10 Nitrogen – Ultra-high-purity grade. Used as a nebulizer gas in the ESI interface, as collision gas, and to concentrate sample extracts.

10.3.11 Laboratory Prepared Reagents:

10.3.11.1 20 mM LC-MS grade Ammonium Acetate, Chromatographic mobile phase – To prepare 0.5 L, add 0.77 g ammonium acetate to 0.5 L of ultrapure reagent water. **This solution is volatile and must be replaced at least once per week**. More frequent replacement may be necessary if unexplained losses in sensitivity or retention time shifts are encountered.

10.3.11.2 0.3% ammonium hydroxide in methanol – used for soil extraction. Dilute 1.0mL of concentrated ammonium hydroxide up to 100mL of P&T methanol. **Method 1633 gives a 1-month expiration date; however, it is recommended that this solution should be made fresh on the day of extraction.**

10.3.11.3 1% ammonium hydroxide in methanol – Used for pre-conditioning of SPE cartridges and for elution of SPE cartridges during water and solid prep. Dilute 3.3 mL of concentrated ammonium hydroxide up to 100 mL P&T methanol. **Method 1633 gives a 1-month expiration date; however, it is recommended that this solution should be made fresh on the day of extraction.**

10.3.11.4 0.3M formic acid – aqueous, dissolve 13.8 grams of formic acid into 1L of ultrapure reagent water. Replace after 2 years. Store at room temperature.

10.3.11.5 0.1M formic acid – aqueous, dissolve 4.6 grams into 1L of ultrapure reagent water. Replace after 2 years. Store at room temperature.

10.3.11.6 50% aqueous formic acid – mix 50mL formic acid and 50mL of reagent water. Replace after 2 years. A smaller amount may be made to conserve reagents and reduce waste, (ie. 5ml formic acid and 5 ml reagent water).

10.3.11.7 3% aqueous ammonium hydroxide – mix 10mL of ammonium hydroxide (30%; 10.3.5) and 90mL of reagent water. A smaller amount may be made to conserve reagents and reduce waste, ie. 1ml of ammonium hydroxide and 9 ml reagent water. Replace after 3 months.

10.3.11.8 1:1 0.1M formic acid/methanol solution – mix equal amounts of 0.1M formic acid (10.3.12.6) and methanol. Replace after 1 year. Store at room temperature.

10.3.11.9 1633 IB/Standard reagent – used to make instrument blanks, for standard (ICAL/CCV/ICV) make-up and if sample dilutions are needed. Mix 3.3mL of ammonium hydroxide (10.3.5), 1.7 mL of ultrapure reagent water and 0.625mL of LC/MS acetic acid up to 100mL of LC/MS grade methanol. Store at room temperature. Replace after 1 month.

10.4 Stock standards - Stock solutions purchased as certified solutions. Opened stock standards must be replaced after 1 year or sooner; if comparison with check standards indicates a problem (common problems occur from degradation or evaporation of the standard). Certificates of analysis are stored in the SVOC lab in accordance with Quality Manual 5.0. Store purchased standards according to manufacturer specifications. All purchased stock standards solutions must be replaced after reaching the manufacturer's expiration date assigned to the standard.

Note: Alternative standards from the ones listed below may be used, provided they are from a certified vendor.

Note: Fluorinated carboxylic acids will esterify in anhydrous acidic methanol. To prevent esterification, standards must be stored under basic conditions. If base is not already present, this may be accomplished by the addition of sodium hydroxide (approximately 4 mole equivalents) when standards are diluted in methanol. When calculating molarity for solutions containing multiple PFAS, the molecular weight can be estimated as 250 atomic mass units (amu). It is necessary to include sodium hydroxide in solutions of both isotopically labeled and native analytes. The amount of sodium hydroxide needed may be calculated using the equation in Section 15. The standards purchased from Wellington and Absolute already contain the appropriate amount of sodium hydroxide to prevent esterification.

Note: When a compound purity is assayed to be 96% or greater, the weight can be used without correction to calculate the concentration of the stock standard. Sorption of PFAS analytes in methanol solution to glass surfaces after prolonged storage has not been evaluated. PFAS analyte and isotopically labeled analogues commercially purchased in glass ampoules are acceptable; however, all subsequent transfers or dilutions performed by the analyst must be stored in polypropylene containers. Standards for sample fortification generally should be prepared in the smallest volume that can be accurately measured to minimize the addition of excess organic solvent to aqueous samples.

Note: When not being used, store standard solutions in the dark at less than 4 °C unless the vendor recommends otherwise in screw-capped vials with foiled-lined caps.

10.4.1 Tuning Mix – ESI-L Low Concentration Tuning Mix (100mL, Agilent part # G1969-85000), or equivalent. Use as received; no prep required.

10.4.2 Bile Salts

10.4.2.1 TDCA – Taurodeoxycholic acid, sodium salt – EMD Millipore part# 580221-5GM, or equivalent.

10.4.2.2 TUDCA – Tauroursodeoxycholic acid, sodium salt – EMD Millipore part# 580549-1GM, or equivalent.

10.4.2.3 TCDCA – Sodium taurochenodeoxycholate, EMD Millipore part#T6260-100MG, or equivalent.

10.4.3 Mass-labelled PFAS Injection Standard Solution/Mixture (Non-extracted Internal standard - NIS) – Wellington part# MPFAC-HIF-IS, 1.2 mL, various concentrations, or equivalent.

10.4.4 Mass-labelled PFAS Extraction Standard Solution/Mixture (Extracted Internal Standards -EIS) – Wellington part# MPFAC-HIF-ES, 1.2 mL, various concentrations, or equivalent.

10.4.5 Analyte Standard Materials

10.4.5.1 Technical Grade Standards (for evaluation of the retention time of branched isomers). At the time of this SOP revision only 4 technical grade standards were found by the lab:

10.4.5.1.1 PFOA (Wellington Part No. T-PFOA, or equivalent)

10.4.5.1.2 N-Et-FOSA - Sigma-aldrich, CDS010729-250MG, neat, or equivalent.

10.4.5.1.3 N-Me-FOSE – Toronto Research Chemicals – M327345, neat, or equivalent.

10.4.5.1.4 N-Et-FOSE – Toronto Research Chemicals – E917650, neat, or equivalent.

Note: This method measures all forms of the analytes as anions while the identity of the counterion is inconsequential. Analytes may be commercially available as neat materials or as certified stock standards as their corresponding ammonium, sodium, or potassium salts. These salts are acceptable standards provided the measured mass, or concentration, is corrected for the salt content. The equation for this correction is provided in Section 15. The correction for the salt content is calculated on the vender’s Certificate of Analysis; this predetermined corrected value is used to quantify the target analytes in salt form.

10.4.5.2 Primary Stock Standards

10.4.5.2.1 Native 30 PFAS mix; 30 analytes; 1000ng/mL (Wellington Part No. PFAC30PAR, or equivalent).

10.4.5.2.2 Native MXG PFAS mix; 2 analytes, 2000ng/mL (Wellington Part No. PFAC-MXG, or equivalent).

10.4.5.2.3 L-PFDoS solution; 1 analyte, 50ug/mL (Wellington part No. L-PFDoS, or equivalent)

10.4.5.2.4 Native N-Me/EtFOSA and N-Me/Et FOSE Solution/Mixture; 4 analytes, 1.0ug/mL/10ug/mL (Wellington part No. PFAC-MXI, or equivalent)

10.4.5.2.5 Native X:3 Fluorotelomer Carboxylic Acid Solution/Mixture, 3 analytes, 4.0ug/mL/20ug/mL (Wellington part No. PFAC-MXJ, or equivalent)

10.4.5.3 Secondary Stock Standards

10.4.5.3.1 EPA method 533 analytes; 25 analytes; 500ng/mL (Wellington Part No. EPA-533PAR, or equivalent)

10.4.5.3.2 Native PFAS Solution/Mixture; 25 analytes, various concentrations (Wellington Part No. PFAC-MXH, or equivalent)

10.4.5.3.3 N-Et-FOSE stock, 50ug/mL (Wellington part No. N-EtFOSE-M, or equivalent)

10.4.5.3.4 N-MeFOSE stock, 50ug/mL (Wellington part No. N-MeFOSE-M, or equivalent)

10.4.5.3.5 N-EtFOSA stock, 50ug/mL (Wellington part No. N-EtFOSA-M, or equivalent)

10.4.5.3.6 N-MeFOSA stock, 50ug/mL (Wellington part No. N-MeFOSA-M, or equivalent)

10.4.5.3.7 3:3FTCA stock, 50ug/mL (Wellington part No. FPrPA, or equivalent)

10.4.5.3.8 5:3FTCA stock, 50ug/mL (Wellington part No. FPePA, or equivalent)

10.4.5.3.9 7:3FTCA stock, 50ug/mL (Wellington part No. FHpPA, or equivalent)

10.5 Laboratory Prepared Standards

10.5.1 All laboratory prepared standard solutions should be prepared in a hood and must be replaced after 1 year or sooner if routine QC indicates a problem or the method requires a shorter expiration date. An assigned expiration date of a lab prepared standard cannot exceed the manufacturer's expiration date for any component used in the standard formulation.

10.5.2 Bile salts: 1) In to a tared 10.0 mL volumetric flask, weigh approximately 0.01 grams of the bile salt (either TDCA, TUDCA and/or TCDCA). Add LC/MS methanol to volume, thus making a standard approximately 1.0mg/mL. Transfer and store in a 12 mL glass vial. 2) Dilute 100uL of the stock solution (1.0mg/mL) up to 1.0mL of LC/MS methanol to make a 100ug/mL intermediate solution. Make and store in a 2.0mL glass autosampler vial. 3) Dilute 10uL of all 3 intermediate solutions (100ug/mL) up to 1.0mL of the 1633 Blank MeOH solution (10.3.12.9) thus making a 1.0ug/mL working standard containing all 3 bile salts.

10.5.3 1633 Non-extracted Internal standard Working Solution (1633NIS WS)

10.5.3.1 Prepare the non-extracted internal standard working solution in methanol by diluting 100uL of IS stock (10.4.3) up to 1.0mL of LC/MS methanol. During collection of method performance data, 1.0mL of the final extracts were fortified with 10 µL of the 1633NIS WS. 10uL of the 1633NIS WS are added to the 1.0mL ICAL and ICV standard solutions.

10.5.4 1633 Mass-labeled Extracted Internal Standard solution (1633EIS WS)

10.5.4.1 Prepare the isotope dilution analogue EIS by diluting 100uL of the 1633 EIS stock (10.4.4) in 1.0mL of LC/MS methanol. 50uL of the EIS is added to each batch QC item and sample, which equates to 10uL per 1.0mL. Thus 10uL of the EIS is added to each 1.0mL ICAL and ICV solution.

10.5.4.1.1 Note that the concentrations of sulfonates in the isotope dilution analogue PDS is based on the weight of the salt. It is not necessary to account for difference in the formula weight of the salt compared to the free acid for sample quantitation.

10.5.5 Analyte PDS – Primary and Secondary source

10.5.5.1 The primary analyte stock solutions listed in 10.4.5.2 are used to prepare High intermediate and a Low intermediate. Before the intermediates can be made the stock solution for L-PFDoS must be diluted to a working level. These intermediates are used to prepare the calibration standards and are used for batch spiking:

10.5.5.2 L-PFDoS Working Intermediate solution (PFDoS INT) – 100uL of 10.4.5.2.3 is brought up to 1.0mL of LC/MS methanol. This yields a working solution of 5000 ng/mL.

10.5.5.2.1 Select nominal analyte concentrations for the intermediates such that between 5 and 100 µL of the PDS is used to fortify samples and prepare standard solutions. The analyte INTs are prepared at 2 different concentrations:

10.5.5.2.1.1 100ng/mL (1633 High Int): Prepared by diluting 100uL of PFAC30PAR, 50uL of PFAC-MXG, 20uL of PFDoS

INT, 100uL of PFAC-MXI and 100uL of PFAC-MXJ into 1.0mL of LC/MS methanol.

10.5.5.2.1.2 10ng/mL (1633 Low Int): Prepared by diluting 100uL of the 100ng/mL 1633 High Int (Section 10.5.5.2.1.1) into 1.0mL of LC/MS methanol.

10.5.5.2.2 These INTs are used to spike batch QC (LCS/LCSD/MS/MSD) to allow for all analytes to be contained within the spikes. The user may modify the concentrations of the individual analytes based on the confirmed MRLs and the desired monitoring range.

10.5.5.2.3 The INTs are stored cold; warm the vials to room temperature and vortex prior to use.

10.5.5.3 The Secondary source stocks are used to make the Initial Calibration Verification (ICVs). Due to limited availability of source standards; several solutions are used to make ICV intermediates, which are then combined to make a working ICV standard. The 50ug/mL stocks must be diluted to a lower concentration prior to making the ICV Intermediate:

10.5.5.3.1 ICV Intermediates:

10.5.5.3.1.1 533 ICV INT: Prepared by diluting 50uL of the EPA-533PAR (Section 10.4.5.3.1) into 100% methanol and adding sodium hydroxide if not already present to prevent esterification. The final volume of the standard is 1.0mL.

10.5.5.3.1.2 1633 MXH INT: 100uL of the MXH stock (10.4.5.3.2) brought up to 1.0mL of LC/MS grade methanol.

10.5.5.3.1.3 1633 ICV1 INT: 20uL of N-Me-FOSA stock (10.4.5.3.6) + 20uL of N-Et-FOSA stock (10.4.5.3.5) + 200uL of N-Me-FOSE stock (10.4.5.3.4) + 200uL of N-Et-FOSE stock (10.4.5.3.3) up to 1.0mL of LC/MS grade methanol.

10.5.5.3.1.4 1633 ICV2 INT: 80uL of 3:3FTCA (FPrPA) (10.4.5.3.7) up to 1.0mL of LC/MS grade methanol.

10.5.5.3.1.5 1633 ICV3 INT: 400uL of 5:3FTCA (FPePA) (10.4.5.3.8) up to 1.0mL of LC/MS grade methanol.

10.5.5.3.1.6 1633 ICV4 INT: 400uL of 7:3FTCA (FHpPA) (10.4.5.3.9) up to 1.0mL of LC/MS methanol.

10.5.5.3.2 1633 ICV INT Working Stock

10.5.5.3.2.1 Combine 100uL of ICV1 INT (10.5.5.3.1.3) + 100uL of ICV2 INT (10.5.5.3.1.4) + 100uL of ICV3 INT (10.5.5.3.1.5) + 100uL of ICV4 INT (10.5.5.3.1.6) up to 1.0mL of LC/MS grade methanol.

10.6 Initial Calibration (ICAL) and Initial Calibration Verification (ICV) Standards

PFAS Calibration Standards – Prepared as described below in 1633 Blank MeOH (10.3.12.7).

ICAL (ng/mL)	**Amount of PFAS Int1 to use in uL**	**Amount of PFAS Int2 to use in uL**	**Final Volume (mL)**	**Amount of NIS WS to Use (uL)***	**Amount of EIS Spike to Use (uL)**
ICAL1 0.1	-	10	1	10	10
ICAL2 0.2	-	20	1	10	10
ICAL3 0.5	-	50	1	10	10
ICAL4 0.8	-	75	1	10	10
ICAL5 1.0	10	-	1	10	10
ICAL6 1.5	15	-	1	10	10
ICAL7 2.0	20	-	1	10	10
ICAL8 5.0	50	-	1	10	10
ICAL9 10.0	100	-	1	10	10

***NIS is added to the 1.0mL final volume**

1633 Initial Calibration Verification (ICV) - combined

ICV (ng/mL)	**Amount of 1) ICV INT WS + 2) MXH INT + 3) 533 ICV INT (uL)**	**Final Volume (mL)**	**Amount of NIS WS to Use (uL)***	**Amount of EIS Spike to Use (uL)**
ICVC	1)20uL + 2)10uL + 3)10uL	1	10	10

***NIS is added to the 1.0mL final volume**

Note: During the multi-laboratory validation study, laboratories reported that NMeFOSA was an impurity in the branched isomer qualitative standard for NMeFOSE and NEtFOSA was an impurity in the branched isomer qualitative standard for NEtFOSE supplied for the study. Those impurities did not preclude the use of these standards, but laboratories should be aware of the possibility.

11.0 Sample collection, preservation, shipment, and storage

11.1 See AEL Admin-005 and Admin-023.

11.2 See AEL Quality Manual Section 6.0 for sample acceptance policy.

11.3 See FDEP SOP FS1000 for preservation requirements, shipping conditions, and holding time requirements.

11.4 Samples must be collected in HDPE containers fitted with unlined polyethylene screw- caps, Discard sample bottles after a single use. The bottle volume should approximate the volume of the sample. Subsampling from a single bottle is not permitted except as described in Section 14.4.3.5.7.

11.5 Samples must be shipped on ice. Samples are valid if any ice remains in the cooler when it is received at the laboratory or bottles are received within 2 days of collection and are confirmed to be between 0 - 6 ºC. Once at the laboratory, samples should be stored at or below -20 °C until extraction for both waters and solids.

11.6 Aqueous samples (including leachates) should be analyzed as soon as possible; however, samples may be held in the laboratory:

11.6.1 For up to 90 days from collection, when stored at ≤ -20 ºC and protected from the light, or

11.6.2 For up to 28 days when stored at 0 - 6 ºC and protected from the light, with the caveat that issues were observed with certain perfluorooctane sulfonamide ethanols and perfluorooctane sulfonamidoacetic acids after 7 days. These issues are more likely to elevate the observed concentrations of other PFAS compounds via the transformation of these precursors if they are present in the sample.

11.7 Solid samples (soils and sediments) and tissue samples may be held for up to 90 days, if stored by the laboratory in the dark at either 0 - 6 ºC or ≤ -20 ºC, with the caveat that samples may need to be extracted as soon as possible if NFDHA is an important analyte.

11.8 Store sample extracts in the dark at less than 0 - 4 ºC until analyzed. If stored in the dark at less than 0 - 4 ºC, sample extracts may be stored for up to 90 days, with the caveat that issues were observed for some ether sulfonates after 28 days. These issues may elevate the observed concentrations of the ether sulfonates in the extract over time. Samples may need to be extracted as soon as possible if NFDHA is an important analyte.

12.0 Quality Control

12.1 For every analytical sequence (not to exceed 30hours of runtime), the LC-MS/MS system must pass the QC Check Tune for the unit, wide, and widest settings.

12.2 There must be an initial calibration of the LC-MS/MS system – see Section 13.

12.3 The LC-MS/MS system must meet the calibration verification acceptance criteria – see Section 13.

12.4 The Retention Time position shall be set using the midpoint of the ICAL when a calibration curve is performed. On days when the ICAL is not performed, the initial CCV is used.

12.5 Initial Demonstration of Capability – each laboratory must demonstrate initial proficiency with each sample preparation and determinative method combination it utilizes, by generating data of acceptable accuracy and precision for target analytes in a clean matrix. The laboratory must also repeat the following operations whenever new staff is trained or significant changes in instrumentation are made.

12.5.1 For water and soil IDOC prep will consist of a method blank and four replicates for each analyte spiked with the EIS and the native analytes (see section 14.1.1 for the spike standards and volumes for water IDOCs, and section 14.2.1 for the spike standards and volumes for soil IDOCs).

12.5.2 The average recovery for IDOC analytes shall fall within 80-120% of the expected value and the percent relative standard deviation for the IDOC analytes shall be less than 20%.

Note: Once Table 5 in the EPA Draft 1633 method is revised for the multi-laboratory study and finalized, the laboratory will adopt those specific OPR limits.

12.5.3 The Demonstration of Capability is not considered complete until the analyst has documentation saying that they have read, understood, and agreed to follow the AEL-SOP for this method and the associated EPA and/or Standard Methods on which the AEL-SOP was based.

12.5.4 Initial DOC's must be successfully performed by each analyst in accordance with the Quality Manual and ADMIN-030.

12.6 Method Detection Limit (MDL) - MDLs must be established for all analytes, following the procedures outlined in ADMIN SOP-012, which conforms to EPA CFR 40 Part 136.6 appendix B, updated October 2017. Below is a summary of the steps for performing MDLs. Please refer to the ADMIN SOP-012 for the full procedures.

12.6.1 New MDL Study: Most MDL determinations are for already established analyte, matrix, and instrument combinations. In those cases where a new analyte is to be introduced, an initial MDL study will have to be implemented. Select a spiking level, typically 2 to 10 times the estimated MDL. Process a minimum of seven spiked samples and seven method blank samples through all steps of the method. The samples used for the MDL must be prepared in at least three batches on three separate calendar dates and analyzed on three separate calendar dates.

12.6.2 New Instrument: To bring on a new instrument for an already established method a full set of seven low-level replicates is not needed. Only two spiked samples and two method blank samples prepared and analyzed on different calendar dates are required for the new instrument. The resulting values shall be compared against existing MDLs for validity. If both method blank results are below the existing MDL, then the existing MDL_b is validated. Combine the new spiked sample results to the existing spiked sample results and recalculate the MDLs. If the recalculated MDL_s is within 0.5 to 2.0 times the existing MDL and fewer than 3% of the MB have results above the existing MDL, the existing MDL can be left unchanged and the new instrument is validated.

12.6.3 Existing Instrument, Major Maintenance: Follow the procedures for bringing on a new instrument.

12.6.4 Ongoing Data Collection: During any quarter in which samples are being analyzed, prepare, and analyze a minimum of two spiked samples on each instrument, in separate batches (separate prep batches and separate analytical batches), using the same spiking concentration used with established MDLs. If any analytes are repeatedly not detected in the quarterly spiked sample analyses, or do not meet the qualitative identification criteria of the method then this is an indication that the spiking level is not high enough and should be adjusted upward. Note that it is not necessary to analyze additional method blanks together with the spiked samples; the method blank population should include all of the routine method blanks analyzed with each batch during the course of sample analysis.

12.6.4.1 At least once per year, re-evaluate the spiking level. If more than 5% of the spiked samples do not return positive numerical results that meet all method qualitative identification criteria, then the spiking level must be increased, and the initial MDL re-determined following the procedure for establishing a new MDL.

12.6.5 Ongoing Annual Verification: At least once every thirteen months, re-calculate MDLs and MDL_b from the collected spiked samples and method blank results using the equations in the ADMIN SOP-012. These calculations shall be performed by the QA department along with updating and maintaining all chart and LIMs entry of any MDL changes.

12.7 Calibration Verification: Analyze an ICV to confirm the accuracy of the primary calibration standards.

12.7.1 An ICV must be analyzed during the IDOC and then quarterly thereafter.

12.7.2 For this method, the laboratory is not required to obtain standards from a source independent of the primary calibration standards. Instead, the laboratory should acquire the best available quantitative standards and use these to prepare both the primary calibration standards and the ICV.

12.7.3 The ICV must be an independent dilution beginning with the common starting materials.

12.7.4 The acceptance criterion for the ICV is 70–130% of the true value. If the accuracy for any analyte fails the recovery criterion, prepare fresh standard dilutions, and repeat the Calibration Verification.

12.8 On Going QC requirements

12.8.1 The laboratory must also have procedures for documenting the effect of the matrix on method performance (precision, accuracy, and detection limit). At a minimum, this includes the analysis of QC samples including a method blank (MB), a matrix spike (MS), a duplicate (MSD, DUP, or LCSD), a laboratory control sample (LCS), a low-level laboratory control sample (LLCS) and the addition of isotope dilution analogues to each field sample and QC sample.

12.8.1.1Each sample, MB, LCS, LCSD, LLCS, MS, and MSD must be spiked with the isotope dilution analogues spike.

12.8.1.2Recovery of isotopically labeled compounds from sample matrices must be assessed and records maintained.

12.8.2 Every analytical sequence (not to exceed 30 hours of runtime), prior to sample analysis, the laboratory must run a CheckTune. See Section 10.4.1 for the identification of the Tuning solution. If any of the masses do not Pass criteria for Wide or Widest, then the analyst may choose to manually tune to bring those masses back in acceptance criteria; otherwise, a new Autotune must be ran. If any of the masses do not Pass for Unit, then a new Autotune must be analyzed.

12.8.3 Every analytical sequence, prior to sample analysis, after the high standard of the ICAL, after every CCV and after any field sample with an analyte detection above the range of the calibration curve (if observed in time to edit/update the analytical sequence) the laboratory must analyze an Instrument Blank (IB).

12.8.3.1The IB contains only the isotope dilution analogues and the non-extracted internal standards in the blank MeOH solution used for calibration standards.

12.8.3.2The IB must not contain any analyte of interest above ½ the MRL/LOQ, or else the instrument system is contaminated. A new IB may be made and analyzed to verify the contamination.

12.8.4 Every calibration sequence, and every sequence in which DOD sample are analyzed, a bile salt check standard (Section 10.5.2) must be analyzed. Each bile salt must not elute within 1 minute of all PFOS isomers.

12.8.4.1 DOD QSM 5.4 requires the bile salt check be analyzed at the beginning of every analytical sequence regardless of the matrix to be analyzed.

12.8.4.2 EPA Draft 1633 requires an initial bile salt interference when establishing chromatographic conditions (regardless of matrix). A daily salt check is not required unless running tissue samples.

12.8.5 Daily, at the beginning of the analytical sequence, qualitative identification standards must be analyzed to Confirm the RT of each linear and known branched isomer or isomer group. Quantitative standards containing isomeric mixtures for an analyte are commercially available for PFOS, PFHxS, NMeFOSAA, and NEtFOSAA; the isomer RTs for those quantitative standards can be verified during the instrument calibration and in the CCVs. Qualitative/technical standards are available for PFOA, NEtFOSA, NMeFOSE, and NEtFOSE; those standards should be analyzed daily for RT verification.

12.8.6 Every analytical shift, prior to sample analysis, after every tenth field sample, and at the end of the analysis sequence, the laboratory must analyze a CCV (see Section 13.3 for acceptance criteria).

12.8.7 With every batch of 20 samples (or less) the laboratory must analyze the following:

12.8.7.1MB -1 per batch of 20 or less.

12.8.7.1.1 For non-DOD EPA 1633: Any analyte of interest must not be detected above the MRL, greater than 1/3rd any regulatory compliance limits, or greater than 1/10th the concentration found in any sample within the prep batch – whichever is greater.

12.8.7.1.2 For DOD QSM: Any analyte of interest must not be detected above one-half of the LOQ, or greater than 1/10th the amount found in any sample, or greater than 1/10th the regulatory limit – whichever is greater. The laboratory will strive to have no detections of target analytes at concentrations above the MDL.

12.8.7.2LCS/LLCS – 1 per batch of 20 or less.

12.8.7.2.1 A Laboratory Control Sample (LCS) and Low-Level Laboratory Control Sample (LLCS) are included with each analytical batch and once every twenty samples. The LCS consists of an aliquot of a clean (control) matrix corresponding with the sample matrix and of the same weight or volume. A low-level LCS (LLCS) is required for every batch, and must be spiked at, or below, the MRL. The LCS concentration must be spiked near the mid-point of the calibration curve. A LCS Duplicate must be prepped if there is not enough field sample to prep a MS/MSD.

12.8.7.2.2 For non-DOD EPA 1633: Standard AEL limits of 80-120% have been assigned until the multi-laboratory evaluation is completed by the EPA. The lab may also evaluate LCS against EPA Draft Method Table 5 (see section 24.9 Table); criteria subject to change upon finalization of the draft method

12.8.7.2.3 For DOD QSM: Recovery must be within 40-150%, until in-house limits can be created, or if project limits are not provided. In-house limits cannot be lower than 40%.

12.8.7.3MS/MSD – May be analyzed with every batch of 20 samples or less per matrix. An MS/MSD set may not be required for non-DOD 1633 projects but are required for DOD projects.

12.8.7.3.1 Documenting the effect of the matrix should include the analysis of at least one matrix spike and one duplicate un-spiked sample or one matrix spike/matrix spike duplicate pair. The decision on whether to prepare and analyze duplicate samples or a matrix spike/matrix spike duplicate must be based on knowledge of the samples in the sample batch. If samples are expected to contain target analytes, then laboratories may use one matrix spike and a duplicate analysis of an un-spiked field sample. If samples are not expected to contain target analytes, the laboratories should use a matrix spike and matrix spike duplicate pair. A matrix spike is required for every twenty samples and every extraction batch.

12.8.7.3.2 The MS/MSD should be fortified at a concentration close to the mid-point of the ICAL.

12.8.7.3.3 The spike recoveries must be within 40-150% of the true value if spiked at a level greater than 2X the MRL, if project limits are not provided, or until in-house limits are established.

12.8.7.3.4 The RPD for all analytes shall be less than, or equal to, 30% for MS/MSDs spiked at a level greater than 2X the MRL.

12.8.8 The laboratory must maintain performance records to document the quality of data that is generated.

12.8.8.1 Isotope dilution analogue recoveries: The laboratory must calculate the percent recovery for the isotope dilution analogues spiked before sample/QC prep. The recoveries for the isotopes must be within the limits below, if project specific limits are not provided, or until in-house limits are established.

12.8.8.1.1 For non-DOD EPA 1633: Standard AEL limits of 20-150% have been assigned until the multi-laboratory evaluation is completed by the EPA. The lab may also evaluate the EIS against EPA Draft Method Table 9 (see section 24.8 Table); criteria subject to change upon finalization of the draft method

12.8.8.1.2 For DOD QSM: Recovery must be within 20-150%, until in-house limits can be created, or if project limits are not provided. In-house limits cannot be lower than 20%.

12.8.8.2 If an isotope dilution analogue fails to meet the recovery criterion, evaluate the area of the isotope performance standard to which the analogue is referenced and the recovery of the analogues in the CCCs.

12.8.8.2.1 If necessary, recalibrate and service the LC-MS/MS system. Take corrective action, then analyze the failed extract in a subsequent Analysis Batch.

12.8.8.2.1.1 If the repeat analysis meets the 20–150% recovery criterion, report only data for the reanalyzed extract.

12.8.8.2.1.2 If the repeat analysis fails the recovery criterion after corrective action, extraction of the sample must be repeated provided a sample is available and still within the holding time.

12.8.9 Non-extracted internal standard (NIS) recovery: The laboratory must monitor the recovery of the non-extracted internal standards in all injections of the analysis sequence.

12.8.9.1 For non-DOD EPA 1633: Standard AEL criteria of greater than 30% of the average area measured during the initial calibration have been assigned until the multi-laboratory evaluation is completed by the EPA. The lab may also evaluate area recoveries against EPA Draft 1633 Table 10 (see section 24.7 Table); criteria subject to change upon finalization of the draft method. *(optional): NIS areas in field samples and QC samples should be 50-200% of the mean area of the ICAL.*

12.8.9.2 For DOD QSM: Area recoveries must be greater than 30% of the average of the ICAL.

12.8.9.3 NIS areas corrected for the dilution factor must be greater than 30% of the average area of the calibration standards in diluted samples when additional NIS was not added post dilution of the extract.

12.8.9.4 Random evaporation losses have been observed with the polypropylene caps causing high- biased NIS areas. The cap(s) must be replaced after an injection to minimize solvent loss.

12.8.9.4.1 If a non-extracted internal standard area for a sample does not meet these criteria, reanalyze the extract in a subsequent analytical sequence.

12.8.9.4.2 If the NIS fails to meet the acceptance criteria in the repeat analysis, extraction of the sample must be repeated, provided the sample is still within holding time.

12.8.9.4.3 If a dilution is required, add appropriate amount of NIS based on the dilution performed. The area for the NIS must be greater than 30% of the average of the ICAL for the diluted sample.

12.8.10 The experience of the analyst performing LC/MS analyses is invaluable to the success of the methods. Each day that analysis is performed, the calibration verification standard should be evaluated to determine if the chromatographic system is operating properly. If the peaks look normal, if the response obtained is comparable to the response from previous calibrations, etc., the instrument is considered still in calibration.

13.0 Calibration and Standardization

Note: See also Section 10 for initial calibration curve standard preparation and curve concentration levels.

Note: See also AEL SOP ADMIN-038 for Calibration, Manual Integrations, and Rules for Chromatography, which outlines the procedures for choosing curve type, calculations performed, integrations allowed, and associated statistics.

13.1 Initial Calibration

13.1.1 The LC/MS operating conditions –

13.1.1.1 The LC operating conditions listed in Table 3 Section 24 serve as guidelines only. Changes to the chromatographic conditions can be made by the analyst in order to improve the speed of analysis, lower the cost of analysis, and/or improve the separation or lower the detection limit as long as the changes meet the initial and continuing calibration criteria and quality assurance criteria listed in this SOP.

Note: The gradient and initial temperatures may require slight adjustments to accommodate the bile salt retention time criteria; such adjustments will not significantly affect the sensitivity or instrument performance (accuracy and precision).

13.1.1.2 Once these operating conditions are established they will be used to calibrate the instrument. All samples, blanks and quality assurance samples must be analyzed with the same operating conditions.

13.1.1.3 MS Optimization: During the development of this method, instrumental parameters were optimized for the precursor and product ions listed in Table 3 Section 24. Product ions other than those listed may be selected; however, the analyst should avoid using ions with lower mass or common ions that may not provide sufficient discrimination between the analytes of interest and co-eluting interferences.

13.1.1.3.1 There have been reports that not all product ions in the linear PFOS are produced in all branched PFOS isomers. (This phenomenon may exist for many of the PFAS.) For this method, the m/z 80 product ion must be used for PFOS and PFHxS to minimize this problem and promote comparability between laboratories.

13.1.1.3.2 Upon instrument installation, the response of the precursor ion ([M – H]– or [M – CO2 – H]–) and production ion for each analyte was optimized as per manufacturer's guidance. Analyte concentrations of 5.0 ng/mL were used for this step during method development. The MS parameters (source voltages, source and desolvation temperatures, gas flows, etc.) were varied by the Mass Hunter software until optimal analyte responses were determined. The analytes exhibited different optimal parameters, requiring some compromise on the final operating conditions.

13.1.1.3.3 The peak shape of the early eluting compounds may be improved by increasing the volume of the injection loop or increasing the aqueous content of the initial mobile phase composition.

13.1.1.4 Prepare and analyze the technical-grade standard of PFOA, discussed in Section 10.4.5.1, at a mid- to high- level concentration. Identify the retention times of the branched isomers of PFOA present in the technical-grade PFOA standard. When PFOA is chromatographed on a reversed-phase column, the branched isomers elute prior to the linear isomer. Repeat the procedure in this section for PFHxS, PFOS, N-Et-FOSA, N-Me-FOSE, and N-Et-FOSE discussed in Section 10.4.5.1, and any other analytes for which technical-grade standards have been acquired. The branched isomer identification checks must be repeated any time chromatographic changes occur that alter analyte retention times.

13.1.1.5 Inject a mid- to high-level calibration standard under optimized LC-MS/MS conditions to obtain the retention times of each method analyte. Divide the chromatogram into segments that contain one or more chromatographic peaks. For maximum sensitivity, minimize the number of MRM transitions that are simultaneously monitored within each segment. Ensure that the retention time window used to collect data for each analyte is of sufficient width to detect earlier eluting branched isomers.

13.1.1.6 Retention Time window position establishment occurs once per ICAL and at the beginning of the analytical sequence. The 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.

13.1.1.6.1 The 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.

13.1.1.6.2 Analytes must elute within 0.1 minutes of the associated EIS. This criterion applies only to analyte and labeled analog pairs.

13.1.1.6.3 When establishing the chromatographic conditions, it is important to consider the potential interference of bile salts during analyses. Inject the bile salt interference check standard containing TDCA, TCDCA and TUDCA (section 10.4.2). Ensure that the bile salts do not coelute with any of the target analytes, EIS, or NIS standards. Analytical conditions must be set to allow a separation of at least 1 minute between the bile salts and the retention time window of PFOS. This evaluation is required when establishing the chromatographic conditions for the method, regardless of the sample matrices to be analyzed.

13.1.2 Mass spectrometer tuning and LC performance requirements

13.1.2.1 For every analytical sequence (not to exceed 30hours of runtime), the LC-MS/MS system must pass the QC Check Tune for the unit, wide, and widest settings prior to any additional analysis.

13.1.2.2 Before injecting calibration standards, the IB should be analyzed at the beginning of a run to confirm that the analytical system is free from contamination. The IB is used to determine the level of noise and baseline rise attributable solely to the analytical system, in the absence of any other analytes or non-analytical related contaminants. The IB is considered to be passing if the results for all target compounds are below the method detection limit (MDL).

13.1.3 Initial Calibration Curve (ICAL) – The isotope dilution/internal standard calibration technique is used for this method. The internal standard approach assumes that variations in instrument sensitivity, amount injected, etc. can be corrected by determining the ratio of the response of the analyte to the response of an internal standard that has been added to the extract.

13.1.3.1 This method has 7 Non-extracted Internal Standards that are used as reference compounds for the internal standard quantitation of the isotope dilution analogues. The suggested isotope performance standard reference for each isotope dilution analogue is listed in Table 1 Section 24. The 24 isotope dilution analogues are used as reference compounds to quantitate the native analyte concentrations. The suggested isotope dilution analogue references for the native analytes are listed in Table 2 Section 24.

13.1.3.2 Nine standards are used to calibrate the instrument for PFAS analysis; a minimum of six standards must be used. The lowest concentration standard (Practical Quantitation Limit (PQL)) is at the MRL; the highest concentration is at the end of the linear range (Upper Quantitation Limit (UQL)). See Section 10 for appropriate dilutions to prepare the calibration curve.

13.1.3.3 Analyze the Calibration Standards following the same GC operating procedures as the client samples (recommended procedures are listed in Table 3 Section 24.4).

13.1.3.4 Calibrate the LC-MS/MS and fit the calibration points with either a linear or quadratic regression. Weighting may be used. **Forcing the calibration curve through the origin is mandatory for this method. Forcing zero allows for a better estimate of the background levels of method analytes.**

13.1.3.4.1 When using an average response factor (RF) calibration (using a calibration factor (CF) fit), for the curve evaluation, a %RSD of <20% for the CF's over the working range verifies acceptance of the calibration curve. A minimum of six calibration points are required for an average RF calibration model.

13.1.3.4.2 When using a linear regression model, a minimum of 6 calibration points are required, and the coefficient of determination (r^2) must be equal to or greater than 0.990 (or the correlation coefficient (r) must be equal to or greater than 0.995).

13.1.3.4.3 When using a quadratic regression model, a minimum of 7 calibration points are required, and the coefficient of determination (r^2) must be equal to or greater than 0.990 (or the correlation coefficient (r) must be equal to or greater than 0.995).

13.1.3.4.4 The qualifier ion ratios must be updated within the quantitation method using the average of the ICAL levels. This is accomplished by using the MassHunter function “Average Qualifier Ratios” found in the “Method” tab. The method must be in “Edit” mode for this feature to be active. Select the “Cals” button and Select All, then select OK. Once the ratios have been updated to the average and the calibration curves are set up as desired, save the new calibration method using the format “J11A-PFAS-YYMMDD”.

13.1.3.5Quantitate

13.1.3.5.1 Native Analytes: Quantitate the native analytes using the internal standard calibration technique. The internal standard technique calculates concentration based on the ratio of the peak area of the native analyte to that of the isotope dilution analogue.

13.1.3.5.2 Isotope Dilution Analogues: The isotope dilution analogues are quantified using the internal standard calibration technique. Because isotope dilution analogues are added at a single concentration level to the calibration standards, calibrate for each of these using an average response factor.

13.1.3.5.3 Non-extracted Internal Standards: Because Isotope performance standards are added at a single concentration level to the calibration standards, calibrate for each of these using an average response factor.

13.1.3.6 Evaluate the initial calibration by calculating the concentration of each analyte as an unknown against its regression equation. The MassHunter software automatically calculates these recoveries.

13.1.3.6.1 Instrument sensitivity: Sufficient instrument sensitivity is established if a signal-to-noise ratio ≥ 3:1 can be achieved when analyzing the lowest concentration standard within the quantitation range that the laboratory includes in its assessment of calibration linearity.

13.1.3.6.2 All calibration points should be within 70– 130% of their true value.

13.1.3.6.3 If these criteria cannot be met, the analyst could have difficulty meeting ongoing QC criteria. In this case, corrective action is recommended such as reanalyzing the calibration standards, restricting the range of calibration, or performing instrument maintenance. If the cause for failure to meet the criteria is due to contamination or standard degradation, prepare fresh calibration standards and repeat the initial calibration.

13.1.3.7 If the minimum response factors are not met, the system must be evaluated, and corrective action must be taken before sample analysis begins. Possible problems include standard mixture degradation, injection port inlet contamination, contamination at the front end of the analytical column, and active sites in the column or chromatographic system. This check must be met before sample analysis begins.

13.1.4 Bile salts interference check

13.1.4.1 The laboratory must analyze a bile salt interference check standard, containing TDCA, TCDCA and TUDCA (section 10.4.2), after the initial calibration as a check on the chromatographic conditions, even if tissue samples are not going to be run. If an interference is present, the chromatographic conditions must be modified to eliminate the interference from the bile salts (e.g., changing the retention time of the bile salts such that they fall outside the retention time window for any of the linear or branched PFOS isomers in the standard by at least one minute), and the initial calibration repeated.

13.2 Initial Calibration Verification (ICV) – Before sample analysis can begin, the integrity of the standard used to prepare the calibration curve must be verified by the analysis of a second source (see Section 10.7).

13.2.1 For the ICV to be valid, the recovery for all analytes must be between 70-130%.

13.3 Continuing Calibration Verification (CCV) – Analyzed prior to sample analysis, after the IB, and ICAL/ICV (if a calibration was performed). A CCV must be run at the beginning of every 24-hour analysis window, after every tenth field sample, and at the end of the analytical sequence.

13.3.1 The beginning CCV for each Analysis Batch must be at, or below, the MRL for each analyte. This CCV verifies instrument sensitivity prior to the analysis of samples and meets the DOD requirement for an Instrument Sensitivity Check (ISC). If standards have been prepared such that all low calibration levels are not in the same solution, it may be necessary to analyze two standards to meet this requirement. Alternate subsequent CCVs between the mid and high calibration levels. The acquisition start time of the final CCC must be within 24 hours of the acquisition start time of the low-level CCC at the beginning of the Analysis Batch. More than one Analysis Batch within a 24-hour period is permitted.

13.3.2 CCV Criteria:

13.3.2.1 Verify Retention Times: The analyst must ensure that each method analyte elutes entirely within the assigned window during each Analysis Sequence.

13.3.2.1.1 Make this observation by viewing the quantitation ion for each analyte in the CCCs analyzed during an Analysis Batch.

13.3.2.1.2 If an analyte peak drifts out of the assigned window, then data for that analyte is invalid in all injections acquired since the last valid CCC.

13.3.2.1.3 In addition, all peaks representing multiple isomers of an analyte must elute entirely within the same MRM window.

13.3.2.2 Non-extracted Internal Standard Area: The absolute area of the quantitation ion for each of the 7 NIS must be greater than 30% of the average area measured during the initial calibration.

13.3.2.3 Isotope Dilution Analogue Recovery: Using the average response factor determined during the initial calibration and the internal standard calibration technique, calculate the percent recovery of each isotope dilution analogue in the CCC. The recovery for each analogue must be within a range of 70–130%.

13.3.2.4 Native Analyte Recovery:

13.3.2.4.1 The concentration of the analytes in CCVs must be within 70–130%.

13.3.2.4.2 If these limits are exceeded, then all data for the failed analytes must be considered invalid. Any field samples analyzed since the last acceptable CCV that are still within holding time must be reanalyzed after an acceptable calibration has been restored.

13.3.2.4.3 If the CCV fails because the calculated concentration is greater than 130% for a method analyte, and field sample extracts show no concentrations above the MRL for that analyte, non-detects may be reported without re-analysis.

14.0 Procedure

Note: Some of the PFAS adsorb to surfaces, including polypropylene. During the elution step of the procedure, sample bottles must be rinsed with the elution solvent whether extractions are performed manually or by automation. For water samples containing particles and for solids % solids need to be determined. Aqueous samples containing up to 50mg solids may be prepped using this procedure. For samples with greater than 50mg, a smaller aliquot may be prepped if necessary; however, subsampling should be avoided whenever possible. The sample should be processed in its entirety and should not be filtered.

14.1 Determination of % Solids

14.1.1 For aqueous samples using the following procedure:

14.1.1.1 Desiccate and weigh a glass-fiber filter to 3 significant figures.

14.1.1.2 Filter 10mL of well-mixed sample through the filter.

14.1.1.3 Dry the filter for a minimum of 12 hours at 110 +/- 5C, and cool in a desiccator.

14.1.1.4 Calculate %solids

$$\% \, solids = \frac{weight\ of\ sample\ aliquot\ after\ drying\ (g) - weight\ of\ filter\ (g)}{10\ g}\ x\ 100$$

14.1.2 Percent solids for solid samples are determined using the laboratory's typical SM2540 procedure.

14.2 Aqueous Liquid Extraction Procedure: A default sample volume of 500mL is used for this SOP. Leachate samples are analyzed using a 100-mL sample volume. Therefore, they must not be included in the same sample preparation batch as aqueous samples analyzed which are analyzed using 500-mL sample volumes.

14.2.1 Sample Preparation:

14.2.1.1 Homogenize the sample by inverting 3 to 4 times, and then allowing to settle. Do not filter.

14.2.1.2 Determine sample volume:

14.2.1.2.1 An indirect measurement is accomplished by weighing the sample and bottle to the nearest 0.1 gram. After extraction, weigh the empty bottle to the nearest 0.1 gram and subtract this value from the weight recorded prior to extraction. Assume a sample density of 1.0g/mL. Record the sample volumes for use in the final calculations of analyte concentrations.

14.2.1.2.2 Some of the PFAS adsorb to surfaces, thus the sample may not be transferred to a graduated cylinder for volume measurement.

14.2.1.2.3 The MB, LCS and LLCS must have the same volume as that of the field samples and may be prepared by measuring reagent water with a graduated cylinder.

14.2.1.3 Verify that the sample has a pH between 6.0 and 7.0. If adjustment is necessary, then 50% formic acid (10.3.12.6) or 3% aqueous ammonium hydroxide (10.3.12.7) may be added.

14.2.1.4 Fortify the QC Samples: Fortify LCS/LCSD (LFBs), LLCS (LLFB), MS (LFSMs), and MSD (LFSMDs), with an appropriate volume of Analyte PDS (Section 10.5.5.2.1.1) – 25uL for the LLCS and 100uL for the LCS/D, MS and MSD. Spike the solution directly into the original bottle. Cap and invert each sample several times to mix.

14.2.1.5 Add a 50uL aliquot of the isotope dilution EIS (Section 10.5.4) to each batch QC (MB, LCS, LCSD, LLCS), Matrix QC (MS and MSD), and field sample. Spike the solution directly into the original bottle, then cap and invert to mix.

14.2.2 Solid Phase Extraction for aqueous samples:

14.2.2.1 Cartridge Cleaning and Conditioning: Do not allow cartridge packing material to go dry during any of the conditioning steps. If the cartridge goes dry during the conditioning phase, the conditioning must be repeated. Do not use vacuum during the conditioning.

14.2.2.1.1 Pack each cartridge to half height with methanol washed salinized glass wool. Rinse each cartridge with 15 mL of 1% ammonium hydroxide in methanol (10.3.12.3).

14.2.2.1.2 Next, rinse each cartridge with 5 mL of 0.3M formic acid (10.3.12.4) without allowing the rinse to drop below the top edge of the packing.

14.2.2.1.3 Discard the wash solvents.

14.2.2.1.4 Close the valve and fill the tube with reagent water.

14.2.2.2 Cartridge Loading:

14.2.2.2.1 Attach the sample transfer tubes to the SPE cartridges and adjust the vacuum to approximately 5 inches Hg.

14.2.2.2.2 Begin adding sample to the cartridge. Adjust the vacuum and control valves so that the approximate flow rate is 5 mL/min.

14.2.2.2.3 Do not allow the cartridge to go dry before all the sample has passed through.

14.2.2.2.4 Flow rates above 5 mL/min during loading may cause low analyte recovery.

14.2.2.3 Sample Bottle Rinse:

14.2.2.3.1 After the entire sample has passed through the cartridge, but not allowing the sample level to drop below the top edge of the packing material, rinse the sample bottle with a 10 mL aliquot of reagent water using the Class A graduated cylinder or a repeater pipette.

14.2.2.3.2 Draw the rinse through the sample transfer tubes and the cartridges. Add 5 mL of 1:1 0.1M formic acid/methanol to the sample bottle and draw through the transfer tube and SPE cartridge. As the rinses near completion, do not allow the cartridges to go dry and shut the valve. Once all samples and QC have reached the same step, then open all valves, allow the remaining liquid to elute and dry the cartridges for approximately 15 seconds.

14.2.2.4Sample Bottle and Cartridge Elution and Extract completion/storage:

14.2.2.4.1 After the drying step, release the vacuum on the extraction manifold, ensure the valves are closed and place labeled 15mL collection tubes under each sample position.

14.2.2.4.2 Rinse the sample bottles with 5 mL of 1% ammonium hydroxide in methanol, then elute the analytes from the cartridges by pulling the elution solvent through the sample transfer tubes and the cartridges.

14.2.2.4.3 Use a low vacuum such that the solvent exits the cartridge in a dropwise fashion.

14.2.2.4.4 After elution is complete, add 25uL of the LC/MS acetic acid (10.3.10) and approximately 10mg of the loose carbon (10.3.6) to each extract. Vortex for approximately 15 to 30 seconds, and then centrifuge at 4000 rpm for approximately 5 minutes. It is important to minimize the amount of time the extracts are in contact with the carbon.

14.2.2.4.5 Label clean 15mL centrifuge tubes, remove the plunger from a clean 10mL disposable syringe and attach a 25mm 0.2 um syringe filter. Carefully decant the extract into the syringe leaving the carbon behind and gently replace the plunger while filtering the extract into the clean collection tube.

14.2.2.4.6 Once all extracts are filtered, use a 1.0mL pipette to add an aliquot of the extract to a 2.0mL polypropylene autosampler vial and add 10uL of the NIS working solution (10.5.3.1).

14.2.2.5Recap vials as soon as possible after injection to prevent evaporation losses; the polypropylene caps do not reseal after puncture.

14.2.2.6The remaining extracts can be stored in the 15 mL collection tubes after extraction. Store extracts at 0-4°C and protected from light.

14.3 Solid Extraction Procedure:

14.3.1 Setup and Initial extraction:

14.3.1.1 Perform the daily calibration verification of the open top balance.

14.3.1.2 Homogenize the sample and weigh 5.0 +/- 0.5g of sample in a labeled 50mL polypropylene centrifuge tube. Ottawa sand is used for the MB, LCS, LCSD, and LLCS QC samples. Add 2.5mL of reagent water to the Ottawa sand in the QC samples.

14.3.1.3 Add 50uL of the Isotope EIS standard to each sample and QC (MB, LCS, LCSD, LLCS, MS, and MSD).

14.3.1.4 Add 100uL of the 1633 High Int standard to the LCS, LCSD, MS, and MSD. Add 25uL of the 1633 High Int standard to the LLCS. Vortex to mix well. Let stand for 30 minutes.

14.3.1.5 Add 10mL of the 0.3% Ammonium hydroxide in methanol solution to each tube using the repeater pipette.

14.3.1.6 Cap and vortex the contents to mix.

14.3.1.7 Shake on the shaker table at 300-350 rpm for approximately 30 minutes. Use a NIST timer to measure the 30min.

14.3.1.8 Centrifuge for approximately 10 minutes at 2800rpm. Decant the supernatant to a clean labeled 50mL centrifuge tube.

14.3.1.9 Add 15mL of the 0.3% ammonium hydroxide in methanol to the centrifuge tube containing the soil for a second extraction. Vortex to mix and shake on the shaker table for approximately 30 minutes.

14.3.1.10 Centrifuge for approximately 10 minutes at 2800rpm. Decant the supernatant into the tube containing the extract from the first shake.

14.3.1.11 Add 5mL of the 0.3% ammonium hydroxide in methanol to the tube containing the soil and vortex for approximately 30 seconds. Centrifuge for approximately 10 minutes at 2800rpm. And decant the supernatant into the tube containing the first 2 extractions.

14.3.1.12 Add approximately 10mg of the loose carbon to the combined extract in each tube, vortex for approximately 15 to 30 seconds and then centrifuge for approximately 5 minutes at 4000rpm. It is important to minimize the amount of time the extracts are in contact with the carbon. Decant into a clean 50mL centrifuge tube leaving the carbon behind.

14.3.2 Extract concentration:

14.3.2.1 At this step the analyst has the option of adding reagent water to the extract to dilute to approximately 35mL; this may be necessary for dry samples; however, the analyst should use their best judgement as to if adding water is necessary.

14.3.2.2 Concentrate each extract using an N-Evap with the water bath set to 55-60°C and N2 flow of approximately 1.2L/min. Allow the extracts to concentrate for approximately 25 minutes and then remove and vortex for 5-10 seconds. Continue blow down, stopping approximately every 10 minutes and vortexing, until the desired final volume is reached as outlined below:

Water Content in Sample*	Concentrated Final Volume**
< 5 g	12mL
5 – 8 g	12-15mL
8 – 9 g	15-18mL
9– 10 g	16-19mL

*the water content in the sample is determined from the %solids plus if any water was added in step 14.3.2.1. Per the method – a good rule of thumb is to make the “concentrated final volume” 7-10mL above the “water content in sample.”
**Note: the concentrated final volumes used were obtained from Alyssa Wingard’s email Memo on 05/18/2022 06:08AM EDT: “Clarification of draft method 1633 extract concentration procedures.”

Note: Slowly concentrating extracts, in 1-mL increments, is necessary to prevent excessive concentration and the loss of neutral compounds (methyl and ethyl FOSEs and FOSAs) and other highly volatile compounds. The extract must be concentrated to remove the methanol as excess methanol during SPE clean-up results in poor recovery of C13 and C14 carboxylic acids and C10 and C12 sulfonates. If all of the methanol is evaporated, the aforementioned neutral compounds are likely to have poor recovery; if too much methanol is in the final extract, then the aforementioned longer-chain compounds are likely to have poor recovery.

14.3.2.3Add reagent water to the extract to bring the volume to approximately 50mL and vortex. Check that the pH is 6.5 ±0.5 and adjust as necessary with 50% formic acid or 30% ammonium hydroxide (or with 5% formic acid and 3% aqueous ammonium hydroxide. The extracts are ready for SPE and cleanup.

14.3.3 SPE Cartridge Conditioning: Do not allow the cartridge(s) to go dry between steps. Do not use vacuum during the conditioning steps.

14.3.3.1Pack each cartridge to half height with methanol washed salinized glass wool. Attach a 60mL reservoir to each cartridge. Rinse each reservoir and cartridge with 15 mL of 1% ammonium hydroxide in methanol (10.3.12.3).

14.3.3.2Next, rinse each reservoir and cartridge with 5 mL of 0.3M formic acid (10.3.12.4) without allowing the rinse to drop below the top edge of the packing. Close the valve and fill the tube with reagent water.

14.3.3.3Discard the wash solvents.

14.3.3.4Pour the sample extracts into the reservoir being careful not to spill or splash. Pull the extracts through the cartridges using the vacuum at approximately 5mL/min. Retain the 50mL centrifuge tubes for later rinsing.

14.3.3.5Discard the eluate.

14.3.3.6As the extracts near filter completion, rinse the reservoir sides with 2 x 5mL rinses of reagent water. Follow with a 5mL rinse using 1:1 0.1M formic acid/methanol and stop the flow without allowing the cartridge to go dry. Once all of the extracts have reached the same point, open the valves and elute the remaining liquid and dry the cartridges for approximately 15 seconds.

14.3.3.7 Discard the rinse solution.

14.3.4 Elution and Extract Prep and Storage:

14.3.4.1 After the drying step, release the vacuum on the extraction manifold, ensure the valves are closed and place a labeled 15mL collection tube under each sample position.

14.3.4.2 Add 5mL of 1% ammonium hydroxide in methanol to the 50mL centrifuge tubes retained from step 14.3.3.4, cap and shake to rinse the walls.

14.3.4.3 Pour the 5mL aliquot of 1% ammonium hydroxide/methanol into the respected reservoir for each sample, being careful not to spill or splash. Elute the cartridges pulling the 1% ammonium hydroxide/methanol through the cartridges in a drop-wise fashion.

14.3.4.4 Add 25uL of LC/MS grade acetic acid and vortex for approximately 15-30 seconds.

14.3.4.5 Label a clean set of 15mL polypropylene tubes, remove the plunger from a 10mL disposable syringe and attach a 25mm 0.2um syringe filter. Carefully pour the sample extract into the syringe and gently replace the plunger while filtering the extract into a clean tube.

14.3.4.6 Once all extracts are filtered, use a 1.0mL pipette to add an aliquot of the extract to a 2.0mL polypropylene autosampler vial and add 10uL of the NIS working solution (10.5.3.1).

14.3.4.7 Recap the autosampler vials after analysis to prevent evaporation; the polypropylene caps do not reseal. The remaining extract should be stored at 0-4°C and protected from light.

14.4 LCS-MS/MS analysis of samples:

14.4.1 Inject a 6 µL aliquot of the sample extract into the LC-MS/MS system, using the same operating conditions that were used for the calibration (Table 3 Section 24). The injection volume must be the same volume used for the calibration standards.

14.4.2 Qualitative analysis:

See also ADMIN SOP-038: Calibration, Manual Integration, and Rules for Chromatography.
See also TECH SOP-009 Multi-peak Compound Identification for Organics.
See also TECH SOP-010 Establishing and Maintaining Retention Time Windows.
(These three SOPs are required reading for any analyst performing this method).

14.4.2.1 Because environmental samples may contain both branched and linear isomers of the method analytes, but quantitative standards that contain branched isomers do not exist for all method analytes, integration and quantitation of the PFAS is dependent on the type of standard materials available.

14.4.2.2 Identify peaks by retention times. At the conclusion of data acquisition, use the same software settings established during the calibration procedure to identify analyte peaks in the predetermined retention time windows. Confirm the identity of each analyte by comparison of its retention time with that of the corresponding analyte peak in an initial calibration standard or CCV.

14.4.2.3 A native or isotopically labeled compound is identified in a standard, blank, sample, or QC sample when all of the following criteria are met:

14.4.2.3.1 Peak responses must be at least three times the background noise level (S/N 3:1). If the S/N ratio is not met due to high background noise, the laboratory must correct the issue (e.g., perform instrument troubleshooting to check and if needed, replace, the transfer line, column, detector, liner, filament, etc.). If the S/N ratio is not met but the background is low, then the analyte is to be considered a non-detect.

14.4.2.3.2 Target analyte, EIS analyte, and NIS analyte RTs must fall within ± 0.4 minutes of the predicted retention times from the midpoint standard of the ICAL or initial daily CV, whichever was used to establish the RT window position for the analytical batch. The retention time window used must be of sufficient width to detect earlier-eluting branched isomers. For all method analytes with exact corresponding isotopically labeled analogs, method analytes must elute within ± 0.1 minutes of the associated EIS.

14.4.2.3.3 For concentrations at or above the method LOQ, the total quantification ion (Q1) response to the total confirmation ion (Q2) response ratio must fall within ± 50% of the ratio observed in the mid-point initial calibration standard. If project-specific requirements involve reporting sample concentrations below the LOQ or ML, the response ratio must also fall within ± 50% of the ratio observed in the initial daily CCV.

14.4.2.3.3.1 The total response of all isomers (branched and linear) in the quantitative standards should be used to define ratio. In samples, the total response should include only the branched isomer peaks that have been identified in either the quantitative or qualitative standard. If standards (either quantitative or qualitative) are not available for purchase, only the linear isomer can be identified and quantitated in samples. The ratio requirement does not apply for PFBA, PFPeA, NMeFOSE, NEtFOSE, PFMPA, and PFMBA because suitable (not detectable or inadequate S/N) secondary transitions (Q2) are unavailable.

14.4.2.4 If the field sample result does not all meet the criteria above, and all sample preparation avenues (e.g., extract cleanup, sample dilution, etc.) have been exhausted, the result may only be reported with a data qualifier alerting the data user that the result could not be confirmed because it did not meet the method-required criteria and therefore should be considered an estimated value. If the criteria listed above are not met for the standards, the laboratory must stop analysis of samples and correct the issue.

14.4.2.5 For DOD work:

14.4.2.5.1 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.

14.4.2.5.2 Exception is made for analytes where two transitions do not exist (PFBA, PFPeA, and FOSA).

14.4.2.5.3 Documentation of the primary and confirmation transitions and the ion ratio is required.

14.4.2.5.4 In-house acceptance criteria for evaluation of ion ratios must be used and must not exceed 50-150% of the ion abundance ration in the midpoint calibration standard or daily CCV. The average qualifier ion ratios must be updated whenever a new calibration curve is ran; see section 13.1.3.4.4.

14.4.2.5.5 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.

14.4.2.5.6 Quant ion and confirmation ion must be present and must maximize simultaneously (±2 seconds).

14.4.3 Quantitative analysis

14.4.3.1 Once a compound has been identified, the analyte concentrations will be automatically quantified by the MassHunter software using the multipoint calibration and the measured sample volume. Report only those values that fall between the MDL and the highest calibration standard.

14.4.3.2 Proceed with quantitation based on the type of standard available for each method analyte.

14.4.3.2.1 If standards containing the branched and linear isomers cannot be purchased (i.e., only the linear isomer is available), only the linear isomer can be identified and quantitated in field samples and QC samples because the retention time of the branched isomers cannot be confirmed.

14.4.3.2.2 Multiple chromatographic peaks, representing branched and linear isomers, are likely to be observed for standards of PFHxS, PFOS, N-Me-FOSAA and N-Et-FOSAA. For these analytes, all the chromatographic peaks observed in the standard must be integrated and the areas summed. Chromatographic peaks in all field samples and QC samples must be integrated in the same way as the calibration standard for analytes with quantitative standards containing the branched and linear isomers.

14.4.3.2.3 For **PFOA**, identify the branched and linear isomers by analyzing a technical-grade standard that includes both linear and branched isomers and ensure that all isomers elute within the same acquisition segment. **Quantitate field samples and fortified matrix samples by integrating the total response, accounting for peaks that are identified as linear and branched isomers. Quantitate based on the initial calibration with the quantitative PFOA standard containing just the linear isomer**.

14.4.3.3 Calculate the concentration of each isotope dilution analogue using the multipoint calibration and the measured sample volume. Verify that the percent recovery is within 20–150% of the true value.

14.4.3.4 The non-extracted internal standard area counts must be greater than 30% of the average of the ICAL for each sample and QC item.

14.4.3.5 The analyst must not extrapolate beyond the established calibration range. If an analyte result exceeds the range of the initial calibration curve, the extract may be diluted up to 10X and re-analyzed.

14.4.3.5.1 Dilute the extract accordingly using the methanol blank solution in section 10.3.11.9 as the final solvent, making a 1.0 mL volume. Select the dilution performed based on ensuring the EIS recovery is greater than 5%. For example, if the EIS recovery was 50% in the initial analysis, then a 10X dilution may be performed.

14.4.3.5.2 Add the appropriate amount of the Non-extracted internal standard to compensate for the dilution performed.

14.4.3.5.3 Report all concentrations measured in the original sample that do not exceed the calibration range.

14.4.3.5.4 Report concentrations of analytes that exceeded the calibration range in the in the original sample based on measurement in a diluted sample.

14.4.3.5.5 Incorporate the dilution factor into final concentration calculations and the resulting data must be annotated as a dilution. This is the only circumstance when subsampling is permitted.

14.4.3.5.6 If the EIS responses in the diluted extract do not meet the S/N and retention time requirements, then the compound cannot be measured reliably by isotope dilution in the diluted extract. In such cases, the laboratory must take a smaller aliquot of any affected aqueous sample and dilute it to 500 mL with reagent water and analyze the diluted aqueous sample or analyze a smaller aliquot of soil sample. Adjust the compound concentrations, detection limits, and minimum levels to account for the preparation dilution.

14.4.3.5.7 If a dilution greater than 10x is indicated, then the laboratory must prepare and analyze a diluted aqueous sample or a smaller aliquot of a solid sample.

14.4.3.5.8 If the recovery of any isotopically labeled compound is outside of the acceptance limits, a diluted aqueous sample or smaller aliquot (for solids and tissue) must be analyzed. If the recovery of any isotopically labeled compound in the diluted sample is outside of the normal range, the method does not apply to the sample being analyzed and the result may not be reported or used for permitting or regulatory compliance purposes.

14.4.4 Data reporting

14.4.4.1 Report results for aqueous samples in ng/L. Report results for solid samples in ng/g, on a dry-weight basis, and report the percent solids for each sample separately. Other units may be used if required in a permit or for a project. Report all QC data with the sample results.

15.0 Calculations

15.1 Multiply all concentrations by any dilutions incurred during extraction to obtain the final result.

15.2 Calculation for Stability of Methanolic Solutions:

$$\frac{Total\ PFAS\ mass\ (g) \times 160(\frac{g}{mol})}{250\ (\frac{g}{mol})} = Mass\ of\ NaOH\ Required\ (g)$$

15.3 Correction for Analytes Obtained in the Salt Form

$$mass(acid\ form) = mass(salt\ form) \times \frac{MWacid}{MWsalt}$$

15.4 Calculation of Isotope Dilution Analogue Recovery

$$\%R = \frac{A}{B} \times 100$$

Where,

A = measured concentration of the isotope dilution analogue, and

B = fortification concentration of the isotope dilution analogue.

15.5 Average (% RSD) Calibration Calculations:

15.5.1 Calculate the Response factors (RF) or Relative response factor (RRF); for each compound:

The response ratio (RR) for each compound calibrated by isotope dilution is calculated according to the equation below, separately for each of the calibration standards, using the areas of the quantitation ions (Q1) with the m/z shown in Table 2. RR is used for the 24 compounds quantified by true isotope dilution.

$$RR = \frac{Area_n\ M_l}{Area_l\ M_n}$$

where:

$Area_n$ = The measured area of the Q1 m/z for the native (unlabeled) PFAS

$Area_l$ = The measured area at the Q1 m/z for the corresponding isotopically labeled PFAS added to the sample before extraction

M_l = The mass of the isotopically labeled compound in the calibration standard

M_n = The mass of the native compound in the calibration standard

Similarly, the response factor (RF) for each unlabeled compound calibrated by extracted internal standard is calculated according to the equation below. RF is used for the 16 compounds quantified by extracted internal standard.

$$RF = \frac{Area_s\ M_{EIS}}{Area_{EIS}\ M_s}$$

where:

$Area_s$ = The measured area of the Q1 m/z for the target (unlabeled) PFAS

$Area_{EIS}$ = The measured area at the Q1 m/z for the isotopically labeled PFAS used as the extracted internal standard (EIS)

M_{EIS} = The mass of the isotopically labeled PFAS used as the extracted internal standard (EIS) in the calibration standard

M_s = The mass of the target (unlabeled) PFAS in the calibration standard

A response factor (RF_s) is calculated for each isotopically labeled compound in the calibration standard using the equation below. RF_s is used for the 24 isotopically labeled compounds quantified by non-extracted internal standard.

$$RF_s = \frac{Area_l \, M_{NIS}}{Area_{NIS} \, M_l}$$

where:

$Area_l$ = The measured area of the Q1 m/z for the isotopically labeled PFAS standard added to the sample before extraction

$Area_{NIS}$ = The measured area at the Q1 m/z for the isotopically labeled PFAS used as the non-extracted internal standard (NIS)

M_{NIS} = The mass of the isotopically labeled compound used as the non-extracted internal standard (NIS) in the calibration standard

M_l = The mass of the isotopically labeled PFAS standard added to the sample before extraction

15.5.2 Calculate the mean response factor (RF) for each compound:

$$\overline{RF} = \frac{\sum_{i=1}^{n} RF_i}{n}$$

Where: n = The number of standards analyzed.

15.5.3 The processing software will calculate the standard deviation (SD) and the RSD of the calibration factors for each analyte as:

$$SD = \sqrt{\frac{\sum_{i=1}^{n}\left[RF_i - \overline{RF}\right]^2}{(n-1)}} \qquad RSD = \frac{SD}{\overline{RF}} * 100$$

Where: n = The number of standards analyzed.

15.5.4 Calculation of the percent difference (%D) for all analytes in the ICV and/or CCV:

$$\%D = \frac{C_{expected} - C_{found}}{C_{expected}} * 100 = \frac{RF_{ccv} - \overline{RF}}{\overline{RF}} * 100$$

Where:

$C_{expected}$ = the true value of the analyte or surrogate.
C_{found} = the on-column analyte or surrogate result

15.5.5 Determine the concentration of individual compounds in the sample using the following equation:

$$\text{Concentration (ug/L)} = \frac{(As)\,(Is)}{(Ais)\,(\overline{RF})}$$

Where:

A_s = response of the analyte in the sample
I_s = concentration of internal standard present (in ug/L).
A_{is} = response of the internal standard
$\overline{RF}$ = Average Response Factor (unitless)

15.6 Linear Calibration Calculations (using a least squares regression (first-order) calibration fit):

15.6.1 Option 1: X_s is the concentration of the analyte in the calibration standard aliquot introduced into the instrument and Y_s is the ratio of response of the analyte to the response of internal standard times the mass of the internal standard in the calibration standard aliquot introduced into the instrument.

$X_s = C_s$ and $Y_s = A_s \times \frac{C_{is}}{A_{is}}$

Where:

Cs = concentration of analyte in the volume of calibration standard introduced into the instrument.
Cis = concentration of internal standard in the volume of calibration standard injected into the instrument.
As = Peak response of analyte.
Ais = Peak response of internal standard.

15.6.2 Option 2: *x* is the ratio of the analyte concentration in the calibration standard aliquot introduced into the instrument to the internal standard concentration in the calibration standard aliquot introduced into the instrument and *y* is the ratio of response of the analyte to the response of internal standard.

$x = \frac{C_s}{C_{is}}$ and $y = \frac{A_s}{A_{is}}$

Where:

Cs = concentration of analyte in the volume of calibration standard introduced into the instrument.
Cis = concentration of internal standard in the volume of calibration standard injected into the instrument.
As = Peak response of analyte.
Ais = Peak response of internal standard.

15.6.3 The linear least squares regression equation is:

$y = ax + b$

Where:
a = The slope of the linear regression.
b = The intercept of the linear regression.

15.6.4 The processing software will calculate the coefficient of determination (r^2) for each analyte by squaring the correlation coefficient as:

$$r^2 = \left[r = \frac{n\sum_{i=1}^{n} x_i y_i - \sum_{i=1}^{n} x_i \sum_{i=1}^{n} y_i}{\sqrt{\left(n\sum_{i=1}^{n} x_i^2 - \left(\sum_{i=1}^{n} x_i\right)^2\right)\left(n\sum_{i=1}^{n} y_i^2 - \left(\sum_{i=1}^{n} y_i\right)^2\right)}} \right]^2$$

15.6.5 Calculation of the Percent Drift for all analytes in the ICV and/or CCV:

% Drift = (Analyte Result / True Value) * 100

15.6.6 Calculations of sample amounts when using a linear regression calibration fit:

$$\text{Option 1} \qquad X_s = \frac{\left(\frac{(A_s \text{ x } C_{is})}{A_{is}}\right) - b}{a}$$

$$\text{Option 2} \qquad X_s = \frac{\left(\left(\frac{A_s}{A_{is}}\right) - b\right) \text{ x } C_{is}}{a}$$

Where:
X_s = calculated concentration of the analyte or surrogate in the sample aliquot introduced into the instrument
A_s = peak response of the analyte or surrogate in the sample
A_{is} = peak response of the internal standard in the sample
C_{is} = concentration of the internal standard in the sample aliquot introduced into the instrument.
a = The slope of the linear regression.
b = The intercept of the linear regression.

15.7 Percent Recovery for standards and LCS/LCSD

% Recovery = (LCS Result / True Value) * 100

15.8 Percent Recovery for MS and MSD samples

% Recovery = [(MS/D Result - Parent Sample Result) / Spike True Value] * 100

15.9 Dry weight determination:

$$\text{mg/dry kg PH} = \frac{\text{Cs}}{1 - (\text{\%moisture}/100)}$$

Where:
Cs = Concentration of Pesticides (in mg/L or mg/kg)

15.10 Relative Percent Difference (RPD)

$$\% \text{ RPD} = \frac{|\text{Difference b/w Dups}|}{\text{Average of Dups}} * 100$$

15.11 Qualifier Ion Ratio: Mass Hunter calculates this value as the response(area) for the qualifier ion divided by the response(area) of the quantification ion times 100:

Ratio = (qualifier ion area/quantifier ion area)*100

15.12 Non-extracted Internal Standard Mean area:

$\text{Mean Area}_{\text{NISi}} = (\sum \text{Area}_{\text{NISi}})/n$

Where:

$\text{Area}_{\text{NISi}}$ = Area counts for the ith NIS, where i ranges from 1 to 7, for the seven NIS compounds.

n = The number of ICAL standards (the default value is n = 6). If a different number of standards is used for the ICAL, for example, to increase the calibration range or by dropping a point at either end of the range to meet the linearity criterion, change 6 to match the actual number of standards used)

15.13 Method Detection Limit: The MDL is typically calculated as 3.143 times the standard deviation (SD).

$$\overline{X} = \frac{\sum_{i=1}^{n} X_i}{n} \qquad SD = \sqrt{\frac{\sum_{i=1}^{n}\left[X_i - \overline{X}\right]^2}{(n-1)}} \qquad \text{MDL} = \text{SD x } 3.143$$

Where: n = The number of standards analyzed.
X = One of the seven replicate MDL values.

16.0 Method Performance (See Sections 12.0 Quality Control and 18.0 Data Assessment and acceptance criteria for quality control measures).

17.0 Pollution Prevention

17.1 See Standard Methods section 1100, 22nd Edition or On-Line edition – Waste Minimization and Disposal.

17.2 See SOP Admin-018 and the AEL Safety Manual.

18.0 Data Assessment and acceptance criteria for quality control measures

18.1 It is the responsibility of the analyst to assess all data for quality control acceptance criteria.

18.2 It is the responsibility of the analyst to review all data/data entry for adherence to quality control criteria and any transcription or typographical errors prior to peer or supervisor review.

18.3 It is the responsibility of the analyst and/or supervisor to initiate and/or recommend correction action for out of control data.

18.4 All out of control data will be qualified according to SOP Admin-008.

18.5 See AEL QM Section 10.0.

18.6 All calibration will have a minimum of a six-point curve (Note: a minimum seven-point curve is required for a quadratic calibration fit). Points at the ends of the curve may be dropped if they are non-linear. If a data point is not usable or unacceptable within the curve, it will be re-analyzed. A data point for the ICAL can be dropped only if it can be documented as a non-repeatable error.

18.7 Each analytical batch at a minimum will follow the “24 hour rule,” where, at the beginning of each 24-hour period, an IB, and low level CCV must be analyzed. The following CCV’s will vary between mid and high levels. The final CCV must be injected within 24 hours of the opening CCV.

18.7.1 The instrument must be free of analytes as exhibited by an instrument blank at the beginning of each analysis window.

18.7.2 The Check Tune must pass the method criteria for any following data to be reported.

18.7.3 The CCV must meet method acceptance criteria to report unqualified data.

18.7.3.1 If any analyte fails with a low recovery, no data results can be reported for that analyte.

18.7.3.2 If any analyte fails with a high recovery, non-detects can be reported if qualified or properly noted in the case narrative. Corrective action (ex: remixing standard, cleaning injection liner, etc.) will be taken before the next analysis window (or next analytical sequence if the instrument is running multiple analysis windows in one night).

18.7.3.3 Failure to meet the CCV QC performance criteria requires corrective action.

Following a minor remedial action, such as servicing the autosampler or flushing the column, check the calibration with a mid-level CCV and a CCV at the MRL, or recalibrate according to Section 13. If isotope performance standard and calibration failures persist, maintenance may be required, such as servicing the LC-MS/MS system or replacing the LC column.

18.8 Method Blank (MB) – The MB must be clean of analytes of interest. If there are hits in the method blank, these hits must be below the method detection limit.

18.8.1 If the hits are above the method reporting level, and the samples themselves are clean of those hits (below the MDL), the sample results are fine to report.

18.8.2 If the MB results are above the MDL, and samples have the same hits, then sample results will not be accurate, and the MB and samples must be re-analyzed and/or re-extracted to prove that the hits were not contamination.

18.9 Laboratory Control Spikes (LCS) – The LCS must fall within control chart limits for percent recoveries of both analytes for valid data reporting. If the LCS fails, first check the instrument for possible problems. Document any issues, and then re-analyze the LCS. If the LCS still fails, then all samples in the extraction batch must be re-extracted or re-analyzed.

18.10 Matrix Spike/Matrix Spike Duplicate (MS/MSD) – Failure to meet control limits for analyte and surrogate recoveries does not in itself require data to be rejected. Data can be flagged (J(4)) for matrix interference.

18.11 At any point in the analytical batch, an analyst may use his/her discretion to fail or reject data he/she feels to be suspicious or in error. At this point, the analyst should seek the help of a supervisor or the QC officer.

18.12 Data should be rejected for individual sample runs if the chromatogram looks odd, retention times shift outside retention time windows, or surrogates fail due to reasons other than matrix interferences.

18.13 Any and all QC failures must be reported to a supervisor and the QC officer.

18.14 Extraction personnel should be informed of any failures immediately. They should also be informed of any trends that develop in sample recoveries.

19.0 Corrective action for out of control data

19.1 See Section 20.0 for out of control or unacceptable data.

19.2 See SOP ADMIN-016 and ADMIN-028.

20.0 Contingencies for handling out of control or unacceptable data

20.1 If a blank failure occurs, any sample containing that analyte will get a ‘V’ qualifier and an NCF is required.

20.1.1 If the MB exhibits contamination, but the samples are BDL for the analytes in question, there is no need for any qualifier nor does an NCF need to be written.

20.2 LCS failure

20.2.1 If the LCS fails the lower criteria and there is insufficient sample to re-extract, the sample will be reported as is; however, every analyte that failed will get a "J(3)" qualifier and an NCF is required.

20.2.2 If the LCS fails the upper criteria and the sample is BDL for the analyte in question, the failure will be case narrated. The sample will not be qualified nor does an NCF need to be written.

20.2.3 If the LCS fails the upper criteria and the sample contains a hit for the analyte in question and there is insufficient sample to re-extract, the sample will be reported as is; however, the analyte in question will get a "J(3)" qualifier and an NCF is required.

20.3 If the native sample that is used for the MS/MSD has a target analyte detected at a concentration greater than 4 times the spike value, the spike recovery in the MS and MSD will not be calculated. The MS/MSD failure will be case narrated and the sample will not be qualified.

20.4 See ADMIN-016 for the NCF writing process.

20.5 See ADMIN-028 for the Case Narrative writing process.

21.0 Waste Management

21.1 Refer to SOP for Waste Management (ADMIN-018) for any other questions.

21.2 See Standards Method section 1090, 22nd Edition or On-Line edition– Waste Minimization and Disposal.

22.0 Cautions/Preventative Maintenance

22.1 Routine, preventative instrument maintenance must be performed and documented in a maintenance logbook to assure optimum instrument performance. All maintenance is documented in the maintenance log in accordance with Quality Manual 8.0.

22.2 System Carryover – Highly concentrated calibration standards and client samples containing high concentrations of target analytes can be retained in the GC systems and bleed out (carryover) into subsequent QC and client samples. Blanks must be analyzed after the initial calibration and "hot" client samples to prove the system is free of such contamination before more batches QC (MB, etc.) are analyzed. It is not acceptable to delete carryover from batch QC or client samples. Client samples must be rerun to confirm suspected hits from carryover.

22.3 Liquid Chromatogram

22.3.1 A regular schedule of maintenance is dictated more by the instrument checks and a visual check of the chromatography more than by any set schedule. Most maintenance is done in response to a failure of one of the QC checks done during the course of normal operation or poor chromatographic performance. These checks ensure that the instrument is working at top performance and is proof that the instrument is in good working order.

22.3.2 “Hot” or “dirty” samples or the cumulative effect of many samples can cause the chromatography to degrade as well. Performing routine maintenance can bring performance back to normal operation. However, in some cases when the chromatography is not improved with this maintenance, the column will require replacement.

22.3.3 A dirty detector can result with use over time. If the baseline is seen as becoming erratic or the signal response is seen to degrade, this may indicate that the detector needs cleaning. Cleaning the source will most times restore full signal response.

22.4 When any maintenance is performed, the system should be carefully inspected for leaks prior to beginning analysis. Any parts of the instrument that have been recently taken apart and re-assembled are the most likely places for a leak to develop. It is also important to periodically check for leaks at the detectors where the columns are inserted.

22.5 Typical Instrument Preventative Maintenance Schedule – LC-MS/MS

22.5.1 Daily:

22.5.1.1 Keep wash/syringe rinse filled with appropriate reagent.

22.5.1.2 Check the Nitrogen tank pressure, replace tank as needed.

22.5.2 Monthly:

22.5.2.1 Clean auto-samplers and check that needles are clean and in working condition (clean or replace the syringes if needed.

22.5.2.2 Clean any accumulated dust and dirt off of the instrumentation.

22.5.2.3 Check the fore line pump oil level. Add pump fluid as needed until the oil level in the window is near, but not above, the upper fill line.

22.5.2.4 Clean the spray shield and the surrounding areas within the source. Remove and inspect the nebulizer, checking the tip for proper position and for build up and/or clogging.

22.5.3 Semi-Annual:

22.5.3.1 Schedule a preventative maintenance visit from Agilent.

22.5.3.2 Vent the system and change and/or clean the capillary.

22.5.4 Yearly:

22.5.4.1 Replace oil in rotary pump.

22.5.4.2 Replace column (or earlier if needed).

22.5.5 The laboratory must be cleaned regularly to prevent background contamination of the analyte PFBA. During method development it was found that PFBA was coming from the room's ventilation system. The duct coverings must be wiped down at least every 2 weeks. Also, HEPA filters are used in the system intake, and the intake grate should also be wiped down every 2 weeks. The HEPA filter should be replaced at a minimum of every 6 months.

23.0 References

23.1 *DETERMINATION OF PER- AND POLYFLUOROALKYL SUBSTANCES IN DRINKING WATER BY ISOTOPE DILUTION ANION EXCHANGE SOLID PHASE EXTRACTION AND LIQUID CHROMATOGRAPHY/TANDEM MASS SPECTROMETRY*, Method 533, November 2019, U.S. EPA Document No. 815-B-19-020.

23.2 *2nd DRAFT method 1633 – Analysis of Per- and Polyfluoroalkyl Substances (PFAS) in Aqueous, Solid, Biosolids, and Tissue Samples by LC-MS/MS. June 2022.*

23.3 Standard Methods 22nd Edition or On-Line edition.

23.4 EPA CFR 40 Part 136.6, Appendix B.

23.5 TNI Standards 2016

23.6 ISO 17025: 2005 & 2017 Standards

23.7 DoD ELAP QSM Rev. 5.4 October 2021

23.8 AEL Health and Safety Manual.

23.9 AEL Policy and Procedures Manual.

23.10 AEL Quality Manual, latest revision.

23.11 AEL Admin SOPS.

24.0 Tables, Diagrams, flowcharts, and validation data

24.1 SOP Validation Data. See the employee file for the following individuals for an acceptable initial demonstration of capability, which serves as validation data for this method at AEL.

24.2 Table 1 – NIS and EIS mass labeled analytes and Retention Times, and Reference NIS for each EIS.

Non-extracted Internal Standards (NIS)		**RT(min)**
Full Name	**Abbreviation**	
Perfluoro-n-[2,3,4-13C3]butanoic acid	13C3-PFBA	6.68
Perfluoro-n-[1,2-13C2]hexanoic acid	13C2-PFHxA	13.14
Perfluoro-n-[1,2,3,4-13C4]octanoic acid	13C4-PFOA	18.36
Perfluoro-n-[1,2,3,4,5-13C5] nonanoic acid	13C5-PFNA	20.66
Perfluoro-n-[1,2-13C2]decanoic acid	13C2-PFDA	23.99
Perfluoro-1-hexane[18O2]sulfonic acid	18O2-PFHxS	16.26
Perfluoro-n-[1,2,3,4-13C4]octanesulfonic acid	13C4-PFOS	20.731

Extracted Internal Standards (EIS)		**RT (min)**	**Reference NIS**
Full Name	**Abbreviation**		
Perfluoro-n-[13C4]butanoic acid	$^{13}C_4$-PFBA	6.67	$^{13}C_3$-PFBA
Perfluoro-n-[13C5]pentanoic acid	$^{13}C_5$-PFPeA	13.14	$^{13}C_2$-PFHxA
Perfluoro-1-[2,3,4-13C3]butanesulfonic acid	$^{13}C_3$-PFBS	10.63	$^{18}O_2$-PFHxS
1H,1H,2H,2H-Perfluoro-1-[1,2-13C2]hexane sulfonic acid	$^{13}C_2$-4:2FTS	12.79	$^{18}O_2$-PFHxS
Perfluoro-n-[1,2,3,4,6-13C5]hexanoic acid	$^{13}C_5$-PFHxA	13.14	$^{13}C_2$-PFHxA
Tetrafluoro-2-heptafluoropropoxy-13C3-propanoic acid	$^{13}C_3$-HFPO-DA	14.07	$^{13}C_2$-PFHxA
Perfluoro-n-[1,2,3,4-13C4]heptanoic acid	$^{13}C_4$-PFHpA	16.00	$^{13}C_2$-PFHxA
Perfluoro-1-[1,2,3-13C3]hexanesulfonic acid	$^{13}C_3$-PFHxS	16.25	$^{18}O_2$-PFHxS
1H,1H,2H,2H-Perfluoro-1-[1,2-13C2]octane sulfonic acid	$^{13}C_2$-6:2FTS	18.18	$^{18}O_2$-PFHxS
Perfluoro-n-[13C8]octanoic acid	$^{13}C_8$-PFOA	18.36	$^{13}C_4$-PFOA
Perfluoro-n-[13C9]nonanoic acid	$^{13}C_9$-PFNA	20.66	$^{13}C_5$-PFNA
Perfluoro-1-[13C8]octanesulfonic acid	$^{13}C_8$-PFOS	20.73	$^{13}C_4$-PFOS
1H,1H,2H,2H-Perfluoro-1-[1,2-13C2]decane sulfonic acid	$^{13}C_2$-8:2FTS	23.78	$^{18}O_2$-PFHxS
Perfluoro-n-[1,2,3,4,5,6-13C6]decanoic acid	$^{13}C_6$-PFDA	23.98	$^{13}C_2$-PFDA
Perfluoro-n-[1,2,3,4,5,6,7-13C7]undecanoic acid	$^{13}C_7$-PFUnA	27.69	$^{13}C_2$-PFDA
Perfluoro-n-[1,2-13C2]dodecanoic acid	$^{13}C_2$-PFDoA	28.37	$^{13}C_2$-PFDA
N-ethyl-d5-perfluoro-1-octanesulfonamidoacetic acid	d5-N-Et-FOSAA	27.69	$^{13}C_4$-PFOS
N-methyl-d3-perfluoro-1-octanesulfonamidoacetic acid	d3-N-Me-FOSAA	26.12	$^{13}C_4$-PFOS
Perfluoro-n-[1,2-13C2]tetradecanoic acid	M2PFTeDA	28.97	$^{13}C_2$-PFDA
Perfluoro-1-[13C8]octanesulfonamide	$^{13}C_8$-PFOSA	27.27	$^{13}C_4$-PFOS
N-methyl-d3-perfluoro-1-octanesulfonamide	D_3-NMeFOSA	28.90	$^{13}C_4$-PFOS
N-ethyl-d5-perfluoro-1-octanesulfonamide	D_5-NEtFOSA	29.20	$^{13}C_4$-PFOS
N-methyl-d7-perfluorooctanesulfonamidoethanol	D_7-NMeFOSE	28.85	$^{13}C_4$-PFOS
N-ethyl-d9-perfluorooctanesulfonamidoethanol	D_9-NEtFOSE	29.15	$^{13}C_4$-PFOS

24.3 Table 2 – Method analytes, Retention times, and Suggested Isotope Dilution Analogue References

Analyte	RT (min)	Isotope Dilution Analogue
PFBA	6.68	$^{13}C_{4}$-PFBA
PFMPA	7.86	$^{13}C_{5}$-PFPeA
3:3FTCA	9.79	$^{13}C_{5}$-PFPeA
PFPeA	9.92	$^{13}C_{5}$-PFPeA
PFBS	10.63	$^{13}C_{3}$-PFBS
PFMBA	10.92	$^{13}C_{5}$-PFPeA
PFEESA	11.90	$^{13}C_{5}$-PFHxA
NFDHA	12.61	$^{13}C_{5}$-PFHxA
4:2FTS	12.80	$^{13}C_{2}$-4:2FTS
PFHxA	13.14	$^{13}C_{5}$-PFHxA
PFPeS	13.61	$^{13}C_{3}$-PFHxS
HFPO-DA	14.07	$^{13}C_{3}$-HFPO-DA
PFHpA	16.01	$^{13}C_{4}$-PFHpA
PFHxS	16.26	$^{13}C_{3}$-PFHxS
ADONA	16.35	$^{13}C_{3}$-HFPO-DA
5:3FTCA	16.32	$^{13}C_{5}$-PFHxA
6:2FTS	18.19	$^{13}C_{2}$-6:2FTS
PFOA	18.36	$^{13}C_{8}$-PFOA
PFHpS	18.48	$^{13}C_{8}$-PFOS
PFNA	20.67	$^{13}C_{9}$-PFNA
PFOS	20.74	$^{13}C_{8}$-PFOS
7:3FTCA	21.33	$^{13}C_{5}$-PFHxA
9Cl-PF3ONS	22.72	$^{13}C_{3}$-HFPO-DA
8:2 FTS	23.77	$^{13}C_{2}$-8:2FTS
PFNS	24.03	$^{13}C_{8}$-PFOS
PFDA	23.99	$^{13}C_{6}$-PFDA
N-Me-FOSAA	26.20	d3-N-MeFOSAA

Analyte	RT (min)	Isotope Dilution Analogue
PFDS	27.67	$^{13}C_{8}$-PFOS
FOSA	27.27	$^{13}C_{8}$-PFOSA
PFUnA	27.68	$^{13}C_{7}$-PFUnA
N-Et_FOSAA	27.71	d5-N-EtFOSAA
11Cl-PF3OUdS	28.19	$^{13}C_{3}$-HFPO-DA
PFDoA	28.37	$^{13}C_{2}$-PFDoA
PFDoS	28.67	$^{13}C_{8}$-PFOS
PFTrDA	28.71	*Average**
N-Me-FOSE	28.88	D7-NMeFOSE
N-Me-FOSA	28.91	D3-NMeFOSA
PFTeDA	28.97	M2PFTeDA
N-Et-FOSE	29.17	D9-NEtFOSE
N-Et-FOSA	29.21	D5-NEtFOSA

*For improved accuracy, PFTrDA is quantitated using the average areas of the labeled analytes 13C2-PFTeDA and 13C2-PFDoA.

24.4 Table 3 – Recommended LC-MS/MS Operating Conditions

HPLC Program		
Time (min)	**% 20 mM ammonium acetate**	**% Methanol**
Initial	95.0	5.0
0.5	95.0	5.0
3.0	60.0	40.0
16.0	32.0	68.0
24.0	32.0	68.0
26.0	5.0	95.0
28.5	5.0	95.0
29.0	95.0	5.0
30.0	95.0	5.0

LC-MS/MS Conditions[a,b]					
Analyte	**Precursor Ion[c] (*m/z*)**	**Product Ion[c,d] (*m/z*)**	**Confirmation Ion (*m/z*)**	**Fragmentor (v)**	**Collision Energy[e] (v)**
PFBA	213	169	NA	60	8
$^{13}C_3$-PFBA	216	172	NA	65	8
$^{13}C_4$-PFBA	217	172	NA	60	8
PFMPA	229	85	NA	60	12
PFPeA	263	219	68.9	70	4
$^{13}C_5$-PFPeA	268	223	NA	60	8
$^{13}C_3$-PFBS	302	80	99	125	38
PFBS	299	80	99	137	38
PFMBA	279	85	NA	70	12
PFEESA	315	134.9	83	104	26
NFDHA	295	201	85	83	2
$^{13}C_2$-4:2FTS	329	80.9	309	135	34
4:2FTS	327	307	81	125	20
$^{13}C_5$-PFHxA	318	273	120	58	6
$^{13}C_2$-PFHxA	315	270	N/A	68	6
PFHxA	313	269	119	53	6
PFPeS	349	80	99	142	50
$^{13}C_3$-HFPO-DA	287[f]	169	185	68	2
HFPO-DA	285[f]	169	185	68	6
$^{13}C_4$-PFHpA	367	322	NA	72	0
PFHpA	363	319	169	71	10

LC-MS/MS Conditions (Continued) [a,b]

Analyte	Precursor Ion [c] (*m/z*)	Product Ion[c,d] (*m/z*)	Confirmation Ion (*m/z*)	Fragmentor (v)	Collision Energy[e] (v)
$^{13}C_3$-PFHxS[g]	402	80	99	152	50
$^{18}O_2$-PFHxS[g]	403	83.9	NA	134	42
PFHxS[h]	399	80	99	140	50
ADONA	377	251	85	60	10
$^{13}C_2$-6:2FTS	429	80.9	309	130	38
6:2FTS	427	407	81	125	24
$^{13}C_4$-PFOA	417	172	NA	76	22
$^{13}C_8$-PFOA	421	376	NA	69	4
PFOA	413	369	169	125	6
PFHpS	449	80	99	140	58
$^{13}C_9$-PFNA	472	427	NA	66	4
$^{13}C_5$-PFNA	468	423	NA	81	6
PFNA	463	419	219	91	6
$^{13}C_4$-PFOS[g]	503	80	99	180	52
$^{13}C_8$-PFOS[g]	507	80	99	155	60
PFOS[h]	499	80	99	160	58
9Cl-PF3ONS[i]	531	351	532.8→353.0	130	30
$^{13}C_2$-8:2FTS	529	80	509	170	54
8:2FTS	527	507	81	170	28
$^{13}C_6$-PFDA	519	474	NA	81	4
$^{13}C_2$-PFDA	515	470	NA	81	4
PFDA	513	469	219	98	8
$^{13}C_7$-PFUnA	570	525	NA	73	5
PFUnA	563	519	269	132	10
$^{11}C_l$- PF3OUdS[j]	631	451	632.9→452.9	160	30
$^{13}C_2$-PFDoA	615	570	NA	79	5
PFDoA	613	569	319	89	10
$^{13}C_8$-PFOSA	506	78	NA	125	40
FOSA	498	78	478	150	42
PFNS	549	80	99	127	54
PFDS	599	80	99	145	60
N-Et-FOSAA	584	419	526	117	18
N-Me-FOSAA	570	419	438	129	18
d5-N-Et-FOSAA	589	419	NA	115	24
d3-N-Me-FOSAA	573	419	NA	115	16
PFTeDA	713	669	169	101	14
PFTrDA	663	619	169	109	10
M2PFTeDA	715	670	NA	100	13
PFDoS	699	80	99	132	60

LC-MS/MS Conditions (Continued) [a,b]

Analyte	Precursor Ion [c] (*m/z*)	Product Ion[c,d] (*m/z*)	Confirmation Ion (*m/z*)	Fragmentor (v)	Collision Energy[e] (v)
3:3FTCA	241	177	117	76	2
5:3FTCA	341	237	217	83	10
7:3FTCA	441	317	337	109	22
N-Me-FOSA	512	219	169	140	22
N-Et-FOSA	526	219	169	126	26
N-Me-FOSE	616	58.9	NA	89	14
N-Et-FOSE	630	58.9	NA	119	50
D3-NMeFOSA	515	219	NA	137	26
D5-NEtFOSA	531	219	NA	165	26
D7-NMeFOSE	623	58.9	NA	94	14
D9-NEtFOSE	639	58.9	NA	91	54

ESI Conditions for Agilent 6470 QQQ	
Polarity	Negative ion
Capillary needle voltage	-2.5 kV
Sheath Gas Flow	12 L/min
Nitrogen desolvation gas	8 L/min
Desolvation gas temperature	170°C

NA = These analytes do not produce a confirmation ion mass

[a] An LC-MS/MS chromatogram of the analytes obtained using these parameters is shown in **Figure 1**.

[b] Segments are time durations in which single or multiple scan events occur.

[c] Precursor and product ions listed in this table are nominal masses. During MS and MS/MS optimization, the analyst determined precursor and product ion masses to one decimal place by locating the apex of the mass spectral peak (e.g., *m/z* 498.9 79.9 for PFOS). These precursor and product ion masses (with at least one decimal place) should be used in the MS/MS method for all analyses.

[d] Ions used for quantitation purposes.

[e] Nitrogen used as collision gas.

[f] HFPO-DA and NFDHA are not stable in the ESI source and the $[M-H]^-$ yields a weak signal under typical ESI conditions. The precursor ion used during method development was $[M-CO_2-H]^-$.

[g] The isotope dilution analogue used during method development was composed of the linear isomer exclusively.

[h] Analyte has multiple resolved chromatographic peaks due to linear and branched isomers. All peaks summed for quantitation purposes. To reduce bias regarding detection of branched and linear isomers, the *m/z* 80 product ion must be used for this analyte.

[i] The qualifier ion transition used for this analyte is 532.8-353.0.

[j] The qualifier ion transition used for this analyte is 632.9-452.9.

24.5 Table 4 – Typical 1633 Analytical Sequence

Calibration Curve Analytical Sequence
Rinse
IB
ICAL (1 through 9)
IB
ICV
IB
Qualitative ID standards
Bile salts mix
ISC (Low-Level CCV)
Mid-level CCV
IB
Batch QC, matrix QC and 10 client samples
Mid-Level CCV
10 client samples
Mid-Level CCV

Daily Analytical Sequence
Rinse
IB
Qualitative ID standards
Bile salts mix
ISC (Low Level CCV)
Mid-level CCV
Batch QC and 10 client samples
Mid-Level CCV
10 client samples
Mid-level CCV

24.6 Table 5 – Method Required Quality Control for 1633 and DOD Table B-24

Initial Demonstration of Capability		
Requirement	**Specification and Frequency**	**Acceptance Criteria**
Establish retention times for branched isomers	Each time chromatographic conditions change.	All isomers of each analyte must elute within the same MRM window.
Demonstration of low system background	After calibration, analyze an Instrument Blank (IB) following the highest standard in the calibration range.	Demonstrate that the method analytes are less than one-half of the Minimum Reporting Level (MRL).
Initial Precision and Recovery (IPR): demonstration of accuracy and precision	For each matrix, extract and analyze a MB and 4 replicate Laboratory Fortified Blanks (LFBs) near the mid-range concentration. All processing steps must be included (extraction, cleanup, and concentration). IPR is required for new staff and whenever method modifications are made.	Results must be within 80–120% of the true value to meet AEL acceptance criteria. Percent relative standard deviation must be ≤20% to meet AEL acceptance criteria. *Note: Once Table 5 in the EPA Draft 1633 method is finalized, the laboratory will adopt those specific limits.*
Method Detection Limit	Establish MDLs as per Section 12.0 of this SOP and 40 CFR Part 136 App. B. MDL verification is required at initial instrument set-up, and whenever method modifications are made.	Initial MDL: 7 spiked samples and 7 method blank samples prepared in at least three batches on three separate calendar dates and analyzed on three separate calendar dates. New Instrument or Method Modification: 2 spiked samples and 2 method blank samples prepared & analyzed on different calendar dates & compared against existing MDLs for validity. If both method blank results are below the existing MDL, then the existing MDL_b is validated. Recalculate the MDL_s to include the two spiked samples. If the recalculated MDLs is within 0.5 to 2.0 times the existing MDL, the existing MDL is validated.

Quality Control Requirements		
Requirement	**Specification and Frequency**	**Acceptance Criteria**
Mass Calibration	Annually and on as-needed basis perform a full Autotune. Daily before starting an analytical sequence perform a Checktune.	Follow vendor's procedure. If daily checktune fails any mass for the Negative mode (EPA 1633 specifies +/- 0.2Da), then stop and perform a full Autotune. A new ICAL will need to be ran following a new Autotune.
Retention time windows	Set RT windows for each analyte, EIS, and NIS during ICAL, and with each CCV ran at the beginning of the sequence.	Method analytes, EIS and NIS must be within 0.4 minutes of the RT from the mid-level standard of the ICAL, or the daily CCV. Each analyte must fall within 0.1 minute of its EIS; this only applies to analytes that have a mass-labeled analog.
Bile salts	DOD – Ran at the beginning of an analytical sequence for DOD only. 1633 – Requires an initial bile salt interference when establishing chromatographic conditions (regardless of matrix). A daily salt check is not required unless running tissue samples.	Each bile salt must not elute within 1 minute of all PFOS isomers.
Qualitative Identification Standard	Analyze daily at the beginning of the analytical sequence.	Confirm the RT of each linear and known branched isomer or isomer group. Quantitative standards containing isomeric mixtures for an analyte are commercially available for PFOS, PFHxS, NMeFOSAA, and NEtFOSAA. Qualitative/technical standards are available for PFOA, NEtFOSA, NMeFOSE, and NEtFOSE.

Quality Control Requirements (Continued)

Requirement	Specification and Frequency	Acceptance Criteria
Initial calibration	Analyzed as a corrective action for CCC exceedances, after major instrument maintenance, or after mass recalibration. Use the isotope dilution calibration technique to generate a calibration curve using either average CF, linear or quadratic curve fits. Use at least 6 standard concentrations; 7 for Quadratic. Linear and Quadratic fits must be forced through origin. Weighted fits allowed. Qualifier ion ratios must be updated with each new calibration curve to the average of the calibration levels used to generate the curves.	When each calibration standard is calculated as a known using the calibration curve, all levels should be within 70–130% of the true value. 1633 – Low Level signal-to-noise Ratio ≥ 3:1 %RSD/RSE must be </= 20%; Record the mean area response for each NIS. Analyze a Bile Salt standard after calibration (see acceptance criteria above). DOD – %RSD</=20%, or R2 > 0.990
Instrument Blank	Analyze an instrument blank at the beginning of a sequence, after the High-level of the ICAL (if running), after each CCC and after any field sample that has analyte detections exceeding the range of the ICAL (if possible).	DOD – All analytes must be </= ½ the MRL/LOQ. If any samples ran after a sample with a detection above the calibration range, had detections for that analyte above 1/2MRL, they must be re-analyzed.
Initial calibration verification (ICV)	Second source standard ran after Initial calibration, prior to sample analysis. May be from same vendor but must be different mix/lot.	DOD – Analyte concentrations must be 70-130% of their true value.
Instrument Sensitivity Check	Ran daily prior to sample analysis; DOD specifies once every 12 hours thereafter. Concentrations of analytes at, or below, MRL/LOQ.	1633 – Signal to noise must be ≥ 3:1. DOD – all analytes must be 70-130% of true value.
Continuing Calibration Check (CCC) or Calibration Verification (CV)	Verify initial calibration by analyzing a mid-level CCC at the beginning of each Analysis Batch. Subsequent CCCs are required after every tenth field sample and to complete the batch.	1633 and DOD – all analytes and EIS must be 70-130% of true value. Set sequence IAR acceptance window as 50-150% of IAR in midpoint calibration standard or daily CCV.

Quality Control Requirements (Continued)		
Requirement	**Specification and Frequency**	**Acceptance Criteria**
Non-extracted Internal Standards (NIS)	Non-extracted Internal standards are added to all standards and sample extracts.	1633 – area recoveries are evaluated against EPA Draft 1633 Table 10 (see section 24.7 Table); criteria subject to change upon finalization of the draft method. (optional): NIS areas in field samples and QC samples should be 50-200% of the mean area of the ICAL. DOD – Area recoveries must be greater than 30% of the average of the ICAL. NIS areas corrected for the dilution factor must be greater than 30% of the average area of the calibration standards in diluted samples when additional NIS was not added post dilution of the extract.
Extracted Internal Standards (EIS).	Isotope dilution analogues are added to all samples prior to extraction.	1633 - % recovery for the EIS are evaluated against EPA Draft 1633 Table 9 (see section 24.8 Table); criteria subject to change upon finalization of the draft method. DOD – EIS recoveries must be within 20-150% until in-house limits can be created, or no project limits are provided. In-house limits cannot be lower than 20%.
Laboratory Control Sample (LCS) and Low-Level Laboratory Control Sample (LLCS). (Equivalent to as OPR and LLOPR in method 1633)	Include one LCS per Extraction Batch. Fortify the LCS with method analytes at a concentration near the mid-point of the curve. If not enough sample is provided for MS/MSD, then a LCSD must be performed.	1633 – Standard AEL limits of 80-120% have been assigned until the multi-laboratory evaluation is completed by the EPA. The lab may also evaluate LCS against EPA Draft Method Table 5 (see section 24.9 Table); criteria subject to change upon finalization of the draft method DOD – recovery must be within 40-150%, until in-house limits can be created, or if project limits are not provided. In-house limits cannot be lower than 40%.

Quality Control Requirements (Continued)

Requirement	Specification and Frequency	Acceptance Criteria
Method Blank	Prepare a method blank with each extraction batch. Must be spiked with EIS and subjected to prep procedure.	1633 – must be 1) less than the ML for any/all analytes; 2) less than 1/3 any regulatory compliance limits; or 3) < 1/10 the concentration found in any sample within the prep batch. DOD – Must be 1) less than ½ the MRL/LOQ, or 2) < 1/10th the concentration found in any sample in the prep batch, or 3) < 1/10th the regulatory limit, which ever of the three concentrations is greater.
Laboratory Fortified Sample Matrix (LFSM)	Include one LFSM per Extraction Batch. Fortify the LFSM with method analytes at a concentration close to but greater than the native concentrations (if known), or near the mid-point of the curve. Not required for method 1633.	DOD – recoveries must be within the LCS limits – 40-150% (or in-house limits), if project limits are not provided.
Laboratory Fortified Sample Matrix Duplicate (LFSMD) or Field Duplicate (FD)	Include at least one LFSMD or FD with each Extraction Batch. Not required for method 1633.	DOD – recoveries must be within the LCS limits – 40-150% (or in-house limits), if project limits are not provided. % RSD must be </= 30%.

24.7 EPA Draft 1633 Table 10 – NIS Recoveries

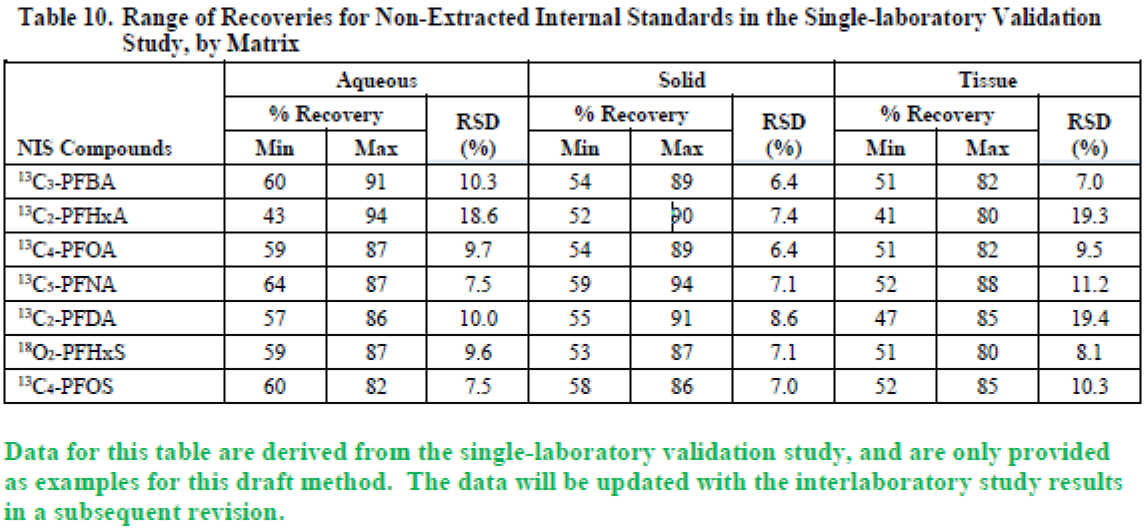


Table 10. Range of Recoveries for Non-Extracted Internal Standards in the Single-laboratory Validation Study, by Matrix

NIS Compounds	Aqueous			Solid			Tissue		
	% Recovery		RSD (%)	% Recovery		RSD (%)	% Recovery		RSD (%)
	Min	Max		Min	Max		Min	Max	
$^{13}C_3$-PFBA	60	91	10.3	54	89	6.4	51	82	7.0
$^{13}C_2$-PFHxA	43	94	18.6	52	90	7.4	41	80	19.3
$^{13}C_4$-PFOA	59	87	9.7	54	89	6.4	51	82	9.5
$^{13}C_5$-PFNA	64	87	7.5	59	94	7.1	52	88	11.2
$^{13}C_2$-PFDA	57	86	10.0	55	91	8.6	47	85	19.4
$^{18}O_2$-PFHxS	59	87	9.6	53	87	7.1	51	80	8.1
$^{13}C_4$-PFOS	60	82	7.5	58	86	7.0	52	85	10.3

Data for this table are derived from the single-laboratory validation study, and are only provided as examples for this draft method. The data will be updated with the interlaboratory study results in a subsequent revision.

24.8 EPA Draft 1633 Table 9 – EIS Recoveries

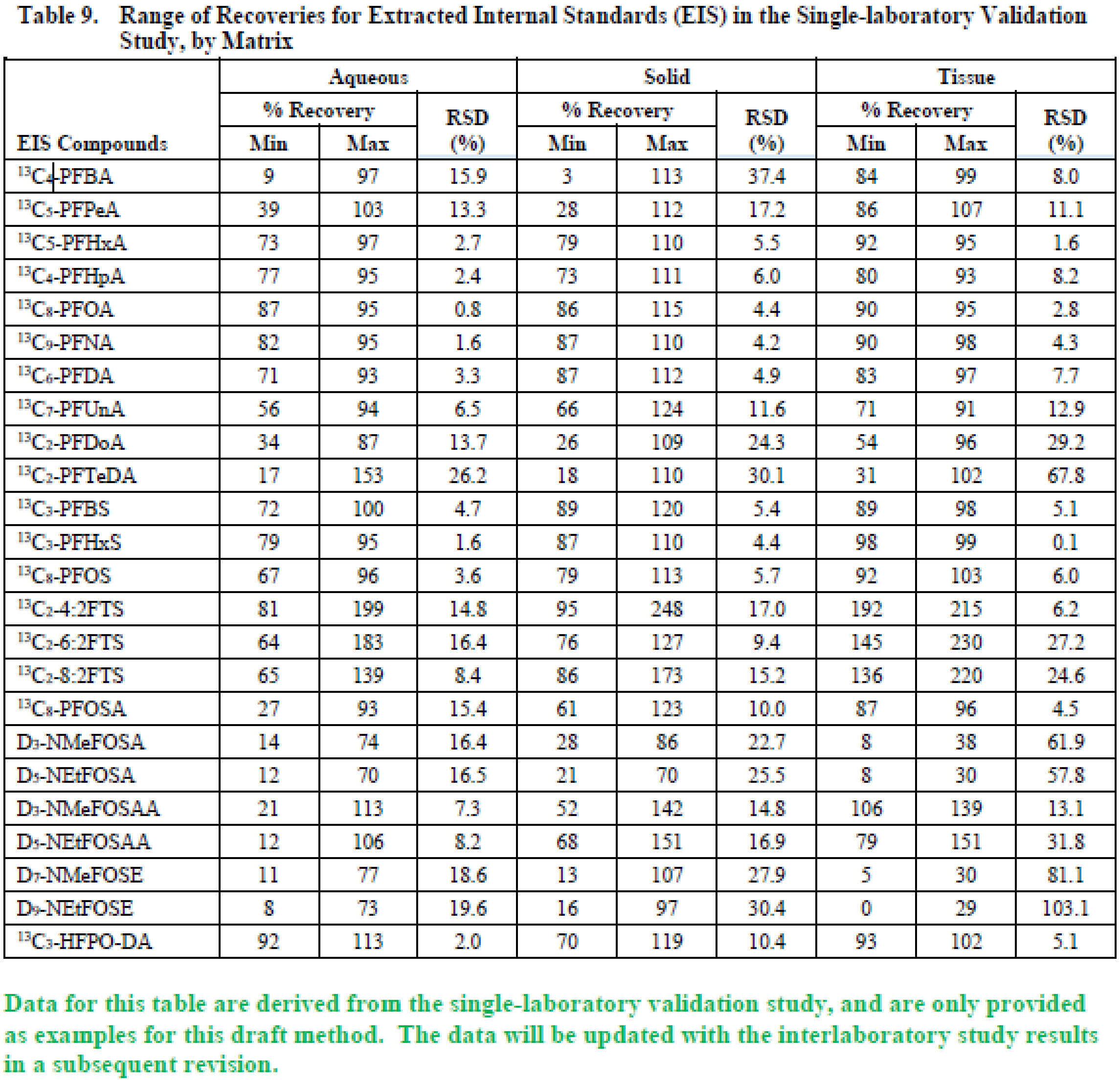


Table 9. Range of Recoveries for Extracted Internal Standards (EIS) in the Single-laboratory Validation Study, by Matrix

EIS Compounds	Aqueous			Solid			Tissue		
	% Recovery		RSD (%)	% Recovery		RSD (%)	% Recovery		RSD (%)
	Min	Max		Min	Max		Min	Max	
$^{13}C_4$-PFBA	9	97	15.9	3	113	37.4	84	99	8.0
$^{13}C_5$-PFPeA	39	103	13.3	28	112	17.2	86	107	11.1
$^{13}C5$-PFHxA	73	97	2.7	79	110	5.5	92	95	1.6
$^{13}C_4$-PFHpA	77	95	2.4	73	111	6.0	80	93	8.2
$^{13}C_8$-PFOA	87	95	0.8	86	115	4.4	90	95	2.8
$^{13}C_9$-PFNA	82	95	1.6	87	110	4.2	90	98	4.3
$^{13}C_6$-PFDA	71	93	3.3	87	112	4.9	83	97	7.7
$^{13}C_7$-PFUnA	56	94	6.5	66	124	11.6	71	91	12.9
$^{13}C_2$-PFDoA	34	87	13.7	26	109	24.3	54	96	29.2
$^{13}C_2$-PFTeDA	17	153	26.2	18	110	30.1	31	102	67.8
$^{13}C_3$-PFBS	72	100	4.7	89	120	5.4	89	98	5.1
$^{13}C_3$-PFHxS	79	95	1.6	87	110	4.4	98	99	0.1
$^{13}C_8$-PFOS	67	96	3.6	79	113	5.7	92	103	6.0
$^{13}C_2$-4:2FTS	81	199	14.8	95	248	17.0	192	215	6.2
$^{13}C_2$-6:2FTS	64	183	16.4	76	127	9.4	145	230	27.2
$^{13}C_2$-8:2FTS	65	139	8.4	86	173	15.2	136	220	24.6
$^{13}C_8$-PFOSA	27	93	15.4	61	123	10.0	87	96	4.5
D_3-NMeFOSA	14	74	16.4	28	86	22.7	8	38	61.9
D_5-NEtFOSA	12	70	16.5	21	70	25.5	8	30	57.8
D_3-NMeFOSAA	21	113	7.3	52	142	14.8	106	139	13.1
D_5-NEtFOSAA	12	106	8.2	68	151	16.9	79	151	31.8
D_7-NMeFOSE	11	77	18.6	13	107	27.9	5	30	81.1
D_9-NEtFOSE	8	73	19.6	16	97	30.4	0	29	103.1
$^{13}C_3$-HFPO-DA	92	113	2.0	70	119	10.4	93	102	5.1

Data for this table are derived from the single-laboratory validation study, and are only provided as examples for this draft method. The data will be updated with the interlaboratory study results in a subsequent revision.

24.9 EPA Draft 1633 Table 5 – OPR and IPR Criteria

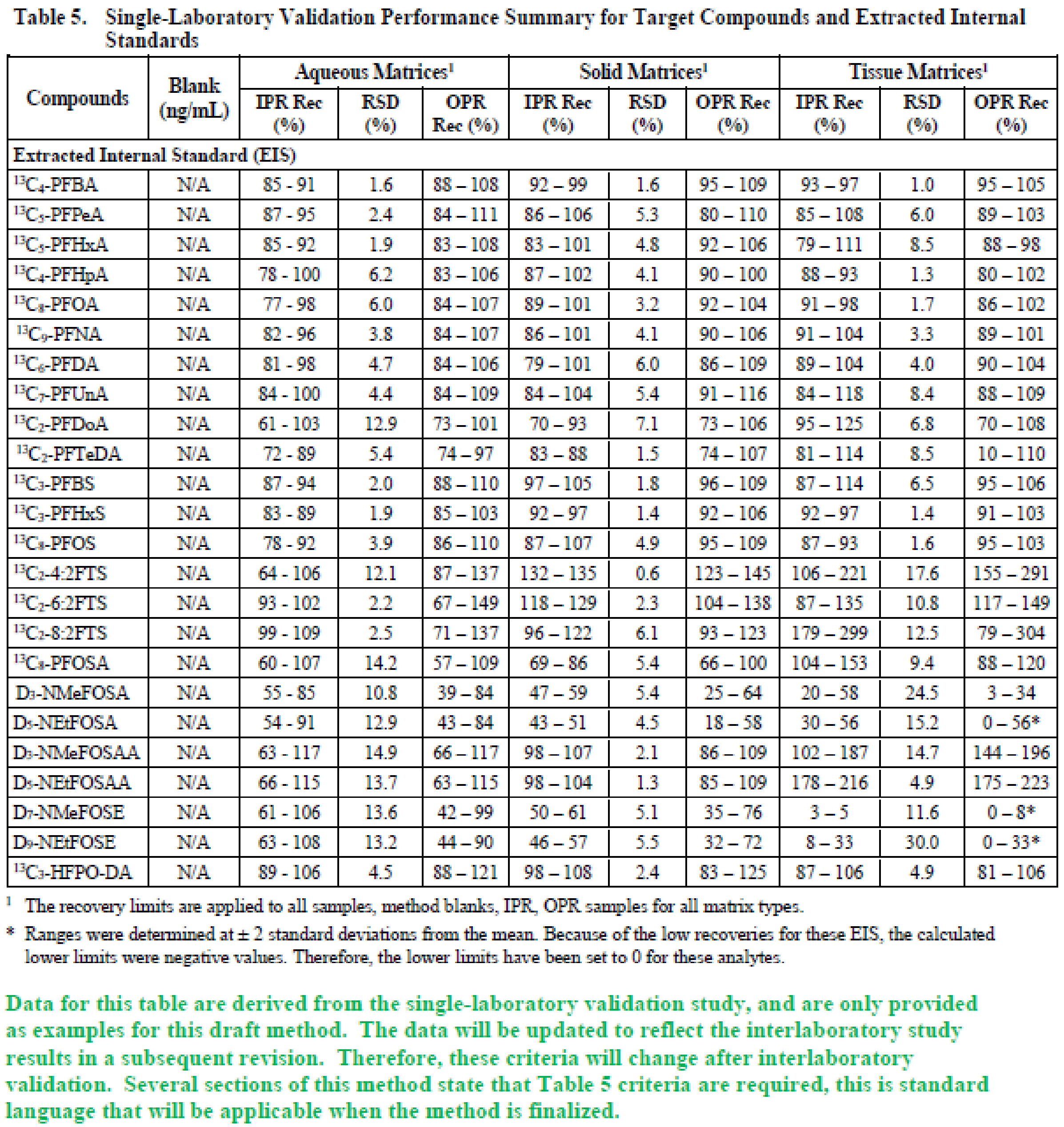


Table 5. Single-Laboratory Validation Performance Summary for Target Compounds and Extracted Internal Standards

Compounds	Blank (ng/mL)	Aqueous Matrices[1]			Solid Matrices[1]			Tissue Matrices[1]		
		IPR Rec (%)	RSD (%)	OPR Rec (%)	IPR Rec (%)	RSD (%)	OPR Rec (%)	IPR Rec (%)	RSD (%)	OPR Rec (%)
Extracted Internal Standard (EIS)										
$^{13}C_4$-PFBA	N/A	85 - 91	1.6	88 – 108	92 – 99	1.6	95 – 109	93 – 97	1.0	95 – 105
$^{13}C_5$-PFPeA	N/A	87 - 95	2.4	84 – 111	86 – 106	5.3	80 – 110	85 – 108	6.0	89 – 103
$^{13}C_5$-PFHxA	N/A	85 - 92	1.9	83 – 108	83 – 101	4.8	92 – 106	79 – 111	8.5	88 – 98
$^{13}C_4$-PFHpA	N/A	78 - 100	6.2	83 – 106	87 – 102	4.1	90 – 100	88 – 93	1.3	80 – 102
$^{13}C_8$-PFOA	N/A	77 - 98	6.0	84 – 107	89 – 101	3.2	92 – 104	91 – 98	1.7	86 – 102
$^{13}C_9$-PFNA	N/A	82 - 96	3.8	84 – 107	86 – 101	4.1	90 – 106	91 – 104	3.3	89 – 101
$^{13}C_6$-PFDA	N/A	81 - 98	4.7	84 – 106	79 – 101	6.0	86 – 109	89 – 104	4.0	90 – 104
$^{13}C_7$-PFUnA	N/A	84 - 100	4.4	84 – 109	84 – 104	5.4	91 – 116	84 – 118	8.4	88 – 109
$^{13}C_2$-PFDoA	N/A	61 - 103	12.9	73 – 101	70 – 93	7.1	73 – 106	95 – 125	6.8	70 – 108
$^{13}C_2$-PFTeDA	N/A	72 - 89	5.4	74 – 97	83 – 88	1.5	74 – 107	81 – 114	8.5	10 – 110
$^{13}C_3$-PFBS	N/A	87 - 94	2.0	88 – 110	97 – 105	1.8	96 – 109	87 – 114	6.5	95 – 106
$^{13}C_3$-PFHxS	N/A	83 - 89	1.9	85 – 103	92 – 97	1.4	92 – 106	92 – 97	1.4	91 – 103
$^{13}C_8$-PFOS	N/A	78 - 92	3.9	86 – 110	87 – 107	4.9	95 – 109	87 – 93	1.6	95 – 103
$^{13}C_2$-4:2FTS	N/A	64 - 106	12.1	87 – 137	132 – 135	0.6	123 – 145	106 – 221	17.6	155 – 291
$^{13}C_2$-6:2FTS	N/A	93 - 102	2.2	67 – 149	118 – 129	2.3	104 – 138	87 – 135	10.8	117 – 149
$^{13}C_2$-8:2FTS	N/A	99 - 109	2.5	71 – 137	96 – 122	6.1	93 – 123	179 – 299	12.5	79 – 304
$^{13}C_8$-PFOSA	N/A	60 - 107	14.2	57 – 109	69 – 86	5.4	66 – 100	104 – 153	9.4	88 – 120
D_3-NMeFOSA	N/A	55 - 85	10.8	39 – 84	47 – 59	5.4	25 – 64	20 – 58	24.5	3 – 34
D_5-NEtFOSA	N/A	54 - 91	12.9	43 – 84	43 – 51	4.5	18 – 58	30 – 56	15.2	0 – 56*
D_3-NMeFOSAA	N/A	63 - 117	14.9	66 – 117	98 – 107	2.1	86 – 109	102 – 187	14.7	144 – 196
D_5-NEtFOSAA	N/A	66 - 115	13.7	63 – 115	98 – 104	1.3	85 – 109	178 – 216	4.9	175 – 223
D_7-NMeFOSE	N/A	61 - 106	13.6	42 – 99	50 – 61	5.1	35 – 76	3 – 5	11.6	0 – 8*
D_9-NEtFOSE	N/A	63 - 108	13.2	44 – 90	46 – 57	5.5	32 – 72	8 – 33	30.0	0 – 33*
$^{13}C_3$-HFPO-DA	N/A	89 - 106	4.5	88 – 121	98 – 108	2.4	83 – 125	87 – 106	4.9	81 – 106

[1] The recovery limits are applied to all samples, method blanks, IPR, OPR samples for all matrix types.

* Ranges were determined at ± 2 standard deviations from the mean. Because of the low recoveries for these EIS, the calculated lower limits were negative values. Therefore, the lower limits have been set to 0 for these analytes.

Data for this table are derived from the single-laboratory validation study, and are only provided as examples for this draft method. The data will be updated to reflect the interlaboratory study results in a subsequent revision. Therefore, these criteria will change after interlaboratory validation. Several sections of this method state that Table 5 criteria are required, this is standard language that will be applicable when the method is finalized.

24.10 DOD/DOE QSM 5.4, Appendix B QC Requirements: Table B-15

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

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

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

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

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

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

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

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action	Flagging Criteria	Comments
Sample PFAS Identification	All analytes detected in a sample.	The chemical derivation of the ion transitions must be documented. A minimum of two ion transitions (Precursor → quant ion and precursor → confirmation ion) and the ion transitions ratio per analyte are required for confirmation. Exception is made for analytes where two transitions do not exist (PFBA and PFPeA). Documentation of the primary and confirmation transitions and the ion ratio is required. In-house acceptance criteria for evaluation of ion ratios must be used and must not exceed 50150%. 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).	NA.	PFAS identified with Ion ratios that fail acceptance criteria must be flagged. Any quantitation ion peak that does not meet the maximization criteria shall be included in the summed integration and the resulting data flagged as "estimated, biased high".	For example: Ion Ratio = (quant ion abundance/ confirm ion abundance) Calculate the average ratio (A) and standard deviation (SD) using the ICAL standards. An acceptance range of ratio could be within A ±3SD for confirmation of detection.

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

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action	Flagging Criteria	Comments
Ion Transitions (Precursor-> Product)	Every field sample, standard, blank, and QC sample.	In order to avoid biasing results high due to known interferences for some transitions, the following transitions must be used for the quantification of the following analytes: PFOA: 413 → 369 PFOS: 499 → 80 PFHxS: 399 → 80 PFBS: 299 → 80 4:2 FTS: 327 → 307 6:2 FTS: 427 → 407 8:2 FTS: 527 → 507 NEtFOSAA: 584 → 419 NMeFOSAA: 570 → 419 If these transitions are not used, the reason must be technically justified and documented (e.g., alternate transition was used due to observed interferences).	NA.	Flagging is not appropriate	NA.

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

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action	Flagging Criteria	Comments
Initial Calibration (ICAL)	At instrument set-up and after ICV or CCV failure, prior to sample analysis.	The isotopically labeled analog of an analyte (Extracted Internal Standard Analyte) must be used for quantitation if commercially available (Isotope Dilution Quantitation). Commercial PFAS standards available as salts are acceptable providing the measured mass is corrected to the neutral acid concentration. Results shall be reported as the neutral acid with appropriate CAS number. If a labeled analog is not commercially available, the Extracted Internal Standard Analyte with the closest retention time or chemical similarity to the analyte must be used for quantitation. (Internal Standard Quantitation) Analytes must be within 70-130% of their true value for each calibration standard. *(continued next page)*	Correct problem, then repeat ICAL.	Flagging is not appropriate.	No samples shall be analyzed until ICAL has passed. External Calibration is not allowed for any analyte. Calibration can be linear (minimum of 5 standards) or quadratic (minimum of 6 standards); weighting is allowed.

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

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action	Flagging Criteria	Comments
Initial Calibration (ICAL) *(Continued)*		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 non-linear calibrations must have $r^2 \geq 0.99$ for each analyte.			
Retention Time window position establishment	Once per ICAL and at the beginning of the analytical sequence.	Position shall be set using the midpoint standard of the ICAL curve when ICAL is performed. On days when ICAL is not performed, the initial CCV is used.	NA.	NA.	Calculated for each analyte and EIS.
Retention Time (RT) window width	Every field sample, standard, blank, and QC sample.	RT of each analyte and EIS analyte must fall within 0.4 minutes of the predicted retention times from the daily calibration verification or, on days when ICAL is performed, from the midpoint standard of the ICAL. Analytes must elute within 0.1 minutes of the associated EIS. This criterion applies only to analyte and labeled analog pairs.	Correct problem and reanalyze samples.	NA.	Calculated for each analyte and EIS.

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

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action	Flagging Criteria	Comments
Instrument Sensitivity Check (ISC)	Prior to analysis and at least once every 12 hours.	Analyte concentrations must be at LOQ; concentrations must be within ±30% of their true values.	Correct problem, rerun ISC. If problem persists, repeat ICAL.	Flagging is not appropriate.	No samples shall be analyzed until ISC has met acceptance criteria. ISC can serve as the initial daily CCV.
Initial Calibration Verification (ICV)	Once after each ICAL, analysis of a second source standard prior to sample analysis.	Analyte concentrations must be within ±30% of their true value.	Correct problem, rerun ICV. If problem persists, repeat ICAL.	Flagging is not appropriate.	No samples shall be analyzed until calibration has been verified.
Continuing Calibration Verification (CCV)	Prior to sample analysis, after every 10 field samples, and at the end of the analytical sequence.	Concentration of analytes must range from the LOQ to the mid-level calibration concentration. Analyte concentrations must be within ±30% of their true value.	Immediately analyze two additional consecutive CCVs. If both pass, samples may be reported without reanalysis. If either fails, or if two consecutive CCVs cannot be run, perform corrective action(s) and repeat CCV and all associated samples since last successful CCV. Alternately, recalibrate if necessary; then reanalyze all associated samples since the last acceptable CCV.	If reanalysis cannot be performed, data must be qualified and explained in the Case Narrative. Apply Q-flag to all results for the specific analyte(s) in all samples since the last acceptable calibration verification.	Results may not be reported without valid CCVs. Instrument Sensitivity Check (ISC) can serve as a bracketing CCV.

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

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action	Flagging Criteria	Comments
Instrument Blanks	Immediately following the highest standard analyzed and daily prior to sample analysis.	Concentration of each analyte must be ≤ ½ the LOQ. Instrument Blank must contain EIS to enable quantitation of contamination.	If acceptance criteria are not met after the highest calibration standard, calibration must be performed using a lower concentration for the highest standard until acceptance criteria is met. If sample concentrations exceed the highest allowed standard and the sample(s) following exceed this acceptance criteria (>1/2 LOQ), they must be reanalyzed.	Flagging is only appropriate in cases when the sample cannot be reanalyzed and when there is no more sample left.	No samples shall be analyzed until instrument blank has met acceptance criteria. Note: Successful analysis following the highest standard analyzed determines the highest concentration that carryover does not occur. When the highest standard analyzed is not part of the calibration curve, it cannot be used to extend out the calibration range, it is used only to document a higher concentration at which carryover still does not occur.

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

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

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

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

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

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action	Flagging Criteria	Comments
Matrix Spike Duplicate (MSD) or Matrix Duplicate (MD)	For MSD: One per preparatory batch. For MD: Each aqueous sample prepared by serial dilution instead of SPE.	For MSD: Sample spiked with all analytes at a concentration ≥ LOQ and ≤ the mid-level calibration concentration. A laboratory must use the DoD/DOE QSM Appendix C Limits for batch control if project limits are not specified. If the analyte(s) are not listed, use in-house LCS limits if project limits are not specified. RPD ≤ 30% (between MS and MSD or sample and MD).	Examine the project-specific requirements. Contact the client as to additional measures to be taken.	For the specific analyte(s) in the parent sample, apply J-flag if acceptance criteria are not met and explain in the Case Narrative.	The data shall be evaluated to determine the source of difference. For Sample/MD: RPD criteria only apply to analytes whose concentration in the sample is ≥ LOQ. The MD is a second aliquot of the field sample that has been prepared by serial dilution.
Post Spike Sample	Only applies to aqueous samples prepared by serial dilution instead of SPE that have reported value of < LOQ for analyte(s).	Spike all analytes reported as < LOQ into the dilution that the result for that analyte is reported from. The spike must be at the LOQ concentration to be reported for this sample as < LOQ. When analyte concentrations are calculated as < LOQ, the post spike for that analyte must recover within 70130% of its true value.	When analyte concentrations are calculated as < LOQ, and the spike recovery does not meet the acceptance criteria, the sample, sample duplicate, and post spike sample must be reanalyzed at consecutively higher dilutions until the criteria is met.	Flagging is not appropriate.	When analyte concentrations are calculated as < LOQ, results may not be reported without acceptable post spike recoveries.

24.11 DOD/DOE QSM 5.4, Appendix B QC Requirements: Table B-24

Table B-24. Per- and Polyfluoroalkyl Substances (PFAS) Analysis by LC/MS/MS (EPA Draft Method 1633)

****ALL OF THE REQUIREMENTS CONTAINED IN EPA DRAFT METHOD 1633 MUST BE MET. This table contains additional requirements that must be met. Where the name for the QC sample listed in this table differs from EPA Draft Method 1633 terminology, the corresponding EPA Draft Method 1633 terminology is provided in the Comments column.****

QC Check	Minimum Frequency	Acceptance Criteria	Corrective Action	Flagging Criteria	Comments
AFFF samples	Each AFFF sample. Note: This does not include AFFF samples that are to be evaluated for MIL-PRF-14385 compliance. Those AFFF samples must be performed in compliance with DoD AFFF01, not EPA Draft Method 1633.	AFFF samples must be subsampled in duplicate for analysis in accordance with DoD AFFF01, Section 11.2.1 through 11.2.9. Note: In lieu of the LCSD required in Section 11.2.6 of DoD AFFF01, one MS/MSD pair must be prepared with each batch of AFFF samples. All AFFF samples must be processed in duplicate in the same manner as whole sample aqueous samples (SPE, carbon cleanup) per EPA Draft Method 1633.	NA.	NA.	A copy of the latest version of DoD AFFF can be found at https://denix.osd.mil/edqw/

Table B-24. Per- and Polyfluoroalkyl Substances (PFAS) Analysis by LC/MS/MS (EPA Draft Method 1633)

Ion Transitions (Precursor-> Product)	Every field sample, standard, blank, and QC sample.	In addition to the requirements of EPA Draft Method 1633, the following must be met: 1) If a qualitative or quantitative standard containing an isomeric mixture (branched and linear isomers) of an analyte is commercially available for an analyte, the quantification ion used must be the quantification ion identified in Table 2 of EPA Draft Method 1633 unless interferences render the product ion unusable as the quantification ion. 2) In cases where interferences render the product ion unusable as the quantification ion, project approval is required before using the alternative product ion.	NA.	Flagging is not appropriate. Provide technical justification in the Case Narrative.	Currently, qualitative or quantitative standards containing isomeric mixtures for an analyte are commercially available for PFOA, PFOS, PFHxS, NMeFOSAA, NEtFOSAA, PFNA, PFOSA, NMeFOSA, NEtFOSA, NMeFOSE, and NEtFOSE.

Table B-24. Per- and Polyfluoroalkyl Substances (PFAS) Analysis by LC/MS/MS (EPA Draft Method 1633)

Ion Ratio	All analytes detected in a sample.	Must meet all of the requirements of EPA Draft Method 1633.	Must meet all of the requirements of EPA Draft Method 1633.	Document and discuss the failure in the Case Narrative. Apply I-flag to the result associated with the failure.	
Instrument Sensitivity Check (ISC)	Daily. At the beginning of each analytical sequence, prior to sample analysis.	In addition to the requirements of EPA Draft Method 1633, the following must be met: All analyte concentrations must be within ± 30% of their true values.	Correct problem, rerun ISC. If problem persists, repeat ICAL.	Flagging is not appropriate.	No samples shall be analyzed until acceptance criteria for ISC has been met.
Initial Calibration Verification (ICV)	Once after each ICAL, prior to sample analysis.	Must be made from a second source standard. All analyte concentrations must be within ± 30% of their true values.	Correct problem, rerun ICV. If problem persists, repeat ICAL.	Flagging is not appropriate.	No samples shall be analyzed until acceptance criteria for ICV has been met.

Table B-24. Per- and Polyfluoroalkyl Substances (PFAS) Analysis by LC/MS/MS (EPA Draft Method 1633)

Instrument Blank (IB)	Immediately following the highest standard analyzed in the calibration, daily prior to analyzing standards, after each CCV, and immediately following samples with PFAS concentrations exceeding the quantification range.	In addition to the requirements of EPA Draft Method 1633, the following must be met: Concentration of each analyte must be ≤ ½ the LOQ.	If acceptance criteria are not met after the highest calibration standard, calibration must be performed using a lower concentration for the highest standard until acceptance criteria is met. If sample concentrations exceed the highest calibration standard and the sample(s) following exceed this acceptance criteria (> 1/2 LOQ), they must be reanalyzed using a fresh aliquot of the sample extract.	Flagging is only appropriate in cases where the extract cannot be reanalyzed and re-extraction is not possible.	EPA Draft Method 1633 equivalent to the CCV is the Calibration Verification (CV).

Table B-24. Per- and Polyfluoroalkyl Substances (PFAS) Analysis by LC/MS/MS (EPA Draft Method 1633)

Extracted Internal Standard (EIS) Compounds	Every field sample, standard, blank, and QC sample.	In addition to the requirements of EPA Draft Method 1633, the following must be met: 1) Isotopically labeled analogs of analytes must be used when they are commercially available. 2) QC samples and field samples must recover within in-house limits if project limits are not provided; otherwise, project limits must be met. Preliminary inhouse acceptance criteria of 20-150% must be used until inhouse limits are generated in accordance with Sections 9.4.1 and 9.4.2 of EPA Draft Method 1633. 3) The lower limit of inhouse acceptance criteria cannot be < 20%.	Repeat the analysis using a fresh aliquot of the extract. If failure does not confirm, report the second analysis. If the failure confirms, follow the requirements listed in EPA Draft Method 1633, Section 15.3.2. If EIS recoveries still fall outside of the acceptance range, the client must be contacted for additional measures to be taken.	Document and discuss the failure in the Case Narrative. Apply Q-flag to the result associated with the failure.	

Table B-24. Per- and Polyfluoroalkyl Substances (PFAS) Analysis by LC/MS/MS (EPA Draft Method 1633)

Non-extracted Internal Standard (NIS) Compounds	Every field sample, standard, blank, and QC sample.	In addition to the requirements of EPA Draft Method 1633, the following must be met: 1) NIS areas must be greater than 30% of the average area of the calibration standards in undiluted sample extracts and sample extracts that required additional NIS to be added. 2) NIS areas corrected for the dilution factor must be greater than 30% of the average area of the calibration standards in diluted samples when additional NIS was not added post dilution of the extract.	Repeat the analysis using a fresh aliquot of the extract. If failure does not confirm, report the second analysis. If the failure confirms, examine the project-specific requirements. Contact the client as to additional measures to be taken.	Document and discuss the failure in the Case Narrative. Apply Q-flag to the result associated with the failure.	

Table B-24. Per- and Polyfluoroalkyl Substances (PFAS) Analysis by LC/MS/MS (EPA Draft Method 1633)

Method Blank (MB)	One per preparatory batch	In addition to the requirements of EPA Draft Method 1633, the following must be met: No analytes detected > ½ LOQ or > 1/10th the amount measured in any associated sample or 1/10th the regulatory limit, whichever is greater	Correct the problem. If required, re-extract and reanalyze MB and all QC samples and field samples processed with the contaminated blank. Samples may be reextracted and analyzed outside of holding times, as necessary for corrective action associated with QC failure. Examine the project specific requirements. Contact the client as to additional measures to be taken.	If reanalysis cannot be performed, data must be qualified and explained in the Case Narrative. Apply B-flag to all results for the specific analyte(s) in all samples in the associated preparatory batch.	
Matrix Duplicate (MD)	Each AFFF sample prepared using an aliquot of the field sample must be prepared in duplicate.	In addition to the requirements of EPA Draft Method 1633, the following must be met: RPD ≤ 30% (between sample and MD)	Examine the project specific requirements. Contact the client as to additional measures to be taken. If the analyte(s) are not listed, use inhouse LCS limits if project limits are not specified.	For the specific analyte(s) in the parent sample, apply J-flag if acceptance criteria are not met and explain in the Case Narrative.	The data shall be evaluated to determine the source of difference. For Sample/MD: RPD criteria only applies to analytes whose concentration in the sample is ≥ LOQ.

Table B-24. Per- and Polyfluoroalkyl Substances (PFAS) Analysis by LC/MS/MS (EPA Draft Method 1633)

Bile Salt Standards	Daily, prior to analysis of all matrix types (aqueous, solid, tissue, and AFFF).	All EPA Draft Method 1633 requirements for evaluation of the relationship of the retention time of the bile salt peak(s) to the retention time window of PFOS must be met for all matrix types. The retention time window of PFOS applies to the retention time of all isomers of PFOS. The retention time of the bile salt(s) peak must fall out of the retention time window of PFOS by at least one minute.	NA.	NA.	No samples shall be analyzed until acceptance criteria for the bile salt standard(s) has been met.

Table B-24. Per- and Polyfluoroalkyl Substances (PFAS) Analysis by LC/MS/MS (EPA Draft Method 1633)

Laboratory Control Sample (LCS) and Low-Level Laboratory Control Sample (LLLCS)	One set per preparatory batch.	In addition to the requirements of EPA Draft Method 1633 the following must be met: 1) Analyte recoveries must be within in-house limits if project limits are not provided; otherwise, project limits must be met. Preliminary inhouse acceptance criteria of 40-150% must be used until inhouse limits are generated in accordance with Section 14.5.4 of EPA Draft Method 1633. 2) The lower limit of inhouse acceptance criteria cannot be < 40%.	In addition to the requirements of EPA Draft Method 1633, the following must be met: Samples may be reextracted and analyzed outside of holding times, as necessary for corrective action associated with QC failure. Examine the project specific requirements. Contact the client as to additional measures to be taken.	If reanalysis cannot be performed, data must be qualified and explained in the Case Narrative. Apply Q-flag to specific analyte(s) in all samples in the associated preparatory batch.	EPA Draft Method 1633 equivalent to the LCS is the Ongoing Precision and Recovery Standard (OPR). EPA Draft Method 1633 equivalent to the LLLCS is Low-Level Ongoing Precision and Recovery Standard (LLOPR).

Table B-24. Per- and Polyfluoroalkyl Substances (PFAS) Analysis by LC/MS/MS (EPA Draft Method 1633)

Matrix Spike (MS) and Matrix Spike Duplicate (MSD)	One MS/MSD pair per preparatory batch.	In addition to the requirements of EPA Draft Method 1633, the following must be met: Analyte recoveries must be within in-house LCS limits if project limits are not provided; otherwise, project limits must be met. RPD ≤ 30% (between MS and MSD)	Examine the project-specific requirements. Contact the client as to additional measures to be taken. If the analyte(s) are not listed, use inhouse LCS limits if project limits are not specified.	For the specific analyte(s) in the parent sample apply J-flag if acceptance criteria are not met and explain in the Case Narrative.	The data shall be evaluated to determine the source of difference.

24.12 Figure 1 – Example Chromatogram for Reagent Water Fortified with Method Analytes (Chromatogram Plot Report)

Quantitative Analysis Sample Based Report

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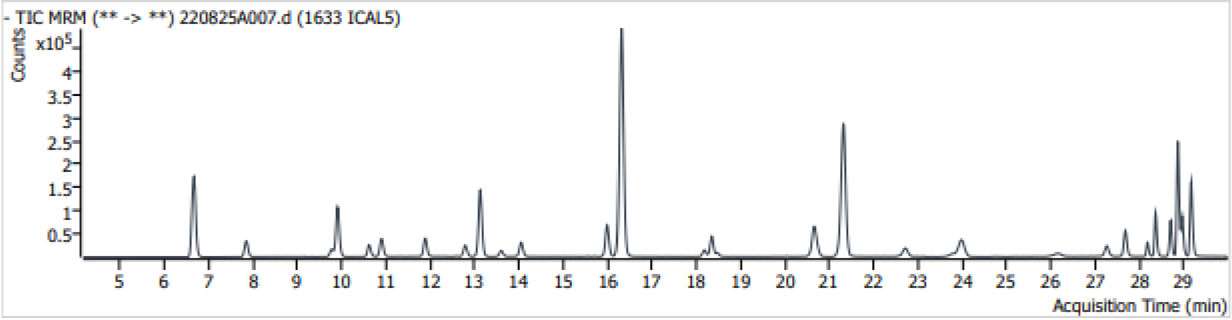
Result file D:\MassHunter\Data\220825A\QuantResults\220825A1633.batch.bin
Quant. method D:\MassHunter\methods\J11AQUANT\J11A-1633DOD-220825.m
Calibration Last Update 8/26/2022 08:45:11
Report Method PFAS method is EPA 533 - Modified. FDOH certification is AEL SOP-041 / LC MS MS and DoD certification is PFAS by LCMSMS Compliant w/ QSM 5.3 Table B-15

Sample Name	1633 ICAL5	**Acquisition Time**	8/25/2022 14:31:54
Data File	220825A007.d	**Type**	Cal
Acquisition Method	PFAS_1633DODAW1_acquisition.m	**Dilution**	1
Analyst	SWT	**Instrument Name**	J11A
Trace Number	SVOC-B046-PAR3-B	**Batch Number**	

Sample Chromatogram



Name	ISTD	RT	Resp.	ISTD Resp.	RR	Final Conc. Units	Ratio
13C4-PFBA(EIS)	13C3-PFBA	6.674	562368	247797	2.2695	1.9992 ng/ml	
PFBA	13C4-PFBA	6.679	254534	562368	0.4526	0.9941 ng/ml	
PFMPA	13C5-PFPeA	7.862	192765	241919	0.7968	1.0273 ng/ml	
3:3FTCA	13C5-PFPeA	9.786	64575	241919	0.2669	3.7811 ng/ml	44.3
13C5-PFPeA(EIS)	13C2-PFHxA	9.918	241878	207239	1.1671	0.9651 ng/ml	
PFPeA	13C5-PFPeA	9.919	348927	241919	1.4423	1.0344 ng/ml	0.2
13C3-PFBS(EIS)	18O2-PFHxS	10.628	33616	19780	1.6995	0.4701 ng/ml	34.9
PFBS	13C3-PFBS	10.629	67848	33616	2.0183	0.9398 ng/ml	34.7
PFMBA	13C5-PFPeA	10.915	217767	241919	0.9002	1.0194 ng/ml	
PFEESA	13C5-PFHxA	11.899	199679	179498	1.1124	0.9931 ng/ml	6.8
NFDHA	13C5-PFHxA	12.606	3300	179498	0.0184	0.9942 ng/ml	31.9
13C2-4:2FTS(EIS)	18O2-PFHxS	12.793	17374	19780	0.8784	0.8598 ng/ml	243.5
4:2FTS	13C2-4:2FTS	12.802	59409	17374	3.4194	1.1512 ng/ml	41.2
13C5-PFHxA(EIS)	13C2-PFHxA	13.138	179498	207239	0.8661	0.4873 ng/ml	0.9
PFHxA	13C5-PFHxA	13.140	425203	179498	2.3688	1.1013 ng/ml	2.3
PFPeS	13C3-PFHxS	13.607	54345	24022	2.2623	0.9288 ng/ml	34.3
HFPO-DA	13C3-HFPO-DA	14.073	39910	93609	0.4264	0.9730 ng/ml	30.5
13C3-HFPO-DA(EIS)	13C2-PFHxA	14.064	93609	207239	0.4517	2.1590 ng/ml	28.5
13C4-PFHpA(EIS)	13C2-PFHxA	16.004	85007	207239	0.4102	0.5281 ng/ml	
PFHpA	13C4-PFHpA	16.005	249312	85007	2.9328	0.9749 ng/ml	22.2
13C3-PFHxS(EIS)	18O2-PFHxS	16.254	23995	19780	1.2131	0.5015 ng/ml	38.5
PFHxS	13C3-PFHxS	16.255	37460	24022	1.5594	0.9634 ng/ml	47.8
5:3FTCA	13C5-PFHxA	16.316	1391286	179498	7.7510	21.8245 ng/ml	69.4
ADONA	13C3-HFPO-DA	16.347	532917	93609	5.6930	0.8905 ng/ml	32.3
13C2-6:2FTS(EIS)	18O2-PFHxS	18.178	13380	19780	0.6764	1.0445 ng/ml	171.3
6:2FTS	13C2-6:2FTS	18.188	30004	13380	2.2424	0.9256 ng/ml	45.9
13C8-PFOA(EIS)	13C4-PFOA	18.356	156810	13424	11.6816	0.4401 ng/ml	
PFOA	13C8-PFOA	18.356	57057	156810	0.3639	1.0860 ng/ml	16.0
PFHpS	13C8-PFOS	18.480	24545	9640	2.5461	0.7470 ng/ml	56.7
13C9-PFNA(EIS)	13C5-PFNA	20.657	58016	67882	0.8547	0.2638 ng/ml	
PFNA	13C9-PFNA	20.666	261202	58016	4.5022	0.9798 ng/ml	17.6
13C8-PFOS(EIS)	13C4-PFOS	20.730	15611	18403	0.8483	0.5004 ng/ml	61.8
PFOS	13C8-PFOS	20.740	23337	9640	2.4208	0.9307 ng/ml	53.0
7:3FTCA	13C5-PFHxA	21.330	860645	179498	4.7947	22.2759 ng/ml	148.0
9Cl-PF3ONS	13C3-HFPO-DA	22.721	127249	93609	1.3594	0.8366 ng/ml	21.3
13C2-8:2FTS(EIS)	18O2-PFHxS	23.778	7782	19780	0.3934	0.8823 ng/ml	168.7
8:2FTS	13C2-8:2FTS	23.770	15965	7782	2.0515	1.0290 ng/ml	68.3

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Quantitative Analysis Sample Based Report

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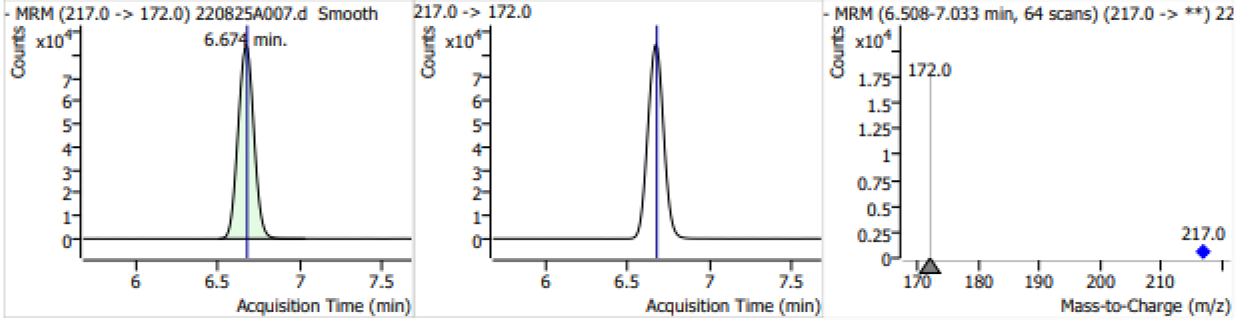
Name	ISTD	RT	Resp.	ISTD Resp.	RR	Final Conc. Units	Ratio
13C6-PFDA(EIS)	13C2-PFDA	23.981	43499	49768	0.8740	0.2398 ng/ml	
PFDA	13C6-PFDA	23.990	210759	43497	4.8453	1.0423 ng/ml	13.4
PFNS	13C8-PFOS	24.027	28709	9640	2.9780	0.8297 ng/ml	51.1
N-Me-FOSAA	d3-N-MeFOSAA	26.196	32564	37323	0.8725	1.0124 ng/ml	39.0
d3-N-MeFOSAA(EIS)	13C4-PFOS	26.119	37323	18403	2.0281	1.1080 ng/ml	
FOSA	M8FOSA	27.273	89660	50818	1.7643	0.9551 ng/ml	0.7
M8FOSA(EIS)	13C4-PFOS	27.272	50819	18403	2.7615	0.5363 ng/ml	
PFDS	13C8-PFOS	27.671	31398	9640	3.2570	0.7785 ng/ml	36.3
13C7-PFUnA(EIS)	13C2-PFDA	27.689	58539	49768	1.1762	0.2433 ng/ml	
PFUnA	13C7-PFUnA	27.681	78294	58539	1.3375	0.9584 ng/ml	11.5
N-Et-FOSAA	d5-N-EtFOSAA	27.714	35762	34881	1.0253	1.0886 ng/ml	69.1
d5-N-EtFOSAA(EIS)	13C4-PFOS	27.688	34881	18403	1.8954	0.9580 ng/ml	
11Cl-PF3OUdS	13C3-HFPO-DA	28.189	100608	93609	1.0748	0.8528 ng/ml	13.6
13C2-PFDoA(EIS)	13C2-PFDA	28.366	52148	49768	1.0478	0.2202 ng/ml	
PFDoA	13C2-PFDoA	28.366	265680	52148	5.0947	0.9940 ng/ml	14.0
PFDoS	13C8-PFOS	28.674	18158	9640	1.8836	0.8794 ng/ml	41.4
PFTrDA	EIS Average	28.708	252749	53822	4.6960	1.0347 ng/ml	9.2
N-Me-FOSE	d7-N-Me-FOSE	28.878	681323	244053	2.7917	10.7578 ng/ml	
d7-N-Me-FOSE(EIS)	13C4-PFOS	28.852	244053	18403	13.2618	4.9259 ng/ml	
N-Me-FOSA	d3-N-Me-FOSA	28.907	17126	9721	1.7618	0.8409 ng/ml	175.6
d3-N-Me-FOSA(EIS)	13C4-PFOS	28.898	9721	18403	0.5282	0.5318 ng/ml	
PFTeDA	M2PFTeDA	28.967	227841	55497	4.1055	0.9028 ng/ml	11.8
M2PFTeDA(EIS)	13C2-PFDA	28.967	55496	49768	1.1151	0.2404 ng/ml	
N-Et-FOSE	d9-N-Et-FOSE	29.170	391926	219223	1.7878	9.7107 ng/ml	
d9-N-Et-FOSE(EIS)	13C4-PFOS	29.153	219223	18403	11.9125	4.9663 ng/ml	
N-Et-FOSA	d5-N-Et-FOSA	29.208	25852	9026	2.8642	1.0571 ng/ml	125.9
d5-N-Et-FOSA(EIS)	13C4-PFOS	29.199	9026	18403	0.4905	0.4836 ng/ml	

13C4-PFBA(EIS)



PFBA