REMEDIAL DESIGN

Lockwood Solvent Groundwater Plume Site

Beall Source Area Operable Unit 1

Yellowstone County, Montana

# SUPPLEMENTAL SAMPLING PROGRAM

# QUALITY ASSURANCE PROJECT PLAN

Prepared for:

U.S. Environmental Protection Agency

Region VIII
10 West 15th Street, Suite 3200
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Revision 2

| | |
|---|---|
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**Supplemental Sampling Program**
**Quality Assurance Project Plan**

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Work Assignment No. 122-RDRD-08AK
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| | | |

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## LIST OF ACRONYMS

| | |
|---|---|
| Beall | Beall Trailers, Inc. |
| BSA | Beall Source Area |
| COC | contaminant of concern |
| CPR | cardiopulmonary resuscitation |
| CRQL | contract required quantitation limits |
| DCE | cis-1,2-dichloroethene |
| EDD | electronic data deliverables |
| EPA | U.S. Environmental Protection Agency |
| ft bgs | feet below ground surface |
| ft/ft | foot per foot |
| ft/sec | feet per second |
| GC/MS | gas chromatography/mass spectroscopy |
| GPS | global positioning system |
| LIMS | laboratory information management system |
| LSGPS | Lockwood Solvent Groundwater Plume Site |
| LTTD | low temperature thermal desorption |
| µg/L | microgram per liter |
| MCL | Maximum Contaminant Level |
| MDEQ | Montana Department of Environmental Quality |
| MDL | method detection limit |
| MNA | monitored natural attenuation |
| MRL | method reporting limit |
| MS/MSD | matrix spike/matrix spike duplicate |
| MSE | MSE Technology Applications, Inc. |
| NIST | National Institute of Standards and Technology |
| ORP | oxidation reduction potential |
| OU | Operable Unit |
| Pace | Pace Analytical Services, Inc. |
| PCE | tetrachloroethene |
| PPE | personal protective equipment |
| PRP | Potentially Responsible Party |
| PWT | Pacific Western Technologies, Ltd. |
| QA | quality assurance |
| QAO | Quality Assurance Officer |
| QAPP | Quality Assurance Project Plan |
| QC | quality control |
| RI | Remedial Investigation |
| RPD | relative percent difference |
| RPM | Remedial Project Manager |
| ROD | Record of Decision |
| SOP | Standard Operating Procedure |
| SSL | soil screening level |
| SVE | soil vapor extraction |
| SVOC | semi-volatile organic compound |
| TCE | trichloroethene |
| TDS | total dissolved solids |
| VC | vinyl chloride |
| VOC | volatile organic compound |

# 1.0 INTRODUCTION

The Lockwood Solvent Groundwater Plume Site (LSGPS) is located to the east of Billings, Montana (Figure 1) and consists of chlorinated solvent contamination in soil and groundwater. The groundwater contamination underlies approximately 580 acres. There are four main contaminants of concern (COCs): tetrachloroethene (PCE), trichloroethene (TCE), cis-1,2-dichloroethene (DCE), and vinyl chloride (VC).

Two primary source areas for chlorinated solvent groundwater contamination have been identified at the LSGPS: Soco West (formerly Brenntag) and Beall Trailers, Inc. (Beall). Contaminated groundwater emanating from these source areas make up the Operable Unit (OU) designations. The OU boundaries, including the approximate locations of the Beall Source Area (BSA), the Soco Source Areas, and areas of groundwater contamination exceeding action levels can be found on Figure 2. The BSA is the main feature of OU1 and the Soco Source Area is the important feature of OU2.

The *Record of Decision, Lockwood Solvent Groundwater Plume Site* (ROD) (MDEQ/USEPA 2005) details the selected remedy for the LSGPS. The preferred alternatives identified in the ROD for remediation at the LSGPS are a combination of technologies to clean up the source areas, prevent migration of contaminated groundwater from the source areas, and accelerate cleanup of the contaminated groundwater that has already migrated downgradient of the source areas. The remedial components for OU1 include soil vapor extraction (SVE) and enhanced bioremediation. The remedial components for OU2 include a permeable reactive barrier, enhanced bioremediation, excavation with low temperature thermal treatment (LTTD), SVE, and in-situ chemical oxidation. Monitored natural attenuation (MNA) is also identified for the site-wide groundwater. The results of the Remedial Investigation (RI) completed in 2002 provide some degree of data applicable for remedial design. Additional sampling is necessary to complete remedial design.

This document serves as the Quality Assurance Project Plan (QAPP) for the remedial design supplemental sampling and the semi-annual groundwater sampling at OU1 in accordance with the *EPA Requirements for Quality Assurance Project Plans* (USEPA 2001) and in general accordance with the *EPA Guidance for Quality Assurance Project Plans* (USEPA 2002). The objective of this QAPP is to establish the data objectives to ensure appropriate quality and quantity necessary to complete a remedial design and monitor the site-wide groundwater plume. This QAPP will also provide definitions of the project data quality requirements necessary to meet the data objectives for these field programs. While the United States Environmental Protection Agency's (EPA) *Guidance on Systematic Planning Using the Data Quality Objective Process* (USEPA 2006) was consulted frequently, the exact data quality objective

steps are not articulated in this QAPP. Rather, the elements of the QAPP as a whole encompass the data quality objective process. In addition, this QAPP describes the field and analytical procedures that will be used to ensure that data collected during these field programs are of sufficient quality to meet the project objectives. The following four main groups of elements are included in this QAPP:

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

# 2.0 PROJECT ORGANIZATION AND RESPONSIBILITIES

This section identifies key individuals for all major aspects of the project from management and planning through field sample collection and laboratory analysis and data management, and discusses their responsibilities. Figure 3 presents a project organizational chart. Table 1 provides the contact information for each of the individuals noted in this section.

## 2.1 MANAGEMENT RESPONSIBILITIES

### 2.1.1 U.S. Environmental Protection Agency

Mr. Roger Hoogerheide is the EPA Remedial Project Manager (RPM) and the primary EPA contact for all aspects of the work. Mr. Hoogerheide has overall responsibility for this project and also is responsible for coordinating communication between the EPA, the Montana Department of Environmental Quality (MDEQ), and the public. As RPM, he will be responsible for the following: overall contractual management of this project, including the associated Remedial Design Subcontract under the RAC 2 Region 8 Contract; overall technical management of this project under the RAC 2 Region 8 Contract; day-to-day technical and financial management of this project, including the terms and conditions and budget contained in the approved Remedial Design Contractor Work Plan for this work assignment; monitoring of the project for conformance with the signed contract clauses; consent authority for changes in scope and cost; and monitoring of the project for conformance with the scope of work contained in the EPA Statement of Work and the approved Remedial Design Contractor Work Plan for this work assignment. The RPM will communicate directly with the Pacific Western Technologies Ltd (PWT) Project Manager, Ms. Catherine LeCours, and if necessary with the PWT RAC2 Region 8 Contract Program Manager, Mr. James Bush.

### 2.1.2 State of Montana Department of Environmental Quality

As per the State Superfund Enforcement Agreement for this project, the MDEQ is the support agency. Mr. John Podolinsky is the MDEQ Project Officer for the Site, and as the primary MDEQ site contact, working directly with Mr. Hoogerheide in regulatory oversight and management of the project. MDEQ will participate in various aspects of the project, including meetings, field oversight, investigation activities, community relations, and public meetings, and will have opportunities to review the Project Files upon making advance requests to the EPA.

### 2.1.3 Remedial Design Contractor

PWT will serve as the supervising contractor. Ms. Catherine LeCours is the Project Manager and main point of contact for the supervising contractor. Ms. LeCours will be responsible for day-to-day communication with the EPA Project Manager as well as with the PWT staff assigned to perform various project tasks. She will be responsible for the contractual commitments and for ensuring that the necessary resources are dedicated to the project. Ms. LeCours is responsible for maintaining and updating the approved QAPP for the project; she is also responsible for distributing the revised QAPP when appropriate. As Project Manager, she will define and clarify the scope of work and objectives for the supplemental sampling program and see that the technical, budget, and schedule requirements are met. Supporting Ms. LeCours in her capacity as project manager is PWT's RAC2 Region 8 Program Manager, Mr. James Bush. Mr. Bush has overall responsibility for the successful execution and completion of the work assignments that the EPA awards to PWT under the RAC2 region 8 Contract.

## 2.2 PROJECT RESPONSIBILITIES

### 2.2.1 PWT Supplemental Sampling Program Field Team Leader

The PWT field team leader is Mr. Greg Hayes. Mr. Hayes supports the PWT Project Manager and is responsible for leading and coordinating the day-to-day sampling activities. During the sampling activities, the field team leader's responsibilities will include:

- Day-to-day coordination with the Project Manager on technical issues in specific areas of expertise
- On-site Health and Safety Coordinator pursuant to the *Site-Specific Health and Safety Plan* (PWT 2011)
- Development and implementation of field-related work plans, assurance of schedule compliance, and adherence to management-developed study requirements
- Coordination and management of field staff
- Implementation of quality control (QC) for technical data provided by the field staff including field measurement data
- Adherence to work schedules provided by the Project Manager
- Generation, review, and approval of text and graphics required for field team efforts
- Coordination and oversight of technical efforts of subcontractors

- Identification of problems at the field-team level, discussion of resolutions with the Project Manager, and communication between the field team and upper management.

### 2.2.2 PWT Quality Assurance Officer

The Quality Assurance Officer (QAO) for this project is Mrs. Robin Witt. As the QAO, Mrs. Witt will remain independent of direct project involvement and day-to-day operations. She is responsible for determining that the quality assurance (QA) program defined in the QAPP is implemented. In addition, she will evaluate whether the project follows the EPA and PWT policies and requirements. Her specific responsibilities include:

- Conducting field QA audits, or directing that such audits be conducted by other qualified members of the project technical staff
- Reviewing and approving QA plans and procedures, including reviewing and updating this QAPP as appropriate
- Providing technical assistance to project staff for QA issues.

Mrs. Witt, or her designee, may perform an audit of field activities and documentation to assure compliance with PWT policies and this QAPP. Findings of the audit will be reported to the Project Manager and maintained in the project files. The QAO is also responsible for ensuring the prompt and complete implementation of any corrective or preventative actions selected to address specific QA audit findings. Additional information regarding audits, assessments, and response actions is discussed in Section 12 of this QAPP.

### 2.2.3 PWT Project Chemist

The Project Chemist for this project is Mr. Bill Lutz. His responsibilities include, but are not limited to:

- Reviewing analytical data to ensure conformance with QA testing and standards, performing data validation and verification, and approving analytical data
- Interfacing with the laboratory on matters concerning chemical sampling and analysis, laboratory reports, verifications and validation of data, and the resolution of nonconforming activities or data
- Identifying, reporting, and recommending solutions for nonconforming sampling or analytical activities or data
- Serving as a point of contact for issues related to environmental chemistry.

Mr. Lutz, or his designee, may perform an audit of the laboratory to determine laboratory capability to implement method and contract-specified aspects of work. Findings of the audit will be reported to the QAO and the Project Manager within seven days, and maintained in the project files.

### 2.2.4 PWT Technical Staff

The technical staff for this project will be selected from PWT's corporate resources. The technical staff will gather and analyze data, and prepare various task reports. All of the designated technical staff will be experienced professionals who possess the degree of specialization and technical competence required to effectively and efficiently perform the required work.

## 2.3 LABORATORY RESPONSIBILITIES

Multiple laboratories are required to perform the chemical and physical analysis of samples for this project. To the greatest extent possible, the EPA's analytical programs will provide analytical services for the supplemental sampling activities. PWT has procured Pace Analytical Services, Inc. in Billings MT and MSE Technology Applications, Inc. in Butte MT to complete chemical analyses and geotechnical parameters not supported by the EPA analytical program.

Table 2 lists the required analytical services and identifies which services will be provided by the EPA's analytical program, Pace, and MSE. A general discussion of laboratory organization that represents industry standards is presented in this section. Each of these laboratories has demonstrated that it can perform the analytical methods and meet the criteria specified in this QAPP.

A complete description of the EPA's analytical program can be found at: http://www.epa.gov/superfund/programs/clp/index.htm, including the EPA's QA program. The EPA analytical program simplifies the data quality objective process by pre-defining elements such as analytical methods, laboratory equipment maintenance and calibration, sample shipment chain-of-custody procedures and forms, analytical precision and accuracy, sample disposal procedures, QC requirements, data management, and documentation. The EPA's Laboratory Program Manager will communicate directly with the EPA RPM. The following duties apply to the EPA program; however, not the chain-of-command.

A copy of Pace's and MSE's Laboratory QA Program and certifications for each method they will be performing are included as Appendix B. Table 1 identifies each laboratory and the key personnel listed below, including contact information.

### 2.3.1 Laboratory Project Manager

A Laboratory Project Manager at each laboratory will be the primary contact at that laboratory for PWT and will be responsible for assuring that the project laboratory requirements are met. The Laboratory Project Managers will be responsible for scheduling sample analysis and will ensure that the data are generated in accordance with the specifications presented in this QAPP. They will also be responsible for monitoring the progress and timeliness of the laboratory work, reviewing work orders and laboratory reports, and processing any changes in the scope of work. In addition, the Laboratory Project Managers will be responsible for approving final analytical reports prior to submission to PWT and for ensuring that project-specific corrective actions are taken when necessary to address problems identified by the QC sample results or QA audit results.

### 2.3.2 Laboratory Project Quality Assurance Officer

Each Laboratory Project Manager will assign a project QAO who will be responsible for assuring that the laboratory QA/QC activities are performed in accordance with the requirements specified in both this QAPP and the laboratory's internal QA plan. Responsibilities will include (but are not limited to) preparing QA documents that define QA/QC procedures, reviewing and approving laboratory QC procedures, and oversight of inter-laboratory testing programs and laboratory certifications. These individuals will also be responsible for monitoring method operations through periodic reviews and technical system audits. Unacceptable findings will be reported to the PWT Project Chemist for determination of corrective action.

### 2.3.3 Laboratory Sample Custodian

Each laboratory will assign a designated sample custodian that reports to the Laboratory Project Manager or other designated individual and is responsible for:

- Receiving and inspecting samples
- Recording information regarding sample condition upon receipt and signing the appropriate forms
- Verifying the chain-of-custody and documenting any discrepancies
- Notifying the Laboratory Project Manager or other appropriate laboratory personnel of sample receipt and inspection
- Assigning a unique identification number and customer number to each sample and logging it into the sample receiving log book and laboratory information management system.

- Transferring samples to the appropriate laboratory sections
- Controlling and monitoring access and storage of samples and extracts.

## 2.4 SUPPORTING SUBCONTRACTORS

### 2.4.1 Drilling Subcontractors

Drilling subcontractors will provide the equipment, personnel, and technical skills necessary to collect disturbed and undisturbed soil and groundwater samples from the BSA. The drilling subcontractor(s) will provide a driller and driller's helper(s), if appropriate for the type of drill rig used on the project. The driller will act as the crew on-site supervisor and the point of contact once field activities begin. Drill rigs may include hollow-stem augers or direct-push equipment.

### 2.4.2 Low Temperature Thermal Treatment Bench Scale Treatability Test

A subcontractor will perform a bench-scale treatability test on soil collected at the BSA to evaluate the potential usefulness of an LTTD system for the accessible soils. PWT will provide the subcontractor the appropriate sample volumes for the test. The subcontractor will provide a written report, including results and an evaluation of the treatment option for the BSA.

## 2.5 TRAINING

All staff associated with this project will have sufficient training to safely, effectively, and efficiently perform their assigned tasks. Training will be provided to PWT project personnel for compliance with the *Site-Specific Health and Safety Plan* (PWT 2011) and technical competence in performing the work effort.

Subcontractors associated with this project are responsible for assuring that their staff have sufficient training to assure compliance with health and safety issues and to meet the technical requirements of this project. The individual subcontractors will maintain documentation of this training and will forward this documentation to PWT as appropriate (e.g., 40-hour hazardous waste training, first aid, cardiopulmonary resuscitation [CPR]).

In accordance with the Site-Specific Health and Safety Plan, all personnel (including subcontractors) will have completed an initial OSHA 40-hour Hazardous Materials Health and Safety Course and 8-hour annual refresher course(s). All personnel will also have a minimum of three days of actual field

experience under the direct supervision of a trained, experienced supervisor. The Health and Safety Coordinator will have training in standard first aid measures and CPR.

The PWT Project Manager will ensure all personnel have the appropriate training and maintain copies of the training certificates in the PWT Helena, Montana office. In addition, copies of training certificates for on-site personnel will be kept at the site in the possession of the Health and Safety Coordinator during the performance of field activities.

# 3.0 PROJECT DESCRIPTION AND BACKGROUND

## 3.1 PROBLEM DEFINITION

This QAPP details the planning and implementation steps necessary to collect additional chemical and geotechnical data in order to design the remedial action components for OU1 and support the continuation of the semi-annual groundwater monitoring program. The results of the supplemental sampling will further evaluate the nature and extent of contamination and provide information necessary to develop an optimal remedial design for OU1. The results of the semi-annual groundwater sampling will provide on-going data related to plume migration and characteristics and support remedial design and remedial action. This QAPP is designed to collect physical, geotechnical, and contaminant data necessary for design. However, some of the proposed remedial technologies (SVE, enhanced bioremediation) are also dependent on the permeability or hydraulic conductivity of soils and aquifers in the subsurface. It is likely that an SVE pilot study and aquifer test will need to be conducted in order to obtain site-specific values for some parameters that are necessary for the remedial design.

## 3.2 SITE HISTORY AND BACKGROUND

The EPA added the LSGPS to the National Priority List in December of 2000 after investigations by the MDEQ and the EPA identified groundwater contamination in the area. These investigations were ongoing since 1986, when the Lockwood Water and Sewer District discovered the presence of benzene and other chlorinated solvents in their water supply wells. The MDEQ began to investigate underground storage tanks and a petroleum pipeline in the vicinity of these wells. After testing private residential and commercial wells, the EPA's Emergency Removal Program worked to provide clean drinking water for several area residents whose wells exceeded the Maximum Contaminant Level (MCL) for PCE, TCE, DCE, VC, and/or carbon tetrachloride. The EPA and the MDEQ sampled indoor air and provided mitigation for indoor air contamination. In 2002, the MDEQ began an RI of the site, which included surface and subsurface soil sampling, monitoring well construction and groundwater sampling, aquifer testing, surface water and sediment sampling, and indoor air sampling. In July of 2004, the *Final Feasibility Study Report, Lockwood Solvent Groundwater Plume Site* (FS) (TTEMI 2004) was completed. The EPA issued a ROD for the LSGPS in August 2005 (MDEQ/USEPA 2005).

Beall is one of the two main sources of groundwater contamination; Soco West is the other main source. Beall manufactures and repairs tanker truck trailers, primarily to transport asphalt. From 1978 to 1990, a solution of dissolved TCE and steam was used to clean the trailers prior to repairs. The TCE was stored in an above-ground storage tank on the north side of the steam-clean bay building. The wastewater

containing TCE was then discharged through an oil-water separator and into a drain field. Once the solvents were released into the drain field, they migrated to the alluvial aquifer flowing northwest into the Yellowstone River.

While the transport mechanism for the TCE at the BSA does not directly involve surface disposal, data from the RI indicated very low levels of TCE contamination in the surface soil (0-12 inches for the purposes of the RI). There is a potential for historical leaks from the above-ground storage tank near the steam-clean bay; however, the contaminant was primarily released into the subsurface through the drain in the bay and the associated piping, the oil-water separator tank, and the drain field. DCE and VC are believed to be present primarily as daughter products of the primary TCE contamination, while PCE may have been present as an impurity in the TCE solution used at the steam-clean bay.

## 3.3 REMEDIAL ACTION COMPONENTS

The BSA consists of the contaminated vadose soil on the Beall property encompassing the area around and below the steam-clean bay, the underground piping, the oil-water separator tank, and the drain field, and extending to the groundwater, approximately 45-feet below ground surface (ft bgs). There are other areas of groundwater exceeding action levels established in the ROD; however, the primary focus of this QAPP and remedial design is the contaminated groundwater plume emanating from the Beall property and flowing west. The approximate locations of the soil source area and west plume are shown on Figure 4.

The major components of the selected remedy as defined in the ROD for OU1 are:

- *Groundwater and plume leading edge remediation*. This involves an enhanced bioremediation system to treat the portion of the groundwater plume upgradient of US Highway 87 East and another to treat contaminated groundwater at the BSA groundwater plume leading edge to the west of the Beall property. The design will consider a recirculation treatment system to inject amendments (i.e., hydrogen releasing compounds) to promote reductive dechlorination of the COCs through a series of injection wells configured in a treatment zone across the plume width, both at the BSA and at the leading edge of the plume, to both treat and inhibit further migration of the plume.

- *Source area vadose zone soil remediation*. An SVE system will be constructed to treat inaccessible vadose soil. The design will consider the full extent of vadose soil contamination and ensure treatment from ground surface to the water table. The design will also ensure treatment of soil from beneath the steam-clean bay and waste water piping still in use. Optimal well spacing, screened interval placement, flow rate, and treatment of the vapor discharge (as necessary) will be determined through design.

LTTD was included in the ROD as a remedial component for the Soco Source Areas but not specifically for the BSA. Nevertheless, this QAPP will collect data for additional parameters to evaluate the potential to excavate accessible contaminated vadose soil and treat using LTTD at the BSA. The LTTD may provide cost-effective immediate reduction of contamination in accessible soil around the steam-clean bay, piping, oil-water separator and drain field. Accessible soil is considered soil accessible to conventional excavation that can be conducted without adversely affecting facility foundations and equipment.

In addition, this QAPP includes sampling for MNA parameters at the western extent of the west plume. Comparison of the October 2010 concentrations to the contaminant concentrations since the RI shows that the leading edge of the plume—as identified in the ROD—is not changing, and the data suggest it is not migrating. MNA was identified in the ROD as a remedial component for site-wide groundwater and could be appropriate to reduce the low levels of contamination in groundwater further away from the BSA.

Figure 5 illustrates the pertinent features of the BSA, including the steam-clean bay, oil-water separator tank, drain field, and the approximate locations of the proposed soil remedial components. The precise locations of the SVE system, the enhanced bioremediation well network, the extent of excavation, the staging area for the LTTD, and the area for potential MNA will be better defined based on the results of this supplemental sampling.

## 3.4 REMEDIAL ACTION LEVELS

In the ROD, the EPA established action levels in order to determine areas requiring remediation. The action levels for groundwater are found in Table 3 and soil in Table 4. Groundwater action levels are based on MCLs for drinking water. The risk assessment portion of the *Remedial Investigation Report, Lockwood Solvent Groundwater Plume Site* (TTEMI 2003) concluded that the surface soil did not pose a risk to human health through incidental contact or ingestion. Therefore, the soil action levels are based on the remedial action objective to protect groundwater from contaminants leaching from the soil to the groundwater at levels that result in contaminant concentrations in the groundwater exceeding MCLs. Site-specific modeling resulted in the values shown in Table 4.

## 3.5 REMEDY COMPONENTS DATA EVALUATION AND NEEDS

Existing data are not of adequate quantity to properly design the remedial components at OU1, for several reasons. The previously collected data regarding COC concentrations and physical parameters in both soil and groundwater were collected as part of the RI in 2002. Given the volatile nature of the COCs, recent

data are required to accurately delineate the contaminated soil volume to be treated. Although semi-annual groundwater sampling has continued since the RI, certain physical and chemical parameters necessary for remedial design are not collected. RI activities were intended to generate a general understanding of the likely effectiveness of various proposed treatment options; therefore, the RI collected only the limited data relating to the physical and geotechnical characteristics of soil which were necessary to determine if the soil would be amenable to the selected remedial components. These data are not and were not intended to be of sufficient detail to complete the remedial design.

The following sections provide a limited description of the historical data and additional data needs in order to design each remedial component. As shown on Figure 5, there are seven historical monitor well or borehole locations within the area proposed for soil investigation. Concentration data for COCs are available from only one to four soil samples collected in each borehole. These samples and locations were considered in the design of the proposed soil investigation program reflected on Figure 8; however the number of historical soil samples and locations are sufficiently limited that they did not materially affect the proposed soil investigation program. The historical data will be used similarly to the supplemental data proposed to be collected under this QAPP to help define the extent of the remedial actions. The historical groundwater data within OU1 will be used, in conjunction with the supplemental groundwater data proposed to be collected under this QAPP, in groundwater trend analyses.

A brief summary of a current understanding of the proposed remedial actions for the different media of concern are also presented in the subsequent sections. The alternatives evaluation conducted during the FS is predicated on a number of contingencies. The data collected during this sampling event will assist in evaluation of those contingencies during remedial design. The data collected during this pre-design sampling effort will also be evaluated to propose and implement pilot tests/treatability testing as deemed necessary during the design.

Figure 4 and Figure 6 show locations of the monitoring wells, historic soil boring locations, potentiometric surface contours, and other features noted in the following discussions.

### 3.5.1 Soil Vapor Extraction

The proposed remedial action at the BSA for the subsurface soils is an SVE system. SVE is an in-situ remedial technology that reduces concentrations of volatile organic compounds (VOCs) adsorbed to soil in the unsaturated (vadose) zone. In this technology, a vacuum is applied to the soil matrix to create a negative pressure gradient that promotes volatilization of adsorbed VOCs from soil into the interstitial soil vapors, and induces movement of vapors to the extraction wells, where they can be readily removed

from the subsurface. The extracted vapors are treated as necessary before discharging to the atmosphere. Factors that influence the applicability of SVE include the physical and chemical properties of the soil and the COCs. The soil properties that affect SVE design include: total porosity; permeability; soil structure and stratification; organic carbon content; bulk density; and moisture content. The contaminant properties that affect the SVE design include: VOC composition; vapor pressure; and Henry's Law Constant. A VOC analysis of the subsurface soils will be conducted to determine the concentration of the contaminants present in the subsurface soils. This analysis will allow estimation of the quantity of material to be treated.

Limited subsurface soil sampling for geotechnical parameters was conducted during the RI in 2002. Soil samples were collected from the MW210 borehole (at a sample depth interval of 9.8 to 11.8 ft bgs) and the MW300 borehole (at a sample depth interval of 15.0 to 15.9 ft bgs) for moisture content and organic carbon. The moisture content (by weight percent) in the sample from the MW210 boring was 28 percent, and the moisture content in the sample from the MW300 boring was 4.9 percent. Moisture content of less than 20 percent is desirable for an effective SVE system. The organic carbon (by weight percent) in the soil samples from the MW210 and MW300 borings was 0.18 percent, and 0.13 percent, respectively. These values are within the range of acceptable values for SVE.

Soil samples from SB203 were collected at two sample depth intervals, 19.0 to 21.0 ft bgs and 44.0 to 44.5 ft bgs and analyzed for moisture content, dry bulk density, specific gravity, and effective porosity. Soil samples were also collected from the MW202 borehole (at sample depth intervals of 19.0 to 21.0 ft bgs and 21.0 to 22.5 ft bgs and analyzed for these parameters. The moisture content for these samples ranged from 8.8 to 18.6 percent by weight; the bulk density ranged from 97.5 to 129.6 lbs per cubic feet; specific gravity ranged from 2.68 to 2.72; and effective porosity ranged from 0.236 to 0.422. The ranges of bulk density, specific gravity, and effective porosity are consistent with the BSA soil profiles noted during the RI. These values are not expected to inhibit the effectiveness of SVE.

Intrinsic permeability is an important design parameter for design of a SVE system. Assuming that the soils in the saturated zone are similar to those of the unsaturated zone, hydraulic conductivity may be used to estimate the permeability of unsaturated soils. It is anticipated that although cleanup timeframes are generally longer for dense or compact soils like those found in the BSA, the concentrations in this area only slightly exceed remediation goals and are expected to meet these goals within five years after treatment begins (MDEQ/USEPA 2005).

Since limited soil samples from the BSA were analyzed for geotechnical parameters during the RI, additional information is necessary to characterize the soils for SVE applicability, treatability testing, and design. This information includes the following parameters: moisture content; bulk density; organic carbon content; permeability; and hydraulic conductivity. A detailed list of the geotechnical parameters, methods, and sampling requirements for the subsurface soils are presented in Table 2.

### 3.5.2 Enhanced Bioremediation

The proposed remedial action for the groundwater at the BSA is in-situ enhanced bioremediation. The in-situ bioremediation system is a series of injection/recirculation wells. Enhanced bioremediation technologies are used to accelerate naturally occurring in-situ biodegradation of VOCs by indigenous microorganisms in the saturated zone (groundwater). In this technology, electron donors (hydrogen releasing compounds) are injected along with other nutrients (if necessary) and the electron acceptors (chlorinated solvents) undergo reductive dehalogenation through biochemical reactions to form ethane and ethene as end products. The factors that influence the applicability of enhanced bioremediation include bioavailability characteristics of VOCs (toxicity, concentration), availability of electron donors, microbial populations, presence of other electron acceptors, and optimum conditions for microbial growth such as pH, temperature, oxidation-reduction potential (ORP), and nutrients. The aquifer properties that affect advective and dispersive transport, such as intrinsic permeability, hydraulic conductivity, and hydraulic gradient also influence the applicability of enhanced bioremediation.

Limited groundwater sampling was conducted for the evaluation of bioremediation during the RI. This sampling collected some water quality parameters (pH, temperature, ORP, total dissolved solids [TDS], etc.) as well as data on electron acceptors important to the microbial growth environment. The sampled wells included MW202 (an upgradient background well), MW201, MW204, and MW210. Additionally, one well (MW203) was analyzed for hydraulic conductivity, with a reported value of $2.08 \times 10^{-6}$ feet/second (ft/sec) (TTEMI 2003). At hydraulic conductivities greater than $10^{-6}$ ft/sec, enhanced bioremediation is categorized as effective to generally effective. At hydraulic conductivities between $10^{-6}$ ft/sec to $10^{-7}$ ft/sec, enhanced bioremediation is considered possibly effective, but needs further evaluation (USEPA 2004). Based on the information gathered during the remedial investigation, site hydraulic conductivity ranges from $2.59 \times 10^{-4}$ ft/sec to $2.08 \times 10^{-6}$ ft/sec. Since hydraulic conductivity is one of the most important parameters influencing the transport of nutrients and electron donors in the saturated zone for effective bioremediation, and due to the limited data currently available, the parameters listed in Table 2 will be analyzed to characterize the groundwater for enhanced bioremediation applicability, treatability testing, and for design of the selected remedy. Additionally, site-specific aquifer tests and/or pump tests

will be performed during the pilot scale/treatability testing phase to get an accurate representation of the existing aquifer properties for design of the enhanced bioremediation system for treating groundwater in the BSA.

### 3.5.3 Low Temperature Thermal Desorption

LTTD is a low temperature thermal volatilization, ex-situ remedial technology, that uses heat to physically separate (desorb) and volatilize the VOC's in the soil. The off-gases are generally treated in a secondary treatment unit such as a carbon adsorption unit prior to discharge to the atmosphere. The LTTD equipment would be temporarily placed within the immediate vicinity of the soil removal area. Soil to be treated by LTTD would be excavated, treated, and excavation areas would be backfilled with treated soil. Factors that influence the applicability of thermal desorption (LTTD) include the physical and chemical properties of the soil and VOCs. The soil properties that affect LTTD design include soil plasticity (Atterberg Limits), particle size distribution, moisture content, heat capacity, concentration of humic material (organic content), and bulk density. Heat capacity of the soil determines the amount of heat that must be transferred to raise the temperature of the soils sufficiently to volatilize adsorbed VOCs. Typically, the heat capacity does not vary significantly with different types of soils, and is not expected to impact the effectiveness of the LTTD performance, so it is not included in the proposed list of analyses. The contaminant properties that affect the LTTD design include contaminant concentration, boiling point range, vapor pressure, and octanol/water partition coefficient. Since previous sampling was performed in 2002, a VOC analysis of the soil will be conducted to determine the current concentration of the contaminants present in the soil. Data on the concentration and extent of contamination is necessary to estimate the total volume of potentially treatable contaminated soil.

No geotechnical parameters were measured on samples collected from BSA accessible soils (less than 10-ft bgs) during the RI. Soil samples will be analyzed for the following geotechnical parameters to characterize potential LTTD applicability, treatability testing, and design. These geotechnical parameters include moisture content, bulk density, and organic carbon content. Additionally, a subset of the soil samples collected will be analyzed for Atterberg Limits (Plasticity Index), including grain size distribution. Plastic soils tend to clump together and are difficult to treat thermally, requiring pretreatment such as shredding or amending with more friable soils. A detailed list of the geotechnical parameters, methods, and sampling requirements for the soils are presented in Table 2.

### 3.5.4 Monitored Natural Attenuation

MNA refers to the reliance of natural attenuation processes within the context of a carefully controlled and monitored site cleanup approach to achieve site-specific remediation goals in a timely manner compared to that offered by more active methods. Natural attenuation involves a variety of physical, chemical, and biological processes that, under favorable conditions, reduce the mass, toxicity, volume, and/or concentration of contaminants in soil or groundwater. Processes such as hydrodynamic dispersion, sorption, and volatilization reduce the contaminant concentration and are termed non-destructive attenuation processes. Biotic (biodegradation) and abiotic (hydrolysis) processes, which reduce the mass of contaminants, are termed destructive natural attenuation processes. Although some abiotic destructive mechanisms, and some non-destructive mechanisms, contribute to natural attenuation of VOCs in groundwater, the most important destructive attenuation mechanism is biodegradation. TCE is typically biodegraded under natural conditions via reductive dechlorination, a process that requires both electron acceptors (e.g., TCE) and an adequate supply of electron donors (e.g., sodium lactate).

Since the proposed groundwater remedial action at the BSA is in-situ enhanced bioremediation of VOCs through the addition of electron donors and nutrients and indigenous microorganisms, the factors that influence the applicability of in-situ enhanced bioremediation presented in the previous sections also are applicable for MNA evaluation.

Limited groundwater sampling of the BSA was conducted for the evaluation of MNA during the RI. This sampling collected microbial growth environment characteristics important to the success of MNA, including some water quality parameters (pH, temperature, ORP, TDS etc.), and data on electron acceptors. The wells that were sampled included MW201, MW202, MW204, and MW210. Based on these data, an MNA scoring value of 9 points was presented in the FS for the BSA. The scoring protocol is outlined in the EPA's *Technical Protocol for Evaluating Natural Attenuation of Chlorinated Solvents in Ground Water* (USEPA 1998). A score range of 6 to 14 indicates limited evidence of anaerobic biodegradation of chlorinated organic compounds such as TCE. A score of greater than 20 indicates a strong evidence of anaerobic degradation of chlorinated organic compounds. Based on this limited data, the parameters listed in Table 2 will be analyzed to characterize the groundwater for MNA.

### 3.5.5 Surface Water and Sediment

During the RI in 2002, surface water/sediment samples were collected from site-wide surface water features, except the Lower Lockwood Irrigation Ditch. The subsurface release of contaminants, the lack of communication between the ditch and groundwater, and the containment of the ditch through culverts

crossing the Beall property are all factors suggesting the ditch has not been impacted by the site contaminants. However, surface water and sediment samples will be collected to determine the presence or absence of contaminants in Lower Lockwood Irrigation Ditch. The samples will be analyzed for the COCs.

## 3.6 PROJECT SCHEDULE

The supplemental sampling is anticipated to occur during spring of 2012. Semi-annual sampling will occur in April and October, annually. This will provide time through 2012 to evaluate the data and either begin remedial design of the selected components or develop a pilot study to enable accurate design, most likely for the SVE system. Full-scale implementation and/or pilot studies would likely commence in 2013. Given there are separate and unique components to the remedial design at OU1, each of the components may be at a different phase in the design and implementation process; however, components will be moving forward concurrently.

## 3.7 PROJECT CONSTRAINTS

Practical constraints may include availability (scheduling) of investigation equipment (e.g., direct-push drill rig) and weather. Environmental sampling equipment is readily available in the Billings area and the early spring schedule should allow more flexibility for scheduling. The EPA has secured access to the Beall property and existing groundwater monitoring wells. The EPA will support the remedial contractor's efforts to secure access to any additional properties as needed. Under the EPA direction, Beall managers will move trucks, trailers, and equipment as necessary to ensure complete execution of this QAPP.

# 4.0 QUALITY OBJECTIVES AND CRITERIA

## 4.1 QUALITY OBJECTIVES

The nature and extent of soil and groundwater contamination from VOCs at the BSA is currently unknown. In order to design remedial systems, the nature and extent of contamination must be defined. Additionally, data for geotechnical and physical parameters are necessary for the design of the SVE and enhanced bioremediation systems, and potentially the LTTD and monitored natural attenuation remedial components.

The goals of this study are: 1) to determine the spatial extent of contaminant concentrations in the different media that require remedial action; and 2) to collect data of sufficient quantity and quality necessary for remedial design.

## 4.2 PERFORMANCE CRITERIA

Section 3.5 discusses the fact that historical data is not of adequate quality or quantity to complete the remedial design.

Data collected under this supplemental sampling and analysis program will be used for several general purposes. Soil data will be collected to verify the vertical and horizontal extent of contamination in soil, to calculate a total volume of soil to be treated, to design an LTTD system to treat contamination present in accessible soils (estimated to be from zero to 10 ft bgs), and to design an SVE system to treat subsurface soil contamination from 10 ft bgs to the top of the water table (estimated to be 45 ft bgs). Groundwater samples will be collected to verify the horizontal extent of contamination in water, and to provide data to design and optimize the selected groundwater remedy of enhanced bioremediation. The physical, geotechnical, and chemical properties of the soil and the physical and chemical properties of the aquifer will be used for design. Surface water and sediment samples will be collected to confirm the presence or absence of contamination in these environmental media.

Table 2 identifies each parameter of interest by environmental media, the analytical method, the action level for each COC, the laboratory reporting limit for each COC and analytical method, and the range of anticipated concentrations and/or values. The OU-specific action levels from the ROD provide COC concentrations for comparison purposes, enabling the EPA to make remedial decisions. It is important to note that the analytical method reporting limits (MRLs) for PCE, TCE, DCE, and VC are below the OU-specific action levels for both soil and groundwater.

By establishing an anticipated range of results for the geotechnical and physical properties, the remedial design contractor can identify potential outliers early in the process (even in the field) and address those accordingly. For example, knowing an expected range of dissolved oxygen may help the field team identify a potential problem with the field equipment if the reading is out of expected range. Alternatively, if the "outlying" data are valid, then the remedial design contractor, in consultation with the EPA, will evaluate the potential effectiveness of the design.

## 4.3 DECISION ERRORS

There are two types of decision errors of concern for this QAPP:

1. *False Acceptance*: Deciding the media does require remedial action when in fact it does not.
2. *False Rejection*: Deciding the media does not require remedial action when in fact it does.

The majority of potential decision errors are typically associated with field sample variability and collection procedures. Analytical error is usually a much smaller portion of the total error associated with an environmental measurement; however the analytical data must be reported by the laboratory at low enough levels that will allow comparison to the established soil and groundwater action levels. Any decision regarding the level of soil contamination must be made while considering the protection of the groundwater and reduction of the source area. Any decision regarding the level of groundwater contamination must be made while considering the migration of the plume and reduction of the source area. A goal of this QAPP is to provide sufficient planning and methodologies to prevent against either error.

For the soil excavation and LTTD component, the primary consequence of making a false acceptance decision error is the relatively high expense of treating additional soil by LTTD (approximately $2,600 per 1,000 cubic feet) compared to the relatively low cost of sample collection ($300 per sample) and analysis (approximately $100 per sample). Making a false rejection decision error could possibly leave a risk to groundwater. A tighter spacing for sample collection will reduce the potential for unnecessary treatment; thus reducing the chance of making both a false acceptance and a false rejection error.

For the SVE system, the primary consequence of making a false acceptance decision error is the installation of additional extraction points in the system network. Making a false rejection decision error could possibly leave a risk to groundwater. A tighter spacing for sample collection will reduce the potential for unnecessary extraction points; thus making the chance of a false acceptance error low. In addition, that same sampling grid will ensure the SVE extraction points are of adequate number and location to treat the soil in-situ; thus reducing the chance for a false rejection error.

For the enhanced bioremediation system, the primary consequence of making a false acceptance decision error is the injection of excess hydrogen donors (unnecessary costs) and additional system component wells (injection and recirculation). Making a false rejection decision error could result in not providing adequate electron donors and system components, thereby slowing the biological remediation processes and allowing contamination to remain in the groundwater longer than necessary. Through the semi-annual sampling program already established for the LSGPS, the contaminant concentrations in the Beall groundwater study area are known. This supplemental QAPP includes limited groundwater sampling from direct-push borings to define the edges of the plume at the BSA with a higher precision. Measurements of additional physical and chemical properties of the aquifer will be collected from the direct-push borings and the groundwater monitoring wells to support the design of the enhanced bioremediation system.

The subsurface release of contaminants, the lack of communication between the Lower Lockwood Irrigation Ditch and groundwater, and the containment of the irrigation ditch through the Beall property are all factors suggesting the irrigation ditch has not been impacted by the site contaminants. However, surface water and sediment samples will be collected to confirm the presence or absence of contaminants in the Lower Lockwood Irrigation Ditch. For the surface water and sediment sampling, a consequence of making a false acceptance decision error is designing and implementing a remedial component that is unnecessary. The consequence of making a false rejection decision error is allowing contamination to remain the Lower Lockwood Irrigation Ditch. There are established methods for sampling and analyzing surface water and sediment; therefore, the risk of an inaccurate result is low.

Further discussion regarding the sampling design, including justification for the density and location of sampling points, is presented in Section 5.0.

## 4.4 PRECISION

Precision is the reproducibility of measurements under a given set of conditions, representing random error. For large data sets, precision is expressed as the variability of a group of measurements compared to their average value (that is, the standard deviation). For duplicate or replicate measurements, precision is expressed as the relative percent difference (RPD) of a data pair and is calculated using the following equation (where A and B are the reported concentrations for duplicate sample analysis):

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

Field precision will be assessed through the collection and analysis of field duplicate water samples or field replicate soil samples.

Analytical laboratory precision will be assessed using the calculated RPD between the following data:

- Matrix spike and matrix spike duplicate (MS/MSD) sample data
- Investigative and associated matrix duplicate sample data (as appropriate)

Laboratory precision will also be assessed for three or more replicated samples (for example, response factors for calibration standards).

## 4.5 BIAS (ACCURACY)

Accuracy is the degree of agreement of a measurement or an average of measurements with an accepted reference or "true" value, and is a measure of bias in the system. The accuracy of a measurement system is affected by errors introduced through the sampling process, field contamination, preservation, handling, sample matrix, sample preparation, and analytical techniques. Accuracy will be evaluated using the percent recovery calculated using the following equation:

$$\text{Percent Recovery} = \frac{|A - B|}{C} \times 100$$

Where:

A is the target analyte concentration determined analytically from the spiked sample
B is the background level determined by a separate analysis of the unspiked sample
C is the concentration of spike added

The accuracy requirements for the project COCs are presented in Table 5. Although accuracy of the field program cannot be assessed quantitatively, the following criteria will be used for a qualitative accuracy assessment for this project: sample handling, shipping, preservation, and holding time.

Laboratory accuracy will be assessed quantitatively through the analysis of MS/MSD samples and standard reference materials, which include surrogate spikes (organic analyses only) and response factors for calibration standards and internal standard recoveries.

## 4.6 REPRESENTATIVENESS

Representativeness is a qualitative expression of the degree to which sample data accurately and precisely represent a characteristic of a population, a sampling point, or an environmental condition. Representativeness is maximized by ensuring that, for a given project, the number and location of sampling points and the sample collection and analysis techniques are appropriate for the specific investigation, and that the sampling and analysis program provides information that reflects "true" site conditions.

Representativeness of field data is dependent upon the proper design of the data collection procedures. The sampling and field measurement procedures to be used for the project data collection are based on existing site knowledge, the physical setting, past land use and operation, EPA guidance, and literature-reported methods. These procedures are described in this QAPP. Representativeness of the field data will be evaluated by assessing whether this QAPP was followed during sample collection. In addition, the analytical results from trip and rinse blank samples and field duplicate or replicate samples will be used to evaluate the representativeness of field sampling procedures.

Laboratory data will be evaluated for representativeness by assessing whether the laboratory followed the specified analytical criteria in this QAPP and the standard operating procedures (SOPs), evaluating holding time criteria, and evaluating the results of method, instrument, trip, and rinse blank samples and field replicate or duplicate samples.

## 4.7 COMPLETENESS

Completeness is a measure of the amount of valid data obtained from a measurement system compared to the amount expected under correct normal conditions. Completeness will be calculated using the following equation:

$$\text{Completeness} = \frac{\text{Number of valid data points}}{\text{Total number of measurements}} \times 100$$

Field data completeness is a quantitative measure of the actual number of samples collected compared to those samples scheduled for collection. The field data completeness goal for this project is 95 percent.

Laboratory data completeness is a quantitative measure of the percentage of valid data for all analyses as determined by the precision, accuracy, and holding time criteria evaluation. Completeness will be

calculated using the completeness equation by dividing the total number of valid data points by the total number of data points. The laboratory completeness goal for this project is 95 percent.

## 4.8 COMPARABILITY

Comparability is a qualitative parameter that expresses the confidence with which one data set may be compared to another. Comparability is dependent on similar QA objectives and is achieved through the use of standardized methods for sample collection and analysis, the use of standardized units of measure, normalizing results to standard conditions, and the use of standard and comprehensive reporting formats as defined by this QAPP.

Field data comparability is dependent on the use of similar and standard sampling methodology and the use of standard units of measure between different investigations at a site. For this investigation, field data will be collected using standard sampling and measurement procedures. Field data will be recorded in the field logbook or on the applicable field forms (i.e., sample forms or chain-of-custody forms). Comparability of field data will be evaluated by reviewing the field documentation to determine whether the field data collection procedures and sample collection, handling, and shipping protocols specified in this QAPP were followed.

Like field data, laboratory data comparability is dependent on the use of similar sampling and analytical methodology and standard units of measure between different investigations at a specific site. For this investigation, standard sampling and analytical methodologies that are similar to those used for previous sampling activities will be followed, to the extent possible. Laboratory data comparability will be assessed by comparing data collected during the 2011 field season to historical data (as available) and assessing whether the analytical methodologies presented in this QAPP were followed.

## 4.9 METHOD SENSITIVITY

Method sensitivity (detection limit) is the minimum concentration of an analyte that can be reliably distinguished from background “noise” for a specific analytical method. There are a number of detection limits for any given method: instrument detection limit, MDL, practical quantification limit, and the limit of quantification. For this QAPP, Table 2 illustrates that the field and laboratory MDLs for each parameter of interest are less than the action level, except for VC. While VC is a COC, it is not present at the highest concentrations; therefore, it is not the driver for these remedial actions. The methods selected for identifying and treating contaminated soil will be effective for all of the VOCs together.

Field data sensitivity is dependent on the equipment maintenance, calibration, performance, and operator as well as collection methods and sample handling. For the parameters being measured in the field, standard equipment is readily available to ensure the data collected meet the project's goals and are of adequate quality to be used in making decisions. The field team will follow procedures detailed in this QAPP and SOPs to ensure usability of the data.

Like field data, laboratory data sensitivity is dependent on equipment maintenance, calibration, performance, and operator as well as collection or extraction methods and sample handling. However, laboratories usually can provide lower detection limits with a higher degree of confidence given the controlled environment for the equipment and technician. Laboratories report their MDLs and provide qualifiers for certain values if those values are uncertain.

# 5.0 SAMPLING DESIGN

Building on the discussion in Section 3.5 of this QAPP regarding the remedy components data needs, the following subsections describe the sampling design for each media and remedy component.

## 5.1 GENERAL SOIL SAMPLING APPROACH

The overall soil sampling design is based on the conceptual site model (Figure 7) and the understanding that the soil action levels at OU1 are essentially soil screening levels (SSLs) derived from an assessment of the risk to groundwater posed by contaminated soils (MDEQ/USEPA 2005). The derivation of these levels is contained in Appendix C of the Feasibility Study Report (TTEMI 2004). The EPA's *Soil Screening Guidance: User's Guide* describes the governing equations and simplifying assumptions (USEPA 1996) of the derivation of SSLs. Important conceptual assumptions include an infinite source, uniformly distributed contamination from the surface to the top of the aquifer, and a receptor well at the downgradient edge of the soil contamination. A critical parameter used in the derivation of SSLs is a dilution factor (a factor that accounts for the fact that the contaminant mass leaching into groundwater from the soil will be diluted by the groundwater). This dilution factor in turn is based partially on a contaminant source length term parallel to the direction of groundwater flow (rather than a volume source term).

The assumptions and governing equations suggest that contamination from a single borehole, or series of boreholes (i.e., a source length) in a line parallel to the groundwater flow, should be used to compare against the SSL. The User's Guidance suggests that the average concentration of contaminant (or multiple of that concentration), or a 95 % upper confidence limit of the mean concentration from a borehole, can be used as a basis of comparison to the SSLs. If volatiles were not involved, the sampling design would incorporate compositing of depth samples from each and every borehole, and a "borehole or average" concentration would be compared against the SSLs. However, for VOCs, an alternative sampling method to composite samples in the field would need to be followed (such as field methanol extraction), or each analytical result could be compared against the SSL, or a group of analytical results could be combined mathematically and compared against the SSL.

Field extraction of VOCs using methanol would typically raise the MRLs, and currently the MRL for VC (0.025 mg/kg) is near the SSL of 0.050 mg/kg. In addition, field extraction would slow the sampling process, and as OU1 is an operating facility, expeditious sampling is desired. This approach was therefore not selected.

The sampling approach is based on a plan to either: (1) evaluate individual results against the SSL (any result greater than the SSL from a borehole sample would trigger the need for remedial action in the location of the borehole), or (2) mathematically average a group of analytical results to compare to the SSLs (the mathematical average would then be used to compare against the SSL). The soil sampling approach described below for SVE-related locations is designed to allow results from three adjacent boreholes on a line parallel to the groundwater flow (corresponds to an approximate 50-foot source term used in the derivation of the SSLs) to be combined mathematically to represent an "average" concentration in the soil vertical profile over the length of the source term, if so desired. Although it will not be possible to determine a statistical basis for that "average" concentration, the "average" is conceptually consistent with the soil screening approach on which the action levels are based. It is proposed that the selection between these two approaches be determined after the analytical results are placed in the context of an updated CSM that includes the soil lithology, degree of heterogeneity, the presence of any vertical or horizontal soil contaminant distribution patterns, and a more complete understanding of the groundwater contamination and aquifer parameters.

The decision to use LTTD or SVE in the upper 10 feet of the soil horizon will be based on the overall COC concentrations present in the soil matrix. Based on the historical release mechanisms, there may be higher amounts of contaminants in the soil still remaining immediately below the steam-clean bay and associated piping and drain field than what has migrated to the groundwater table. If this is the case, PWT will evaluate the use of LTTD for the upper soil horizon to reduce the downward migration of contamination and therefore potentially reduce the time necessary for SVE to treat the soil in the lower soil horizons.

## 5.2 SOIL VAPOR EXTRACTION

Figure 8 illustrates the proposed soil borings locations for the COC samples in the subsurface. The black "X" indicates a soil boring location that will extend to the water table. The borings are based on a 20 foot grid pattern in the proximity of the steam-clean bay and former drain field. Preliminary calculations supported by limited data from the RI suggest the radius of influence of the SVE might be 16 feet. Therefore, the 20 foot sampling grid is designed to identify the extent of contamination corresponding to an achievable radius of influence.

Two samples will be collected from every boring. A soil sample from either the 5 to 7 or the 8 to 10 ft horizon will be collected from each boring to be used in the evaluation of LTTD (described below). Each boring will also have one other sample collected from the 15 to 17, 25 to 27, or 38 to 40 ft bgs ranges.

Historical depth to groundwater readings average 41 to 50 ft bgs. The depth of 38 to 40 ft bgs is intended to sample deep vadose zone soil that is not suspected to be impacted by the change in the water table (capillary fringe). There is limited historical data from depths between 10 and 40 ft bgs. The other two sample depth intervals are intended provide results so that the entire vertical profile (0-10, 10-20, 20-30, 30-40) has been sampled for a set of three locations in a line parallel to groundwater flow.

In order to confirm the absence of other contaminants (asphalt constituents) in the subsurface, PWT will also collect samples from three borings in or near the steam clean bay and approximate area of the abandoned oil-water separator tank (Figures 5 and 8). Six samples will be collected from the borings, co-located with the intervals selected for the COCs and submitted for semi-volatile organic compounds (SVOCs) and petroleum based constituents.

Figure 9 identifies the soil borings for the geotechnical sample locations. Based on soil boring logs from the RI, the distribution and frequency of SVE parameter samples is adequate to support the design of the SVE system. The geotechnical samples will be collected from the same depth interval as the corresponding COC samples from the borehole.

In addition to the sample intervals described above, samples of opportunity may be collected based upon field instrument readings, or visual or olfactory observations suggestive of contamination.

Table 2 identifies the analytical method for each chemical and physical parameter to be analyzed.

## 5.3 ENHANCED BIOREMEDIATION

Current and historical groundwater data suggest the groundwater emanating from the BSA is moving on a relatively flat gradient ranging from 0.001 ft/ft to 0.0059 ft/ft. Figure 6 illustrates the potentiometric map for the BSA, based on April 2011 groundwater level measurements. For the Feasibility Study (TTEMI 2004) the groundwater velocity was computed to be about 178.5 ft/year, based on an average hydraulic conductivity of $2.59 \times 10^{-4}$ ft/sec (substantially higher than observed at well MW203) and a hydraulic gradient of 0.0059 ft/ft. Therefore, the most strategic location for the injection and recirculation wells for the enhanced bioremediation system is proposed north of Highway 87.

Figure 10 shows the approximate locations of the injection and recirculation wells for the enhanced bioremediation system. Figure 11 shows the groundwater sample locations for the BSA, both from existing groundwater monitoring wells and from proposed direct-push locations. Additional groundwater sampling locations have been identified to fill data gaps where monitoring well groundwater samples cannot be collected (e.g., MW202). These are locations where additional groundwater data are required to support design of enhanced bioremediation, including nature and extent of the contamination, but repeated or longer-term monitoring of groundwater is not anticipated to be necessary.

The upgradient edge of the plume will be identified through the grid of direct-push boring locations to the east of the steam-clean bay to define the width of the plume. The existing groundwater wells MW012, MW200, MW201, MW203, MW204, MW205, and MW206, along with two additional direct-push locations, will assist with defining the width of the plume north of Highway 87. Each of these locations will be sampled for all analytes listed on Table 2 for groundwater, which includes COCs and other chemical and physical parameters of the groundwater.

In anticipation of the disposal of extraction water from the forthcoming aquifer test to support the design of the enhanced bioremediation component, PWT has coordinated with the City of Billings who has request SVOC and metals analysis from MW201.

## 5.4 LOW TEMPERATURE THERMAL DESORPTION

As described in Section 5.2, Figure 8 illustrates the proposed soil borings locations for the COC samples in the subsurface. The black “X” indicates a soil boring location that will extend to the water table.

Figure 9 identifies the soil borings from which samples for the geotechnical parameters will be collected. The geotechnical parameters are listed on Table 2 and are applicable to both SVE and LTTD.

Soil samples for COCs and geotechnical parameters will be collected from either the 5 to 7 or 8 to 10 ft bgs ranges. Samples from borings near the steam-clean bay and associated piping out to the oil-water separator will be collected from the 5 to 7 ft bgs range; while samples from borings away from the steam-clean bay and near the drain field will represent the 8 to 10 ft bgs range. This sampling protocol is based on the understanding of the historical release of the contamination. TCE is not expected to be found in soil above the oil-water separator or drain field; however, contamination may be found in shallower soil near the former above-ground storage tank and underground piping.

Samples of opportunity may be collected based upon field instrument readings or visual or olfactory observations suggestive of contamination, in lieu of samples from the above specified depth intervals.

## 5.5 MONITORED NATURAL ATTENUATION

Monitoring wells MW023, MW210, MW211, MW212, MW213, MW300 and MW301 will be sampled for MNA parameters and VOCs as identified in Table 2. Figure 4 and Figure 6 illustrate the location of the wells. Evaluation of the historical groundwater data suggests the plume is not migrating or increasing; therefore, MNA is a viable remedial option for this portion of the west plume.

## 5.6 SURFACE WATER AND SEDIMENT

There are three locations identified for co-located surface water and sediment sampling of the Lower Lockwood Irrigation Ditch. Those locations are noted on Figure 12. Samples will be collected at the upstream (2 locations) and downstream (1 location) extents of the culverts which contain the Lower Lockwood Irrigation Ditch through the Beall property. The intent of this sampling is to confirm the presence or absence of COCs in the surface water; therefore, the analyses only include COCs as noted on Table 2.

## 5.7 SEMI-ANNUAL GROUNDWATER MONITORING

Monitoring wells MW012, MW015, MW016, MW023, MW085, MW200, MW201, MW202, MW203, MW204, MW205, MW206, MW207, MW208, MW210, MW211, MW212, MW213, MW214, MW216, MW217, MW219, MW300, MW301 and RW027 will be sampled semi-annually for MNA parameters and VOCs as identified in Table 2. Figure 13 illustrates the location of the wells. Wells are scheduled to be sampled in April and October of 2012.

# 6.0 FIELD SAMPLING ACTIVITIES

This section of the QAPP describes the following field activities: 1) soil sampling for VOCs and chemical and geotechnical LTTD design parameters; 2) soil sampling for VOCs, SVOCs, petroleum constituents, and chemical and geotechnical SVE design parameters; 3) groundwater sampling for VOCs, SVOCs, and select metals and monitored natural attenuation and enhanced bioremediation design parameters (including semi-annual groundwater monitoring); 4) surface water sampling for VOCs; and 5) sediment sampling for VOCs. As stated earlier in this document, several different laboratories will be used, including privately contracted laboratories as well as a laboratory from the EPA's analytical program. Although not relevant to all the proposed field sampling activities, the EPA's *Contract Laboratory Program Guidance for Field Samplers* (USEPA 2010) was consulted frequently during preparation of this QAPP and has been incorporated as applicable.

## 6.1 SAMPLING PROCEDURES

The potential for accidental damage to underground utilities is always present during subsurface drilling and excavation activities. When utility hits occur, there can be negative impacts to residents or businesses due to service interruptions, in addition to the serious safety risk to site personnel. In order to minimize this potential, underground utilities will be located in accordance with PWT's SOP Utility Clearance (PWT/ES.101), before any intrusive activities commence. This is consistent with Section 2.5.3 of the *Contract Laboratory Program Guidance for Field Samplers* (USEPA 2010).

If a Potentially Responsible Party (PRP) or other property owner indicates an interest, the opportunity to collect splits of all soil, water and sediment samples will be provided. Requests of this nature must be received in advance of sampling, and will be coordinated through the EPA. The PRP representative will be required to have appropriate health and safety training, and to read and comply with PWT's Site-Specific Health and Safety Plan (PWT 2011) while onsite. Samples will be collected by PWT technical staff or subcontractors, in the manner described in this QAPP. Since true splits of VOC samples are not available in the field, the split samples will be collected in accordance with applicable PWT SOPs for the collection of duplicate samples. The PRP or other property owner representative will be expected to remain onsite for the duration of the sampling from which splits are desired. The PRP or other property owner will provide appropriate sample containers to the PWT sampling crew when requested, and will accept filled sample containers back from the PWT sample crew. PWT's sample crew will not be responsible for labeling, preservation, storage, custody or shipping of PRP or other property owner split samples. Split samples collected for a property owner or PRP will not be considered in the remedial

action design and thus quality control comparisons outlined in Section 9.1 are not applicable to these samples.

All SOPs referenced in the following sections are provided in Appendix A for reference. Situations or issues not covered by PWT's SOPs often occur in the course of a field investigation. In some cases, these situations can be anticipated for a particular site, and to the extent possible, they have been identified along with appropriate field team responses in the following sections. If unanticipated field conditions not covered by PWT's SOPs or this site-specific QAPP are encountered, the field team will take action as necessary to remain safe, and contact the Project Manager for further instructions.

### 6.1.1 Sample Locations

Each soil boring location will be assigned an SB (soil boring) number. PWT will continue to use the established identification numbers for the monitoring wells. A global positioning system (GPS) reading at each soil boring location will be collected in the field to confirm the location of the boring. The GPS unit will be handheld with an accuracy of ± 0.1 feet and operated according to manufacturer's instructions. PWT will adhere to the EPA's National Geospatial Data Policy (CIO 2131.0) (USEPA 2008a) for the collection of the GPS readings. It is expected the GPS data collected at the LSGPS will meet Tier 1 requirements (less than one meter accuracy).

If existing monitoring wells are damaged and not able to be sampled, the field sampling crew will contact the PWT Project Manager for a decision whether to utilize the direct-push rig and water sampling accessory to collect that groundwater sample. If proposed direct-push soil and/or groundwater sampling locations are not accessible for any reason, the field crew will attempt to adjust to an adjacent location. If an appropriate alternate location cannot be located within one-half the distance between the inaccessible proposed sampling point and the nearest neighboring sampling point, the Project Manager will be contacted for instructions on how to proceed. If surface water and sediment sample locations are not accessible, the field crew will find the next closest accessible location to the original sample location.

### 6.1.2 Soil Sampling for Soil Vapor Extraction and Low Temperature Thermal Desorption Parameters

Collection of soil samples for determination of SVE or LTTD design parameters will be completed utilizing a direct-push drill rig and disposable sample liners in accordance with, and using a project-specific soil sampling form, PWT's SOP Direct Push Soil Sampling (PWT/SS.102) and the En Core® Sampler Sampling Procedures (Appendix A).

Soil borings drilled for collection of soil samples will be logged continuously from ground surface to total depth in accordance with, and using the form provided in, PWT's SOP Borehole Logging (PWT/SS.101). A field team geologist will focus in particular on textural changes in the soil column (i.e., transitions between, lenses of, and relative percentages of clay, silt, and sand within the sample core), observed moisture content, and the observed consistency/density of the soil. SVE, like other in-situ treatment approaches, attempts to mimic a completely mixed, continuous treatment tank or process for remediation of contamination. However, there are inherent challenges to accomplishing complete mixing in a heterogeneous soil environment, which are not typically encountered when applying ex-situ methods. Short circuiting can be particularly troublesome when applying SVE to soil with highly variably grain size distribution and permeability. To minimize short circuiting, the screened intervals of the SVE system wells may be selected at the least permeable zones in the soil column, and may be specifically selected to avoid highly permeable sand stringers of one-half foot or greater thickness. These screened intervals will be selected using the textural information provided on borehole lithologic logs prepared by the field geologist. Horizontal spacing on the proposed boreholes was generally set at a 20 foot grid, in part, to collect this lithologic data at the same spacing as the proposed SVE wells. Detailed observations recorded on the boring log will provide additional qualitative information about these critical LTTD/SVE design parameters at depth intervals where quantitative samples are not proposed to be collected. After each soil boring is completed to the target depth, it will be properly abandoned in accordance with PWT's SOP Well and Borehole Abandonment (PWT/ES.104).

Geotechnical sampling requirements will allow multiple analyses to be performed on the material from a single sample container. Soil sample containers will be filled in order of compound volatility or stability as follows:

1) Volatile Organic Compounds
2) Petroleum constituents
3) Semi-Volatile Organic Compounds
4) Metals
5) Moisture Content, Bulk Density, Specific Gravity, Porosity
6) Permeability, Hydraulic Conductivity
7) Grain Size Analysis, Atterberg Limits, Organic Carbon Content.

In addition, PWT will work closely with the LTTD subcontractor to ensure the appropriate samples are collected and shipped to allow performance of the bench scale treatability test.

### 6.1.3 Groundwater Sampling for Enhanced Bioremediation and Monitored Natural Attenuation Parameters

Prior to initiation of groundwater sampling activities, the field crew will conduct a round of water-level measurements by visiting each monitoring well to measure the static water level in accordance with PWT's SOP Water Level Measurements in Wells and Piezometers (PWT/GW.102). The Water Level Measurement Record form attached to the SOP will be used to record static water-level measurements. Groundwater samples will be collected from existing monitoring wells using low flow sampling techniques in accordance with PWT's SOP Groundwater Sampling (PWT/GW.101). Field Parameters will be measured and recorded in accordance with PWT's SOP Field Parameter Measurements (PWT/GW.108), using a low volume flow-through cell.

Additional groundwater sampling locations have been identified to fill data gaps where monitoring well groundwater samples cannot be collected. Soil borings drilled for collection of groundwater samples will be logged continuously from ground surface to total depth in accordance with, and using the form provided in, PWT's SOP Borehole Logging (PWT/SS.101). A field team geologist will focus in particular on textural changes in the soil column (i.e., transitions between, lenses of, and relative percentages of clay, silt, and sand within the sample core), observed moisture content, and the observed consistency/density of the soil. These boreholes will be advanced to the anticipated depth of groundwater, the presence of groundwater will be verified, and two depths will be selected for groundwater sampling. A groundwater sample will be collected at "first water" and a second will be collected at total depth (just above bedrock). The screened interval for groundwater sampling will be recorded on the field sampling form, along with the depth at which water was first encountered. Field parameters will be measured and recorded in accordance with PWT's SOP Field Parameter Measurements (PWT/GW.108). These groundwater samples will be collected directly from soil borings using a direct-push drill rig equipped with a water sampling accessory such as the GeoProbe Screen Point-15, GeoProbe Screen Point-16, or equivalent. This sampler will consist of a slotted, stainless steel or PVC screen and all rods, o-rings, sheathing and other appurtenances necessary to collect a groundwater sample from a selected interval below ground surface and transport that water to the surface for collection in the appropriate sample container(s). An example of a manufacturer's SOP for groundwater sampling from a soil boring (*GeoProbe Screen Point 16 Groundwater Sampler SOP Technical Bulletin No. MK3142, Prepared November 2006*) is provided in Appendix A and will be used where applicable to supplement PWT's SOP Groundwater Sampling (PWT/GW.101). If an equivalent alternate water sampling device is used, the appropriate manufacturer's SOP will be used. After the groundwater sample

is collected, each of these soil borings will be properly abandoned in accordance with PWT's SOP Well and Borehole Abandonment (PWT/ES.104).

Sample containers will be filled in order of compound volatility or stability as follows:

1) Volatile Organic Compounds
2) Semi-Volatile Organic Compounds (MW201 only)
3) Methane-Ethane-Ethene
4) Fe2+/Total Iron
5) Metals (MW201 only)
6) Manganese
7) Remaining analyses (Chemical Oxygen Demand, Alkalinity, Total Dissolved Solids, Anions, Total Kjeldahl Nitrogen, Ammonia-N, Phosphorous, Hardness, and Hydrogen).

### 6.1.4 Surface Water and Sediment Sampling for Volatile Organic Compounds

Based on the known site history and physical characteristics, surface water and sediment in the Lower Lockwood Irrigation Ditch are believed to be free of site-related contamination. To verify this assumption, co-located surface water and sediment sampling will be conducted in accordance with PWT's SOPs Surface Water Sampling (PWT/SW.101), and Sediment Sampling (PWT/SE.101), respectively. PWT's Surface Water and Sediment Sampling forms (attached to each of these SOPs) will be used. In accordance with PWT's SOPs and industry standard practices, the potential for cross-contamination of these samples will be minimized by collecting the downstream sample first and proceeding upstream. Also, surface water samples will be collected before sediment samples at each of the three proposed sampling locations. Field parameters will be measured in accordance with PWT's SOP Field Parameter Measurements (PWT/GW.108), prior to collection of each surface water sample. VOC sample containers will be filled after field parameters have been collected.

## 6.2 SAMPLE PACKAGING AND SHIPPING

After collection, samples of all media will be managed in accordance with PWT's SOP Sample Handling (PWT/ES.102), and the project specific sampling handling requirements described below.

Soil, water, and sediment samples will be packaged and shipped or hand delivered to the laboratory within 24 hours of sample collection. For samples that are shipped to the laboratory via a commercial carrier, the following procedures apply:

- Sample labels will be completed and attached to sample containers as described previously.

- Sample containers will be placed in plastic resealable bags and placed upright in coolers.
- Ice or blue ice will be placed on top of and between sample bags in coolers. Enough ice or blue ice will be used so that the samples will be chilled and maintained at 4°C ± 2°C during transport to the laboratory.
- To prevent the sample containers from shifting inside the cooler, the remaining space in the cooler will be filled with inert cushioning material.
- The original copy of the completed chain-of-custody will be placed in a waterproof plastic bag and placed inside the cooler.
- The lid will be secured by wrapping strapping tape completely around the cooler in two locations.
- Custody seals will be placed in two locations across the cooler closure to ensure that any tampering is detected. The date and initials of the sampler will be written on the custody seal.
- A copy of the signed chain-of-custody record and the completed waybill (shipping document) will be retained for the project files.

## 6.3 DECONTAMINATION

In general, field sampling equipment used by PWT's sampling team will not be decontaminated in the field. Rather, sampling equipment will be decontaminated prior to use or disposable sampling equipment will be used. After sampling, the equipment will either be properly disposed or decontaminated. If field decontamination is required, it will be conducted and documented in accordance with procedures described in PWT's SOP Personnel and Equipment Decontamination (PWT/ES.103).

Field decontamination is anticipated for the direct-push drill rig. Prior to commencement of drilling operations and before leaving the site, all equipment and tools will be cleaned using a high-pressure steam cleaner or other method provided by the Drilling Subcontractor. Additionally, rods and other non-dedicated equipment coming in direct contact with subsurface materials will be decontaminated between each boring location. The Drilling Subcontractor is responsible for containerizing decontamination water and for cleaning the decontamination area after use. If alternate decontamination procedures are typically implemented by the Drilling Subcontractor, then these procedures shall be presented to PWT for review and acceptance, and shall be in accordance with accepted industry practices.

## 6.4 INVESTIGATION-DERIVED WASTE MANAGEMENT

Sampling environmental media typically results in the generation of investigation-derived waste. Potentially contaminated soil cuttings, groundwater, and surface water, and used personal protective

equipment (PPE) will all be produced in the course of the proposed supplemental sampling program. These wastes will generally be containerized, labeled, and stored at a secure location onsite until they can be treated along with their respective source materials as part of the remedial action. Used PPE will be disposed of in accordance with PWT's SOP Investigation Derived Waste Management (PWT/GW.105).

# 7.0 SAMPLE CHAIN-OF-CUSTODY/DOCUMENTATION

To ensure that samples are identified correctly and remain representative of the environment, careful sample documentation and custody procedures will be used during the LSGPS remedial design supplemental sampling program to maintain and document sample integrity during collection, transportation, storage, and analysis. Field sampling personnel will be responsible for ensuring that proper documentation and custody procedures are initiated at the time of sample collection and maintained until custody of the samples is transferred to the laboratory or to a commercial freight carrier. The Project Manager or field team leader will review and approve field documentation before it is finalized. The analytical laboratory will be responsible for maintaining sample custody and documentation in accordance with the procedures outlined in the QAPP, from the time the laboratory receives the samples until final sample disposition. Field documentation and sample chain-of-custody requirements are presented below.

## 7.1 FIELD LOGBOOK

Field logbooks will be bound notebooks or field survey books. All entries to field logbooks, and all other field documentation, will be made using indelible ink. Any errors will be corrected by drawing a single line through the incorrect entry, entering the correct information, and dating and initialing the change. Logbooks will be assigned to field personnel. After completion of the project, all field logbooks will be stored in the final project file.

The title page of each field logbook will contain the following:

- Name and address of the field contact person (individual who is assigned the field book)
- Logbook number
- Project name and location
- Project start/end date.

Daily information to be entered in the logbook may include the items listed below. However, information recorded on field forms is not required to be duplicated in the field logbook.

- The date
- Personnel on site (including visitors)
- Weather conditions
- Type(s) of field equipment used

- Field equipment calibration methods (if applicable)
- Approximate sample location and depth
- Date and time of sample collection
- Sample identification number
- Visual description of sampling location
- Sample type (e.g., field replicates)
- Photographic documentation of sample area (if applicable)
- Problems and corrective actions
- Any deviations from the QAPP
- Any other observations that may be relevant to the specific field program or activities that might affect the resulting analytical data.

## 7.2 PHOTOGRAPHS

Photographs may be taken during sampling activities. Photographs will be numbered and documented in a photograph log which will include the following information: 1) number; 2) date; and 3) description, including the following as applicable – direction, sample location, personnel, equipment. Sample locations may be prepared for photographing using a scale (i.e., ruler) and sample location marker (i.e., label).

## 7.3 SAMPLE DOCUMENTATION

To minimize common problems such as labeling errors, chain-of-custody errors, transcription errors, or preservation failures, detailed procedures for properly recording sample information and analytical requests on chain-of-custody records, for preserving samples as appropriate, and for sample packaging and shipment are described below.

### 7.3.1 Sample Naming Convention

The sample naming convention was selected to provide as much information about each sample as practical, while still being reasonable to implement in the field. The first two letters of the sample identification will indicate the current investigation, (i.e. RD for Remedial Design), followed by two letters which indicate the sample source: SB = soil boring, MW = monitoring well, or DP = direct-push groundwater sampling location. This four-letter code is then followed by a three-digit number identifying the soil boring, monitoring well, or direct-push groundwater sampling location, and a two-digit sample number. This produces a complete sample name for investigative samples, or a root sample name for QC samples. For the QC samples, one or two additional letters will be appended to the end of the root sample

name to indicate the QC sample type. Rinse blank samples will use the root name of the investigative sample collected immediately prior to equipment decontamination followed by “RB”. Field duplicate samples (liquid media) or replicate samples (solid media) will use the same root name of the investigative sample, followed by “FD” or “RS”. Trip blank samples will use the root name of the first investigative sample to be placed in the cooler, followed by “TB”. MS/MSD samples will not have any additional identification, but extra sample volume will be collected as indicated by the appropriate laboratory or the *Contract Laboratory Program Guidance for Field Samplers* (USEPA 2010).

The following are examples of the proposed sample identification scheme:

*Soil Samples:*

> RDSB201-02RS is the second sample collected from soil boring number 201 and is a replicate sample (RDSB–three digit soil boring identification number–two digit sample number–QC sample type).

*Groundwater Samples:*

> RDMW210-01RB is the rinse blank sample collected after decontaminating the equipment used to sample MW210 (RDMW–three digit monitoring well identification number–two digit sample number–QC sample type).
>
> RDDP005-01 is the first investigative groundwater sample collected from the direct-push boring number 5 (RDDP–three digit direct-push boring number–two digit sample number).
>
> RDDP005-01TB is the trip blank sample transported in the cooler with sample RDDP005-01, assuming that groundwater from direct-push boring number 5 comprised the first VOC sample placed in that cooler (RDDP–three digit direct-push boring number–two digit sample number–QC sample type).

If the EPA analytical program assigned for this investigation is CLP, rather than Environmental Services Assistance Team (ESAT), then CLP numbers will be assigned to each sample, and recorded on the sample label in accordance with CLP requirements as identified in the *Contract Laboratory Program Guidance for Field Samplers* (USEPA 2010).

### 7.3.2 Sample Labeling

Sample labeling will be completed in accordance with PWT's SOP Sample Handling (PWT/ES.102). Sample labels will be completed using water-proof ink and attached to the sample containers at the time each sample is collected. The following information will be included on the sample label:

- Company's name
- Project name/location
- Sample identification
- Date and time of sample collection
- Preservative (if applicable)
- Analyses to be performed
- Sample Matrix
- Sampler's initials.

### 7.3.3 Sample Field Forms

PWT will complete field sample forms for soil, groundwater, surface water, and sediment sampling. PWT's field sample forms for environmental sampling are attached to their respective sampling SOPs and are included in Appendix A for reference.

## 7.4 CHAIN-OF-CUSTODY RECORDS AND PROCEDURES

To ensure that samples are identified correctly and remain representative of the environment, careful sample documentation and custody procedures will be used to maintain and document sample integrity during collection, transportation, storage, and analysis.

### 7.4.1 Field Chain-of-Custody Procedures

Field sampling personnel will be responsible for ensuring that proper documentation and custody procedures are initiated at the time of sample collection and followed until custody of the samples is transferred to the laboratory or to a commercial freight carrier. Field sampling personnel will be required to become familiar with this QAPP and PWT's SOP Sample Handling (PWT/ES.102), prior to initiating field work. The analytical laboratories will be responsible for maintaining sample custody and documentation, in accordance with the procedures outlined below, from the time the laboratory receives the samples until final sample disposition.

Chain-of-custody procedures provide an accurate written record of the possession of each sample from the time it is collected in the field through laboratory analysis. A sample is considered in custody if one of the following applies:

- It is in an authorized person's immediate possession
- It is in view of an authorized person after being in that person's physical possession
- It is in a secure area after having been in an authorized person's physical possession
- It is in a designated secure area, restricted to authorized personnel only.

Each chain-of-custody form will be completed properly to ensure that sample custody is documented, appropriate samples have been collected, and scheduled analyses are properly assigned. As described previously, all entries will be made using indelible ink. Any errors will be corrected by drawing a single line through the incorrect entry, entering the correct information, and then initialing and dating the change. Laboratories typically provide a chain-of-custody form which they prefer be used. At a minimum, these forms will contain the following information:

- Sample identification
- Date and time of sample collection
- Sample matrix (i.e., soil, water)
- Number and type of containers per sample
- Preservative (if applicable)
- Analyses to be performed
- Sampler's name and initials
- Release and acceptance information including date, location, and sampler's signature.

Unused portions of the chain-of-custody will be crossed out and initialed. The carrier will relinquish samples to the laboratory upon arrival, and the laboratory personnel will then complete the chain-of-custody.

### 7.4.2 Laboratory Chain-of-Custody Procedures

A signed chain-of-custody form will be obtained from the laboratory custodian after the samples have been received and their condition checked. For samples shipped by commercial carrier, the waybill will serve as an extension of the chain-of-custody. PWT will retain and file copies of the chains-of-custody and waybills.

Upon receipt in the laboratory, samples will be carefully checked to ensure that there are not any broken or leaking sample containers, proper preservation methods have been followed (including receipt at 4°C ± 2°C when applicable), and labels and custody seals are intact. Each chain-of-custody will be verified for accuracy and completeness, and any discrepancies will be brought to the attention of PWT. If there are no deficiencies or discrepancies identified, the sample chain-of-custody will be signed, and a copy will be returned to PWT. From the time of receipt, the laboratory will use its standard internal chain-of-custody procedures to ensure that the samples are appropriately tracked through completion of the analytical process.

If the samples and documentation are acceptable, each sample container will be assigned a unique laboratory identification number and entered into the laboratory's sample tracking system. Sample tracking will be documented in the laboratory information management system (LIMS). Other information that will be recorded includes date and time of sampling, sample description, and required analytical tests.

When sample log-in has been completed, the samples will be transferred to limited-access temperature controlled storage areas. The sample storage areas (coolers, refrigerators) will be kept at 4°C ± 2°C and their temperatures will be recorded daily with thermometers calibrated against National Institute of Standards and Technology (NIST) thermometers. Storage blanks will be used to assess the cleanliness of sample storage areas. Separate refrigerators will be used for samples suspected of containing high concentrations of organic compounds. Samples for VOC analyses will be stored separately from other samples, standards, and sample extracts.

Sample custody will be maintained within the laboratory's secure facility until the samples are disposed. Laboratories will be instructed to hold the remaining sample quantities for the duration of the holding time or 6 months, whichever is shorter. The laboratory will be responsible for sample disposal, which will be conducted in accordance with all applicable local, state, and federal regulations. Disposal of all samples will be documented. The laboratory will maintain records in the project file.

### 7.4.3 Final Project Files Custody Procedures

The final project files for the supplemental sampling project data will be maintained by PWT and will be under the custody of the Project Manager in a secured area. At a minimum, the project file will contain relevant records including:

- Field logbooks
- Photographs
- Sample location drawings
- Original field sampling forms
- Laboratory data deliverables
- Data validation reports
- Data assessment reports
- Progress reports, QA reports, interim project reports
- Custody documentation (chain-of-custody forms, waybills).

## 7.5 CORRECTIONS TO DOCUMENTATION

All entries will be made using indelible ink. Any errors will be corrected by drawing a single line through the incorrect entry, entering the correct information, and initialing and dating the change.

# 8.0 ANALYTICAL METHODS

This section describes the analytical procedures that will be used for the acquisition of chemical, physical, and geotechnical data for the LSGPS remedial design project. Relevant aspects of field and laboratory procedures (sample preparation and extraction procedures, instrumentation, MDLs, and MRLs) are also included or referenced. Analytical QC requirements, evaluation criteria, acceptance criteria, calibration procedures, preventative maintenance, and corrective actions are discussed in following sections. These discussions apply to the non-EPA laboratories under direct contract to PWT. The EPA analytical program has separate contracts with laboratories with specific requirements; however, the EPA's analytical program will be provided a copy of this QAPP and will ensure the requirements herein are met.

## 8.1 ANALYTICAL METHODOLOGY

The methods included in the QAPP are presented in Table 2. All samples will be prepared and analyzed in accordance with the methods listed in Table 2 and in accordance with the laboratory's SOPs.

Analytical methods and holding times for each proposed analysis are detailed in Table 2. Turnaround times will be established in consultation with the laboratory chosen for the specific parameter and will be documented through an amendment to Table 2 of this QAPP.

## 8.2 METHOD DETECTION LIMITS AND METHOD REPORTING LIMITS

The MDL is an empirically derived value that is used to estimate the lowest concentration a method can detect in a matrix-free environment. The MDL is defined as the minimum concentration of a substance that can be measured and reported with 99 percent confidence that the analyte concentration is greater than zero. The MDLs are laboratory-dependent; however, specific laboratories have not yet been identified for this project.

More important than the MDL is the MRL. The MRL is the lowest concentration that can be reliably achieved within limits of precision and accuracy during routine operating conditions and is based on the MDL for each analyte. Like MDLs, MRLs are laboratory specific. The MRLs for the analytical methods included in this QAPP are presented in Table 2 and must be met by the laboratory. The laboratory's lowest calibration standard concentration will be at or below the MRL for each target analyte.

Table 2, therefore, identifies the highest acceptable MRL for each given analyte, considering the data quality requirements for this investigation. In order to support remedial action decisions, it is important that the MRLs for the four main COCs are below the action limits established in the ROD. The EPA's analytical program has confirmed their ability to achieve the required MRL for the COCs.

The MRLs for the other parameters listed in Table 2 are not critical reporting requirements. Some of the soil analysis listed in Table 2 measure direct properties of the soil such as moisture content, whereas other analyses are used to measure indirect properties of the soils such as Atterberg limits. These indirect analyses provide useful information about the soil without directly measuring a desired property. The results of soil geotechnical parameters listed in Table 2 will provide information to perform engineering analyses required to support the design of the selected remedies for the appropriate media. The nature of these geotechnical analyses are such that a minimum reporting limit is not established for these tests.

## 8.3 REPORTING REQUIREMENTS

The MRLs for the COCs are below the action limits for both soil and groundwater. No detections in method blanks will be reported as less than the MDL (<MDL). For all other samples the following will apply:

- Target analyte nondetections will be reported (at a minimum) as less than the MRL.
- If target analytes are detected at or above the MRL, they will be reported as quantified.

Additional reporting requirements for definitive data will be required if a sample must be diluted and reanalyzed to bring the concentration of a single compound of interest within the linear calibration range of the instrument, resulting in nondetect values for other originally detected target analytes. The data for both the initial analysis and the reanalysis will be reported with the appropriate notation in the case narrative. The PWT Project Chemist and QAO will be notified immediately regarding the failure of target analytes to meet MRLs to assess potential corrective action. The decision to implement corrective action will be based on whether there are any analytical alternatives or clean-up steps that would improve the detection limits and whether the elevated detection limits will adversely affect data use. Any data that do not meet the MRLs due to sample dilution will be included in the case narrative, and the supporting documentation (chromatograms) will be included in the data packages.

# 9.0 QUALITY CONTROL

The QC samples that will be used to evaluate analytical data in terms of the quality criteria parameters described in Sections 4.4 through 4.9 are listed by data type and analytical method in Table 2. These include QC samples prepared both in the field and by the laboratory. Method specific QC procedures are detailed in the respective method SOP. Frequency of QC sample analysis, acceptance criteria (control limits), and corrective actions are discussed below. The following paragraphs also describe the QC samples and holding time criteria that will be used to assess data quality.

## 9.1 FIELD PROGRAM

The QC methods that will be used to assess the accuracy and precision of field measurements include obtaining multiple readings on a single grab sample, and calibrating the field instruments or equipment as described in this QAPP.

For field sampling, QC samples are used to assess sample collection techniques and to assess environmental conditions during sample collection and transport. For this project, field QC samples will include duplicate samples, replicate samples, rinse blanks, trip blanks, and temperature blanks. The field duplicate and MS/MSD QC samples are identified in Table 2. Rinse blank and trip blank samples are typically a function of the number of days of sampling, rather than the number of investigative samples proposed; therefore, tally of these QC samples is not included on Table 2. Field blank samples are not proposed to be collected as part of this investigation because ambient conditions at the site are not expected to contain high concentrations of COCs that are likely to contaminate the investigative samples; this is consistent with the *Contract Laboratory Program Guidance for Field Samplers* (USEPA 2010).

**Duplicate Samples.** Duplicates (refers to liquid media only) will be used to assess variability in the sample medium as well as sampling and analytical precision. A duplicate sample pair is typically a single grab sample that is split into two samples during collection. For surface water and groundwater sample collection, a duplicate sample pair will be a set of water samples that are collected consecutively from a running stream of water (irrigation ditch or sampling pump). For each duplicate sample pair, one of the samples is labeled with the investigative sample identification and the other is labeled with duplicate sample identification in accordance with the naming convention described in Section 7.3.1. This sample pair is then submitted to the same laboratory as two separate samples. Precision will be evaluated by calculating the RPD between the field duplicate samples. The RPD will be calculated for field duplicate pairs whose measured values are greater than the MRL. The RPD must be less than 25 percent for duplicate water sample pairs. The frequency for duplicate samples shall be 1 per 20 investigative samples.

**Replicate Samples**. Replicate samples (refers to solid media only) will be used to assess variability in the sample medium and to assess sampling and analytical precision. A replicate sample pair is a single grab or composite sample that is split into two samples during collection. If the sample is a composite, the material will be thoroughly homogenized before it is split into the investigative and replicate samples. For each replicate sample pair, one of the samples is labeled with the investigative sample identification and the other is labeled with the replicate sample identification in accordance with the naming convention described in Section 7.3.1. This sample pair is then submitted to the same laboratory as two separate samples. Precision will be evaluated by calculating the RPD between the field replicate samples. The RPD will be calculated for field replicate pairs whose measured values are greater than the MRL. The RPD is expected to be less than 35 percent for replicate soil sample pairs, with RPD higher than 35% indicating a high level of heterogeneity in the solid matrix. If highly variable soils are encountered, as evidenced by RPDs consistently above 35%, then the sample frequency in that area may be increased to ensure that representative data are collected. The frequency for replicate samples will be one per 20 investigative samples.

**Rinse Blanks.** Rinse blanks will be used to evaluate the effectiveness of field decontamination procedures. Rinse blanks are clean, laboratory grade, organic-free water samples that are exposed to sampling procedures (i.e. exposed to decontaminated sampling equipment in a manner consistent with how investigative sample water contacts the equipment), and transported back to the laboratory for analysis. Rinse blanks will be analyzed for VOCs only, and therefore will specify the same methods and sampling containers as used for volatile analyses. Rinse blanks will be collected at a frequency of one per day on those days when field sampling equipment was decontaminated and then reused. No rinse blanks are proposed for soil.

**Trip Blanks.** Trip blanks will be used to evaluate representativeness. Trip blanks are clean water samples that are prepared in the laboratory using laboratory provided, organic-free water, transported to the sampling site, and transported back to the laboratory for analysis without having been exposed to sampling procedures. Trip blanks are analyzed for VOCs only, and therefore will specify the same methods as used for volatile analyses. Sealed 40-milliliter VOC analysis vials containing the trip blank will remain in the sample cooler while sampling is in progress. Trip blanks will only be submitted when soil or water samples for VOCs are submitted to the laboratory.

**Temperature Blanks**. A temperature blank is used to monitor temperature preservation of samples transported to the analytical laboratory. The temperature blank is distilled water stored in a glass/plastic vial or jar. A temperature blank must be included with each sample cooler submitted for chemical

analysis. Upon receipt by the analytical laboratory, the sample custodian will measure and record the temperature of the blank sample. The temperature blank must be within the project criteria of 4 ± 2 degrees Celsius (2° to 6°C).

## 9.2 LABORATORY PROGRAM

The general objectives of the internal laboratory QC program are to:

- Ensure that procedures are documented, including any changes in administrative or technical procedures
- Ensure that analytical procedures are validated and conducted according to method guidelines and laboratory SOPs
- Monitor the performance of the laboratory using a systematic inspection program
- Ensure that data are properly reported and archived
- A complete description of the EPA's analytical program can be found at: http://www.epa.gov/superfund/programs/clp/index.htm, including the EPA's QA program. The EPA analytical program specifies analytical methods, laboratory equipment maintenance and calibration, analytical precision and accuracy, QC requirements, data management, and documentation.

Laboratory QC consists of two distinct components, a laboratory component and a matrix component. The laboratory component measures the performance of the laboratory analytical process during sample analyses, while the matrix component measures the effects of a specific medium on the method performance. The QC samples that will be used to assess the laboratory component and the media component of analysis are described the following paragraphs. Corrective actions for instrument calibrations or QC sample data out of compliance are typically described in the laboratory-specific QA/QC program.

The laboratory will conduct internal QC checks for analytical methods in accordance with their SOPs, the individual method requirements, and this QAPP. The laboratory will notify the Project Manager or Project Chemist in writing before making significant changes resulting from corrective actions to procedures described in this QAPP, or to the laboratory standard analytical methodology.

The laboratory will, at a minimum, analyze internal QC samples at the frequency specified by the analytical method and in this QAPP (Table 2). Method-specific QC procedures, frequency of QC sample analysis, acceptance criteria (control limits), and corrective actions will be identified in the SOPs provided by the contracted analytical laboratories, and will be in accordance with industry standards. The

following paragraphs discuss holding times and the QC samples that the laboratory will use to assess data quality.

**Sample Holding Time.** Sample holding time refers to the length of time that a sample or sample extract remains representative of environmental conditions. For methods that do not require sample extraction, one holding time will be evaluated: the length of time from sample collection to analysis. For methods that require sample extraction prior to analysis, two holding times will be evaluated: the length of time from sample collection until sample extraction, and the length of time from sample extraction to sample analysis. These holding times will be compared to the holding times specified for these methods. No samples will be analyzed outside of the specified method holding times without approval by the Project Chemist. The holding times are presented in Table 2 for each analytical method.

**Method Blanks.** Method blanks will be used to monitor the laboratory preparation and analytical systems for interferences and contamination from glassware, reagents, sample manipulations, and the general laboratory environment. The method blank is an analyte-free matrix (reagent grade water or laboratory grade sand) to which all reagents will be added in the same volumes or proportions as used in sample processing and will be taken through the entire sample preparation/extraction and analytical process. Method blanks will be analyzed at the frequency specified by the method and in the laboratory QA program and SOPs.

**Internal Standards.** Internal standards are compounds that behave similarly to the target analytes during analysis and will be used to assess accuracy for gas chromatography/mass spectroscopy (GC/MS) analysis. Internal standards will be prepared and added to the initial calibration standard, the continuing calibration verification standard, and both field and QC samples prior to analysis in accordance with the analytical method and laboratory's SOPs.

**Matrix Spikes and Matrix Spike Duplicates.** MS/MSDs measure matrix-specific method performance and will be used to assess accuracy and precision. MS/MSD samples will be used to assess the influence of the sample media (media interference) on the analysis. Samples for MS/MSD analysis will be site specific and analyzed at a frequency of five percent of the total number of samples for all organic analyses. Each MS/MSD sample will be spiked with the compounds specified by the analytical method prior to sample extraction or analysis in accordance with the laboratory's SOPs. MS recovery criteria are presented in Table 5.

**Matrix Duplicates.** Matrix duplicates will be used to assess laboratory precision for inorganic analyses. A matrix duplicate consists of a single grab sample that is split into two equal portions. This sample pair

is then submitted to the sample laboratory as two separate samples. To evaluate precision, the RPD between the investigative sample and its matrix duplicate will be calculated and compared to the project acceptance criteria (see Table 5).

## 9.3 LABORATORY BATCH QUALITY CONTROL LOGIC

The frequency of instrument calibration and QC sample analysis for the analytical methods are batch controlled. Site sample data for this project will be associated with sample batch QC samples that were extracted concurrently with the site samples and analyzed in the same analytical batch (sequenced on the same instrument relative to the primary sample results). The following paragraphs define sample and instrument batches.

For this project, a sample batch is a group of 20 or fewer environmental samples of the same matrix that are extracted within the same time period (concurrently) or in limited continuous sequential time periods. Samples in each batch are of similar matrix (e.g., soil), are treated in a similar manner, and the same reagents are used for each sample batch. Keeping batches “open” for more than 2 hours will not be accepted; samples and their associated QC samples (method blank and MS/MSD) will be prepared in a continuous process. The sample batch will be analyzed sequentially on a single instrument.

# 10.0 CALIBRATION, TESTING, INSPECTION, AND MAINTENANCE OF EQUIPMENT, INSTRUMENTATION AND SUPPLIES

## 10.1 CALIBRATION

Calibration refers to the process of verifying, adjusting, or fine-tuning the investigative measurements produced by a given instrument to agree with known values. In general, the calibration process involves analyzing commercially prepared calibration standards of known concentrations or values which span either the measurement range of the instrument or the range of values anticipated to be encountered in a given investigation. The measured value produced by the instrument is then compared to the published value for that calibration standard, and the difference is compared to project, method, or instrument acceptance criteria. If the difference between the published and measured values for the calibration standard is smaller than the acceptance criteria, then the instrument is considered to be in calibration. If the difference is greater than the applicable acceptance criteria, the instrument is considered to be out of calibration, and must be recalibrated in accordance with applicable PWT SOP and the manufacturer's SOP before any valid measurements may be made with the device. Field and laboratory equipment calibration procedures and requirements are described in the following sections.

## 10.2 FIELD EQUIPMENT CALIBRATION

Field equipment anticipated to be needed during this investigation is identified on Table 6 along with acceptance/inspection, storage, and handling requirements for each item. All field equipment will be calibrated in accordance with the manufacturer's SOP and recommendations. At a minimum, field equipment will be calibrated prior to the start of each day's field activities, at the frequency recommended by the manufacturer, and whenever measurements from the device appear questionable. Water quality meters will be calibrated in accordance with PWT's SOP Field Parameter Measurements (PWT/GW.108), which is provided in Appendix A.

Field calibration standards will be obtained from the NIST, the EPA Cooperative Research and Development Agreement vendors, American Association of Laboratory Accreditation vendors, or other reliable commercial sources. Standards will be obtained as working standard concentration solutions. For the purposes of field instrument calibration, dilutions will not be made from the vendor standards. Before each use, standards will be checked for signs of deterioration (e.g., discoloration, formation of precipitates, and changes in concentrations), and will be discarded if deterioration is suspected or the expiration date identified by the vendor has passed.

## 10.3 LABORATORY INSTRUMENT CALIBRATION

Laboratory instrument calibration is necessary to ensure that the analytical system is operating correctly and functioning at the proper sensitivity to meet the contract required quantitation limits (CRQL). Calibration establishes the dynamic range of an instrument, establishes response factors to be used for quantitation, and demonstrates instrument sensitivity. Criteria for calibration are specific to the instrument and the analytical method. Laboratory instruments will be calibrated in accordance with the analytical method and the laboratory SOPs. The following paragraphs describe laboratory instrument calibration procedures.

### 10.3.1 Calibration Standard Preparation

All instruments will be calibrated in accordance with the analytical method and the laboratory SOPs. To ensure the highest quality standard, primary reference standards will be used by the laboratory and will be obtained from the NIST, the EPA Cooperative Research and Development Agreement vendors, American Association of Laboratory Accreditation vendors, or other reliable commercial sources. When standards are received at the laboratory, the date received, supplier, lot number, purity, concentration, and expiration date will be recorded in a standard logbook. Vendor certificates for the standards will be retained in the files and made available upon request.

Standards will be obtained in their pure form or in a stock or working standard solution. Dilutions will be made from the vendor standards. Records regarding standards will clearly trace their preparation, use in calibration, expiration dates, and quantitation of sample results. Standards will be given a standard identification number, and the following information will be recorded in the standards logbook:

- Source of standard
- Initial concentration of the standards
- Final concentration of the standard
- Volume of the standard that was diluted
- The solvent and the source and lot number of the solvent used for standard preparation
- Expiration date of the standard
- Preparer’s initials.

All standards will be verified prior to use.

After preparation and before routine use, the identity and concentration of the standards will be verified. Verification procedures include a check for chromatographic purity (if applicable) and verification of the standard's concentration by comparing its response to a standard of the same analyte prepared or obtained from a different source. Reagent purity will be assessed by analyzing an aliquot of the reagent lot using the analytical method in which it will be used; for example, every lot of dichloromethane (for organic extractables) is analyzed for purity prior to use in the laboratory. Standards will be routinely checked for signs of deterioration (e.g., discoloration, formation of precipitates, and changes in concentrations), and will be discarded if deterioration is suspected or the expiration date has passed. Expiration dates may be taken from the vendor recommendation, the analytical methods, or from internal research.

### 10.3.2 Instrument Calibration

Criteria for calibration are specific to the instrument and the analytical method. Each instrument will be calibrated according to the manufacturer's guidelines using standard solutions appropriate to the type of instrument and the linear range established for the analytical method. The instrument calibration will be from the lowest to the highest calibration standard and the lowest calibration standard concentration will be at or below the CRQL for each target analyte.

Instrument calibration information will be documented, and at a minimum include the equipment calibrated, the reference standards used for calibration, the calibration techniques, actions, acceptable performance tolerances, frequency of calibration, and calibration documentation format. The laboratory will maintain records of standard preparation and instrument calibration. Calibration records will include daily checks using standards prepared independently of the calibration standards, and instrument response will be evaluated against established criteria. The analysis logbook, maintained for each analytical instrument, will include, at a minimum, the date and time of calibration, the initials of the person performing the calibration, and the calibration reference number and concentration.

Instruments will be calibrated in accordance with the criteria specified by the applicable analytical method. Method SOPs will be provided by the analytical laboratories once they are identified.

## 10.4 EQUIPMENT TESTING, INSPECTION, AND MAINTENANCE

A preventive maintenance program is necessary to promote the timely and effective completion of a measurement effort for either field or laboratory programs. The preventive maintenance program will be designed to minimize the downtime of crucial sampling or analytical equipment due to unexpected component failure. In implementing this program, efforts will be focused on establishment of

maintenance responsibilities, establishment of maintenance schedules for major or critical instrumentation and apparatus, and establishment of an adequate inventory of critical spare parts and equipment.

### 10.4.1 Field Equipment/Instruments

The field equipment used for the LSGPS remedial design supplemental sampling will be maintained and used according to the manufacturer's directions and as specified in the QAPP. The field team leader will ensure that each piece of equipment is operational and is inspected on a regular basis. Any preventative maintenance or repair conducted in the field will be recorded in the field logbook or other appropriate field forms. If equipment is determined to be damaged, in need of maintenance or otherwise unusable, it will be immediately labeled "OUT OF SERVICE. DO NOT USE" and taken out of service until such time as it can be returned, repaired, or replaced. After an out–of-service event, the field team leader will be responsible for inspecting and testing the field equipment to verify it is in an acceptable condition before the item is put back into service. Backup instruments and equipment will be available on site or within a short turnaround time to avoid delays in the field schedule.

Field instruments will be checked and calibrated before they are shipped or carried to the field, and will be checked and calibrated before use. Calibration checks will be performed as specified in the manufacturer's directions.

### 10.4.2 Laboratory Equipment

Preventive maintenance of laboratory equipment and instruments is essential to ensure the quality of the analytical data produced. The objective of preventive maintenance is to ensure instrument operation is appropriate for both project and method data quality objectives. The laboratory will have a routine preventive maintenance program to minimize the occurrence of instrument failure or other system malfunctions. Designated individuals will be responsible for routine scheduled maintenance for each instrument system and required support activity. The following paragraphs focus on maintenance responsibilities, maintenance schedules, record keeping, and inventory of spare parts and equipment.

#### Maintenance Responsibilities

Maintenance responsibilities for laboratory equipment will be assigned to designated personnel. These individuals will establish maintenance procedures and schedules for each major equipment item. The instrument manufacturer will perform instrument maintenance and repair, as scheduled or needed. The analysts will perform other routine preventive maintenance tasks. Only qualified individuals will perform maintenance activities.

### Maintenance Schedules

Maintenance schedules are based on the manufacturer's recommendations or sample load. Maintenance activities for each instrument will be documented in a maintenance logbook, as described below.

### Record Keeping

Maintenance will be documented in instrument-specific bound logbooks, which will be kept with the instrument. The date, initials of the individual performing the maintenance, and the type of maintenance will be recorded in this logbook. Receipts for routine maintenance performed by the manufacturers' representatives will be filed in the appropriate laboratory department (e.g., GC/MS maintenance receipts are stored in the organic section). This logbook serves as a permanent record, which documents routine preventive maintenance, as well as any service by external individuals such as manufacturers' service representatives.

In addition, all receipts from routine maintenance by manufacturers' representatives will be maintained in the laboratory's file. These records will be made available upon request during internal or external audits.

### Spare Parts

An adequate inventory of spare parts will be maintained to minimize equipment down time. This inventory will include those parts (and supplies) that are subject to frequent failure, have limited useful lifetimes, or cannot be obtained in a timely manner if failure occurs.

### Laboratory Contingency Plan

In the event of instrument failure, every effort will be made to analyze samples by an equivalent alternate means within holding times. If the redundancy in equivalent instrumentation is insufficient to handle the affected samples, PWT will be immediately notified and the corrective action to be taken will be determined by the laboratory and PWT.

## 10.5 INSPECTION/ACCEPTANCE OF SUPPLIES AND CONSUMABLES

Field sampling equipment, supplies, and consumables are identified on Table 6, along with the supply source, inspection/acceptance requirements, and any special storage or tracking requirements. The field team leader will be responsible for ensuring that all required field equipment and supplies are listed on Table 6, for performing routine field supply inventory tracking, and for ordering, receiving, inspecting,

and storing additional supplies when necessary. The Project Manager will be consulted regarding non-routine supply or equipment needs.

## 11.0 NON-DIRECT MEASUREMENTS

The proposed LSGPS remedial design supplemental sampling program for the BSA does not include use of any non-direct measurements, but rather is focused on the collection and analysis of specific additional environmental samples to produce data suitable for completion of a remedial design for SVE, enhanced bioremediation, MNA, and LTTD. If it is determined that the supplemental sampling program will collect non-directly measured data from sources such as databases, literature or computer models, an addendum to this QAPP will be issued.

The addendum will address the intended use for the non-directly measured data, the rationale for their selection, and the applicable acceptance criteria for the data. Key resources and support facilities necessary to the collection or use of the non-directly measured data will be identified at that time. QC requirements and procedures specific to the model or program selected will also be discussed, along with the metrics which will be used to evaluate the validity of the data (beta testing, sensitivity analysis, internal checks, etc).

# 12.0 ASSESSMENTS AND RESPONSE ACTIONS

Independent technical systems and performance audits of field and laboratory activities will be conducted to assess whether sampling and analysis protocols conform to the criteria specified in this QAPP. The systems audit is a qualitative review of the overall sampling or measurement system, while the performance audit is a quantitative assessment of the measurement system, and includes both internal and external audits. These audits will be used to assess whether the resulting data meet the project-specific data quality objectives, to assess whether the data comply with QC criteria, and to identify the need for corrective action. Definitive data validation is also a quantitative check of the analytical process, where documentation and calculations are evaluated and verified. Data verification and validation procedures are discussed in Section 13.4 of this QAPP. PWT or the Laboratory's QAO will conduct internal audits. The EPA Region 8 will be responsible for external audits.

PWT anticipates conducting one assessment of field activities and procedures during the first 21 days of field investigation activities; if warranted by the findings of the first audit, and if the duration of field activities permits, a follow-up audit will be conducted approximately one month later.

## 12.1 FIELD PERFORMANCE AND SYSTEM AUDITS

Oversight of field procedures will be the direct responsibility of the PWT Project Manager, who will review elements of the project-specific work plan and this QAPP to ensure that the objectives of the project are met. In addition to an initial review, the sampling procedures will be reviewed as the fieldwork progresses so that any necessary modifications are made in a timely manner.

PWT's QAO or designee will conduct internal audits of field activities (sampling and measurements) to assess the performance and effectiveness of the existing quality management system in accordance with this QAPP. The intent of these audits is to identify, correct, and prevent problems that hinder the achievement of the project data quality objectives. If the QAO (or designee) determines during an assessment that non-conformances are occurring which will seriously impact the usability of the data being collected, the QAO (or designee) has the authority to stop work until the issues are resolved. If the QAO issues a stop work order to the field sampling team, the Project Manager will be notified immediately so that the deficiencies may be resolved and work can recommence.

The audits will include examining field equipment calibration and documentation records; field instrument operation records; field measurement records; field sampling records, log books and field sampling forms; sample collection, handling, storage, and transportation procedures, including

organization and minimization of potential contamination sources; and chain-of-custody records and procedures.

After an internal audit is completed, a debriefing session will be held for participants to discuss the preliminary audit results. The auditor will prepare an audit evaluation report that includes observations of the deficiencies and the necessary recommendations for corrective actions. A draft audit evaluation report will be provided to the Project Manager and the PWT RAC2 Program Manager within 10 days after the field or system performance audit is completed, and will be finalized no later than 30 days after the audit was performed. Conformance with the specifications presented in the manufacturer's SOPs, PWT's SOPs, and this QAPP will be noted, and nonconformance or deviations will be addressed through corrective or preventative actions identified by the QAO and the project team and approved by the Project Manager and the RAC2 Program Manager. Upon request, the audit evaluation report and any associated proposed corrective or preventative actions will be forwarded to the EPA RPM along with a time frame for implementation of corrective actions. Follow-up audits will be performed prior to completion of the project to ensure corrective actions have been implemented appropriately and completely by the field team.

External field audits are the responsibility of the EPA Region 8. Field audits may be conducted at any time during the field operations and will be based upon the information presented in PWT's SOPs and/or the manufacturer's SOPs, and this QAPP. The audits may or may not be announced, at the discretion of the auditing agency.

## 12.2 LABORATORY PERFORMANCE AND SYSTEM AUDITS

In-house and regulatory agency audits of laboratory systems and performance will be a regular part of the laboratory's QA program. Routine audits will be conducted by the Laboratory's QAO or designee, and consist of a review of the entire laboratory system and, at a minimum, include examination of sample receiving, log-in, storage, and chain-of-custody documentation procedures, sample preparation and analysis, and instrument procedures.

To verify proper implementation of laboratory procedures and adherence to this QAPP, the EPA Region 8 may perform an external audit prior to or during this project. These audits may or may not be announced and will be conducted at the discretion of the auditing agency. External audits will include (but not be limited to) review of laboratory analytical procedures, laboratory on-site audits, or submission of performance evaluation samples to the laboratory for analysis. If conducted, the laboratory audit will include a review of the following items:

- Sample custody procedures
- Sample disposal procedures and documentation
- Calibration procedures and documentation
- Completeness of data forms, notebooks, and other reporting requirements
- Data review and validation procedures
- Data reporting integrity and archiving
- Data storage, filing, and record keeping procedures
- QC procedures, tolerances, and documentation
- Operating conditions of facilities and equipment
- Documentation of training and maintenance activities
- Systems and operations overview
- Security of laboratory automated systems.

Deficiencies and corrective action procedures will be clearly documented in the audit report.

## 12.3 REPORTING

The field team leader shall prepare weekly QA reports and submit them to the PWT Project Manager for review and approval. The weekly QA report will be submitted to the Project Manager by 10 am Monday morning, and will include, at a minimum, the following information:

- A list of all samples collected and boreholes completed during the previous week
- Description of any deviations from PWT's SOPs, including the reason for the deviation and the resolution
- Description of any deviations from this QAPP, including the reason for the deviation and the resolution
- Additional information relating to or having a significant impact on project quality or productivity, such as severe weather, staffing changes, or similar.

# 13.0 DATA MANAGEMENT

A stand alone data management plan has not been prepared for the LSGPS remedial design supplemental sampling project. Instead, data reduction, reporting, validation, and management procedures are presented in detail below.

## 13.1 DATA REDUCTION

### 13.1.1 Field Data Reduction

Field data will be used as reported from the direct-read instruments, field notes, field sampling forms, and chain-of-custody records. All field water quality parameters will be entered into the project SCRIBE database after each sampling event. No further reduction of field data will be required.

### 13.1.2 Laboratory Data Reduction

The laboratory will reduce all analytical data (both screening and definitive) in accordance with the analytical methods, the laboratory SOPs, and the guidance presented in this QAPP. Section 4.0 of this QAPP provides equations that will be used by the laboratory to assess internal precision and accuracy.

## 13.2 DATA REVIEW

The non-EPA laboratory will review in-house data under the direction of the Laboratory Project Manager or the laboratory QA officer. The laboratory will prepare and retain full analytical and QC documentation. Both screening and definitive data will be reviewed prior to release by the laboratory. In general, the laboratory data review will be conducted as described in the following paragraphs.

The bench analyst will conduct the initial data review based on established protocols specified in the laboratory SOPs, analytical method protocol, and project-specific data quality objectives. At a minimum, this review will include the following:

- An assessment of sample preparation and analysis procedures and documentation for accuracy and completeness
- Assessments of whether the appropriate SOPs have been followed
- An assessment of analytical results for accuracy and completeness
- An assessment of whether QC samples are within established control limits and method blank data are acceptable

- An assessment of whether documentation is complete (that is all anomalies in the preparation and analysis have been documented; out-of-control forms, if required, are complete; and holding times are documented).

The calculations used to evaluate precision and accuracy are defined in Section 4.0 of this QAPP, along with the acceptance criteria for calibration, precision, and accuracy assessment.

When an analysis of a QC sample (blank, spike, duplicate/replicate, or similar) indicates that the analysis of that batch of samples is not in control, the analyst will immediately bring the matter to the attention of the appropriate designated QC staff (QAO, Project Manager, section leader). This individual will determine whether the analysis can proceed, or if selected samples should be reanalyzed, or if specific corrective action needs to be taken before analyzing additional samples. Out-of-control analyses and information justifying accuracy or precision outside acceptance criteria must be documented. A nonconformance report will be prepared for laboratory analysis out-of-control events that require documentation. PWT will be notified as soon as possible to determine appropriate corrective action for out-of-control events resulting in unacceptable data. Non-conformance report forms and out-of control analyses forms are specific to each laboratory, and are therefore not included with this QAPP; laboratories will be required to submit these forms to PWT prior to submitting any samples for analysis.

After this review is complete, the analyst will sign the applicable control documentation associated with the analytical batch and forward to the appropriate reviewer. This reviewer (department manager or QAO) will be responsible for review and approval of the analytical control documentation associated with each analytical batch, as well as any corrective action explanations provided by the analyst. This individual will also be responsible for determining whether the analytical data meet QC criteria established by the analytical methods and by this QAPP, and for identifying QC problems that require further resolution. A permanent record of any corrective actions will be maintained in the laboratory files.

The Laboratory Project Manager will provide the final review and approval of the analytical data that have been approved by the analyst and other designated reviewer. The Project Manager will also be responsible for reviewing final data reports for proper format and reporting consistency prior to releasing the reports to PWT. This review will include the following at a minimum:

- Laboratory name and address
- Sample information (includes unique sample identification, sample collection date and time, date of sample receipt, and date(s) of sample preparation and analysis)
- Analytical results, reported with an appropriate number of significant figures

- Reporting limits reflecting dilutions, interferences, and corrections for dry weight as applicable
- Method references
- Appropriate QC results and correlations for sample batch traceability and documentation
- Data qualifiers with appropriate references and narrative on the quality of results
- Confirmation that project-specific requirements have been met.

The Laboratory Project Manager or the Laboratory QAO will also be responsible for qualifying any data that may be unreliable. Data qualifications will be based on the laboratory SOPs, the analytical method, and the principles outlined in the *USEPA Contract Laboratory Program National Functional Guidelines for Organic Data Review* (USEPA 2008b).

## 13.3 DATA REPORTING

Laboratory data will be reported to PWT as electronic data deliverables (EDDs) and presented in a format that will facilitate data input, review, and evaluation. For the EPA laboratories, this format will be as specified under the EPA's analytical program, and for additional laboratories contracted for this investigation, the format will be negotiated during or subsequent to the selection and contracting process. Tables, graphs, or figures will be used to present the data in associated project reports. The analytical data will be reported in a format organized to facilitate data validation.

## 13.4 DATA VERIFICATION AND VALIDATION

As described in Section 3.0 of this QAPP, the validity of the field and analytical data will be evaluated using the precision and accuracy parameters, which are quantitative and qualitative statements that describe data quality. For this project, full validation will be conducted on a minimum of 10 percent of the investigative samples. Data verification will be completed on all other analytical data. Data validation/verifications will be performed by the Project Chemist in accordance with the *U.S. EPA Contract Laboratory Program National Functional Guidelines for Organic Data Review* (USEPA 2008) and the *Guidance for Labeling Externally Validated Laboratory Analytical Data for Superfund Use* (USEPA 2009). PWT does not utilize a data validation software package.

Full validation will be performed on at least 10 percent of the laboratory analytical results for the project COCs (TCE, PCE, DCE, and VC) to ensure that data were produced in accordance with procedures outlined in the QAPP. The following elements will be reviewed for conformance as part of the full data validation:

- Methodology
- Holding times
- Calibration
- Blanks
- Spikes
- Duplicates/Replicates
- Practical quantitation limits
- Analyte identification
- Analyte quantification.

Data validation techniques include accepting, rejecting, or qualifying the data on the basis of acceptance criteria defined in this QAPP.

Data verification will be completed on 100 percent of the analytical results for which full validation was not performed (the remaining approximately 90 percent of analytical results). Data verification simply involves comparing the hard-copy laboratory report to the data in SCRIBE for completeness and accuracy.

The results of the data verification/validation will be documented in a data verification/validation report, and will be appended to the associated data summary report or remedial design report. After the data verification/validation report is complete, it will be submitted to the PWT Project Manager. The Project Chemist will present any significant findings or limitations on data usability to the Project Manager. Data will not be released for use prior to completion of the data verification/validation process.

## 13.5 DATA USABILITY

After environmental data have been reviewed, verified, and validated in accordance with the procedures described in Section 13.4, the data must be further evaluated to determine whether project quality objectives have been met. To the extent possible, PWT will follow the EPA's data quality assessment process to verify that the type, quality, and quantity of data collected are appropriate for their intended use as outlined in the EPA's *Guidance for Data Quality Assessment, Practical Methods for Data Analysis* (USEPA 2000). The assessment process includes five steps: (1) review the data quality objectives and sampling design; (2) conduct a preliminary data review; (3) select a statistical test; (4) verify the assumptions of the statistical test; and (5) draw conclusions from the data.

When the five-step assessment process is not completely followed because the data objectives are qualitative in nature, PWT may systematically assess data quality and data usability. This assessment would include:

- A review of the sampling design and sampling methods to verify that these were implemented as planned and are adequate to support project objectives

- A review of project-specific data quality indicators for precision, accuracy, representativeness, completeness, comparability, and quantitation limits (defined in Section 4.0) to determine whether acceptance criteria have been met

- A review of project-specific data quality objectives to determine whether they have been achieved by the data collected

- An evaluation of any limitations associated with the decisions to be made based on the data collected. For example, if data completeness is only 85 percent compared to a project-specific completeness objective of 90 percent, the data may still be usable to support a decision, but at a lower level of confidence.

Any report or technical memorandum in which data for this project is reported will discuss any potential impacts of these reviews on data usability and will clearly define any limitations associated with the data.

## 13.6 DOCUMENTATION AND RECORDS

### 13.6.1 Project Personnel Responsibilities

The individuals responsible for data management for this project include:

PWT Field Team Leader (or designee):

- Provides information in writing to the sampling crew on the sample location and sampling requirements

- Reviews and initials the sampling forms to insure that all samples were collected appropriately.

PWT Project Chemist or designee:

- Inspects laboratory data deliverables (both hard copy and EDD) for completeness

- Saves EDDs into appropriate locations on PWT server and verifies the accuracy of EDD import to SCRIBE or other electronic databases

- Incorporates hard copy lab deliverables to project filing system.

PWT Sample Team:

- Provides written notification to laboratory of upcoming sampling activity and arranges for a sufficient supply of sample bottles and sample coolers

- Generates sample labels and initiates chain-of-custody form

- Compiles field forms, field notes, chain-of-custody forms and other field documentation and updates the project files to provide a traceable record for data collection activities.

Non-EPA Analytical Laboratories:

- Each laboratory will maintain a project file that includes but is not limited to the following: formulas used for data reduction, computer programs, identification of data transfers as electronic or manual, and data review protocol. All data acquired electronically will be transferred and manipulated electronically to reduce errors inherent in manual data manipulation. Someone who did not perform the original entries or calculations will check data entered, transferred, or calculated by hand for accuracy.

- Each laboratory will maintain a project-specific file such that will allow reconstruction of the analytical process. Each laboratory will preserve information regarding sample analyses (correspondence, sample custody forms, raw data [hard copies], results, calibration records) in the project file. Data storage and documentation will be maintained using logbooks and data sheets that will be included in the project file.

- Computer acquired data will also be stored on magnetic tape, disks, or other media that can be assessed using industry-standard hardware and software for data processing, retrieval, or reporting. Each laboratory will maintain data collected for this project for a minimum of five years following submission of the data reports to PWT.

### 13.6.2 Sample Locations

The sample locations are maintained in an ArcGIS 10 geodatabase structure called “LSGPS_Basedata”, along with other pertinent local geographic data such as road centerlines, streams and wetland polygons. All geographic data will be documented with Federal Geographic Data Committee compatible metadata, allowing future users to identify the original source and processing steps of the GIS data. The GPS coordinates data will be downloaded from the handheld unit and imported to the GIS to confirm sample locations for each boring.

### 13.6.3 Analytical Data

Analytical data acquired from historical sampling have been imported by the MDEQ contractor into a Microsoft Access 2010 database structure. PWT understands that this MS Access database is accessible to the EPA and PWT, and can be connected with the GIS system by soil boring or monitoring well number.

New analytical data can be imported from the lab digital data (EDDs) into this structure or downloaded directly from SCRIBE. Field parameter data will be hand-entered into an Excel spreadsheet. Both field

and laboratory analytical data will be exported from the table/database into SCRIBE for the EPA retention and use, and SCRIBE data can be exported to Access or Excel.

### 13.6.4 Documents and Photographs

The PWT Team will manage all historical and future data collected for remedial design. Field notes and data collection forms will be made available to the PWT Helena, Montana office throughout the field activities, where they will be scanned and archived electronically. Every document and photograph relating to an individual sample location will be identified with the boring or well identification number (SB*** or MW***). The originals will be retained for the duration of the project. Each boring or well will have a unique electronic folder containing photographs, field notes, and analytical data.

## 14.0 REFERENCES


MDEQ/United States Environmental Protection Agency (USEPA). 2005. *Record of Decision, Lockwood Solvent Groundwater Plume Site Billings, Montana.* August.

Pacific Western Technologies Ltd (PWT). 2011. *Site-Specific Health and Safety Plan*. June.

Tetra Tech EM Inc. (TTEMI). 2003. *Remedial Investigation Report, Lockwood Solvent Groundwater Plume Site.* June.

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USEPA. 2011. *Organic Multi-SOM01.2* (organic analysis contract as of January 2011).

# FIGURES

# Figure 1

## Site Location

**Remedial Design - Supplemental Sampling Program**
**Quality Assurance Project Plan**
**Beall Source Area Operable Unit 1**
**Lockwood Solvent Groundwater Plume Site**

**September 2011**

**Site Boundary**

**Rail Road**

**Project Location**

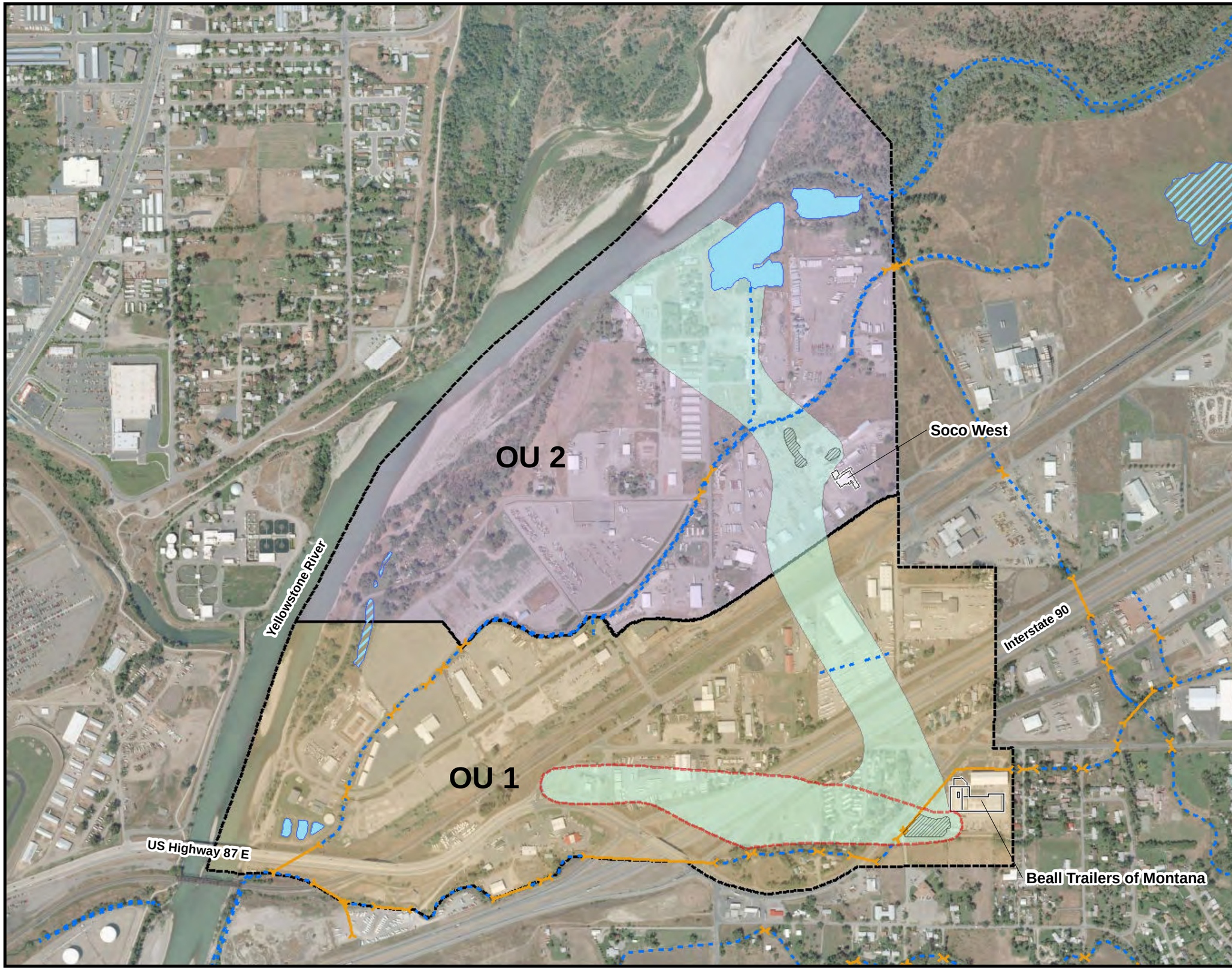
N
W E
S

0 250 500 1,000 Feet

**State Plane Coordinate System**
**Montana - NAD 83**

Aerial Photograhy Provided by Bing Maps
NAIP 2009

PACIFIC WESTERN TECHNOLOGIES, LTD.




# Figure 2

## Site Layout

**Remedial Design - Supplemental Sampling Program**
**Quality Assurance Project Plan**
**Beall Source Area Operable Unit 1**
**Lockwood Solvent Groundwater Plume Site**

**September 2011**

- **OU 1**
- **OU 2**
- **Concentration in groundwater of one or more COC exceeds MCL in October 2010**
- **Beall West Plume**
- **Approximate location of soil source areas**
- **Buildings**
- **Pond**
- **Wetlands**
- **Rail road**
- **Drainage ditch**
- **Culvert**

***Note: All Boundaries Approximate***

N
W E
S

0 200 400 800 Feet

**State Plane Coordinate System**
**Montana - NAD 83**

Aerial Photograhy Provided by Bing Maps
NAIP 2009

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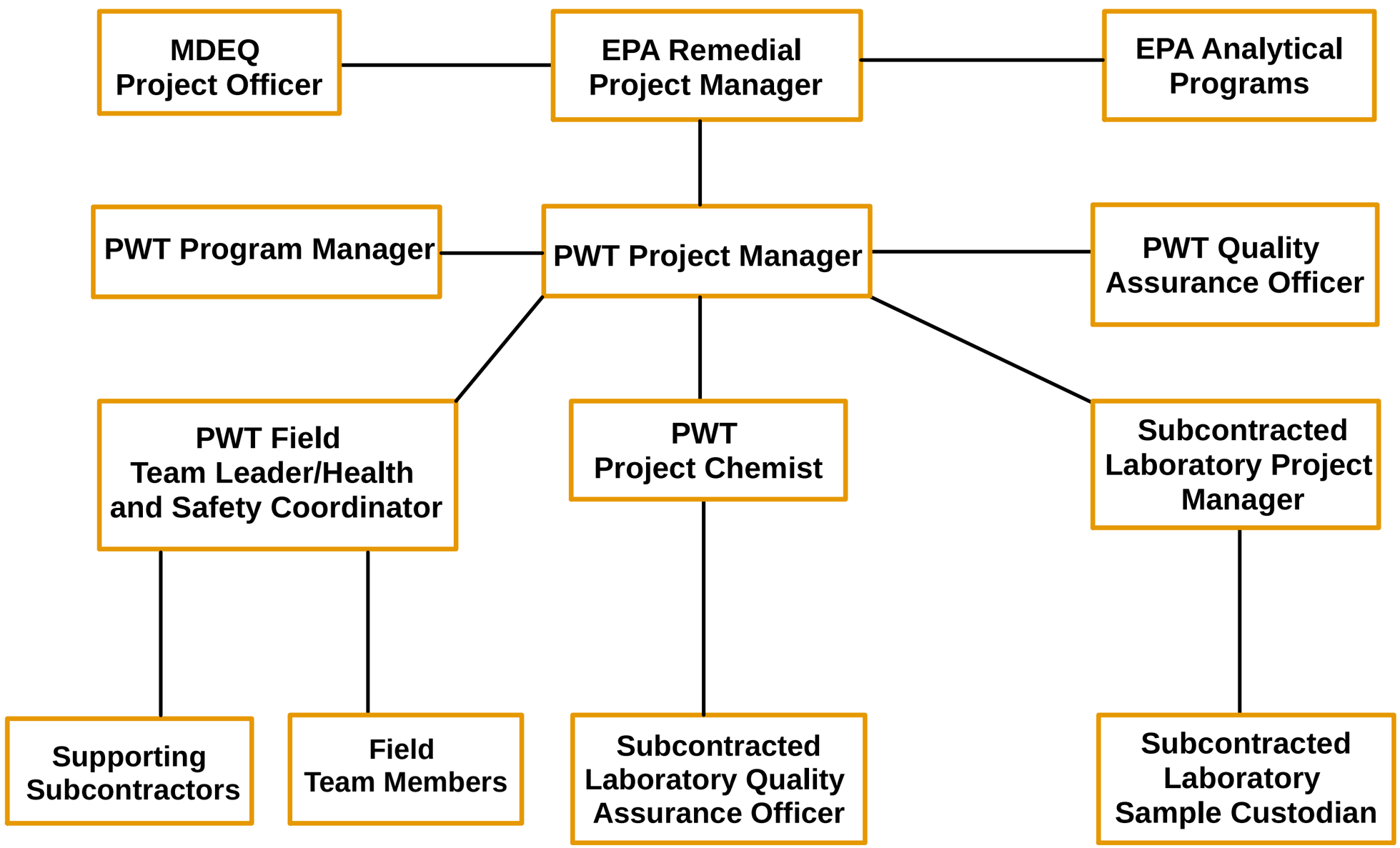


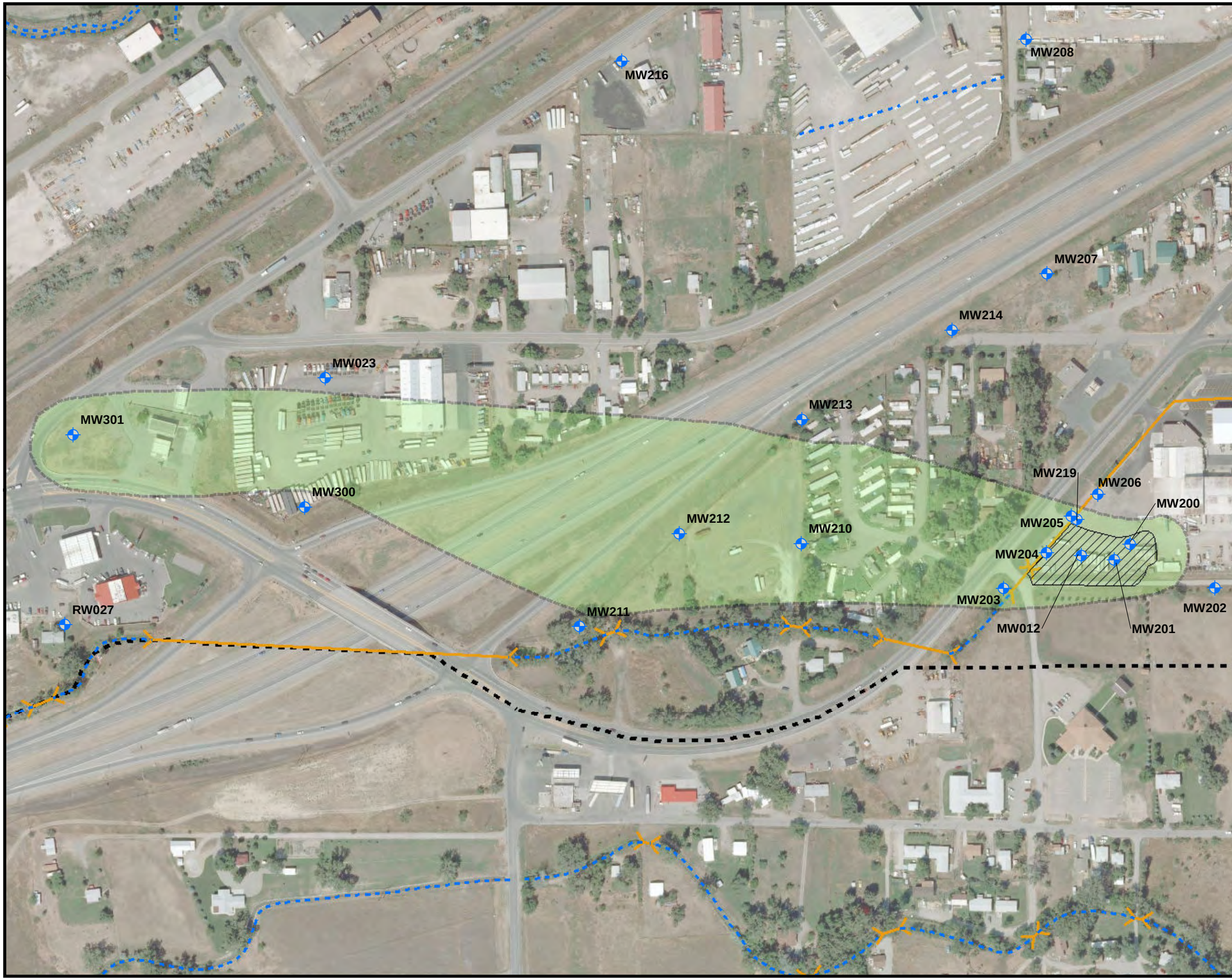

Figure 3

Organizational Chart

**Remedial Design - Supplemental Sampling Program**
**Quality Assurance Project Plan**
**Beall Source Area Operable Unit 1**
**Lockwood Solvent Groundwater Plume Site**

**September 2011**

| | |
|---|---|
| **EPA** | **United States Environmental Protection Agency** |
| **MDEQ** | **Montana Department of Enviromental Quality** |
| **PWT** | **Pacific Western Technologies (Remedial Design Contractor)** |




# Figure 4

## Beall Soil Source and West Plume

**Remedial Design - Supplemental Sampling Program**
**Quality Assurance Project Plan**
**Beall Source Area Operable Unit 1**
**Lockwood Solvent Groundwater Plume Site**

**September 2011**

- **Existing Monitoring Well**
- **Beall West Plume**
- **Beall Soil Source Area**
- **Site Boundary**
- **Culvert**
- **Drainage ditch**

***Note: Areas Approximate***

N
W E
S

0 100 200 400 Feet

**State Plane Coordinate System**
**Montana - NAD 83**

Aerial Photograhy Provided by Bing Maps
NAIP 2009

PACIFIC WESTERN TECHNOLOGIES, LTD.

# Figure 5

## Beall Source Area Pertinent Features

**Remedial Design - Supplemental Sampling Program**
**Quality Assurance Project Plan**
**Beall Source Area Operable Unit 1**
**Lockwood Solvent Groundwater Plume Site**

**September 2011**

- **Existing Monitoring Well**
- **Historic Soil Boring**
- **Low Temperature Thermal Desorption Soil Excavation Area**
- **Low Temperature Thermal Desorption Treatment Area (Each Unit 40' x 100')**
- **Soil Vapor Extraction Treatment Area**
- **Culvert**
- **Drainage ditch**

***Note: Areas Approximate***
***Soil Boring Locations Approximate***

N
W E
S

0 12.5 25 50 Feet

**State Plane Coordinate System**
**Montana - NAD 83**

Aerial Photograhy Provided by Bing Maps
NAIP 2009

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# Figure 6

## Monitoring Wells And Historic Soil Borings

**Remedial Design - Supplemental Sampling Program**
**Quality Assurance Project Plan**
**Beall Source Area Operable Unit 1**
**Lockwood Solvent Groundwater Plume Site**

**March 2012**

- **Existing Monitoring Well**
- **Historic Soil Boring**
- **Site Boundary**
- **Culvert**
- **Drainage ditch**

***Note: Areas Approximate***
***Soil Boring Locations Approximate***

N
W E
S

0 50 100 200 Feet

**State Plane Coordinate System**
**Montana - NAD 83**

Aerial Photograhy Provided by Bing Maps
NAIP 2009

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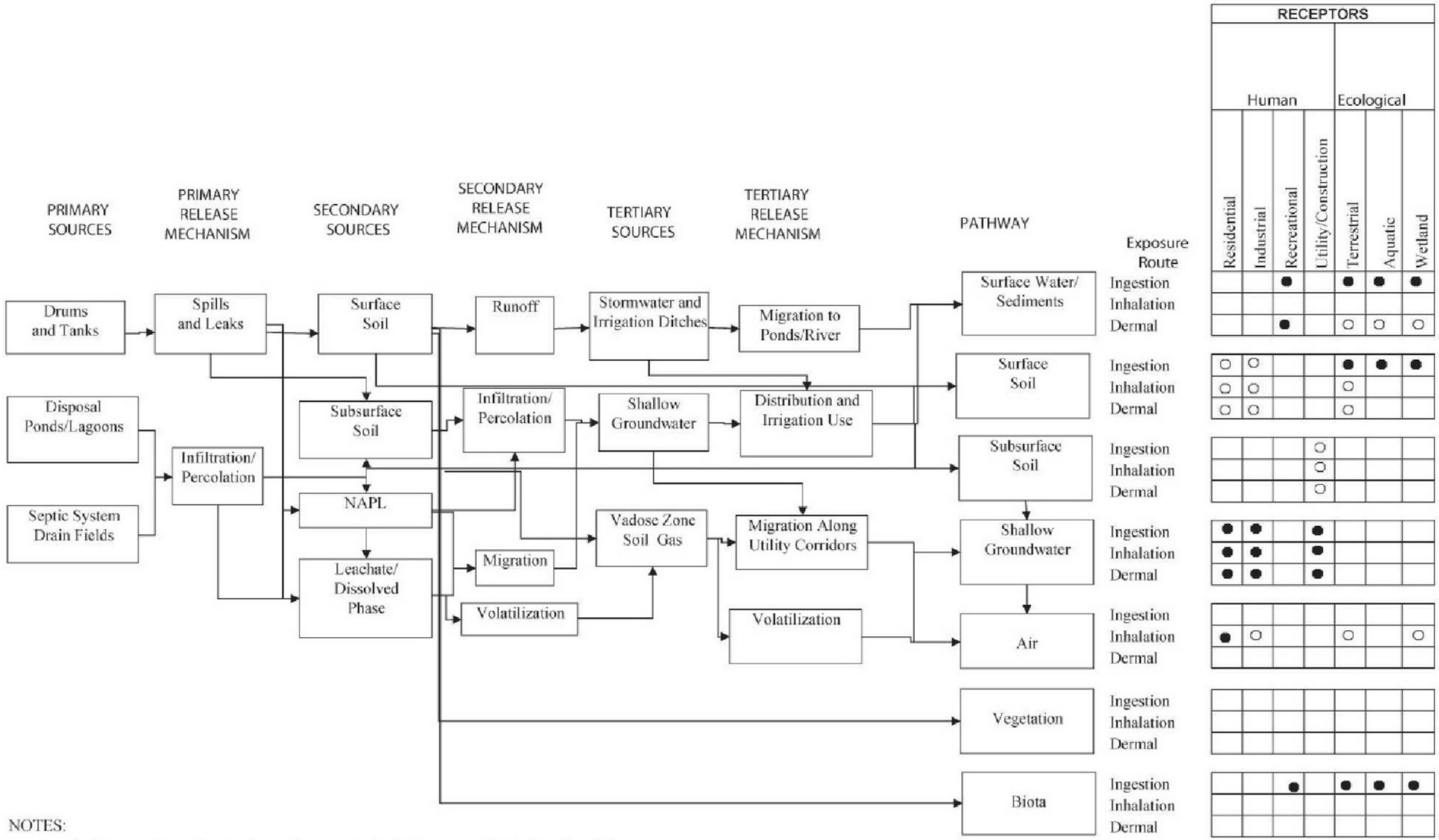
# Figure 7

## Conceptual Site Model

**Remedial Design - Supplemental Sampling Program**
**Quality Assurance Project Plan**
**Beall Source Area Operable Unit 1**
**Lockwood Solvent Groundwater Plume Site**

**September 2011**




NOTES:

● Indicates pathway is complete and was quantitatively assessed in the baseline risk assessment. A screen of maximum detected soil concentrations against EPA Region 9 Preliminary Remediation Goals for direct contact with soil, indicated that no detected volatile organic chemicals are chemicals of potential concern for the human health risk assessment (see RI Section 6.2.2.4).

○ Indicates pathway is potentially complete but was not quantitatively assessed in the baseline risk assessment.

EPA U.S. Environmental Protection Agency

NAPL Non Aqueous Phase Liquid

RECORD OF DECISION
LOCKWOOD SOLVENT GROUNDWATER PLUME SITE
BILLINGS, MONTANA

PACIFIC WESTERN TECHNOLOGIES, LTD.

# Figure 8

## Proposed Soil Sampling Locations

**Remedial Design - Supplemental Sampling Program**
**Quality Assurance Project Plan**
**Beall Source Area Operable Unit 1**
**Lockwood Solvent Groundwater Plume Site**

**September 2011**

**Proposed soil boring location**

**Underground piping and oil-water separator tank**

**Former drain field**

***Note: Locations Approximate***

N
W E
S

0 12.5 25 50 Feet

**State Plane Coordinate System**
**Montana - NAD 83**

Aerial Photograhy Provided by Bing Maps
NAIP 2009

PACIFIC WESTERN TECHNOLOGIES, LTD.

# Figure 9

## Proposed Geotechnical Sampling Locations

**Remedial Design - Supplemental Sampling Program**
**Quality Assurance Project Plan**
**Beall Source Area Operable Unit 1**
**Lockwood Solvent Groundwater Plume Site**

**September 2011**

**Proposed geotechnical soil sampling location**

***Note: Locations Approximate***

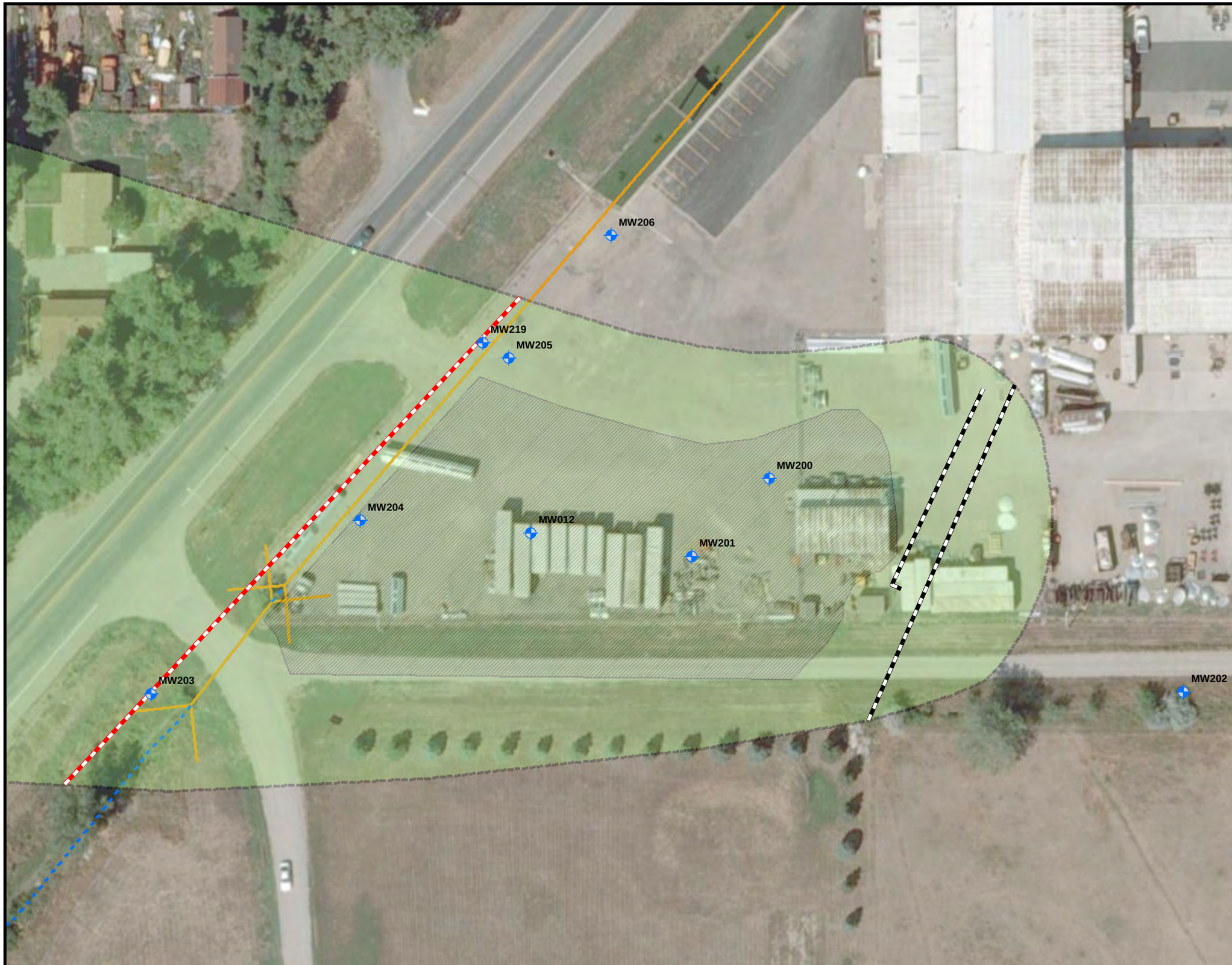
N
W E
S

0 10 20 40 Feet

**State Plane Coordinate System**
**Montana - NAD 83**

Aerial Photograhy Provided by Bing Maps
NAIP 2009

PACIFIC WESTERN TECHNOLOGIES, LTD.




# Figure 10

## Groundwater Remedy Components

**Remedial Design - Supplemental Sampling Program**
**Quality Assurance Project Plan**
**Beall Source Area Operable Unit 1**
**Lockwood Solvent Groundwater Plume Site**

**September 2011**

- **Existing Monitoring Well**
- **Beall Soil Source Area**
- **Beall West Plume**
- **Enhanced Bioremediation Injection Wells**
- **Enhanced Bioremediation Recirculation Wells**
- **Culvert**
- **Drainage ditch**

***Note: Locations Approximate***

N
W E
S

0 15 30 60 Feet

**State Plane Coordinate System**
**Montana - NAD 83**

Aerial Photograhy Provided by Bing Maps
NAIP 2009

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# Figure 11

## Proposed Groundwater Sampling Locations

**Remedial Design - Supplemental Sampling Program**
**Quality Assurance Project Plan**
**Beall Source Area Operable Unit 1**
**Lockwood Solvent Groundwater Plume Site**

**March 2012**

**Proposed Direct Push**

**Existing Monitoring Well**

**Beall West Plume**

**Drainage Ditch**

**Culvert**

***Note: Direct Push Locations Approximate***

N
W E
S

0 50 100 200 Feet

**State Plane Coordinate System**
**Montana - NAD 83**

Aerial Photograhy Provided by Bing Maps
NAIP 2009

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# Figure 12

## Proposed Surface Water and Sediment Sampling Locations

**Remedial Design - Supplemental Sampling Program**
**Quality Assurance Project Plan**
**Beall Source Area Operable Unit 1**
**Lockwood Solvent Groundwater Plume Site**

**September 2011**

**Co-located Surface Water and Sediment**

**Site Boundary**

**Culvert**

**Drainage ditch**

***Note: Locations Approximate***

N
W E
S

0 25 50 100 Feet

**State Plane Coordinate System**
**Montana - NAD 83**

Aerial Photograhy Provided by Bing Maps
NAIP 2009

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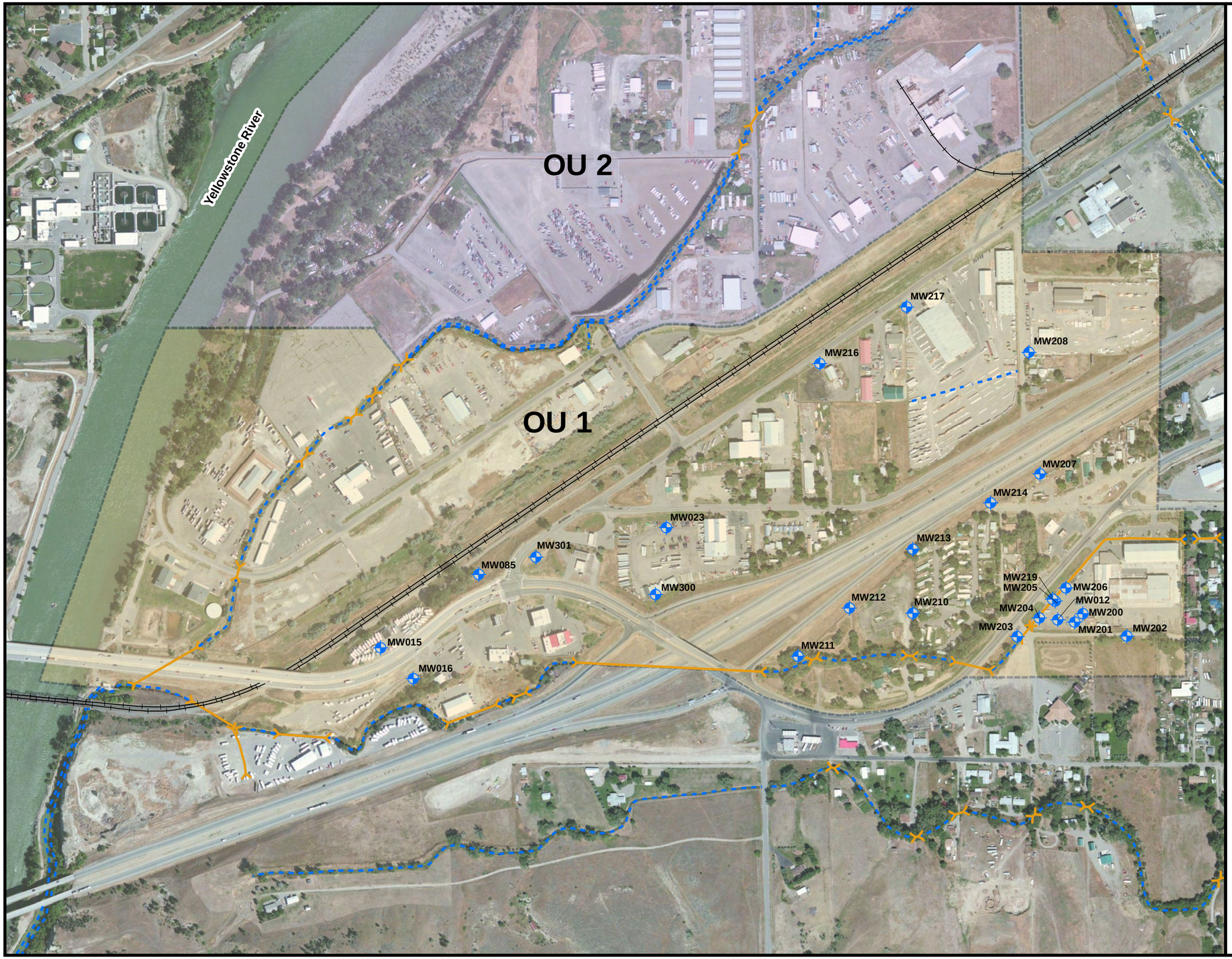


# Figure 13

## Semi-Annual Groundwater Sampling Locations

**Remedial Design - Supplemental Sampling Program**
**Quality Assurance Project Plan**
**Beall Source Area Operable Unit 1**
**Lockwood Solvent Groundwater Plume Site**

**March 2012**

- **Existing Monitoring Well**
- **Rail road**
- **Drainage ditch**
- **Culvert**
- **OU 1**
- **OU 2**

N
W E
S

0 200 400 800 Feet

**State Plane Coordinate System**
**Montana - NAD 83**

Aerial Photograhy Provided by Bing Maps
NAIP 2009

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# TABLES

Table 1
Personnel Responsibilities and Quality Assurance Project Plan Receipt
Lockwood Solvent Groundwater Plume Site

| Name | Organization/Affiliation | Project Responsibilities | Contact Information (phone, fax, email) | Quality Assurance Plan Receipt/Control Number |
|---|---|---|---|---|
| Roger Hoogerheide | Environmental Protection Agency | Remedial Project Manager & Delegated Quality Assurance Approving Officer | 406-457-5031<br>(fax) 406-457-5056<br>Hoogerheide.Roger@epa.gov | Rev 2 – 3/15/2012 |
| John Podolinsky | Montana Department of Environmental Quality | Project Officer | 406-841-5040<br>(fax) 406-841-5050<br>Jpodolinsky@mt.gov | Rev 2 – 3/15/2012 |
| Catherine LeCours | Pacific Western Technologies | Remedial Design Contractor | 406-457-5495<br>(fax) 406-422-6915<br>clecours@pwt.com | Rev 2 – 3/15/2012 |
| Greg Hayes | Pacific Western Technologies | Field Team Leader | 406-457-5495<br>(fax) 406-422-6915<br>greg.hayes@pwt.com | Rev 2 – 3/15/2012 |
| Robin Witt | Pacific Western Technologies | Quality Assurance Officer | 303-274-5400 ext. 35<br>(fax) 303-274-6160<br>rwitt@pwt.com | Rev 2 – 3/15/2012 |
| William Lutz | Pacific Western Technologies | Project Chemist | 303-274-5400 ext. 58<br>(fax) 303-274-6160<br>wlutz@pwt.com | Rev 2 – 3/15/2012 |
| Donald Goodrich | EPA Program Support | EPA R8 Analytical Project Manager | 303-312-6687<br>Goodrich.Donald@epa.gov | Rev 2 – 3/15/2012 |
| Nikki MacDonald | ESAT Region 8 | Project Quality Assurance Officer | 303-312-7054<br>MacDonald.Nikki@epa.gov | Rev 2 – 3/15/2012 |
| Scott Walker | ESAT Region 8 | Project Chemist | 303-312-7726<br>Walker.Scott@epa.gov | Rev 2 – 3/15/2012 |

Table 1
Personnel Responsibilities and Quality Assurance Project Plan Receipt
Lockwood Solvent Groundwater Plume Site

| Name | Organization/Affiliation | Project Responsibilities | Contact Information (phone, fax, email) | Quality Assurance Plan Receipt/Control Number |
|---|---|---|---|---|
| Samantha Rupe | Pace Analytical Services, Inc. | Project Manager | 406-545-5486<br>Samantha.rupe@pacelabs.com | Rev 2 – 3/15/2012 |
| Melanie Ollila | Pace Analytical Services, Inc. | Project Quality Assurance Officer | 612-607-1700<br>Melanie.ollilia@pacelabs.com | Rev 2 – 3/15/2012 |
| Denise Jensen | Pace Analytical Services, Inc. | Sample Custodian | 406-254-7226<br>Denise.jensen@pacelabs.com | Rev 2 – 3/15/2012 |
| Sara Ward | MSE Technology Applications, Inc. | Project Manager | 406-494-7334<br>(fax) 406-494-7230<br>sara.ward@mse-ta.com | Rev 2 – 3/15/2012 |
| Marcee Cameron | MSE Technology Applications, Inc. | Project Quality Assurance Officer | 406-494-7371<br>(fax) 406-494-7230<br>marcee.cameron@mse-ta.com | Rev 2 – 3/15/2012 |
| Betty O'Donnell | MSE Technology Applications, Inc. | Sample Custodian | 406-494-7334<br>(fax) 406-494-7230<br>betty.odonnell@mse-ta.com | Rev 2 – 3/15/2012 |
| Scott Wisher | Vironex, Inc. | Drilling | 303-423-2547<br>(fax) 303-423-9547<br>swisher@vironex.com | Rev 2 – 3/15/2012 |
| Gerard Bryant | Hilltop Enterprises | LTTD Bench Scale Testing | 774-454-1173<br>gbryant@hilltopenterprises.com | Rev 2 – 3/15/2012 |

Table 3
Groundwater Action Levels
Lockwood Solvent Groundwater Plume Site

| **Contaminant of Concern** | **Action Level** |
|---|---|
| Tetrachloroethene | 5 µg/L |
| Trichloroethene | 5 µg/L |
| Cis-1,2-Dichloroethene | 70 µg/L |
| Vinyl Chloride | 2 µg/L |

µg/L = micrograms per liter

Table 4
Soils Action Levels
Lockwood Solvents Groundwater Plume Site

| **Contaminant of Concern** | **Action Levels** | |
|---|---|---|
| | **Beall Source Area** | **Soco Source Area** |
| Tetrachloroethene | 0.22 mg/kg | 0.65 mg/kg |
| Trichloroethene | 0.24 mg/kg | 0.72 mg/kg |
| Cis-1,2-Dichloroethene | 1.64 mg/kg | 4.90 mg/kg |
| Vinyl Chloride | 0.05 mg/kg | 0.16 mg/kg |

mg/kg = milligrams per kilogram

Table 5
Volatile Organic Compounds
Precision and Accuracy Goals
Lockwood Solvent Groundwater Plume Site

| Fraction | Matrix Spike Compound | Water | | Soil | |
|---|---|---|---|---|---|
| | | % Recovery | RPD | % Recovery | RPD |
| VOC | Tetrachloroethene | 76-118 | 20 | 69-135 | 30 |
| VOC | Trichloroethene | 71-120 | 14 | 62-137 | 24 |
| VOC | Dichloroethene | 61-145 | 14 | 59-172 | 22 |
| VOC | Vinyl chloride | 70-128 | 20 | 57-134 | 30 |

VOC = volatile organic compound

RPD = relative percent difference

Table 6
Field Equipment List
Lockwood Solvent Groundwater Plume Site

| Item | Supply Source | Rental/Purchase | Quantity | Storage Requirements |
|---|---|---|---|---|
| Plastic sheeting | grainger.com | P | 30 | None |
| Nitrile Gloves | grainger.com | P | 30 | None |
| Spray Bottle | homedepot.com | P | 4 | None |
| Decon brush | homedepot.com | P | 4 | None |
| Contractor bags | homedepot.com | P | 6 | None |
| Decon sprayer | grainger.com | P | 2 | None |
| Alconox | grainger.com | P | 3 | Store in dry conditions |
| Paper towells | homedepot.com | P | 10 | Store in dry conditions |
| Distilled water | kmart.com | P | 50 | Do not allow to freeze |
| Engineering tape | grainger.com | P | 2 | None |
| Multi parameter water quality meter | geotechenv.com | R | 3 | Protected from moisture and weather |
| Submersible pump | geotechenv.com | R | 3 | Store in provided case |
| Submersible pump controller | geotechenv.com | R | 3 | Store in provided case |
| Submersible pump Inverter box | geotechenv.com | R | 3 | Store in provided case |
| 500' of poly line for Sumbersible pump | geotechenv.com | R | 2 | None |
| Water quality calibration fluids (ph/Cond) | geotechenv.com | P | 4 | Store in provided case |
| Water quality calibration fluids (ORP) | geotechenv.com | P | 1 | |
| Turbidity Meter | geotechenv.com | R | 3 | Store in provided case |
| Spare C Cell Batteries | homedepot.com | P | 2 | Do not allow to freeze |
| Spare 9 volt Batteries | homedepot.com | P | 2 | Do not allow to freeze |
| Photo Ionization Detector (PID) | geotechenv.com | R | 3 | Store in provided case, avoid moisture |
| PID calibration gas | geotechenv.com | R | 1 | Store in provided case, avoid heat |
| Munsell Color chart | PWT | NA | 1 | Protected from moisture and weather |
| Water Level Indicator | PWT | NA | 2 | Protected from moisture and weather |
| Utility knife | homedepot.com | P | 2 | None |
| 5 gallon buckets | homedepot.com | P | 2 | None |

# APPENDIX A

## STANDARD OPERATING PROCEDURES

# APPENDIX A

## STANDARD OPERATING PROCEDURES

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Manufacturer Standard Operating Procedure

Disposable En Core® Sampler Sampling Procedures, En Novative Technologies, Inc.

Geoprobe® Screen Point 16 Groundwater Sampler Standard Operating Procedure, Technical Bulletin No. MK3142, November, 2006

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| Revision Number | Description | Date |
| 1.0 | Original SOP | July 2011 |
| 2.0 | Revise for Montana Operations | March 2012 |

## 1.0 PURPOSE

This Standard Operating Procedure (SOP) provides technical guidance and procedures for utility clearances at project sites. This SOP serves as a supplement to site-wide and investigation area specific workplans and the site-specific Quality Assurance Project Plan (QAPP) and may be used in conjunction with other SOPs.

## 2.0 RESPONSIBLE PERSONNEL

The contractor project manager has the overall responsibility for implementing this SOP. The project manager will be responsible for assigning staff to implement this SOP and for ensuring that the procedures are followed by all personnel. The contractor site manager is responsible for ensuring that the appropriate utility clearances have been performed prior to any intrusive field activities. All utility clearances will comply with applicable portions of the project-specific health and safety plan (HASP).

## 3.0 PROCEDURES

Locations selected for intrusive field activities (e.g. borehole drilling, trenching) will be cleared of utilities before field activities begin. Before intrusive field activities can be performed. Each location will be cleared for the following utilities; natural gas, telecommunications, water and sewer, electrical, fiber optics and cable. At some locations additional utilities that may require clearance include petroleum service lines, irrigation lines, and building foundations. Notification for a utility clearance should be scheduled at least 1 week in advance.

It is the responsibility of the contractor to contact utility organizations directly for utility clearance.

Some utility companies guarantee that they will be present at the scheduled meet time. Other utility companies may call to reschedule at a different time or day or reschedule the day of the scheduled utility meet. If possible the utility clearance should be done a few days prior to intrusive work to allow enough time for utilities companies to clear their lines.

The utility companies will identify their utilities with spray paint on the ground. They also may leave a map at the location with their lines identified.

In addition to the contractor, each subcontractor performing the actual intrusive work is required to attend the utility clearance, to pose any necessary questions. The subcontractors should request the same meet time that the primary contractor has set up. A representative from each of the subcontractors is required to be present at the utility meet.

## 4.0 DOCUMENTATION

Utility clearance activities will be documented in the field logbook by the site manager or rig geologist. The documentation will include the utility locator service sign-off, personnel present for the locate, the final project-site representative approval (if requested), and any current and historical maps used in locating utilities (or references to locations of maps for future reference).

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| 2.0 | Revise for Montana Operations | March 2012 |

## 1.0 PURPOSE AND SCOPE

This Standard Operating Procedure (SOP) provides technical guidance and methods that will be used to handle environmental samples (such as: soil, groundwater, surface water, sediment, waste, and air samples) during environmental investigations. This SOP serves as a supplement to site-wide and investigation area specific workplans and the site-specific Quality Assurance Project Plan (QAPP) and may be used in conjunction with other SOPs.

## 2.0 PERSONNEL QUALIFICATIONS

Personnel performing sample handling activities will have knowledge and experience in the equipment and procedures used, or will work under the direct field supervision of knowledgeable and experienced personnel. Personnel will also be qualified to perform this work in accordance with the project-specific health and safety plan (HASP).

Sample handling will be directed by a PWT field sample manager responsible for ensuring proper handling and shipment of samples. The field sample manager will be knowledgeable and experienced in handling and shipping of environmental samples.

## 3.0 MATERIALS AND EQUIPMENT

The following materials and equipment may be needed for sample handling, packaging, and shipping:

- Monitoring equipment and personal protective equipment (PPE) as specified in the HASP.
- Appropriate clean sample containers as specified for each analytical method being tested. Sample containers will contain appropriate preservatives, according to method specifications. Sample containers will be provided by the analytical laboratory, unless otherwise specified in the QAPP.
- Decontamination equipment and supplies (e.g., wash/rinse tubs, brushes, Alconox, plastic sheeting, paper towels, sponges, baby wipes, garden-type water sprayers, large plastic bags, potable water, distilled water and/or deionized water).
- Sample handling supplies (e.g., recloseable plastic bags, waterproof markers and sample labels, cooler for sample storage, ice or ice substitute).
- Sample management supplies (e.g., soil sample field data sheets, chain-of-custody [COC] forms). An example COC form is included as Attachment A.
- Sample shipping supplies (shipping coolers, recloseable plastic bags, shipping labels, shipping forms [provided by shipping courier], bubble wrap, tape [e.g., clear tape, packing tape, and custody seal tape]).

Other materials and equipment may be needed based on field conditions.

## 4.0 PROCEDURES

### 4.1 Sample Identification

Samples collected during investigation activities will be identified using a pre-determined sample identification (ID) scheme described in the project or investigation –specific sampling plan.

Typically, sample ID numbers consist of two main components:

- The investigation location site identifier, which may include numbers, letters, or a combination of the two, and which corresponds to the investigation location at which the sample was collected

- Sample-specific information, such as the sample collection method, sample depth interval, sample type and sequential sample number

4.2 Sample Labeling

Sample labels will be filled out to the extent possible before field sampling activities begin. However, the date, time, sample depth, and sampler's initials or signature will typically not be completed until the time of sample collection. Sample labels will be filled out using waterproof ink. At a minimum, each label will contain the following information:

- Company's name
- Project name/site location
- Sample ID
- Date and time of sample collection
- Method of preservation (if any) used
- Analyses required
- Sample matrix (e.g., soil, water)
- Sampler initials

4.3 Sample Handling

This section discusses proper sample containers, preservatives, and handling and shipping procedures.

4.3.1 Sample Containers

Unless otherwise specified in the QAPP, certified clean sample containers will be obtained from the subcontracted analytical laboratory performing the analyses. Extra containers will be ordered to account for the possibility of breakage during shipment or sample collection. To the extent possible, required preservatives will be prepared and placed in the bottles at the laboratory before shipment to the site. Project-specific sample containers will be identified in the site-specific QAPP.

4.3.2 Sample Preservation

Samples will be preserved in accordance with the site-specific QAPP. Chemical preservatives, if necessary, will be added to the sample containers by the laboratory (or vendor) before shipment to the field. Samples will be stored at appropriate temperatures as specified in the site-specific QAPP.

4.3.3 Sample Handling and Shipping

Sample containers will be packaged properly to prevent breakage of containers and leakage of contents. The following procedures will be followed during the packaging and shipping process:

1. Place sample containers in recloseable plastic bags.
2. If sample container is glass, wrap individual sample containers with bubble wrap.
3. Place sufficient amounts of bubble wrap in the bottom and sides of the shipping cooler to prevent movement of contents.
4. Add enough ice (in double bags) or ice substitute to the cooler to maintain proper preservation temperature in accordance with the QAPP.
5. Place the samples inside a plastic trash bag, tie the bag shut, and place in cooler.
6. Fill any void space in the cooler with packing material (e.g., bubble wrap) to prevent movement of sample containers.

7. Place the original COC form inside a recloseable plastic bag, and tape the bag to the inside of the cooler lid.
8. Close the cooler lid, and seal the cooler and the cooler drain spout with appropriate packaging tape.
9. Place two custody seals (tampering seals) on the cooler in separate areas over (across) the seal between the lid and the cooler base. Example custody seals are included as Attachment B.

A shipping bill should be completed for the shipper and taped to the top of the cooler using the envelope provided by the shipper. The following markings may also be placed on the top of the cooler:

- This end up
- Fragile
- Laboratory delivery address
- Sender's return address

A copy of the shipping bill will be retained by the field sample manager for attachment to the corresponding COC form. Samples will be hand delivered or shipped by express courier for delivery to the analytical laboratory.

The field sample manager is responsible for verifying that samples collected by the field team(s) have been properly identified, preserved, and packaged, and for verifying the accuracy and completeness of sample labels, COC forms, and applicable sample field data sheets and logbook entries.

The following is a summary of steps to be performed by the field sample manager:

- Verify sample labels.
- Verify samples were collected and preserved in accordance with the site-specific FSP and QAPP.
- Check or complete the COC form, photocopy, and retain a copy for the project files.
- Pack samples in shipping containers and verify labels and shipping forms meet shipping requirements.
- Send original COC form to the laboratory.
- Retain a copy of the shipping bill and staple it to the corresponding COC copy.
- Send copies of sample field data sheets and photocopied pages of field logbooks to the project manager.

Close coordination will be maintained between the field sample manager and the analytical laboratory during sample collection and shipment. The laboratory will be instructed to report any handling or preservation issues immediately to the field sample manager (or other designated person) so that corrections can be made to field procedures, if necessary.

#### 4.3.4 Sample Container Tampering

If, at any time after samples have been secured, custody seals on the cooler are identified as having been tampered with, the following procedures will be conducted to ensure that sample integrity has not been compromised:

- Check with personnel having access to sample coolers to assess the possibility of inadvertent breakage of custody seals.

- Inspect sample containers for signs of tampering, such as loose lids, foreign objects in containers, or broken or leaking containers.
- Review sample packaging and handling procedures.
- Document findings of the incident in the sample management logbook.

If it is determined that intentional tampering of samples has occurred, or it is believed that sample integrity has been compromised in any way, the Quality Assurance Officer and appropriate project managers will be notified.

4.3.5 Holding Times and Analyses

Samples will be shipped to the analytical laboratory for analysis as soon as practical following collection. At a minimum, samples will be shipped daily with the following exception. For small projects, samples may be collected over a period of several days at the discretion of the project managers, and then collectively shipped. No samples will be shipped on Friday for weekend delivery unless receipt and analysis procedures are pre-coordinated with the analytical laboratory. Allowable holding times for specific samples will be specified in the site-specific QAPP.

## 5.0 DOCUMENTATION

Documentation of sample handling is critical to project defensibility. The field sample manager will be responsible for ensuring all sample collection and handling documentation is complete and accurate.

### 5.1 Sample Management Logbook

The field sample manager will maintain a complete and accurate sample management logbook documenting sample handling procedures and observations. The logbook will be a permanently bound weatherproof field logbook with consecutively numbered pages. The field sample manager will also maintain a complete and accurate sample management file containing copies of all sample field data sheets, sampling crew logbooks, COC forms, shipping documentation, and written logs of correspondence or communications with the laboratory and other pertinent correspondence and communications. The sample management logbook will contain sufficiently detailed information to allow all significant sampling issues to be reconstructed without relying on the memory of sampling personnel.

The sample management logbook will contain daily entries for the following information:

- Project name
- Sampling activities performed that day
- Sampling crews and affiliations
- Sample location identifications
- List of samples collected, including sample IDs, collection time/date, media, analysis methods, and associated COC and shipping documentation
- QA/QC samples collected and submitted for analysis
- Field observations
- Instrument calibration information
- Correspondence and communications

- Field sample manager's signature

Changes or deletions in the logbook will be lined out with a single strike mark, initialed and dated by the person making the change. Sufficient information should be recorded to allow the reason for the change to be reconstructed without relying on the memory of field personnel.

At the end of each day, the field sample manager will prepare copies of the sample management logbook, sample field data sheets, and field crew logbooks for the project manager. The field sample manager will coordinate with the project manager on the required frequency of transmittal of this information to the client. The client will expect this information to be available, accurate, and complete on a daily basis for possible inspection by the client, quality assurance personnel, the project manager or the regulatory agency.

5.2 Chain of Custody

Written documentation of the proper and secure handling of samples from the time samples are collected until laboratory data are issued is critical to project defensibility. The chain of custody of the physical sample and its corresponding documentation will be maintained throughout the handling of the sample. Sample custody applies to both the field and laboratory operations. Information on the custody, transfer, handling, and shipping of samples will be recorded on a COC form. An example COC form is provided as Attachment A. The COC form will ideally consist of a triplicate, pressure-sensitive form prepared by the contract laboratory. The COC form may vary depending on investigation activities. The investigation contractor will select an appropriate COC form subject to approval by the client.

A sample is under custody if it is in:

- The possession of the sampler/analyst.
- The view, after being in the possession, of the sampler/analyst.
- A sealed shipping container being carried by a designated commercial carrier.
- A designated secure area.

The sampling team will be responsible for initiating the original COC form and will sign and date the COC form when relinquishing sample custody to another person (e.g., the field sample manager) or to the analytical laboratory. The COC form and sample labels will be checked by the field sample manager to verify that samples are accounted for and in good condition, and that no errors were made.

The COC form will include the following information:

- COC number (unique, sequential number on the upper right corner of the form)
- Project name and number
- Sample ID number
- Sample preservatives
- Number of containers
- Sample collection date and time
- Sample matrix
- Requested analyses
- Signature and date blocks for personnel relinquishing or receiving sample custody

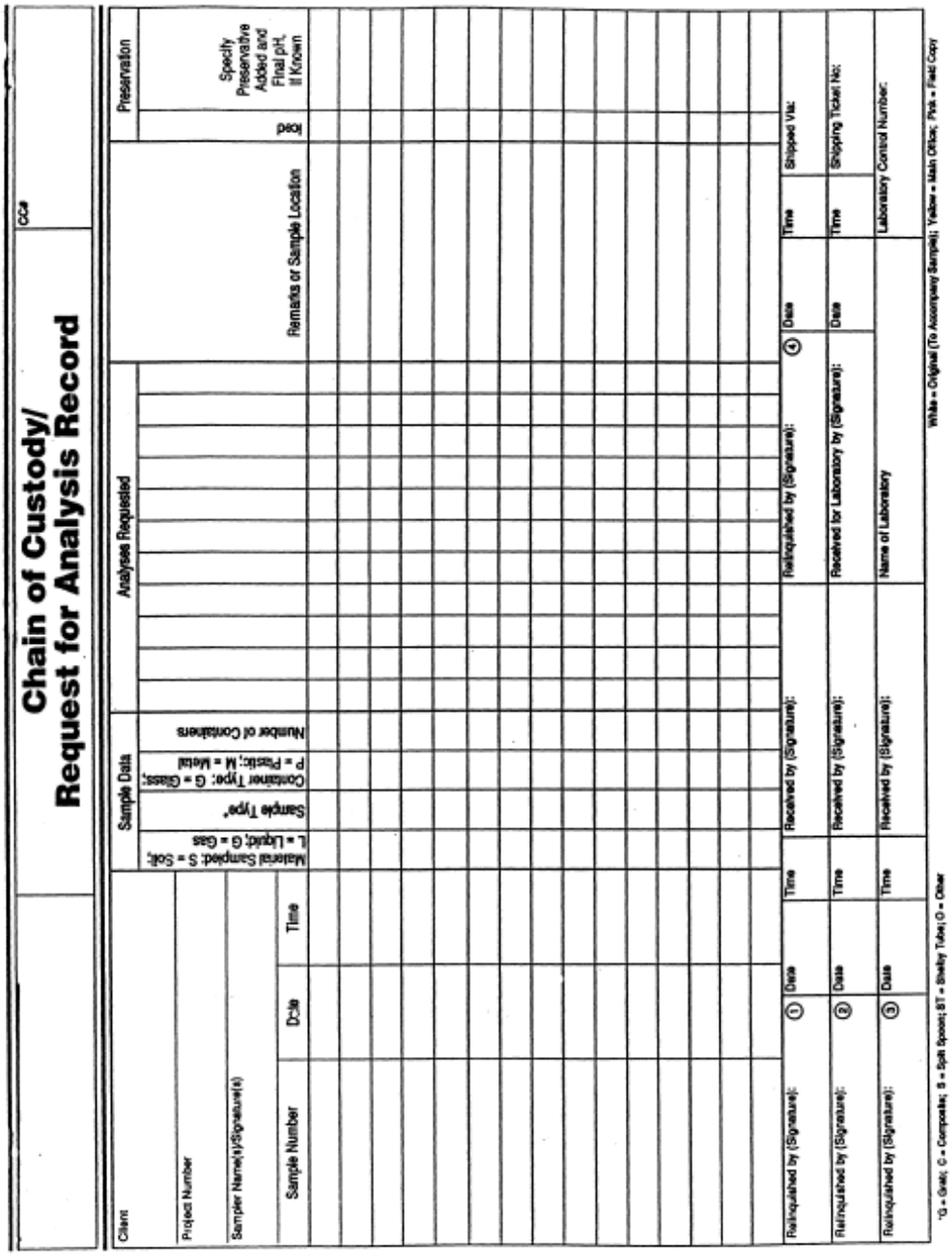
- Name and phone number of contractor contact person

Transfer of samples to the analytical laboratory may be via commercial carrier. The field sample manager will verify the proper packaging and shipment of samples. Prior to shipping, the field sample manager will officially transfer sample custody to the commercial carrier or analytical laboratory and secure the COC form inside the shipping container. Shipping containers transferred via commercial carrier will be sealed with strapping tape and with two custody seals. An example custody seal format is provided as Attachment B. Receipts of bills of lading from the carrier will be maintained as part of the custody record. Commercial carriers are not required to sign the COC form as long as the COC form is sealed inside the shipping container and the custody seals remain intact.

Upon receipt at the laboratory, the person receiving the samples will sign the COC form accepting transfer of custody to the laboratory. The laboratory will return a copy of the signed COC form to the designated investigation contractor personnel (i.e., project chemist, field sample manager, or project manager), and will retain a copy on file at the laboratory. The original COC form will remain with the samples until final disposition of the samples by the laboratory in accordance with the site-specific QAPP. After sample disposal, a copy of the original COC will be sent by the analytical laboratory to the investigation contractor.

# ATTACHMENT A

# EXAMPLE CHAIN OF CUSTODY FORM



**Chain of Custody/ Request for Analysis Record**

CC#

Client

Project Number

Sampler Name(s)/Signature(s)

| Sample Number | Date | Time | Sample Data: Material Sampled: S = Solid; L = Liquid; G = Gas | Sample Type* | Container Type: G = Glass; P = Plastic; M = Metal | Number of Containers | Analyses Requested | Remarks or Sample Location | Preservation: Iced | Preservation: Specify Preservative Added and Final pH, If Known |
|---|---|---|---|---|---|---|---|---|---|---|
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|---|---|---|---|---|---|---|---|
| Relinquished by (Signature): | ① Date | Time | Received by (Signature): | Relinquished by (Signature): | ④ Date | Time | Shipped Via: |
| Relinquished by (Signature): | ② Date | Time | Received by (Signature): | Received for Laboratory by (Signature): | Date | Time | Shipping Ticket No: |
| Relinquished by (Signature): | ③ Date | Time | Received by (Signature): | Name of Laboratory | | | Laboratory Control Number: |

*G = Grab; C = Composite; S = Split Spoon; ST = Shelby Tube; O = Other

White = Original (To Accompany Sample); Yellow = Main Office; Pink = Field Copy

# ATTACHMENT B
# EXAMPLE CUSTODY SEAL

| | | | | | |
|---|---|---|---|---|---|
| *CUSTODY SEAL* | SAMPLE NO. | DATE | TIME | SEAL BROKEN BY | DATE |
| | SIGNATURE | | | | |
| | PRINT NAME AND TITLE (Inspector, Analyst or Technician) | | | | |

**Custody Seal**

# PWT STANDARD OPERATING PROCEDURE

**PERSONNEL AND EQUIPMENT DECONTAMINATION**

Procedure No.PWT/ES.103
Revision 2
Date effective: 03/1/12
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APPROVED: /s/ _____
PWT Project Manager, Date

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| Revision Number | Description | Date |
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| 2.0 | Revise for Montana Operations | March 2012 |

## 1.0 PURPOSE AND SCOPE

This Standard Operating Procedure (SOP) provides technical guidance and methods that will be used to conduct decontamination of personnel and investigation equipment during environmental investigations. This SOP serves as a supplement to site-wide and investigation area specific workplans and the site-specific Quality Assurance Project Plan (QAPP) and may be used in conjunction with other SOPs.

## 2.0 PERSONNEL QUALIFICATIONS

Personnel overseeing and performing decontamination activities will have knowledge and experience in the equipment and methods proposed, or will work under the direct field supervision of knowledgeable and experienced personnel. Personnel will also be qualified to perform this work in accordance with the project-specific health and safety plan (HASP).

## 3.0 MATERIALS AND EQUIPMENT

The following materials and equipment may be needed for personnel and equipment decontamination:

- Monitoring equipment and personal protective equipment (PPE) as outlined in the HASP.
- Decontamination equipment and supplies (e.g., wash/rinse tubs, nitrile disposable gloves, brushes, Alconox, plastic sheeting, paper towels, sponges, baby wipes, garden-type water sprayers, large plastic bags, potable water, distilled water and/or deionized water [laboratory-grade])
- High pressure washer/steamer
- Four-foot long capped PVC casing for decontamination of submersible pumps
- Drums or other approved water-tight containers for containing decontamination sediment and fluids
- Materials necessary to construct an investigation site-specific decontamination facility, if required (e.g., heavy plastic sheeting, berming materials, sump pump, water tanks, roll-off bins)

## 4.0 PROCEDURES

This procedure describes the method for physically removing contaminants. It applies to chemical and radioactive decontamination of personnel and equipment used in field investigations. All equipment must be decontaminated before use at the project site, prior to sample collection, and before being removed from the project site. Decontamination of personnel, sampling equipment (e.g., soil sampling equipment and submersible pumps) and heavy equipment (e.g., hollow stem auger rigs, backhoes) is required to ensure the health and safety of personnel, reduce the potential for sample cross-contamination, and reduce the potential for contamination to enter or leave the project site on personnel or equipment.

### 4.1 Decontamination

#### 4.1.1 Location of Decontamination Activities

Decontamination activities may take place either in the exclusion zone of the investigation site or at a decontamination facility designed to contain larger volumes of potentially contaminated fluids and materials, or at a combination of the two. Decontamination activities conducted in the exclusion zone will be limited to washing of personnel and small sampling equipment using wash tubs or wipes. Scraping of PPE and large equipment to remove adhered clumps of soil will also be performed in the exclusion zone.

Decontamination of heavy equipment or equipment requiring high-pressure washing will be performed at a decontamination facility designed to contain large volumes of washing fluids. The decontamination facility may consist of an investigation area-specific temporary facility constructed near the investigation

site, or a decontamination facility central to the project site that may be used for multiple investigations. If a central decontamination facility is used, sufficient decontamination of equipment will be performed in the exclusion zone prior to moving to the central facility to reduce the potential for deposition of contaminated materials on roadways between the investigation area and decontamination facility.

Decontamination facilities will be constructed to limit the potential for contact of potentially contaminated materials (decontamination sediment and fluids) with environmental media (i.e., soil or water) in the decontamination area. This will be accomplished by performing decontamination activities in lined and bermed areas, and by containing decontamination sediment and fluids as they are generated.

4.1.2 Personnel Decontamination

The following steps will be used to perform personnel decontamination:

- Soil adhering to boots, apparel and equipment will be scraped off at the sampling or excavation site.
- Boots and outer apparel that will not be damaged by water will be washed with Alconox low-sudsing detergent and potable water and scrubbed with a bristle brush or similar utensil (if possible). Apparel will be rinsed with potable water.
- Coveralls removed (if used).
- Hard hat and other safety equipment removed and washed with Alconox and rinsed with potable water.
- Gloves and respirator (if used) removed.
- Personnel shall wash hands, face, and forearms before eating/drinking.
- Following decontamination, apparel will be placed in a clean area, on clean plastic sheeting to prevent contact with contaminated soil. If the apparel is not used immediately, the equipment will be stored in plastic sheeting or heavy duty trash bags.
- Disposable PPE will be handled in accordance with Section 4.1.1 of PWT's Investigation Derived Waste Management SOP.

4.1.3 Small Sampling Equipment Decontamination

Small sampling equipment consists of split spoons, sample bowls, scoops, hand augers, filtering devices, non-dedicated pumps, water level meters, and other such small equipment used in the exclusion zone or the immediate vicinity of the sample collection location. Small sampling equipment is designed to be decontaminated at the sampling location using small wash tubs. Decontamination of small sampling equipment does not require high-pressure washing or steam cleaning, or result in production of large volumes of decontamination sediment or fluids.

The following steps will be used to decontaminate small sampling equipment:

- To reduce personal exposure, personnel will dress in suitable PPE in accordance with the HASP.
- Soil adhering to equipment will be scraped off at the sampling site and containerized.
- Equipment that will not be damaged by water will be placed in a wash tub containing Alconox or equivalent detergent and potable water and scrubbed with a brush. Equipment will then be rinsed initially with potable tap water and then with distilled water.
- Equipment that cannot be submerged in water (e.g., air monitoring devices, electronic devices) will be carefully wiped clean using a sponge and detergent water or baby wipes.

- Wash and potable rinse water should be replaced frequently. Decontamination sediment and water will be handled as investigation derived waste (IDW) (see Section 4.1.6).
- Disposable sampling equipment will be handled in accordance with PWT's Investigation Derived Waste Management SOP.

Following decontamination, equipment will be placed in a clean area or on clean plastic sheeting. If the equipment is not used immediately, the equipment will be covered or wrapped in plastic sheeting or trash bags.

#### 4.1.4 Decontamination of Submersible Pumps

Submersible pumps used to conduct groundwater sampling will be decontaminated before being placed in the well. A decontaminated four-foot length of polyvinyl chloride (PVC) capped on one end will be utilized for this procedure. The following steps will be used to decontaminate submersible pumps:

- To reduce personal exposure, personnel will dress in suitable PPE in accordance with the HASP.
- Scrub the outside of the pump with a solution of Alconox or equivalent detergent and potable water and then rinse with potable water and distilled water.
- Fill the PVC tube with Alconox/potable water solution.
- Pump the solution through the submersible pump by lowering the intake tube of the pump to the bottom of the PVC tube. Be careful not to uncover the intake of the pump to prevent damage to the pump.
- Rinse the inside of the PVC tube with potable water to remove detergent and then fill the PVC tube with potable water.
- Pump the potable water through the pump.
- Repeat the rinse procedure with distilled water.
- Decontamination sediment and water will be handled as IDW (see Section 4.1.6 below).

Following decontamination, the pump will be wrapped in plastic sheeting or trash bags and placed in a clean area.

#### 4.1.5 Heavy Equipment Decontamination

Heavy equipment used within the exclusion zone and/or for intrusive activities (e.g., drill rigs and associated heavy drilling and sampling equipment, backhoes, sampling-related vehicles) will be decontaminated upon arrival at the project site, between investigation locations (i.e., between boreholes and test pits), and prior to leaving the project site. The following steps will be used to decontaminate heavy equipment:

- To reduce personal exposure, personnel will dress in suitable PPE in accordance with the HASP.
- Prior to use at the project site and between investigation locations (i.e., between boreholes, test pits), the portion of the equipment directly exposed to potential contamination (e.g., augers, drill rods, backhoe bucket) will be decontaminated by pressure washing the equipment at the decontamination facility.
- Drill rigs and vehicles will not require pressure washing between investigation locations unless they have become substantially dirty as a result of drilling or investigation activities.
- Prior to leaving the project site, the portions of the heavy equipment potentially exposed to contamination will be pressure washed using potable water at the decontamination facility.

Special attention will be given to removing any soil or other site-related foreign materials on the equipment.

- Decontamination sediment and water will be handled as IDW as described in Section 4.1.6 below.

4.1.6 Decontamination Sediment and Fluids

Sediment and fluids from decontamination activities will be initially contained and stored in approved water-tight containers at the sampling site or decontamination facility. Each container will be labeled with its contents and the date using a paint pen, or permanent marker. As soon as practical, decontamination sediment and fluids will be transferred from the sampling site to a designated IDW management area. Handling of IDW is addressed by PWT's Investigation Derived Waste Management SOP.

4.2 Equipment Rinsate Sampling

Equipment rinsate blank samples may be collected to verify the effectiveness of the decontamination procedures. Equipment rinsate blank sampling is usually performed for small sampling equipment, rather than heavy equipment. The frequency of rinsate blank sample collection, as well as the analysis methods, will be specified in the investigation-specific FSP. In general, the rinsate blank sample collection procedure will consist of rinsing decontaminated equipment with laboratory-grade deionized water and collecting the rinsate water in sample bottles provided by the analytical laboratory. Special attention will be given to rinsing the portions of the equipment exposed to environmental samples or potential contamination. Rinsate samples will be handled in the same manner as environmental and other quality assurance/quality control (QA/QC) samples in accordance with PWT's Sample Handling SOP. Rinsate sample collection will be documented in the same manner as environmental and other QA/QC samples.

## 5.0 DECONTAMINATION DOCUMENTATION

Field personnel will be responsible for documenting proper sampling and heavy equipment decontamination. The purpose of documentation is to demonstrate in the written field record that decontamination was performed in accordance with this SOP. Decontamination activities will be documented at least each day they are performed. The documentation will be recorded in a logbook or on appropriate project forms (i.e., boring log, sample field data sheets). The information recorded concerning decontamination will include:

- Date and times of decontamination
- Location of decontamination activities (i.e., sample site, central decontamination facility)
- Decontamination personnel and materials
- Decontamination steps/observations
- Other applicable information

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Attachment A Borehole Abandonment Form

| REVISION LOG | | |
|---|---|---|
| Revision Number | Description | Date |
| 1.0 | Original SOP | July 2011 |
| 2.0 | Revise for Montana Operations | March 2012 |

## 1.0 PURPOSE

This Standard Operating Procedure (SOP) provides technical guidance and methods that will be used to seal and abandon wells and boreholes. This SOP serves as a supplement to site-wide and investigation area specific workplans and the site-specific QAPP. This SOP may be used in conjunction with other SOPs.

## 2.0 PERSONNEL QUALIFICATIONS

Personnel overseeing and performing a well/borehole abandonment will have knowledge and experience in working with drill rigs and sealing and abandoning environmental boreholes. Personnel will also be qualified to perform this work in accordance with the project-specific health and safety plan (HASP).

## 3.0 MATERIALS AND EQUIPMENT

The following materials and equipment may be needed for well/borehole abandonment:

- Personal protective equipment (PPE) as outlined in the HASP
- Drill rig equipped with a hoist (for removal of well/piezometer casing and screen)
- Grout mixing and pumping equipment
- Grouting materials and equipment (potable water, bentonite powder, bentonite chips, cement for grouting [portland type II or IV], large tank for mixing grout, trash pump for mixing grout, plastic or steel tremie pipe)
- Well/Borehole Abandonment Form

Other materials and equipment may be needed based on field conditions.

## 4.0 PROCEDURES

Abandonment is the procedure by which a borehole is permanently sealed in place, or a monitoring well or piezometer is sealed in place or removed. The objective of abandonment is to eliminate the potential vertical pathway to the subsurface associated with boreholes or unneeded wells. Abandonment will be performed at the project site for the following:

- Following drilling and sampling of investigation wells/boreholes.
- To remove wells or piezometers no longer needed.

### 4.1 Borehole Abandonment

Investigation wells and boreholes drilled for collection of subsurface material samples will be abandoned immediately following sampling and/or data collection. Prior to any intrusive drilling associated with abandonment, utility clearance will have been accomplished according to the PWT Utility Clearance SOP.

The following steps will be performed to abandon a well or borehole:

- All wells/boreholes to be abandoned will be grouted with a cement/bentonite grout.
- Grout will be injected into the borehole using a tremie pipe as the hollow-stem augers are pulled. Measurements will be taken of the grout level during the process to verify that the grout level does not fall below the bottom of the augers, thus ensuring a continuous seal is injected into the borehole.
- The cement-bentonite grout mixture will consist of the following in accordance with in accordance with state specific well abandonment regulations. The amount of bentonite shall not

exceed 8% bentonite per dry weight of cement. The volume of water used is limited to 0.75 gallons per 94 pound sack of cement for each 1% of bentonite added.

- During grouting, water present in the well/borehole will be displaced up the well/borehole. Displaced water cannot be discharged to the ground surface. Displaced water will be pumped from the well/borehole as grouting progresses and contained in drums or other approved water-tight containers for handling as investigation derived waste (IDW). IDW management is addressed in the PWT Investigation Derived Waste Management SOP.
- Twenty-four hours after grouting, the well/borehole will be checked for grout settlement and will be topped off to the ground surface with grout, if necessary.
- Any excess grout will be placed in drums for disposal in accordance with the PWT Investigation Derived Waste Management SOP.

4.2 Monitoring Well and Piezometer

Monitoring wells or piezometers that are no longer needed may be abandoned at the client's request. The preferred method of abandonment is to remove the surface completion (i.e., protective casing, bollards, and surface seal), pull or drill out the well or piezometer casing and screen, drill out the annular seal and filter pack material, and seal the well/borehole.

In some cases it may not be feasible to remove the well casing. Wells that are not pulled or drilled out, will be sealed by injecting grout under pressure into the well casing. Well casings may be split prior to grouting.

Typically, the following steps will be performed to abandon a well or piezometer:

1. Remove the surface completion and surface seal.
2. Attempt to pull the well casing and screen using the rig hoist.
3. If the casing and screen cannot be pulled, attempt to drill out the casing and screen with the drill rig.
4. Once the casing and screen are removed, use the drill rig to drill out all annular seal and filter pack material.
5. Seal the well/borehole as described in Section 4.1.

If the well or piezometer cannot be pulled or drilled out, the well or piezometer will be sealed in place by injecting grout under pressure into the well casing. The PVC well casing may be split using a down-hole casing splitter prior to grouting.

All well/piezometer casing and annular materials will be handled as IDW. IDW management is addressed in the PWT Investigation Derived Waste Management SOP.

## 5.0 DOCUMENTATION

This rig geologist or other responsible person will document all borehole or well/piezometer abandonment procedures on the Well/Borehole Abandonment Form (Attachment A) and in the field logbook.

The following information will be documented:

- Borehole or well/piezometer designation
- Investigation contractor and personnel names
- Abandonment subcontractor and personnel names

- Dates of abandonment
- Measured diameters and depths of wells/boreholes and wells/piezometers prior to initiating abandonment activities
- Detailed record of abandonment procedures
- Volume of water produced and contained during abandonment
- Grout composition and quantity used
- Casing reused or left in place
- IDW generated

# ATTACHMENT A
# WELL/BOREHOLE ABANDONMENT FORM

**Pacific Western Technologies Well/Borehole Abandonment Form**

**Well/Borehole Designation** _____

**Project Information**

Project Name: _____

Investigation Contractor: _____ Rig Geologist: _____

Abandonment Contractor and Personnel: _____

Rig Type: _____ Tremie and Pumping Equipment _____

**Well/Borehole Information**

Circle one: Borehole Well

Borehole Dia. (in) _____ Borehole Depth (ft bgs) _____

Casing/Screen Material: _____ Surface Completion: _____

Depth to Water (ft ) _____ from (circle) TOC (PVC) Ground Surface

**Abandonment Information**

Date and Time of Abandonment: _____

Borehole Abandonment:

Volume of Water Displaced and Contained _____

Grout Composition _____

Volume of Grout Placed ($ft^3$ or gal): _____

Well Abandonment: Casing and annular material removed? (circle) YES or NO

Describe well and annular materials removed and/or left in place (type, length, dia., condition):

_____

Volume of Water Displaced and Contained _____

Grout Composition _____

Volume of Grout Placed ($ft^3$ or gal): _____

IDW Generated: _____

**Chronological Record of Activities (and comments)**

_____

Rig Geologist's Name and Signature: _____

# PWT STANDARD OPERATING PROCEDURE

**GROUNDWATER SAMPLING**

Procedure No.PWT/GW.101
Revision 1
Date effective: 03/01/12

APPROVED: /s/ _____ _____
PWT Project Manager, Date



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| REVISION LOG | | |
|---|---|---|
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| 0.0 | Original SOP | March 2007 |
| 1.0 | Revise for Montana Operations | March 2012 |

## 1. 0 PURPOSE

This standard operating procedure (SOP) describes procedures that will be used by PWT to sample groundwater from monitoring wells. This SOP describes equipment decontamination and transport, site preparation, detection and sampling of immiscible layers, water level measurements, well purging, sample collection, field and analytical parameters, quality assurance/quality control (QA/QC) requirements, and documentation that will be used for field data collection.

## 2.0 SCOPE

This document applies to all PWT personnel and subcontractors conducting groundwater-related work identified in project specific Quality Assurance Project Plans (QAPPs). This (SOP) describes acceptable methods for the sampling of wells and piezometers installed or monitored under the project QAPP.

## 3.0 RESPONSIBILITIES AND QUALIFICATIONS

Personnel performing groundwater sampling procedures are required to have completed the initial 40-hour OSHA classroom training that meets the Department of Labor requirements 29 CFR 1910.120(e)(3)(i), and must maintain a current training status by completing the appropriate annual 8-hour OSHA refresher courses. Personnel must also have read and signed the appropriate Health and Safety Plan(s). Prior to engaging in groundwater sampling activities, personnel must have a complete understanding of the procedures described within this SOP and, if necessary, will be given specific training regarding these procedures by other personnel experienced in the methods described within this SOP.

## 4.0 GROUNDWATER SAMPLING PROCEDURES

### 4.1 Introduction

Monitoring wells that are typically encountered or installed during environmental investigation activities are constructed of either 2 or 4 inch carbon steel, or 2 or 4-inch flush threaded PVC casing. Some temporary piezometers have been completed as monitoring wells that are usually constructed of ¾ or 1inch inside diameter, flush threaded PVC casing. Most wells have been constructed to incorporate a sump below the well screen. Since these vary in length, the well construction diagrams should be consulted to determine the sump lengths for specific wells. Most piezometers are constructed with a flush threaded cap at the bottom of the well screen. Well construction diagrams should be consulted prior to initiating field sampling and/or acquiring downhole sampling equipment to insure that the well diameter can accommodate the sampling equipment.

Procedures for groundwater sampling are designed to obtain a sample that is representative of the formation water beneath the site in question. Also, a measure of the static water elevations is important to determine the effect of seasonal horizontal and vertical flow gradient changes during site characterization activities.

Groundwater sampling procedures can be initiated after taking the required water level measurements (SOP PWT/GW.102, Water Level Measurements in Wells and Piezometers) and purging the well in accordance with this SOP. Methods for accomplishing each of these activities are included in this SOP in the following sequence:

- Collection of immiscible layers samples, if present
- Well purging and micropurging
- Groundwater sampling using a bailer
- Groundwater sampling using a peristaltic pump
- Groundwater sampling with a bladder pump
- Groundwater sampling using no-purge samplers

## 4.2 General Equipment Requirements

Down-hole sampling equipment will be constructed of inert material such as polytetrafluoroethylene (Teflon®) or stainless steel. This equipment will be assessed on an individual basis prior to use in the field.

The following is a primary list of well sampling and associated equipment:

- Bailers - Teflon®, stainless steel, or other appropriate inert materials
- Teflon® coated stainless steel cable with reels
- Peristaltic pump or bladder pump, and tubing
- Water level measuring devices - sufficiently accurate to measure water levels to the nearest 0.01 foot
- Graduated purge water containers
- Plastic sheeting
- Distilled or deionized water
- Decontamination equipment and supplies
- Organic vapor detector (OVD)
- Gloves (nitrile)
- Calculator and watch
- Sample containers precleaned to EPA specifications
- pH paper
- Custody tape
- Coolers with sufficient blue ice to cool samples to $4^0$C
- Preservatives (trace metals grade)
- Disposable in-line 0.45-micron membrane filters
- Logbooks and field forms
- Black waterproof pens
- Portable laboratory equipment for measuring field parameters for pH, temperature, specific conductance, and turbidity
- Total alkalinity reagent
- Beakers and graduated cylinders

Additional equipment may be required, to meet the subcontractor's health and safety standards, perform specialized sampling, and meet personnel and equipment decontamination requirements.

## 4.3 Equipment Decontamination and Transport

Guidelines presented in the Split Sampling Field Sampling Plan, will be followed for decontaminating equipment involved in groundwater sampling operations. Equipment associated with the tasks involved in groundwater sampling will be decontaminated prior to use in the field. All sampling equipment will be decontaminated between sample locations. If field conditions require more frequent decontamination, the frequency will be increased appropriately.

Transportation of all equipment will be performed in a manner that eliminates any possibility of cross-contamination. Calibration solutions, fuel, decontamination solutions and wastewater, and all other sources of contamination will be segregated from sampling equipment during transport. Purge water being transported to holding areas will be kept in closed containers.

If the decontamination of downhole equipment is not performed at the well, used downhole equipment will be wrapped in plastic sheeting and/or segregated from clean equipment to eliminate the possibility of cross contamination. The equipment will then be decontaminated as soon as possible.

### 4.3.1 *Routine Field Decontamination*

Decontamination of delicate equipment and the routine decontamination of sampling equipment prior to use at each well will consist of the following steps:

- The equipment will be vigorously scrubbed with a brush and solution of phosphate-free laboratory grade detergent (e.g. Liquinox) and distilled water.
- The equipment will then be rinsed thoroughly with approved distilled water.
- If the decontaminated equipment will not immediately be packaged to eliminate any adhesion of airborne impurities, an additional final rinse, or decontamination and rinse, should be performed immediately prior to actual sampling operations.

### 4.3.2 *Routine Decontamination of Sampling Pumps*

The external surfaces of all non-dedicated pumping equipment will be decontaminated as described in Subsection 4.3.1. Internal surfaces will be decontaminated according to the following procedures, except under special situations where the pump(s) must be disassembled and the internal parts cleaned separately (see Subsection 4.3.3). For routine decontamination, the following procedures will be followed:

- Pump several pump volumes of a solution of a phosphate-free laboratory grade detergent (e.g. Liquinox) and water through the equipment.
- Displace the soap solution immediately by pumping approved distilled water, equivalent to 3 or more volumes of the pump storage capacity, through the equipment.
- If any detergent solution remains in the pump, continue pumping distilled water through the system until the detergent is no longer visibly present. Sudsing will be the common indicator used to determine incomplete rinsing.

### 4.3.3 *Unusual Decontamination Requirements*

When equipment becomes grossly contaminated, such as from the collection of immiscible layer samples (see Subsection 4.5) routine decontamination of sampling equipment is not considered sufficient and thus is not allowed. This situation and other unusual equipment decontamination problems shall be reported to the field team leader. Under certain circumstances a pump can be disassembled and the parts cleaned separately using approved solvents (i.e. hexane, alcohol, etc). If specific instructions are required, the field sampler will consult with the PWT Field Team Leader for proper decontamination procedures.

4.3.4 *Disposition of Decontamination and/or Purge Water*

All water generated during the decontamination of equipment used for the sampling of wells will be containerized in either a satellite container or drum, or in a purge water container in the groundwater-sampling vehicle. It will then be disposed of according to SOP PWT/GW.105 Investigation Derived Waste Management.

All water removed from a well during sampling operations will be collected either in a satellite container, drums or the purge water collection container in the groundwater-sampling vehicle. The water from these containers will then be transferred to a contract waste disposal company for disposal, or will be delivered to an appropriate waste disposal facility. When the collection container is filled, or is near capacity, it will be secured, labeled and prepared for transfer and treatment according to SOP PWT/GW.105 Investigation Derived Waste Management.

4.4 Site Preparation

Sheet plastic may be used to protect clean equipment from contacting contaminated surfaces. Plastic bags and sheeting, along with the segregation of clean and dirty equipment, can be used to reduce the chances of cross contamination. If a mechanical bailer retrieval system is used, the amount of plastic appropriate for protection of sampling equipment may be lessened. The sample crewmembers will be responsible for determining the amount of plastic sheeting required.

Disposable nitrile gloves, or gloves made of other approved materials, will be used at all times when handling sampling equipment. Gloves will be changed between each site and as often as necessary to ensure the integrity of clean sampling equipment.

4.5 Collection of Immiscible Layer Samples

When specified in the Field Sampling Plan (FSP), or when the well to be sampled contains immiscible layers, immiscible phases must be collected before purging activities begin. The appropriate method for detecting these layers is discussed in SOP PWT/GW.102, Water Level Measurements in Wells and Piezometers. The method of choice for collecting non-aqueous phase liquids (LNAPLS) is a bottom valve bailer or peristaltic pump. Dense non-aqueous phase liquids (DNAPL) will be collected with a bottom double check valve bailer or peristaltic pump.

In all cases, the bailer will be carefully lowered into the well so that agitation of the immiscible layer is minimal. Any bailer used to collect immiscible layers will be dedicated to the well that is sampled. Peristaltic pumps will be equipped entirely with silicon, or other chemical compatible tubing, when sampling immiscible layers. The PWT Field Team Leader will be responsible for determining the type materials to be used for specific projects.

Dedicated equipment used for collecting immiscible layers will be decontaminated prior and after use as described in Subsection 4.3 of this SOP, if removed from the well. Immiscible layer sampling will be performed as follows:

- Dedicated bailers will be removed from the well and decontaminated as specified in Subsection 4.3 of this SOP. Dedicated pump tubing if used will also be decontaminated prior to use.
- For LNAPLs, the bailer intake or sampling port will be carefully lowered to the midpoint of the immiscible layer and allowed to fill while it is being held at this level. The bailer must be lowered into the immiscible layer slowly so that minimal agitation of the immiscible layer occurs. Peristaltic pump intakes will also be lowered to the midpoint of the immiscible layer.
- If a DNAPL layer is being sampled, either the double check valve bailer or peristaltic pump may be used. The bailer will be lowered into the well until bottom is encountered. Peristaltic pump intakes will also be lowered to the well bottom. Care must be taken not to immerse the pump intake into accumulated sediments.
- At no time should the bailer or line be allowed to touch the ground or come in contact with other physical objects that might introduce contaminants into the well.
- Immediately after sampling is completed, all equipment will be decontaminated. Dedicated bailers will be suspended in the well from the well cap. The bailer will be suspended above the high water level. Silicon tubing used with peristaltic pumps will be discarded.

## 4.6 Groundwater Sampling: Well Purging Method

Purging stagnant water from a well is required so that the collected sample is representative of the formation groundwater. The device used (bailer or pump) depends upon aquifer properties, individual well construction, and data quality objectives. Wells which contain immiscible layers will not be purged unless specified in the site specific work plan. Any well scheduled for purging and sampling that subsequently is found to contain immiscible layers must be reported to the PWT Field Team Leader, and the PWT Project Manager will be notified immediately prior to continued activities.

Before obtaining water level elevations or initiating purge activities, obtain the following information in reference to the well to be sampled, and enter the applicable information on the sample collection log (Form PWT.GW.101B).

- Location code (well number)
- Previous purge volume (information only)
- Depth to top of screen (bailed wells only- Form PWT/GW.101B)
- Well sample number
- COC number (Chain of Custody Number)
- Depth to bottom of well (if previously determined)

Record the location code (well number), date, sampling team members, visitors, well condition, and any other pertinent information on the sample collection log. Enter the well number, time well is opened, and other information regarding the field activities on the Field Activity Daily Log (form No PWT/GW.101A).

The field instruments will be standardized (to check calibration) and the results recorded on the sample collection form. Instruments for measurement of groundwater field parameters will be calibrated as described in the instrument instruction manual.

Water level measurements will be collected as specified in SOP PWT/GW.102, Water Level Measurements in Wells and Piezometers. Measure the depth to the top of the water column and the total depth of the well in order to determine the height of the water column in the well. Calculate the well casing volume using the well casing inner diameter and the height of the water column in the well. The formula for calculating the volume in gallons of water in the well casing is as follows:

$(\pi r^2 h)\ 7.481$ = gallons; where $\pi = 3.142$
r = inside radius of the well pipe in feet
h = linear feet of water in well
7.481 = gallons per cubic foot of water
1 gallon = 3785 ml

Calculations of the volume of water in typical well casings may be done as follows:

a. 2" diameter well:
0.16 gal./ft x ___ (linear ft of water) = gallons of water
b. 4" diameter well:
0.65 gal./ft x ___ (linear ft of water) = gallons of water
c. 3/4" diameter well:
87 ml./ft x ___ (linear ft of water) = milliliters of water

4.6.1 *Purging Duration*

Purging will be considered complete if any of the following conditions are met:

1. At least three casing volumes of water are removed from the well, and the last three consecutive pH, specific conductance, and temperature measurements do not deviate by more than the following: 1) pH =±0.2 pH units; 2) Specific Conductance = *±10%* and; 3) Temperature *± 10%* (°C). A turbidity measurement will be taken for every other purge sample for wells that are purged using a bailer. For wells that are equipped with a dedicated bladder pump, the turbidity will be measured each time the parameters are taken. The purge rate should be such that the turbidity is maintained at 5 NTU units or less (if possible). If the 5 NTU standard is determined to be unachievable due to poor well construction or geologic formation conditions, turbidity will be considered stable with three consecutive readings with ± 20%. If the readings are not stabilized after three volumes, continue purging until stabilization or until five volumes have been removed. Field parameter measurements shall be collected after every casing volume (approximate) is removed from the well. If readings do not stabilize after five well volumes have been recovered, obtain additional guidance from the PWT Field Team Leader concerning the proper course of action.

2. A well is considered dewatered when only a few milliliters of water (or none) can be recovered each time the bailer is lowered into the well. When this occurs, a 10-minute recharge rate will be calculated

(linearly). If, at the end of the 10-minute period, the well has not recovered sufficiently to continue the purge in thirty minutes, the purge is considered completed. If, at the end of the 10-minute period, there is sufficient water to collect the VOC samples, the samples may be collected at that time. If the well has not recovered sufficient water during the 10 minutes, and depending upon the well history, the samplers may elect to return to the well the same day (preferably within two hours), check the water level, and collect the VOC samples (first), and other samples as feasible. If the sample team cannot return the same day, the well will be checked in twenty-four hours to determine if sample collection is feasible. If an extended period of time is required to collect samples the procedures in Subsection 4.8.1 will be followed. The well will not require an additional purge before sampling.

Wells that dewater (have a slow recharge rate as specified in 2 above) will not be restricted by parameter stabilization requirements. Sampling of these wells will follow the protocol established in Subsection 4.8.

4.6.2 *Purging Methods*

Wells will be purged by either bailing or pumping. When purging a well, the rate of water withdrawal during purging should not exceed the rate of withdrawal at which the well was developed (if known). All purge times (initiation and completion) and the rate of purging will be recorded on the field log sheets.

4.6.2.1 Bailing

Generalized procedures for purging a well with a bailer are as follows:

- When purging a well with a bailer, the site will be prepared as discussed in Subsection 4.4. Properly decontaminated equipment will then be used to determine the static water level of the well. The total depth of the well will be measured. This information will be used to determine the volume of water in the well casing.
- Prior to the initiation of purging all dedicated bailers will be decontaminated as described in Subsection 4.3 of this SOP.
- A mechanical reel equipped with Teflon® coated stainless steel cable or nyplon rope attached to a bailer is used for bailing and sampling operations. The bailer will be slowly lowered into the well until water is encountered. Agitation of the well water will be minimized. Lowering the bailer to the bottom of the well will be avoided so sediments accumulated in the bottom do not become suspended. For wells that dewater, the bailer should not be allowed to strike the well bottom with force. The bailer will be raised ensuring that cable does not come in contact with any potentially contaminated surfaces. The bailer should be raised and lowered slowly to limit surge energy. Also, the cable should not be allowed to drag along the well casing or against other objects that will cause fraying. The amount of water purged will be monitored.

Wells with significant levels of contamination may have dedicated bailers installed. These wells will be selected by the PWT Field Team Leader. Dedicated bailer systems will consist of a Teflon® bailer with check valve or double check valve for DNAPLS and a 5-foot leader of Teflon® coated stainless steel cable. Bailer sampling attachments and the stainless steel reel cable will not be dedicated to individual wells.

Dedicated bailers will be decontaminated at the conclusion of sampling activities and suspended from the well cap above the high water table. If the well interval above the high water table is not adequate to allow for storage in the casing, the dedicated bailers will be stored in labeled and sealed plastic bags at the equipment trailer.

4.6.2.2 Pumping

Pump designs that meet the following criteria are allowed for purging:

- The pump is constructed of a material that does not introduce a source of contamination to the well.
- The pump drive system does not introduce a source of contamination into the well.
- All downhole parts to the pump can be easily decontaminated.
- A return check system that does not allow pumped water to return to the well is integral in the pump design.
- The pump is easily used and does not require excessive amounts of time to install, use, remove, and decontaminate.

The pumps currently in use to purge groundwater include peristaltic pumps and dedicated submersible bladder pumps. A procedure for the use of each style of pump is specific to its applications. User manuals, which accompany each pump, will be referenced for operating procedures.

Basic operating procedures common to all pumps are as follows:

- Regardless of the type of pump being utilized, the site will be prepared as described in Subsection 4.4.
- Wells utilizing peristaltic pumps will use properly decontaminated equipment to determine the static water level and the total depth of the well. This information will be utilized to determine the volume of water in the well casing.
- Any tubing that enters the well casing should be composed of inert material. Disposable silicon tubing will be used in the drive mechanism of peristaltic pumps and discarded after each well is purged. The air supply for all air driven pumps (dedicated bladder pumps) will be free of oil (i.e., no hydrocarbon containing substances will be added to the compressor).

## 4.7 Groundwater Sampling: Micropurge Method

02/11/00

The objective of micropurge low flow groundwater sampling is to obtain representative groundwater samples with minimal impact (i.e. drawdown) to the sampled water-bearing zone. This procedure is particularly useful where one does not want to impact vertically adjacent water-bearing zones, such as monitored in nearby nested wells or multiple completed wells (more than one casing in the same well bore). Another advantage of this method is that the low groundwater velocity during sampling minimizes total suspended solids, and results in the generation of less purge water needing disposal. There are also other unusual situations that may benefit from the use of this method (Galloway 2000).

Although this method is called “micropurge” or “low flow”, a limited volume of water must be purged from the screened interval to insure that aquifer water is being sampled. The volume to be purged is provided below.

- Locate appropriate sampling equipment (see Section 4.2).
- Measure depth to water (within +/- 0.01 feet).
- Obtain specific well completion information for each well. Calculate the volume of water in the screened interval:

  $(\pi r^2 h)$ 7.481 = gallons; where $\pi = 3.142$
  r = inside radius of the well pipe in feet
  h = linear feet of water in screened interval of well
  7.481 = gallons per cubic foot of water
  1 gallon = 3785 ml
- Install new sample tubing to the middle of the screened interval.
- Pump water from the well at low flow rates while measuring changes in depth to water, and capturing all removed water. A typical low flow range provided in the literature is 0.0372 to 1.9 L/min (or 0.01 to 0.5 gal/min). A commonly available peristaltic pump can pump as little as 0.065 gal/min, depending on conditions. Flow rate should be kept as low as possible to minimize time required to reach stable head conditions without exceeding guidelines concerning total drawdown.
- Pump until steady-state conditions are achieved. The flow rate can be adjusted to the lowest possible flow rate if necessary to obtain steady-state conditions. The sampler must use good judgment to determine how long to pump in order to establish steady-state conditions, both to ensure that steady-state conditions have actually been achieved and to avoid excessively long sampling times. If steady-state conditions cannot be achieved the sampler should note that the monitoring well is dewatering. While attempting to establish steady-state head conditions, measure physical parameters (pH, conductivity, and temperature at a minimum) in the purged water as identified in required by SOP PWT/GW.108. Collect a series of physical parameter readings prior to sampling to confirm that steady-state head conditions will yield representative samples. The physical parameter measurements can continue through the next step listed below. Use the 10% difference procedure outlined in SOP PWT/GW.108 to determine if a small amount of additional purging may be necessary, despite achieving steady-state head conditions. The 10% “rule” is not an absolute criterion in this case for accepting or rejecting samples, but rather a guideline to assist in establishing the appropriateness of this method for the sampled wells.
- Collect the necessary samples, while maintaining steady-state conditions. After collecting the sample, measure the physical parameters one last time for confirmation. This data shall be provided to the PWT Project Manager at the end of the day for evaluation.
- Maintain chain of custody protocols per the QAPP.

During the sampling process, record at least the following:

- Flow rate;
- Depth to water (multiple measurements, including time of measurement);
- Duration of pumping;
- Screened interval volume;
- Total volume of water removed;
- Time of sampling;
- Physical parameters.

## 4.8 Field Parameters

Manufacturer's instructions will be followed when using field sampling meters for measurement of groundwater field parameters. The following field parameters will be measured during groundwater purging operations unless otherwise specified by the PWT Team Leader:

| Parameter | Relative Precision | Minimum Calibration |
|---|---|---|
| pH | 0.2 pH units | Daily |
| Conductivity | 10 uS/cm | Daily |
| Temperature | 1 $^{0}$C | Weekly |
| Total Alkalinity (unfiltered) | 1 mg/l | None |
| Turbidity (photometric) | 2 FTU (or NTU) | Specified purge samples (bailed wells) Daily (dedicated bladder pump wells) |

The field parameter measuring equipment will be stored and handled in a manner that will maintain the integrity of the equipment. Specific procedures and requirements for calibration and use of measuring equipment are given in the instruction manual for the measuring equipment. Appropriate instruction manuals will accompany each instrument in the field. Each instrument will also be given an identification number. All logbook and field form references to individual instruments will refer to this number for ease of identification.

Field parameters will be measured at the following intervals:

- Conductivity, pH, temperature, and turbidity will be measured from the first water removed from the well when initiating well purging procedures. For bailed wells, the initial bail of water will be carefully removed from the well and the water transferred to a sample beaker by decanting the bailer through a bottom control valve. Wells purged with a peristaltic pump will similarly collect the first water removed in a sample beaker to be measured for parameters. Wells with dedicated pumps will measure the parameters of the first recovered water that is collected in the continuous sampler.
- During purging operations, conductivity, pH, and temperature will be measured for every casing volume (as calculated on the sample collection log form) of water removed from the well (because of the accuracy of the graduated containers for the purge water, the purge volume will be estimated as close as feasible). Turbidity will be measured on every other sample recovered for parameters for bailed wells, or wells purged with a peristaltic pump. All parameters, including turbidity, will be measured at predetermined intervals while purging wells with dedicated pumps.

- During purging, if a well is dewatered prior to the measurement of the final required set of parameters, then conductivity, pH, temperature, and turbidity will be measured immediately before the start of sample collection. These parameters may be delayed until sampling is completed if, at the discretion of the sampling crew, the well recharge has provided insufficient water volume to collect all the samples and also measure parameters. If there is insufficient water for samples and field parameters, the parameters will not be measured.
- Total alkalinity measurements will be collected only once upon completion of purging. For wells that do not dewater and sample collection proceeds to completion immediately after purging, alkalinity will be measured after the completion of all other final purge field parameters. Wells that dewater and require repeated visits for the collection of samples will have alkalinity measured subsequent to the collection of the sample for inorganic water chemistry. Alkalinity will not be measured if sufficient water is not available.
- For micro purged wells, a purge is considered completed when the parameters have stabilized.
- Whenever a method used to remove well water is changed, a set of field parameters will be recorded from water removed with the new method.

## 4.9 Groundwater Sampling

Techniques used to withdraw groundwater samples from a well will be based on consideration of the parameters of interest. The order of collection, collection techniques, choice of sample containers, preservatives, and equipment are all critical to ensure that samples are not altered or contaminated. The preferred methods for collection of groundwater samples are either bailing and/or the use of bladder pumps.

### 4.9.1 *Sample Collection*

The following discussion involves collection of groundwater samples using bailers, and peristaltic or bladder pumps. Regardless of the purge and collection method, care will be taken not to alter the chemical nature of the sample during the collection activity by agitating the sample or allowing prolonged contact with the atmosphere. In order to assist in minimizing the potential for altering the sample and maximizing the available water, the following sample collection sequence is preferred:

- VOC
- SVOC
- Pesticides/PCB
- Dissolved Metals – CLP Standard Analyte List
- Total Metals – CLP Standard Analyte List
- TDS, CL, F, SO4, CO3, HCO3

Upon completion of purging, VOC samples will be collected first and as soon as possible after the well has been purged.

The containers used for sample collection from poor producing wells may differ from those used for high yield wells in some instances due to constraints on obtaining enough sample to fill sample containers. In some instances smaller containers may be utilized, or analyte samples normally collected in separate containers may be

combined into a single container. Well histories can be used to identify which wells may require a modified sample suite and an extended sampling period. These wells will initially be sampled within 48 hours after the completion of purging with the completion of purging considered to be hour 0. The accumulated sample will be compared to the minimum volume requirement identified in Table PWT/GW.101-1, and the allowed sample holding time. If the minimum volume requirement for the sampling suite has not been achieved, then the order of sample collection may be changed based on the sampling volume required. All samples that have only minimum sample volumes collected, and all uncollected samples will be documented on the sample collection log.

Sample containers will be stored away from sunlight and will be cooled to $4^{o}$C prior to filling. Immediately after collection, samples requiring cooling will be cooled to $4^{o}$C. A chilled cooler will be used as the storage container. Whenever a sample bottle that requires chilling is not being physically handled, it will be placed in the cooler to prevent heating or freezing, exposure to sunlight, and possible breakage.

VOC samples that will be collected using a bailer will be equipped with a bottom-decanting control valve or directly from the pump discharge line on wells equipped with bladder/peristaltic pumps. VOC vials will never be filled and stored below capacity because of insufficient quantities of water in the well. Except for the VOC vials, adequate air space should be left in the sample bottles to allow for expansion. The procedures for collecting VOC samples are discussed in Subsection 4.9.1.1of this SOP.

Sites will be prepared prior to sampling as described in Subsection 4.4. All necessary and appropriate information will be recorded on the sample collection log (form PWT/GW.101B) and on the Field Activity Daily Log (form PWT/GW.101A).

Samples will be placed in the appropriate containers and packed with ice in coolers as soon as practical. VOC samples will be stored in the cooler immediately after collection. Packaging, labeling, and preparation for shipment will follow procedures as specified in the project specific Quality Assurance Project Plan (QAPP). When sampling is complete, the well cap will be replaced and locked.

Sampling tools, instruments, and equipment will be protected from sources of contamination before use and decontaminated after use. Liquids from decontamination operations will be handled in accordance with the procedures in Subsection 4.3.4 of this SOP. Sample containers will also be protected from sources of contamination. Sampling personnel will wear chemical-resistant gloves (e.g. nitrile) when handling samples and the gloves will be disposed of between well sites.

#### 4.9.1.1 Groundwater Sampling Using a Bailer

This Subsection describes the use of a bailer for collecting groundwater samples. A bailer attached to a Teflon® coated stainless steel cable or nylon rope is carefully lowered into the well. After filling within the well, the bailer is withdrawn by rewinding the line, and the bailer contents are drained into the appropriate containers. Certain recommendations and/or constraints should be observed when using bailers for sampling groundwater quality monitoring wells:

- Only bottom-filling Teflon® bailers or bailers made of other inert materials will be used. Bailers constructed with adhesive joints will not be used.

- Bailers will be attached to a Teflon® coated stainless steel line that is pre-wound on a reel, or nylon rope.

**TABLE PWT/GW.101-1**
**SAMPLE CONTAINERS AND PRESERVATIVES FOR GROUNDWATER SAMPLES**

| PARAMETER | MINIMUM CONTAINER[1] | PRESERVATIVE | HOLDING TIME |
|---|---|---|---|
| VOC - CLP | 3 - 40ml amber glass | Cool to 4°C | 7 Days |
| SVOC/BNA | 2 L amber glass | Cool to 4°C | 7 Days |
| OCP Pesticides | 2 L amber glass | Cool to 4°C | 7 Days |
| TDS, Cl, F, $SO_4$, $CO_3$, $HCO_3$ | 1 L poly | Cool to 4°C | 7 Days |
| Filtered Metals – SW-846, | 1 L poly | *Filtered, $HNO_3$ to pH <2, Cool to 4° | 6 Months |
| Unfiltered Metals – SW-846 | 1 L poly | Unfiltered, $HNO_3$ to pH <2, Cool to 4° | 6 Months |

[1] The volume listed is the minimum amount required for analysis. Actual sample volumes may be slightly higher and some parameters may be combined in a single container.

* Some samples may not require filtering if taken from a well with a dedicated pump and turbidity of 5 NTU or less. Add preservative to the sample bottle prior to introduction of the filtered sample water.

Lower the bailer slowly to the interval from which the sample is to be collected. VOC samples will be collected using a bailer equipped with a bottom-decanting control valve. The first water through the valve assembly will be discarded into the purge water container. Vials will be filled by dispensing water through the control valve along the inside edge of the slightly tilted sample vial. Care will be taken to eliminate aeration of the sample water. The vials will be filled beyond capacity so the resulting meniscus will produce an airtight seal when capped. The capped vial will be checked for trapped air by lightly tapping the vial in an inverted position. If air becomes trapped in the vial, the sample water will be discarded, and the vial will be refilled. If two consecutive attempts to fill a VOC vial result in trapped air bubbles, the vial will be discarded.

The remainder of the sampling water will be collected in a stainless steel container from which the remaining sample bottles will be filled. Samples requiring filtration will be filtered and then containerized.

4.9.1.2 Groundwater Sampling Using a Peristaltic Pump

Use of peristaltic pumps will generally be limited to collecting sample aliquots where the water table is relatively shallow. All downhole tubing will be Teflon® except in areas of special concern (e.g., where immiscible layers exist) where special tubing, such as stainless steel or Viton®, may be required. If so, this will be determined and provided by the PWT Field Team Leader. Only the portion of tubing that is inserted into the mechanical drive will be made of silicon. This drive portion of the tubing will be discarded after each use. See Section 4.7 for micropurge sampling requirements.

#### 4.9.1.3 Groundwater Sampling Using a Downhole Bladder Pump

Wells may be equipped with dedicated downhole bladder pumps for purging and sampling of the wells. These are wells that will normally produce an adequate amount of water during a single visit to complete the required sampling suite. The equipment required to purge and sample a well consist of a pump control unit, a portable air compressor, a continuous sampler for measuring the field parameters, and the necessary sample containers, graduated cylinders, and container(s) to collect the purge and excess water. See Section 4.7 for micropurge sampling requirements.

The following precautions should be observed during the sampling operation:

- The compressor used to power the pump will be located downwind from the well to eliminate the contamination of equipment and samples with exhaust.
- If the flow-through cell will not maintain a full sample chamber (tends to drain back), then the check valve on the pump is fouled and needs to be cleaned, or the pump replaced.
- The minimum purge volume is routinely calculated using the static water level and the conversion factors on Form PWT/GW.101B. However, a purge is considered completed only when the groundwater parameters have stabilized.
- Upon completion of purging, sampling should be initiated with the collection of the VOC sample(s). The pump should operate with minimum interruptions while the full sample suite is collected. Allowing the pump to stop for an extended period of time will cause the water trapped in the discharge lines to equilibrate to ambient temperatures which is not acceptable. During sampling, the pump can be slowed to any rate that allows efficient sampling while also maintaining stable field parameters.
- Groundwater parameters will be measured periodically during sample collection and recorded on Form PWT/GW.101B to document conditions during sampling.
- Because micropurging is the method used for sampling, the flow rate should be adjusted to limit the drawdown in the well. The rate should also be adjusted such that the turbidity is below 5 NTU for sampling. If this is met, the samples need not be filtered.
- The pump, pump control unit, and the flow-through cell will be operated according to the manufactures recommendations.

#### 4.9.1.4 Groundwater Sampling Using a Push Type Sampler

This portion of this SOP describes the use of a Geoprobe® Screen Point 15 Groundwater Sampler, or similar type equipment, for collecting groundwater samples at predetermined depths. These samples may be used to obtain physical, chemical, or radiological analyses.

A Geoprobe® Screen Point 15 Groundwater Sampler, or equivalent tool, is driven to a predetermined depth by a push type-sampling rig. The Screen Point 15 Groundwater Sampler is equipped with a 41-inch retractable screen and expendable drive point. It can then be partially or fully withdrawn (up to 41 inches) to expose a portion or the entire deployed well screen. After groundwater enters the exposed screen, a sample is collected using either the procedures in Subsection 4.8.1.1, Groundwater Sampling Using a Bailer, or in Section 4.8.1.2, Groundwater

Sampling Using a Peristaltic Pump. Note that these samples are collected only for screening purposes because the sampling tool hole has not been completed as a well.

The method for obtaining QC samples using the push type-sampling tool will follow the method described in Subsection 4.8.4.1 for groundwater sampling. Duplicate groundwater samples will be collected only if there is enough water to collect two full suites of analytes without dewatering the annulus. If insufficient water is available for the collection of a planned QC sample, it well be explained and documented in the field log book, and the PWT Field Team Leader will be informed about any deviation from the planned QA/QC sampling goals. If insufficient water is available for two full suites of analytes, it may be come necessary to prioritize the analyte list. The prioritization sequence should be described in the project specific work plan.

4.9.2 *Sample Filtering and Preservation*

Samples for dissolved metals will be filtered in the field at the well location during the sampling event through a disposable 0.45-micrometer membrane filter. If a peristaltic or bladder pump is being utilized, a disposable filter may be attached directly to the sample delivery line so that the sample is filtered directly into the sample container as it exits the delivery line. Discharge pressure will be gauged so it does not exceed 50 psi. Alternatively, sample water may be collected in a stainless steel container and filtered with a peristaltic pump. Before sample collection, 100 to 200 milliliters of sample water will be passed through the filter in order to rinse the filter and filtration apparatus of possible contaminating substances.

Preservatives will be added to the sample bottles prior to the introduction of the filtered sample water. The preservative will be added in aliquots appropriate to the size of the bottle. After sample collection has been completed the pH of preserved samples will be checked as follows:

- A small amount of sample will be poured from the sample bottle directly onto approved pH paper. Care will be used so that the threaded neck of the bottle does not contact the pH paper. Under no circumstances should the pH paper be inserted into the sample bottle.
- The pH paper will be checked against the supplied color chart. If the appropriate pH has not been achieved, additional preservative will be added to the sample in 5ml aliquots, and the pH test will be repeated.

4.9.3 *QA/QC Samples*

The frequency and types of field QA/QC samples collected during groundwater sampling are described in the QAPP. This document details the applicable criteria for collecting QA/QC samples.

4.9.3.1 Duplicates

Duplicate samples will be collected only from wells that produce enough water to collect two full suites of analytes without dewatering. The wells which produce sufficient water will be incorporated into the sampling program such that the required duplicate frequency can be maintained.

Wells scheduled for duplicate sample collection will be sampled as described in Subsection 4.8 of this SOP, and in the QAPP. Field duplicates are collected following the same sampling procedures used to obtain the real samples. With the exception of VOCs, the typical procedure for a location is to collect the real and duplicate of each sample at the same time, in two equal portions, with each portion going to the laboratory in separate containers. This is accomplished by alternately filling two sample bottles one half at a time to minimize heterogeneity. VOC samples will be collected independently to reduce the possibility of volatilization of the sample.

When a well with a dedicated pump is being used for sample collection, all samples will be collected in the normal order, with duplicate VOC samples being collected first. The remaining samples will be sampled as described above.

If a well is being used for matrix spike (MS) and matrix spike duplicate (MSD) samples the duplicate will be collected after collection of the MS and MSD.

All duplicate samples will be given a sample number different from the original sample and the information recorded on form PWT/GW.101B, as associated QC samples.

4.9.3.2 Matrix Spike and Matrix Spike Duplicate

MS and MSD samples will be collected only from wells that produce enough water to collect the required suites of analytes without dewatering. MS and MSD samples are not collected on a routine basis, but will be collected if so designated in the QAPP, or if requested by the PWT Field Team Leader.

MS and MSD samples will be collected as follows:

- The well will be purged as described in Subsection 4.6 of this SOP.
- After completion of purging, VOC samples will be collected. The real sample will be collected followed by the MS and MSD. These samples will be collected in immediate succession.
- The remaining parameters not requiring filtering will be collected. For each sample parameter, the original sample, MS, and MSD will be collected concurrently. The original sample bottle will be filled one-third full followed by the MS and MSD sample bottles, which will also be filled one-third full. Each bottle will be rotated in the sequence, filling in one-third full until all three bottles are full. For analytes not requiring a MSD, only the original sample and the MS will be collected.
- After the real sample, MS, and MSD (where appropriate) are collected for one parameter, the process will be repeated for the next parameter.
- Parameters requiring filtering will be collected similarly. When a bailer is used, a stainless steel bucket will be filled with sample water. As samples are collected and the reservoir of water in the bucket is depleted, additional water may be added at the discretion of the sample crew. When a pump is used, the filter will be attached directly to the discharge line. Sample bottles will be filled as described above, partially filling the original sample, MS, and MSD in rotating sequence until each parameter bottle is full.
- Field parameter measurements will not be required for MS and MSD samples.

- MS and MSD samples will retain the original sample number. However, a suffix of MS or MSD will be added to the sample number to correspond with each QA/QC sample. All information will be recorded on form PWT/GW.101D, Field QC, Groundwater Sample Collection Log.

4.9.3.3 Replicates and Splits

Replicate and split samples will be collected in the same manner as described for the MS and MSD. Replicates and splits exceeding three samples will be referred to the PWT Field Team Leader for further instructions. All information will be recorded on form PWT/GW.101B.

4.9.3.4 Field Equipment Rinses

Wells scheduled for equipment rinsate samples will be sampled as described in Subsection 4.8 of this SOP, and field equipment rinses will be collected in a manner designed to reflect sampling techniques. All equipment used during sampling will be fully decontaminated as described in Subsection 4.3, then rinsed with distilled or deionized water. The rinse water will then be collected in bottles identical to those used for the original sample, and assigned a separate sample number. Analytes requiring filtration will be filtered using a new filter and tubing as required for the real sample. If disposable or dedicated bailers are used for sampling, rinsate samples need not be collected. All information will be recorded on form PWT/GW.101B.

4.9.3.4.1 Bailed Wells

After completion of sampling, all equipment will be decontaminated. Prior to leaving the well location, the equipment rinse will then be collected as follows:

- The bailer will be filled with distilled or deionized water by pouring the water into the top opening.
- The rinse water should then be decanted to the VOC vials through the bottom valve. This will be done in the same manner used during sample collection.
- For the remaining unfiltered samples, the bailer will be filled with distilled or deionized water each time additional rinsate is needed. The rinsate will then be transferred to sample bottles or to a stainless steel bucket and then to sample containers in the same manner used during collection.
- Filtered samples will also be collected in an identical manner as the real samples. The bailer will be filled with distilled or deionized water. The rinse water will then be transferred to a stainless steel bucket. The rinse water in the bucket will then be filtered through a new disposable filter.
- Rinse samples will be preserved in the same manner as the real samples.

4.8.3.4.2 Pumped Wells

Rinsate samples are not routinely collected from wells that are equipped with dedicated bladder pumps because the samples from these wells are collected directly from the pump discharge line. However, wells sampled using peristaltic pumps for sampling may be selected for rinsate sampling, with equipment used in sample collection (down hole tubing, filter tubing and the stainless steel bucket used for sample water collection, etc.) being decontaminated prior to rinsate sampling. The tubing at the pump head will be replaced, and a new filter used for filtered analytes. To collect the samples, distilled or deionized water will be poured into the decontaminated

stainless steel bucket and pumped, using the decontaminated tubing, into the sample containers. The equipment used to collect the real VOC samples will also be decontaminated, rinsed, and used to collect the VOC rinse samples. All samples will be preserved at the same pH levels as the real samples.

4.9.3.5 Field, Temperature and Trip Blanks

Temperature and Trip blanks are samples that are made up by the analytical laboratory and will accompany the sample cooler from the lab to the field and back to the lab. In general, temperature blanks will accompany each sample cooler shipped to the laboratory. Trip blanks will accompany the coolers that contain VOCs only. Distilled water field blanks are not submitted on a routine basis, but will be made up if so designated in a site specific sampling plan, or if requested by the PWT Field Team Leader. Samples of the distilled or deionized water used for the final decontamination of equipment will be transferred directly to sample bottles to determine any baseline contamination the water may have introduced into the samples. Five gallon bottles of the distilled or deionized water water will be opened in a controlled area, such as the bottle storage room, and then poured directly into the appropriate sample bottle. A Teflon®, glass, or stainless steel funnel may be used to help control flows into small mouth bottles. Field blank samples will be preserved to the appropriate pH required for each analyte. All information will be recorded on form PWT/GW.101B.

4.10 Sample Handling and Control

Pre-cleaned sample containers will be obtained from the contract analytical sample container source. Preserving solution will be added to the bottles by a laboratory, the sample manager or qualified personnel at the sample site. The bottles will be labeled to indicate the preservative added.

The sampling containers, preservation requirements, and holding times for the various types of analyses are shown in Table PWT/GW.101-1. Additional information on containerizing, preserving, and handling of the water samples is given in the QAPP. Groundwater samples will be properly labeled so that they can be easily identified. The sample numbering system has been established in the QAPP.

## 5.0 RECORDS

All field activities will be recorded on Forms PWT/GW.101A, Field Activity Daily Log and PWT/GW.101B, Groundwater Sample Collection Log. Summary information of the day's activities or other pertinent information should always be recorded on the field forms. Under special circumstances the PWT Field Team Leader may assign a bound field logbook to the field personnel which will remain in their custody during all sampling activities. The cover of each logbook will contain the following information at a minimum:

- Name of the organization to which the book is assigned
- Book number
- Project name
- Start and end dates

Logbook pages will be sequentially numbered and marked with the book number before any data recording. All data and information pertinent to field sampling will be recorded in the logbook or on the field forms that

identify all required data entries. Enough detail must be included in the documentation to reconstruct the sampling event. Field form entries will include the following minimum information:

- Date and time
- Names of field personnel
- Names of all visitors
- Location of field activities
- Description of sampling sites including weather conditions
- All field observations and comments
- Field parameters
- Sample identification information
- References to all prepared field activity forms and chain-of-custody records

Field logbooks, when required on specific projects, will be used only to summarize field activities and to document project information not required by the SOP field forms.

Logbooks will be maintained and entries made in accordance with PWT procedures. Permanent ink will be used for all entries in the logbooks and on the field forms. Mistakes will be crossed out with a single line, initialed, and dated. Unused pages or partial pages will be voided by drawing a line through the blank sections that is initialed and dated. Any deviation from this SOP will require documentation in the Field Team Leader's logbook.

The field activity daily log narrative should create a chronological record of the sampling team's activities, including the time and location of each activity. Descriptions of problems encountered, personnel contacted, deviations from the SOP, and visitors on site should also be included. The weather conditions, date, signature of the person responsible for entries, and the number of field activity daily log sheets used to record media team activities for a given day will also be included.

The Groundwater Levels Measurement/Calculations Form (see SOP PWT/GW.102, Water Level Measurements in Wells and Piezometers) will also be completed for each site. All blank fields on the forms must be completed or voided.

## 6.0 REFERENCES

### 6.1 Source References

The following references were reviewed before this procedure was written:

Barcelona, M.J., Varljen, M.D., Puls, R.W., and Kaminski, D., 2005, *Ground Water Purging and Sampling Methods: History vs. Hysteria*. Ground Water Monitoring & Remediation, v. 25, no. 1, page 52-62.

Galloway, Michael J. 2000. *Discussion of "Active Monitoring and Thoughtful Remediation,"* by Michael J. Barcelona, Ground Water Monitoring & Remediation, v. 20, no.2, page 4. Groundwater Monitoring & Remediation v. 20, no. 3, page 194.

Environmental Protection Agency EPA). 1982, *Test Methods for Evaluating Solid Waste, SW-846, Volume II. Field Methods*, 2nd edition.

EPA. 1986a, *Engineering Support Branch Standard Operating Procedures and Quality Assurance Manual*, EPA Region IV Environmental Service Division.

EPA, September 1986b, *RCRA Ground Water Monitoring Technical Enforcement Guidance Document*, OSWER-9950.1.

EPA, 1987a, *A Compendium of Superfund Field Operations Methods*, EPA/540/P-87/001. 1987.

EPA, 1987b, *Data Quality Objectives for Remedial Activities, Development Process*, EPA/540/G-87/003.

EPA, 1996, *Low Stress (low flow) Purging and Sampling Procedure for the Collection of Ground Water Samples from Monitoring Wells*. USEPA Region 1 SOP # GW 0001, July 30, 1996.

EPA. 2011. *Contract Laboratory Program Guidance for Field Samplers*. EPA/540/R-09/03.

Puls, Robert W. and Barcelona, Michael J., 1996, *Low-Flow (minimal drawdown) Ground Water Sampling Procedures*. USEPA Ground Water Issue/540/S-95/504, April 1996.

Sevee, John E., White, Carol A., and Maher, David J. 2000. *An Analysis of Low-Flow Groundwater Sampling Methodology*, Ground Water Monitoring & Remediation, v. 20, no. 2, page 87 – 93.

## 6.2 Internal References

Related SOPs cross-referenced by this SOP are as follows:

- SOP PWT/GW.102, Water Level Measurements in Wells and Piezometers
- SOP PWT/GW.106, Well Development
- SOP PWT/GW.108, Measurement of Groundwater Field Parameters
- SOP PWT/GW.105, Investigation Derived Waste

# APPENDIX A

# STANDARD GROUNDWATER FORMS

**SOP**

FORM PWT/GW101A

# FIELD ACTIVITY DAILY LOG

PROJECT NO.

| | | | |
|---|---|---|---|
| PROJECT: GROUNDWATER SAMPLING PROGRAM | | | |
| FIELD ACTIVITY SUBJECT: | | | |
| DESCRIPTION OF DAILY ACTIVITIES AND EVENTS: | | | |
| | | | |
| Air Monitoring Ins.: | Water Level Ind.: | Field Parameter Kit: | Solomat No.: |

| | | |
|---|---|---|
| VISITORS ON SITE: | OK | SUPPORTING DOCUMENTS |
| | | A: DATE- |
| | | B: DATE |
| | | C: WELL ID- |
| | | |
| WEATHER CONDITIONS: | | D: DATE- |
| | | OTHER |
| | A: WATER LEVEL MEASUREMENT | B: AIR MONITORING |
| | C: SAMPLE COLLECTION LOG(S) | |
| | D: WELL STATUS LOG | |

| | |
|---|---|
| SAMPLING TEAM PERSONNEL: | |
| SIGNATURE OF PREPARER: | DATE: |

**SOP**

FORM PWT/GW101B

GROUNDWATER SAMPLING IN MONITORING WELLS

## Pacific Western Technologies Groundwater Sample Field Data Sheet

| | |
|---|---|
| **Sample Identification No.:** | |
| Chain of Custody No.: | |
| **Project Information** | |
| Project Name: | Task No. |
| Field Team Leader: | Crew: |
| **Well Information** | |
| Well No.: | Well Dia. (in): |
| Screen Interval Depth: | Screen Interval Formation: |
| Total Well Depth: | Pump Depth: |
| **Well Purging Information** | |
| Date and Time of Well Purging: | |
| Depth to Water Level (ft-below TOC): | |

| *Well Diameter (inches)* | *2* | *3* | *4* | *6* |
|---|---|---|---|---|
| *Volume (gal/ft)* | *0.1631* | *0.3670* | *0.6524* | *1.4680* |

| | |
|---|---|
| Well Casing Volume (gallons): | |
| PID/FID Reading in Casing: | |

**Field Water Quality Parameters During Well Purging**

| | Initial | 1st Vol | 2nd Vol | 3rd Vol | 4th Vol | 5th Vol | Sample |
|---|---|---|---|---|---|---|---|
| Time | | | | | | | |
| Volume (Gallons) | | | | | | | |
| pH (SI units) | | | | | | | |
| Temperature (˚C) | | | | | | | |
| Specific Conductance (µs/cm) | | | | | | | |
| DO (mg/l) | | | | | | | |
| Turbidity (NTU) | | | | | | | |
| Color | | | | | | | |
| Other | | | | | | | |

**Sample Collection Information**

| | | | |
|---|---|---|---|
| Date and Time of Sample Collection: | | | |
| Sampling Method (circle one): Bailer Peristaltic Pump Diffuser Micro-Purge Field Filtering Analysis | | | |
| Containers | Number | Preservatives | Analyses |
| | | | |
| | | | |
| | | | |
| | | | |
| Associated QA/QC Samples: | | | |
| Comments/Observations: | | | |

**Reviewed for Completeness (sign and date below):**

**Sampler:** **Reviewer:**

# PWT STANDARD OPERATING PROCEDURE

**WATER LEVEL MEASUREMENTS IN WELLS AND PIEZOMETERS**

Procedure No. PWT/GW.102
Revision 1
Date effective: 3/31/07

APPROVED: _____ _____ Page 1 of 16
PWT Project Manager Date

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## 1.0 PURPOSE

This document contains guidelines for measuring water levels in wells and piezometers. Water level data can be obtained from wells and piezometers, or from surface water manifestations of the groundwater systems such as springs, lakes, and streams.

## 2.0 SCOPE

This document applies to all PWT personnel and subcontractors conducting groundwater-related work on the Vasquez/I70 Phase II RI/FS project. This document, which constitutes a Standard Operating Procedure (SOP), describes various acceptable methods for measuring water levels in wells and piezometers that will meet regulatory guidelines of accuracy.

## 3.0 REQUIREMENTS

The following sections identify the personnel qualifications and equipment for measuring water levels in wells and piezometers.

### 3.1 Personnel Qualifications

Personnel performing water level measurement procedures are required to have completed the initial 40-hour OSHA classroom training that meets the Department of Labor requirements 29 CFR 1910.120(e)(3)(i), and must maintain a current training status by completing the appropriate annual 8-hour OSHA refresher courses. Personnel must also have read and signed the appropriate Health and Safety Plan(s). Prior to engaging in water level measurement activities, personnel must have a complete understanding of the procedures described within this SOP and, if necessary, will be given specific training regarding these procedures by other personnel experienced in the methods described within this SOP.

Only qualified personnel will be allowed to perform these procedures. Required qualifications vary depending on the activity to be performed. The subcontractor's project manager will document personnel qualifications related to this procedure in the subcontractor's project QA files.

### 3.2 Equipment

The following is a list of basic equipment typically required when measuring water levels. Additional equipment may be required in less typical applications, and will be specified in the project-specific work plan or other appropriate document.

- Groundwater Level Measurements/Calculations forms (Form PWT/GW.102A)
- Electronic water level sounder
- Manometer and appropriate polyethylene or polytetrafluoroethylene (PTFE, e.g., Teflon™) tubing
- Interface probe (If required)
- Graduated steel tape and carpenter’s chalk (if required)
- Decontamination equipment and supplies
- Health and safety equipment and supplies (organic vapor monitor and personal protective equipment)

In most water level measuring activities, an electronic water level sounder is preferred. However, some small-diameter well points exist which require the use of a manometer, and some wells may contain immiscible layers that will require an interface probe and/or graduated steel tape and chalk. Some wells may contain down-hole pressure

transducers that will require additional equipment such as a portable computer, diskettes, and the manufacturer's instructions for downloading data, and form PWT/GW.102B.

## 4.0 INSTRUCTIONS

Field measurements typically include depth to standing water and the total depth of the well. Water level measurements will be recorded to the nearest 0.01 foot as specified by the RCRA Groundwater Monitoring Technical Enforcement Guidance Document.

Each well will have a permanent, easily identified measuring point (MP) from which the water level measurement will be made. For the purpose of this SOP, the MP is defined as a surveyed point notched into the northern edge of the inner polyvinyl chloride (PVC) or stainless steel casing. If an MP is not established in a well, the water level will be measured from the northern edge of the inner casing, and the point marked by notching with a file. The addition of the permanent MP will be noted on form PWT/GW.102A.

In addition, the following conditions must be considered in order to obtain acceptably accurate groundwater level measurements:

- Water levels in wells and piezometers will be allowed to stabilize for a minimum of 24 hours following installation or development before the water level is measured. Water levels require varying time periods to reach static conditions in new wells; therefore, the date and time of well construction, and the date, time, and reading of the initial water level measurement will be noted.

- Water levels should be measured before initiating purging and sampling activities.

- At some locations multiple sampling events may occasionally occur over a few days. For wells that recharge slowly the water level measured at such a well may not reflect static water conditions. In order to prevent a misinterpretation of static water levels in these cases, the date of the last sampling or well purging event will be documented in the water level measurement database.

- Static water levels will usually be measured with electronic sounders. If the well or piezometer is too small in diameter to accept an electronic sounder, a manometer and appropriately sized tubing will be used. If non-aqueous phase liquids (NAPLs) are potentially present, an interface probe will be used. In some cases, a graduated steel tape and carpenter's chalk may be preferable to an interface probe.

- Water level measurements that show the water level to be within the well sump will be considered technically dry for purposes of recording water level information.

### 4. 1 Surveying the Measuring Point

Each well must have a permanent, easily identified, notched MP on the north edge of the inner PVC well casing. The elevation of the MP should preferably be established by a licensed surveyor, and should be referenced to an established benchmark. However, depending upon the purpose and location of some wells, the coordinates of the wells and the elevations of their respective MP's may be established by use of Global Positioning System (GPS) technology. In this case the elevation will be established to the nearest foot. For consistency, water level measurements must be referenced to the same datum or elevation. The MP is surveyed with reference to the land surface datum (LSD), and all water levels and total depth measurements are converted to elevations expressed as mean sea level (MSL).

A reference point (RP) for water level measurements is an additional datum elevation established from a permanent benchmark and surveyed by a licensed surveyor. The RP is usually located on the top of the outer steel casing of a well and is used as a backup to the MP. If the MP is disturbed or destroyed, the RP will be used to establish a new MP.

### 4.2 Using an Organic Vapor Monitor

Prior to measuring the water level in any well or piezometer, a photoionization detector (PID) or accepted substitute will be used to measure the levels of organic vapors in background, well bore, and breathing zone air where defined by the project Health and Safety Plan. Operation of the PID shall be in accordance with the manufacturer's instructions.

- The background air will be monitored in the vicinity of the well and working area before the well cap is removed. The effects of any potential sources of organic vapors, such as operating generators, vehicles, or the like will be minimized as much as is practicable (e.g. a vehicle will be turned off or parked downwind from where activities are taking place). The presence of potential sources of organic vapors that are beyond the control of water level measurement personnel will be noted on form PWT/GW.102A. The level of organic vapors in background air will be recorded on form PWT/GW.102A.

- The well cap (s) will be removed and the tip of the PID placed within the opening of the inner well casing to measure the level of organic vapors within the well bore. The results of this measurement will be recorded on form PWT/GW.102A.

- Finally, the level of organic vapors in the breathing zone will be measured and recorded on form PRO.105A.

### 4.3 Instruments and Associated Water Level Measurement Techniques

Water level measurement instruments are used to determine the water level in boreholes, wells, piezometers, and some accessible subsurface structures. Measurements may be made with a number of different devices and procedures. Outside power sources are not generally required to operate most instruments. However some will require that batteries be replaced or recharged periodically.

The following subsections describe the use of electronic water level sounders; the use of a manometer to measure water levels in small diameter well points; the use of an interface probe in the determination of immiscible layers; and the use of a graduated steel tape to measure water levels and total depths of wells.

Electronic water level sounders are the preferred water level measuring instruments. Typically, a steel tape will only be used for measuring the total depth of a well when LNAPLs are present. Using a steel tape under these conditions will help ensure that the interface probe and other electronic water level measuring devices do not become grossly contaminated, and thereby helps to prevent cross-contamination.

#### 4.3.1 *Electric Water Level Sounder*

Typically, an electronic water level sounder marked to 0.01-foot intervals will be used to measure groundwater levels and total depths of wells. Before lowering the electronic sounder probe into the well, the circuitry shall be checked by pressing the test button, if the unit is so equipped, or by dipping the probe in clean water. If the unit is working properly, the results of either test should be an audible tone. The probe will be lowered slowly into the well, minimizing wall contact, until contact with the water surface is indicated. The individual measuring the water level shall perform at least two measurements that agree within 0.01 foot. If the two measurements do not agree within 0.01 foot, this individual shall continue to measure until two consecutive readings agree within 0.01 foot. If

difficulties or inconsistencies persist, a second person shall repeat this process. Measurement shall continue until the values obtained by the two individuals agree within 0.05 foot. An average of the reproducible readings shall be used to determine the water level. Record and average the two reading that agree within 0.05 foot on form PWT/GW.102A, The difficulties or inconsistencies also will be recorded on form PWT/GW.102A, as they may indicate the presence of NAPLs, damage to the water level sounder, or other problems with the well.

Electronic sounders are recommended for measuring the depth to water in wells that are being pumped because sounders generally do not require removal from the well for each reading. However, if oil is present in the well, if water is cascading into the well, or if the water surface is turbulent, measuring water level with an electronic sounder may be difficult. Oil not only insulates the contacts of the probe, but it will also give an erroneous reading if there is a considerable thickness of oil. As noted previously and discussed in Subsection 4.3.4, if LNAPL is present a steel tape shall be utilized for measuring the total depth to the bottom of the well.

4.3.2 *Measuring Water Levels in Well Points*

A manometer may be required to measure the water level in well points because well points are often of too small a diameter to accept the probe and tape of a water level sounder. Before using a manometer, check the unit to be sure it is in working order. The manometer should be able to read 0.1 inches of water. Measure water levels as follows:

- Attach an appropriate length of appropriately sized polyethylene or PTFE (Teflon™) tubing to the manometer.
- Using the adjustment know, zero the display reading.
- Insert the tubing into the well point tubing while watching the manometer. When a change in the manometer reading is observed, mark a point on the inserted tube.
- Withdraw the inserted tubing and measure its length (to the nearest 0.01-foot) from the down-hole end to the marked point. Be sure not to stretch the tubing during this measurement.
- Record the required information on form PWT/GW.102A.

4.3.3 *Immiscible Layers and Use of an Interface Probe*

The NPS co-located well drilling and sampling project does not have the potential for the presence of immiscible organic compounds. However, because there may be locations that have observable immiscible layers in the ground water, procedures have been established to detect the presence of these compounds and to sample them when present.

The first step is to determine whether there is a positive response on the PID when its tip is positioned in the well bore. If the response is positive, the next step is to determine the presence and thickness of any NAPLs by use of an interface probe. In areas where the potential exists for NAPLs, an interface probe will be used to measure water levels. If groundwater samples are to be collected, the interface probe will be used in each well prior to each sampling event.

- The manufacturer's instructions shall be followed when using the interface probe. The probe shall be sufficiently precise to measure water and NAPL levels to the nearest 0.01 foot.
- The accuracy of repeated measurements must agree within 0.05 foot, and shall be measured from the MP on the inner well casing.

- The probe will be lowered very slowly so as to minimize disturbance of any layers of NAPL that may be present, and to limit penetration of any NAPL layers so as to ease decontamination of the probe. When lowering the probe, care will be taken to minimize rubbing of the tape against the well casing.

- Typically, the interface probe will produce different sounds to distinguish between aqueous and non-aqueous organic layers. Depth to aqueous or non-aqueous phases will be recorded to the nearest 0.01 foot, measured from the MP on the inner well casing.

If LNAPLs are not present, the interface probe may be used to determine the presence and thickness of DNAPL layers and the total depth of the well.

- The interface probe will be slowly raised and lowered to pinpoint the depth that the appropriate indicator tone is reproducibly obtained. This will be done slowly and with care so as to minimize disruption of any NAPL layers.

- Measurements from three consecutive readings will be taken by two individuals and must not differ more than ± 0.05 foot or three more readings must be taken.

- An average of the reproducible readings will be used to determine the water or NAPL level. The results of all readings will be recorded on form PWT/GW.102A.

Once the level has been determined and recorded, the probe will be carefully retrieved to ensure minimal rubbing of the tape against the inside well casing. The probe and tape will be decontaminated between use at each well following procedures given in SOP PWT/GW.101, Groundwater Sampling.

Due to the difficulty in decontaminating the interface probe after it has passed through a non-aqueous organic phase, if LNAPLs are present the interface probe will not be used to check for DNAPLs or to measure the total depth of the well. Instead, fluid will be collected to check for DNAPL, and a graduated steel tape and carpenter's chalk will be used to measure the total depth as described in Section 4.3.4.

Wells containing LNAPLs shall be checked for the presence of DNAPLs by very slowly lowering a purge pump or pump tubing to the bottom of the well and collecting the first purge water from the bottom of the well in a one liter colorless glass container. The container will be initially checked with an organic vapor analyzer (OVA) for compared background readings. The liquid shall be allowed to stand for 15 minutes and visually observed for the presence of separate phases. If no DNAPLs have separated out of the solution after 15 minutes, the well shall be presumed free of DNAPLs.

If either LNAPLs or DNAPLs are detected, the well will be sampled for these phases as described in SOP PWT/GW.101, Groundwater Sampling if requested by the project specific work plan.

### 4.3.4 *Graduated Steel Tape*

The use of graduated steel tapes will normally be limited to determination of the total well depth of wells containing LNAPLs. A slender, stainless steel weight will be attached to the end of the tape to create tautness and to permit a feel for obstructions and for the bottom of the well. The weight will be attached using wire, rivets, or other method that does not have the potential for contributing contaminants to the well. The tape will be lowered to the bottom of the well, and the total depth will be read off the tape at the MP on the inner well casing.

The graduated steel tape method is considered accurate for measuring the water level in nonflowing wells (National Handbook of Recommended Methods for Water-Data Acquisition, 1977, pp. 2-8), but will not be used for this purpose except in unusual circumstances as instructed by the subcontractor's project manager. If used to measure the water level, available well construction and prior water level data should be consulted first. After determining what length of tape may be submerged in the water within the well, use the carpenter's chalk to coat the tape from its down-hole end to a point a few feet above what would be a high water level for that well. The coated end shall be lowered down the well, taking care to minimize contact with condensation on the interior surfaces of the well, until the end is resting on the bottom of the well. The total depth (relative to the MP) shall then be recorded and the tape shall be withdrawn, again minimizing contact with the walls of the well. The water level is marked by a water line in the chalk. The water level below MP is calculated by subtracting the wetted length of tape from the total depth measured with the tape.

Before and after each well measurement, that part of the tape measure that extends down the well will be decontaminated. Decontamination procedures are discussed in Subsection 4.5 of this SOP.

### 4.4 Down-Hole Water Level Pressure Transducer

Water levels may be measured on a continuous basis through the use of a probe that is installed below the water level in a well. The probe contains a pressure transducer attached to a network of cables and tubing. The transducer measures pressure changes that result from changes in the volume of water (the head) above the probe. The cables and tubing may perform such functions as positioning the probe at the desired depth, relaying transducer data to a data logger, and venting the probe so that fluctuations in barometric pressure are not recorded as changes in the water level. Because water level is derived from pressure changes detected by the transducer, only vented water level pressure transducer probes will be used.

The data logger may be a separate, stand-alone unit that may be placed on the ground next to the well. It may also be contained within the probe, and feature a data transfer (downloading) cable that extends from the probe to the top of the well casing; or it may be stationed within the top of the well casing. Accumulated data are periodically downloaded from the data logger onto a portable computer.

#### 4.4.1 *Preparation*

If the down-hole water level pressure transducer probe is to be installed in a well for long-term water level monitoring, it may be advantageous to assemble the components to fit the individual well to be studied. Custom fitting will typically be performed by the manufacturer, but at times may be performed by PWT or subcontractor personnel. In most cases this requires cutting the assorted cables and tubing to lengths that, when assembled, allow the probe to be suspended at a depth below the lowest anticipated water level or at the bottom of the well. Personnel performing these activities will be careful not to twist, kink, or otherwise damage cables and tubing.

A variety of diaphragms, with associated pressure ranges, are typically available for the pressure transducer. A diaphragm with a low-pressure rating allows the unit to be used in shallow-water settings, and higher-pressure ratings allow the unit to be used in deeper-water settings. Using the wrong diaphragm may result in poor resolution or faulty data.

The manufacturer's instructions shall be followed during all assembly and modification activities. If the unit is being modified by the manufacturer to fit a particular well, care will be taken to ensure that all depth and head (water column within the well) information reported to the manufacturer are correct.

Prior to installing a probe in a well, (1) the desiccant in the unit (if applicable) will be checked to ensure that it is fresh; (2) All communications between the probe, data logger, and downloading computer will be checked to

ensure that they are functioning properly; (3) The data logger shall be programmed to collect and store the required data at the desired frequency and in the proper storage location; and (4) the unit's internal clock and calendar will be set.

The power source for the data logger and the amount of available memory on the logger will be checked to ensure they are adequate. The probe, cables and tubing, connectors and other down-hole components will be decontaminated according to this SOP or, if these instructions are not appropriate, the manufacturer's instructions. Be sure not to twist, kink, or otherwise damage the components, and keep dry any connectors or other parts that would be damaged if they were to get wet.

Immediately before the probe is installed, The water level in the well will be measured and recorded using other equipment, such as an electronic water level sounder. The transducer will be zeroed, if appropriate. The manufacturer's instructions will be followed to ensure all pre-installation tasks have been performed.

### 4.4.2 Installation

Proper installation of the down-hole pressure transducer probe and the data logger is crucial. A secure and well-known probe placement, together with proper connections to and programming of the data logger, are critical to ensuring high-quality water level data are collected and stored.

The depth at which the probe will be positioned will be determined to within 0.01 foot. (If possible this measurement will be made to within 0.01 foot. However due to stretching of the cables and tubing, this may not be feasible.) When the unit is ready to be installed, the data logger will be activated and the probe will be lowered slowly down the well. The probe will not be allowed to "free fall" as this may damage the transducer and/or strain gauge. When the probe is positioned, a reading will be taken from the probe and recorded on the data logger. The probe's position will gradually stabilize as the cables straighten and stretch from its weight. As the probe's position stabilizes, so will the water level equilibrate to account for the volume of water displaced by the probe. It is recommended that the data logger be programmed to record depths over this stabilization period (generally about an hour, but the manufacturer's instructions should be checked, and up to several hours or more for water level equilibration, depending on the hydrologic setting of the well screen). The frequency at which measurements are made may need to be adjusted to adequately characterize this period, then reset to the frequency desired for long-term measurements. For example, if the water level in the well is to be measured once every hour, the frequency should be adjusted to once every five minutes or so until the probe position and water level have stabilized, then reset to once each hour. However, if instructed by the PWT Field Manager, collection of these stabilization data may be omitted.

### 4.4.3 Operation

Unless requested by the PWT Field Manager, measurement of the total depth of a well will not be made in wells equipped with a down-hole water level probe at the same frequency as it is in wells lacking this equipment. To do so will generally require removal of the unit, which is impractical and time consuming, and can result in damage to the equipment.

The data logger has a finite amount of memory storage space. Data will not be allowed to be overwritten or otherwise lost (e.g., due to delay in downloading data or battery failure). Downloading the logger will occur on a regular schedule that allows plenty of extra time for unforeseen problems (such as weather delays) without a loss of data. Unless the logger is recording measurements every five minutes or less, it should not be necessary to halt data collection during downloading. The communication cable will be plugged into the computer and the data downloaded according to the manufacturer's instructions. After the data have been downloaded to the computer and

downloading has been verified, the data on the logger will be erased and the unit returned to use. This activity will be performed quickly, efficiently, and carefully, so as to ensure that all new data were downloaded and no non-downloaded data are recorded on the data logger and then erased.

The condition of the unit (batteries, desiccant, etc.) will be checked each time the unit is downloaded. If the manufacturer's instructions recommend a more frequent check, these recommendations will be followed. If requested by the PWT or subcontractor Field Manager as an additional check, the water level may be measured using other equipment such as an electric sounder (see Subsection 4.3.1) each time this unit is downloaded. If so, the down-hole probe will be minimally disturbed during this procedure. If it is necessary to partially withdraw the unit in order to make the measurement (for example, if the data logger is installed within and blocks access through the well casing), this will be done carefully and efficiently, without instructing the unit to pause in its data collection and without kinking the cables and tubing or otherwise damaging or contaminating the withdrawn portion. (Note that even partial withdrawal of the unit will cause the water level to drop somewhat relative to its position prior to this withdrawal.) The withdrawn components will not be allowed to contact potentially contaminated media and will be sheltered from windblown dust and debris; if they do contact these media or become dirty, they will be decontaminated according to this SOP, and the manufactures instructions. Components will be restored to their proper place as quickly and carefully as practicable. A chronological log of these activities and their results will be maintained within the comments section of the Groundwater Level Data from Down-Hole Pressure Transducer form (Form PWT/GW.102B).

If groundwater sampling is to be performed on a well equipped with a down-hole water level probe, provisions must be made in advance for storing the probe, cables, tubing, data logger, and associated components during these activities. Depending on the duration of the sampling activities (single or multiple days), the size of the unit, and the quantity of cables and tubing, it may be desirable to store the submersible components in a clean, covered tub filled with deionized or distilled water, and the remaining components in a clean plastic bag adjoining the tub. (The manufacturer's instructions will first be consulted to ensure the unit is compatible with the water to be used, as some pieces of equipment are sensitive to deionized water.) Alternatively, the unit may be placed on clean plastic sheeting. If the well dewaters and takes more than one day to complete sampling, the probe and its associated down-hole components will be safely stored in a clean enclosure such, as one or more large, heavy-duty plastic bags until sampling has concluded, and will be decontaminated before reinstalled in the well.

Regardless of the method of temporary storage, the components will not be allowed to contact potentially contaminated media and will be sheltered from windblown dust and debris. Data collection from the probe will be halted. Withdrawal of the unit from the well will proceed slowly and carefully, and in accordance with the manufacturer's instructions. All components of the down-hole probe assembly will be visually inspected as they are withdrawn. Any necessary cleaning or repairs (for example, removing accumulated sediments from the probe) will be performed following the manufacturer's instructions and/or this SOP. The well will then be sampled as per SOP PWT/GW.101, Groundwater Sampling. After sampling has concluded and the down hole probe reinstalled, data collection will be reactivated.

General maintenance will be performed as recommended by the manufacturer. Routine maintenance may include replacing the desiccant, cleaning the filter at the pressure transducer, clearing the ports at the pressure transducer, replacing the batteries, recalibrating the probe, and general cleaning and checking of components and connections. Depending on the unit, many of these tasks may only be performed by the manufacturer. If necessary, the unit will be removed from the well, decontaminated, and returned to the manufacturer for service.

Computer connectors will be handled carefully and used properly. Some probes have specially-designed connector caps or storage that adequately addresses potential moisture problems. If this is not the case with the connector being used, it will be kept dry by storing it in a plastic bag within the wellhead. If condensation is a problem, a packet of desiccant may be kept in the bag, unless the manufacture's instructions specify other alternatives.

4.5 Decontamination

Methods used to prevent cross contamination include scheduling activities to proceed from locations with potentially lesser to those with potentially greater levels of contamination, and thorough decontamination of all materials contacted by potentially contaminated media. Water level measurement equipment and the personnel who use them are decontaminated for the dual purposes of minimizing cross-contamination and providing a safe and healthy working environment.

Equipment should be constructed of stainless steel, PTFE, or other inert materials that have been approved by PWT. Equipment will be decontaminated before and after use at each well.
If freshly decontaminated equipment is kept clean during transport to the next well by being stored in a clean plastic bag, clean plastic wrap, or clean equipment storage case, the need for repeated decontamination prior to using the equipment at that next well may be eliminated. In such cases the equipment need only be decontaminated immediately following use at each well. Procedures for decontamination are set forth in the site-specific health and safety plan and this SOP.

## 5.0 QUALITY ASSURANCE / QUALITY CONTROL

The frequency of measurements and the accuracy desired in measuring changes in water levels depends on the objectives established in the Work Plan or the Sampling and Analysis Plan for a given project. All appropriate data will be recorded on a Groundwater Level Measurements/Calculations form (Form PWT/GW.102A) or Groundwater Level Data from Down-Hole Pressure Transducer form (Form PWT/GW.102B) before leaving the well site.

Electronic water level sounders will be calibrated quarterly by following the manufacturer's instructions or by suspending the sounder and measuring it against a calibrated steel tape if no other calibration instructions are supplied. Down-hole water level probes will be calibrated by the methods and frequency recommended by the manufacturer and the results documented on a log sheet kept on file in the groundwater monitoring field office.

## 6.0 RECORDS

A permanent record of the implementation of this SOP will be kept by documenting field observations and data in waterproof ink on a Groundwater Level Measurements/Calculations form (Form PWT/GW.102A). If the well is equipped with a down-hole water level probe, the appropriate observations and data will be recorded on a Groundwater Level Data from Down-Hole Pressure Transducer form (Form PWT/GW.102B).

When measuring with tools other than a down-hole pressure transducer, the following information should be recorded for each observation-well site:

- The PWT Project Number and well number
- The date and time of the water level measurements
- The names of personnel performing the measurements
- The equipment manufacturer, model, and serial number
- Results of PID monitoring
- Depth to water and total depth of well, both relative to MP
- The perceived condition of the bottom of the well (soft vs. hard)
- Comments on any unusual conditions that may relate to these data, as appropriate
- The name of the QC reviewer and the date of the QC review.

Individual measurements are entered onto the Groundwater Level Measurements/Calculations form (Form PWT/GW.102A) as the measurements are performed. The information is recorded as follows:

1. Record well number in the first column.

2. Measure and record the depth to water from the measuring point in the second column (WD). The measurement will be taken twice, or more if measurements are difficult to obtain. Measurements from the two readings must agree within 0.01 foot. If the measurements do not agree within 0.01 foot, a second individual may attempt the measurement. Continue to measure until the reason for the lack of agreement is determined or until two consecutive readings are shown to agree within 0.01 foot, or 0.05 foot if the measurements are made by two individuals. An average of the reproducible readings will be utilized for the determination of the water level.

3. Measure the total depth of the well from the MP and record this value in column three (MTD). The measurement will be taken twice. Measurements from the two readings must agree within 0.01 foot. If the two measurements do not agree within 0.01 foot, continue to measure until the reason for the lack of agreement is determined or until two consecutive readings are shown to agree within 0.01 foot (0.05 foot if made by two individuals). An average of the reproducible readings will be utilized for the determination of the total depth.

4. In some devices the length of the probe end may not have been taken into consideration when the measuring tape was marked. In this case the length of the probe end will need to be added to the measured total depth in order to determine the total depth of the well from the MP. Record the length of the probe end in column four (Probe end).

5. Determine the total depth of the well from the measuring point by adding the length of the probe end to the measured total depth from the MP and record this value in column four (TD). Total depths of wells may be measured monthly, quarterly, or as instructed by the PWT Field Manager.

6. In the blank marked “Chk’d by”, record the initials of the individual who checks the calculation performed in Step 5.

7. In the “Comments” section, note any significant features or activities near the well that could affect the water level, PID readings, or other data recorded on form PWT/GW.102A.

In wells equipped with down-hole pressure transducers, form PWT/GW.102B shall be used. The following information shall be recorded for each observation-well site:

- The PWT Project Number and well number
- The names of personnel downloading the data and performing associated activities
- The equipment manufacturer, model, and serial number
- Results of PID monitoring
- The date and time of the first and last water level measurements recorded on the data logger
- The number of records downloaded and the frequency of measurement
- The depth of the probe
- Water level and probe datum, if other than MP
- Battery condition
- The identity of the diskette(s) on which downloaded data were stored
- Whether the water level was checked using other means, and if so, the results of this measurement
- Comments on any unusual conditions that may relate to these data, as appropriate

- The name of the QC reviewer and the date of the QC review

Water level data downloaded from wells equipped with down-hole pressure transducers and data loggers will be archived electronically in their original form without conversion or other data manipulation. If conversion is necessary to render the data useable, converted data shall be archived separately and an explanation of the conversions shall be included. Data diskettes (original and converted forms) will be transmitted to the RMRS project manager on the same schedule as data from wells without down-hole probes unless this individual requests otherwise. Copies of the data diskettes will also be stored by the subcontractor. Summary hydrographs will also be provided to the PWT project manager, and will display water level depth and topographic elevation versus time. Hard copies of the data shall not be provided unless the PWT Field Manager requests them.

## 7.0 REFERENCES

### 7.1 Source References

The following references were reviewed before this procedure was written:

Freeze, R. Allen, and John A. Cherry, 1977, *Groundwater*, Prentice-Hall, Inc., Englewood Cliffs, NJ

U.S. Department of Energy (DOE), August 1987, *The Environmental Survey Manual*, Volumes 1-4, DOE/EH-0053.

U.S. Department of Interior, Water Resources Division , 1977, *National Handbook of Recommended Methods for Water-data Acquisition*.

U.S. Environmental Protection Agency (EPA), September 1986, *RCRA Groundwater Monitoring Technical Enforcement Guidance Document*, OSWER-9950.1.

U.S. Environmental Protection Agency, December 1987, *A Compendium of Superfund Field Operations Methods*, EPA/540/P-87/001.

U.S. Environmental Protection Agency (EPA), October 1988, *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA, Interim Final.*

U.S. Environmental Protection Agency (EPA), May 1989, *RCRA Facility Investigation Guidance, Interim Final.*

### 7.2 Internal References

Related SOPs cross-referenced by this SOP are as follows:

- SOP PWT/GW.101, Groundwater Sampling

**FORM PWT/GW.102A**
GROUND WATER LEVELS
MEASUREMENTS / CALCULATIONS

EQUIPMENT MANUFACTURER:

PROJECT NO.: MODEL:

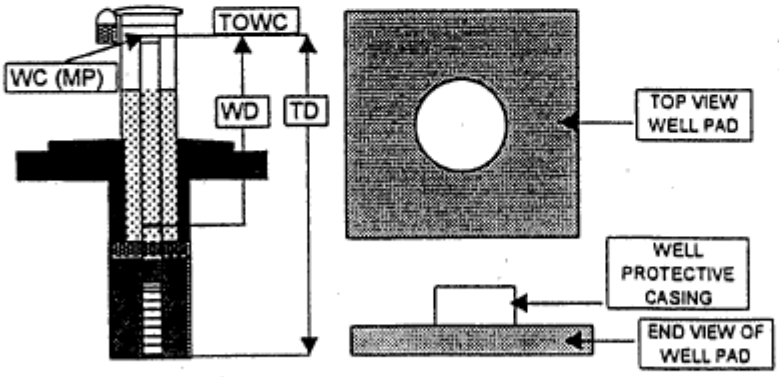
DATE: SERIAL NO.:

PERSONEL: (1) CALIBRATION: DATE PASSED: DATE DUE:

(2) QC REVIEW: NAME DATE:

☐ Quarterly
☐ Monthly
☐ Special

| WELL NO. | | | Comments: | | MINI RAE * |
|---|---|---|---|---|---|
| | WD | MTD | Background | Headspace | Well Bore |
| MEASUREMENT 1 | | | | | |
| MEASUREMENT 2 | | | | | |
| TIME: | | | | | |
| | AVERAGE WD | AVERAGE MTD | PROBE END | TD | CHK'D BY |




COMMENTS:

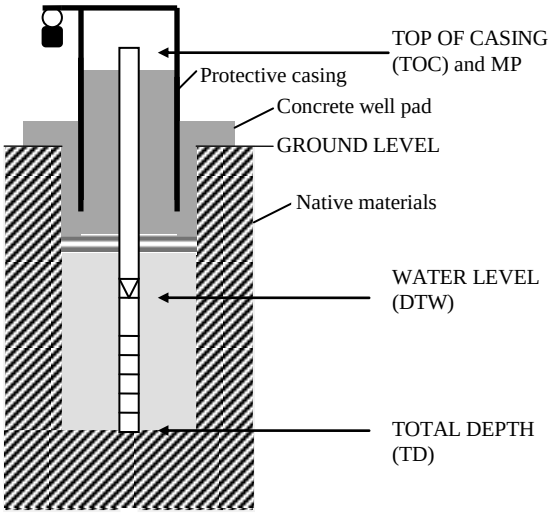
SIGNATURE: DATE:

**FOOTNOTES:**
TOWC=TOP OF WELL CASING
WD = DEPTH OF WATER FROM MP
MTD = MEASURED TOTAL DEPTH FROM MP
PROBE END = LENGTH BEYOND MEASURING POINT OF PROBE
TD = DEPTH OF BOTTOM OF WELL FROM MP

**NOTES:**
ALL MEASUREMENTS ARE MADE IN FEET RELATIVE TO MARK POINT (MP) = N. SIDE OF TOWC.
QC REVIEW BY SUPERVISOR IS A CHECK OF REASONABLENESS
MEASUREMENTS 1 AND 2 MUST BE WITHIN 0 05 FT

**Form PWT/GW.102B**
**Groundwater Levels**
**DATA FROM DOWN-HOLE PRESSURE TRANSDUCER**

| WELL NO. _____ | | | | |
|---|---|---|---|---|
| **DOWNLOAD DETAILS** | DATE / TIME OF FIRST RECORD _____ | DATE / TIME OF LAST RECORD _____ | NO. OF RECORDS DOWNLOADED _____ | PID equipment _____ _____ Background _____ |
| **EQUIPMENT / PROGRAM STATUS** | PROBE DEPTH _____ | BATTERY CONDITION _____ | MEASUREMENT FREQUENCY _____ | Breathing zone _____ Well bore _____ DISKETTE _____ |
| WATER LEVEL DATUM (IF OTHER THAN MP)* _____ | WATER LEVEL CHECKED? [Y] / [N] | IF Y: Equipment used (mfr./serial): _____ _____ | IF Y, DTW = _____ TIME = _____ | Did water level check require partial withdrawal of down-hole tools? [Y] / [N] |




COMMENTS and CHRONOLOGICAL RECORD OF ACTIVITIES

_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____

NAME / SIGNATURE: _____ DATE: _____

TOC = top of well casing
MP = measuring point (on north side of TOC)
DTW = depth to water (from MP)
TD = total depth (from MP)

NOTE:
*Unless otherwise indicated, all measurements are made in feet relative to measuring point (MP), which is located on the north side of TOC.

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List of Attachments


Attachment A Waste Inventory Tracking Form

Attachment B Maximum Concentration of Contaminants for the Toxicity Characteristic


| REVISION LOG | | |
|---|---|---|
| Revision Number | Description | Date |
| 0.0 | SOP No. GW.105 | 1/23/2012 |
| 1.0 | Revised for Montana Operations | 3/1/12 |
| | | |

## 1.0 PURPOSE

This Standard Operating Procedure (SOP) provides technical guidance and methods that will be used for the handling, management, and disposal of investigation derived waste (IDW) encountered or generated during environmental activities supporting CERCLA Remedial Investigations (RI) or RCRA Remedial Facility Investigations (RFI). This SOP serves as a supplement to the investigation area-specific work plans and QAPPs, and is intended to be used with other activity-specific SOPs. IDW management personnel are also referred to *Management of Investigation-Derived Wastes During Site Inspections* (EPA 1991), *Guide to Management of Investigation-Derived Wastes* (EPA 1992) and applicable state and RCRA requirements.

## 2.0 PERSONNEL QUALIFICATIONS

Personnel overseeing the handling and disposal of IDW will have IDW management knowledge and experience, or will work under the direct field supervision of knowledgeable and experienced personnel. Personnel will perform this work in accordance with the project-specific health and safety plan (HASP).

## 3.0 MATERIALS AND EQUIPMENT

The following materials and equipment may be needed for IDW management:

- Personal protective equipment (PPE) as outlined in the HASP
- Decontamination equipment and supplies (e.g., wash/rinse tubs, brushes, alconox, plastic sheeting, paper towels, sponges, baby wipes, garden-type water sprayers, large plastic bags (minimum 0.85 mil), potable water, distilled water and/or deionized water)
- Department of Transportation (DOT)-rated 55-gallon drums or other approved containers for containing soil cuttings, decontamination water, and formation water
- Drum/bung wrench and drum funnel
- Heavy equipment forklift or vehicle with drum grappler
- Laboratory-supplied sample containers
- Photoionization detector (PID) or flame ionization detector (FID)
- Wood pallets
- Non-porous (e.g., stainless steel) shovels
- Hazardous Waste Labels
- Soil roll-off bins with liners and covers (if warranted)
- Polyethylene tank (if warranted)
- Waterproof and permanent marking pens

## 4.0 PROCEDURES

RI or RFI field activities may generate IDW that poses a risk to human health and the environment. It is anticipated that both non-liquid and liquid IDW will be generated or encountered during RI/RFI field activities.

Non-liquid IDW may include:

- Drill cuttings from soil borings
- Sludges (from soil borings in the saturated zone and from development water)
- Excavated soil from trenches
- Construction debris (e.g., concrete and asphalt)
- Buried landfill materials (e.g., burned wood, desks, and metal objects)
- PPE
- Disposable investigation equipment (i.e., bailers, twine, discarded sample bottles, preservative containers, paper towels, aluminum foil)
- Empty drums

Liquid IDW may include:

- Well development water
- Purge water (from monitor wells)
- Well abandonment water
- Decontamination water

Before initiating any field activity that will generate IDW, field personnel must determine if the activity is located within the area potentially containing F-listed waste. Saturated soil and water IDW generated from investigation activities conducted within a defined solvent plume area also potentially contain F-listed waste. Therefore, the saturated soil and water IDW generated from these areas may need to be segregated from other IDW and characterized and disposed of separately.

## 4.1 Non Liquid IDW

### 4.1.1 Soil IDW

- Soil cuttings generated during drilling and soil sampling will be placed into DOT-rated 55-gallon drums, or appropriately sized containers at the point of generation.
- Mixing of the cuttings from several borings or sampling locations is permissible in order to fill the drums. The splitting of cuttings from one boring into several drums should be avoided.
- When drums are full, or daily activities are completed, the drum lids and rings will be fastened. Full drums will be transported to a designated IDW accumulation area on a regular basis to avoid accumulation of drums at investigation sites for extended periods of time. Alternative temporary IDW accumulation areas can be used as specified in the investigation-specific work plan.

- If large volumes of soil IDW will be generated, soil IDW will be transferred from the drums into roll-off bins (lined and covered) located within the designated IDW accumulation area.
- If only a small volume of soil IDW will be generated, DOT-rated 55-gallon drums can be used for the temporary storage of soil IDW pending analysis. Drums will be stored on pallets at the designated IDW accumulation area. Drums from individual sites will be segregated from each other as much as possible. The drums will be sealed and labeled with permanent markings (using paint pens or drum labels) with the following information:
    1. Source: the boring(s), well, or site identification number
    2. Matrix (e.g., soil, water)
    3. Sample interval (e.g., 0–20 ft or well screen depth) (multiple drums of development or purge water will be numbered consecutively as they are filled)
    4. Fill date
    5. Drum identification number
    6. Contractor
    7. The EPA or PWT designee point of contact with phone number
    8. "Contents Pending Analysis"

Soil IDW in drums will typically be characterized and disposed of based on the characterization of associated investigation sample results (if collected and analyzed).

If no associated investigation sample results exist, a composite soil sample will be collected from the soil IDW drums by collecting a drive or hand auger sample from each of the drums associated with a specific field activity. The sample material from all of the drums will be composited into a single sample that will be used to characterized and dispose of the soil IDW.

#### 4.1.2 Excavated Soil from Trenches

Most trenching operations will generate substantial volumes of excavated soil.

Large volumes of excavated soil IDW will be placed directly into roll-off bins (lined and covered) at the excavation site. This procedure will minimize concerns resulting from stock piling the soil IDW, such as wind dispersion and contamination of the ground surface.

- Small volumes of excavated soil can be placed in drums at the excavation site. Drums will be labeled and stored as described in Section 4.1.1.
- Soil IDW in drums will be sampled (if warranted), characterized, and disposed of as described in Section 4.1.1 above.

Soil IDW placed on the ground surface prior to placement into drums or roll-off bins, must be placed on plastic sheeting covering the ground surface. The soil IDW must be transferred to drums or roll-off bins before completion of the days activities.

4.1.3 Construction Debris and Landfill Material

- Small pieces of construction debris or landfill materials, that do not, and have not, contained controlled substances may be placed in the soil IDW roll-off bins or drums. For example, small amounts of wood, concrete, rebar, and paper do not require segregation from the soil IDW.
- Large volumes of the materials listed above, and large objects, such as desks or large metal objects, will be segregated separately from the soil IDW.
  - If the associated soil IDW is characterized as nonhazardous, these materials can be disposed of as nonhazardous solid waste.
  - If the associated soil IDW is characterized as hazardous, potential surface contamination will be removed from the large objects with nonporous surfaces (e.g., metal desks) by brushing off, or using small amounts of water to scrub off, gross potential contamination. After decontamination, these objects can be disposed of as nonhazardous solid waste.
  - If the associated soil IDW is characterized as hazardous, large objects with porous surfaces may require disposal as hazardous waste. Consult the IDW disposal contractor.
- Containers that may contain or potentially contained controlled substances (e.g., paint cans, drums) will be segregated from the materials described above and placed in appropriately sized containers.
  - Consult the IDW disposal contractor for the appropriate disposal requirements for these materials.

4.1.4 PPE and Disposable Investigation Equipment

- PPE and disposable investigation equipment will be segregated separately and placed in dedicated heavy duty (minimum 0.85 mil) plastic bags or containers (e.g., drums).
- Potentially contaminated PPE or disposable investigation equipment will be decontaminated prior to placement in the plastic bags or containers, if warranted.
- Decontamination procedures consist of brushing off, or using small amounts of water to scrub off, gross potential contamination.
- PPE and disposable investigation equipment that have been decontaminated, if warranted, are considered refuse and do not require characterization prior to disposal as nonhazardous solid waste.

4.2 Liquid IDW

- Well development, purge, abandonment, and decontamination water will be contained in DOT-rated drums, or appropriately sized water-tight containers, at the point of generation. When drums are full, or daily activities are completed, the drum lids and rings will be fastened, and the drums will be transported to the designated temporary IDW accumulation area as described

in Section 4.2 of Attachment B. Alternative temporary IDW accumulation areas can be used as specified in the activity-specific work plan.

- If large volumes of water will be generated, the water will be transferred into an appropriately sized polyethylene tank. The liquid IDW in the polyethylene tank will be characterized based on the analytical results of the well or wells sampled, or from a representative grab sample collected from the tank. The sample will be collected using a colliwasa, disposable point source bailer, or bomb sampler for discrete interval sampling within the polyethylene tank.
- After analytical data for the liquid IDW1 are obtained from the laboratory, the data will be directly compared to the hazardous waste concentrations presented in Table 1 i***n*** 40 CFR §261.24 (Appendix A). The liquid IDW1 will then be removed, and treated and disposed of by a certified hazardous waste contractor in accordance with the applicable waste characterization (Section 5.0).
- If only a small volume of water IDW will be generated, DOT-rated 55-gallon drums can be used for the temporary storage of water IDW pending analysis. Water IDW drums will be labeled and stored as described in Section 1.1.1, Soil IDW above.
- Water IDW in drums will be characterized and disposed of based on the characterization of associated investigation sample results (if collected and analyzed).
- If no associated investigation sample results exist, a composite water sample will be collected from each of the water IDW drums associated with a specific field activity. The sample will be used to characterize and dispose of the water IDW.
- The list of chemicals to be analyzed for is the same as the list for soil characterization (Appendix A).

## 5.0 DOCUMENTATION

Project staff are responsible for thoroughly documenting IDW handling and disposal activities. IDW personnel will be responsible for documenting the collection, transportation, labeling (if applicable), and staging or disposition of IDW. The documentation will be recorded with waterproof ink on a Waste Inventory Tracking Form (Attachment A) or in the sampler's field notebook with consecutively numbered pages. The information entered concerning IDW should include the following:

- Project Name
- RI/RFI contractor and personnel
- Site location
- Type of activities
- Date waste generated
- Boring, well, or site number(s)
- Matrix
- Type of container(s) and identification number(s)

- Estimated volume
- Disposition of contents (roll-off/location, tank/location, temporary staging area)
- Waste characterization
- Comments (field evidence of contamination [e.g., PID reading, odors])

# ATTACHMENT A
# WASTE INVENTORY TRACKING FORM

# WASTE INVENTORY TRACKING FORM

**Project Name**: _____

**RI/RFI Contractor and Personnel:**_____

**Site Location**: _____

**Type of Activities**:_____

| Date Waste Generated | Borehole, Well, or Site # | Matrix | Type of Container (Plus ID#, if applicable) | Estimated Volume | Disposition of Contents | Waste Characterization | Comments (Field Evidence of Contamination [e.g., PID reading, odors]) |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| | | | | | | | |
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| | | | | | | | |

**Signature:**_____

## APPENDIX A

# Maximum Concentration of Contaminants for the Toxicity Characteristic

## APPENDIX B

### Maximum Concentration of Contaminants for the Toxicity Characteristic

| EPA Hazardous Waste Number | Contaminant | Regulator Level (mg/L) |
|---|---|---|
| D004 | Arsenic | 5.0 |
| D005 | Barium | 100.0 |
| D018 | Benzene | 0.5 |
| D006 | Cadmium | 1.0 |
| D019 | Carbon tetrachloride | 0.5 |
| D020 | Chlordane | 0.03 |
| D021 | Chlorobenzene | 100.0 |
| D022 | Chloroform | 6.0 |
| D007 | Chromium | 5.0 |
| D023 | o-Cresol | (1) 200.0 |
| D024 | m-Cresol | (1) 200.0 |
| D025 | p-Cresol | (1) 200.0 |
| D026 | Cresol | (1) 200.0 |
| D016 | 2,4-D | 10.0 |
| D027 | 1,4-Dichlorobenzene | 7.5 |
| D028 | 1,2-Dichloroethane | 0.5 |
| D029 | 1,1-Dichloroethylene | 0.7 |
| D030 | 2,4-Dinitrotoluene | 0.13 |
| D012 | Endrin | 0.02 |
| D031 | Heptachlor (and its epoxide) | 0.008 |
| D032 | Hexachlorobenzene | 0.13 |
| D033 | Hexachlorobutadiene | 0.5 |
| D034 | Hexachloroethane | 3.0 |
| D008 | Lead | 5.0 |
| D013 | Lindane | 0.4 |
| D009 | Mercury | 0.2 |
| D014 | Methoxychlor | 10.0 |
| D035 | Methyl ethyl ketone | 200.0 |
| D036 | Nitrobenzene | 2.0 |
| D037 | Pentachlorophenol | 100.0 |
| D038 | Pyridine | 5.0 |
| D010 | Selenium | 1.0 |
| D011 | Silver | 5.0 |
| D039 | Tetrachloroethylene | 0.7 |
| D015 | Toxaphene | 0.5 |
| D040 | Trichloroethylene | 0.5 |
| D041 | 2,4,5-Trichlorophenol | 400.0 |
| D042 | 2,4,6-Trichlorophenol | 2.0 |
| D017 | 2,4,5-TP (Silvex) | 1.0 |
| D043 | Vinyl chloride | 0.2 |

**Notes:**
(1)If o-, m-, and p- Cresol concentrations cannot be differentiated, the total cresol (DO26) concentration is used. The regulatory level of total cresol is 200 mg/L.
Source: 40 CFR 261.24 and WHWRR, Chapter 2, Section 3 (e)(ii).

# PWT STANDARD OPERATING PROCEDURE

**WELL DEVELOPMENT**

Procedure No. PWT/GW.106
Revision 1
Date effective: 03/02/12

APPROVED: /s/ _____ PWT Project Manager _____ Date



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FORM PRO.106A


| REVISION LOG | | |
|---|---|---|
| Revision Number | Description | Date |
| 0.0 | Original SOP | March 2007 |
| 1.0 | Revise for Montana Operations | March 2012 |

## 1.0 PURPOSE

This document contains guidelines for the development of new wells and piezometers installed by PWT as part of ongoing field investigation projects. These procedures also apply to the redevelopment of pre-existing wells or piezometers by removing sediment or other built-up material. The objective of a completed well development activity is to provide groundwater inflow that is as physically and chemically representative as possible of the aquifer that is open to the well or piezometer.

## 2.0 SCOPE

This document applies to all PWT personnel and subcontractors conducting groundwater-related work on remedial investigation projects. This document, which constitutes a Standard Operating Procedure (SOP), describes acceptable methods for the development or re-development of wells and piezometers installed by PWT.

## 3.0 REQUIREMENTS

The following sections identify the personnel qualifications and equipment for the development of wells and piezometers.

### 3.1 Personnel Qualifications

Personnel performing these procedures are required to have completed the initial 40-hour OSHA classroom training that meets Department of Labor Regulation 29 CFR 1910.120(e)(3)(i), and must maintain a current training status by completing the appropriate 8-hour OSHA refresher courses. Personnel must also have read and signed the appropriate Health and Safety Plan(s).

Prior to engaging in well or piezometer activities, personnel are required to have a complete understanding of the procedures described within this and other related SOPs and receive specific training regarding these procedures if necessary.

### 3.2 Equipment

The following is a list of basic equipment typically required when developing wells or piezometers. Additional equipment may be required in less typical applications, and will be specified in the project-specific work plan or other appropriate document.

- Watch
- Graduated purge water container
- Stainless steel or Teflon® bailer
- Mechanical reel equipped with a stainless steel Teflon® coated cable
- Inertial or peristaltic pump
- Positive air displacement pump
- Surge Block
- Water parameter test equipment
- Wash/Rinse tubs
- Clear plastic sheeting or vinyl sheeting which may be decontaminated
- Liquinox detergent
- Containers for development water
- Electronic water level sounder (see SOP PWT/GW.102, Water Level Measurements in Wells and Piezometers)
- Distilled or deionized water

- Field book and/or field forms
- Health and safety equipment and supplies
- Organic vapor detector (OVD, FID or PID) if necessary
- Calculator
- Black water proof pens

## 4.0 DEVELOPMENT PROCEDURES

Monitoring well development is the process by which the well drilling fluids and mobile particulates are removed from within and adjacent to the newly installed wells and piezometers. This process can also be used to remove sediment or other built-up material from an older well. The objective of a completed well development activity is to provide groundwater inflow that is as physically and chemically representative as possible of the aquifer that is open to the piezometer or well.

### 4.1 Low Energy Development Methods

Low energy well development methods are typically applicable to newly installed wells or for pre-existing monitoring wells that have been routinely sampled using standard purging and sampling methods because the sediment in the well is fine grained and has not compacted to the point where suspension and removal is problematical. For new wells or piezometers, perform the development as soon as practical after installation, but no sooner than 48 hours after grouting and pad installation is completed. The equipment of choice for well development is an inertial pump or bottom discharge/filling bailer. Small diameter wells will be developed using either a small diameter Teflon® or stainless steel bailer, or a peristaltic pump. If sediment in the well is not easily removed by low energy methods, high-energy methods such as surge blocks or overpumping may be necessary. See Section 4.1.2 for procedures for development using high energy methods.

New wells that are installed in areas known to be contaminated with organics (e.g., volatile organic compounds), or which cause a positive reading on the OVD, will be checked for the presence of immiscible layers prior to well development. The method for detecting these layers in monitoring wells is discussed in SOP PWT/GW.102, Water Level Measurements in Wells and Piezometers. If an immiscible layer of 5 mm or greater has been detected in a newly installed well, well development procedures will not continue until the PWT Field Team Leader has been notified. In the case where an immiscible layer is not identified, a water level measurement will be taken according to SOP PWT/GW.102, Water Level Measurements in Wells and Piezometers, and well development activities will continue. The water level measurement along with the total depth measurement will be used to determine the volume of water in the well casing. Well casing calculations are presented in Subsection 4.1.1 of this SOP.

For wells where the fines are thought to be interstitial to the sand pack, formation water and fines will be evacuated by slowly lowering and raising the inertial pump or bailer intake throughout the water column of the screen. The inertial pump may be placed inside a decontaminated 1-inch diameter PVC pipe if the pump intake cannot be lowered to the bottom of the well. The PVC pipe will prevent the inertial pump intake from bending prior to reaching the desired depth. PWT personnel will determine whether an inertial pump will be dedicated to a specific well based on verified organic vapor detector (OVD) readings obtained during the drilling of the well. OVD readings are described in the owner's manual for the particular equipment used. If a bailer is used for well development, it will be used with a mechanical reel equipped with a stainless steel Teflon® coated cable or nylon rope. For wells where the fines have collected at the bottom of the well, fines will be evacuated by slowly lowering and raising the inertial pump or bailer intake near the fines to collect the sediment. This action will cause some of the water to be displaced and will help to stir up and suspend the sediment particles. Development equipment will be protected from the ground surface with clear plastic sheeting. Development

equipment, including bailers and pumps, will be decontaminated before well development begins and between well sites.

For small diameter piezometers the formation water and fines will be evacuated by slowly lowering and raising the peristaltic pump intake tubing or bailer throughout the water column. If a peristaltic pump is used, it will be fitted with chemically inert silicon or equivalent type tubing for the intake and discharge lines. If a bailer is used for well development, it will be used with a mechanical reel equipped with a stainless steel Teflon® coated cable or with nylon rope. For wells where the fines have collected at the bottom of the well, fines will be evacuated by slowly lowering and raising the inertial pump or bailer intake near the fines to collect the sediment. This action will cause some of the water to be displaced and will help to stir up and suspend the sediment particles. Development equipment will be protected from the ground surface with clear plastic sheeting. Development equipment, including bailers and pumps, will be decontaminated before well development begins and between well sites. Decontamination and rinse water will be disposed of in either a satellite container or in the purge water storage container in the groundwater sampling vehicle.

Decontamination and development water will be handled according to the procedures outlined in Subsection 4.3 of this SOP.

4.1.1 Low Energy Well Development Instructions

Development shall proceed in the manner described herein and continue until the following are met:

- Removal of a minimum of five well casing volumes. Typical well casing volume calculations include:

  a. 0.75-inch inside diameter well:
  87 milliliters/ft x____(linear ft. of water) = ml of water

  b. 2-inch inside diameter well:
  0.16 gal/ft x ___(linear ft of water) = gallons of water

  c. 4-inch inside diameter well:
  0.64 gal/ft x ___ (linear ft of water) = gallons of water

Graduated containers will be used to measure the amount of water removed.

1. If the initial water measurement (WLM) indicates water is at a depth below the bottom of the screened interval, the well is considered "technically dry" for development purposes. Most wells are installed with a sump that may be up to 2 feet deep. Piezometers that are less than 2 inches in diameter will have sumps that vary in length. If a well is dry or technically dry, it is recommended (but optional) that monthly water level measurements be taken for one year to check seasonal changes in the water table. A well can be developed following a WLM which indicates the well is not dry (water covering all or a portion of the screened interval).

2. When a monitoring well or piezometer has an initial water column that covers only a portion of the screened interval, but does not dewater prior to evacuating the five minimum volumes, well development can proceed if the recharge rate in the well will allow for evacuating the total volume needed within a reasonable timeframe not to exceed one week. Otherwise, the Field Team Leader should be contacted for additional instructions.

3. All wells that measure technically dry may indicate that water is below the screened interval and has collected in the sump. These wells should be bailed dry to remove well construction water and to insure that the first monthly WLM will more accurately reflect any groundwater recharge.

- A well or piezometer is considered successfully developed when consistent measurements of pH, temperature, specific conductance, and turbidity are recorded for the final three consecutive casing volumes evacuated from the well. Consecutive readings are temperatures within 1°C; pH readings within 0.2 units; consecutive conductivity readings within 10 percent of each other; and formazine turbidity units (FTU) within 10 percent of each other. The requirement for temperature stabilization may be waived in cases where the reason for instability is related to limitations associated with the purging technique, such as limited volume of purge water combined with ambient air and purge equipment temperature extremes. It is expected that this condition could exist at wells having less than 2000 ml in storage. This variance must be documented with a full explanation on the Well Development/Redevelopment Log (Form PWT/GW.106A).

- If water was used during drilling, the total fluid added will be recorded, and two times the fluid lost in the borehole during drilling will be recovered in addition to the five well casing volumes. Additional purging will be required if, after removing the required volume, the field parameters have not stabilized. In this case, well development will continue until field parameter stabilization is achieved.

- The sediment in the well should be completely removed from the screened interval and removed from the well sump to the extent practicable. The well will be checked for the accumulation of additional sediment one-week after initial development. If sediment has collected in the screened interval or significant additional sediment has accumulated in the well sump, re-development will be performed using the same procedures.

### 4.2 High Energy Development Methods

In wells where the sediment accumulation cannot be removed by low energy methods, high energy development methods may be necessary. The equipment and procedures used for high energy well development are included in Section 3.2. The methods that will be employed for high energy well development are mechanical surging, bailing and/or overpumping. Once the majority of the sediment is removed from the well using these methods, the low energy methods will be employed to fully develop the well.

Mechanical surging is the process of forcing water to flow into and out of a screen by operating a plunger up and down in the casing similar to a piston in a cylinder. The tool normally used is called a surge block or surge plunger. The concern associated with using a surge block is that it can force fine grained sediment back into the formation. Therefore, this method is most applicable for removing coarser grained materials in the well after the fines have been removed by other methods.
Before starting to surge, the wells should be pumped or bailed to make sure that water will flow in through the screen. The surge block should be lowered until it is 10 to 15 feet beneath the static water level but above the wells screen. The water column in the well casing will effectively transmit the action of the block to the screen section. The initial surging motion should be relatively gentle allowing any material that is blocking the screen to break up and go into suspension. As water begins to move easily in and out of the screen, the surging tool is lowered in steps to just above the screen. In a well with a particularly long screen, it may be necessary to operate the surge block in the screen to concentrate its action at particular levels. Surging should continue for several minutes then the block should be slowly pulled from the well while maintaining the same surging motion. Sediment can be removed using a bailer or by using a bottom filling positive air displacement pump. Piston or drive type pumps such as Grundfos Rediflow pumps should be avoided because they can be damaged by pumping sand sized particles. Surging should be continued until little or no sand sized particles are being drawn into the well. At this point, well development can be conducted using methods in Section 4.1.

Overpumping is another method for removing sediment from the water bearing formation and involves pumping at a higher rate than the well will be pumped during sampling. The general concept is that any well that can be pumped sand free at a high discharge rate can be pumped sand free at a lower discharge rate. The difference between low energy pumping and overpumping as it applies to this procedure is that consideration must be given to using a pump capable of achieving higher flow rates than pumps that may be used for sample collection. Also, if sand sized materials are to be removed from the well a pump that is capable of pumping sand sized particles must be used. A bottom- filling positive air displacement pump such as the Geotech Reclaimer, which is used for product recovery may be preferable to piston or drive type pumps such as Grundfos Rediflow pumps which are damaged by pumping sand sized materials. The pump should be operated starting at the top of the screen and then lowered sequentially to insure that fines are not just removed from the top of the screened interval. Overpumping should be performed for a few minutes at varying depth intervals and checked for sand materials using a bailer. Once the overpumping activity has been performed well development can be conducted using methods in Section 4.1. Concerns that should be considered when using overpumping are that fines are only being pushed in one direction, which may compact finer sediments around the borehole or clog the screen. Overpumping will also tend to generate more development water for disposal.

### 4.3 DISPOSITION OF PURGE AND DEVELOPMENT WATER

All water removed from a well during development procedures will be collected either in a satellite container or drum, or a purge water collection container in the groundwater sampling vehicle. When the collection container is filled, or near capacity, it will be transferred to an appropriate treatment facility or to a contracted service company for disposal. Arrangements must be made with the facility manager or company prior to developing the wells. PWT SOP GW_105 Investigation Derived Waste Management should be referred to for investigation derived waste disposal.

## 5.0 DOCUMENTATION

The following well development information will be recorded on the Well Development and Sampling Form (Form PWT.106A) for newly installed wells, or redevelopment of pre-existing wells.

- Well or piezometer I.D. and location survey coordinates
- Date(s) and time of well development
- Well designation
- Static water level from measuring point
- Total depth from measuring point
- Calculated well casing volume
- Quantity of water lost during drilling (if applicable)
- Quantity of water added during development
- Depth from top of well casing to top of sediment inside well, before and after development
- Development method
- Field measurements of pH, specific conductance (SC), turbidity, and temperature, taken at full casing volumes, or more frequently if desired
- Physical description of removed water throughout development (color and odor)
- Quantity of water removed (incremental and total values)

## 6.0 REFERENCES

### 6.1 SOURCE REFERENCES

The following is a list of references reviewed prior to the writing of this procedure:

Driscoll, F.G. 1986. Groundwater and Wells, Second Edition. Johnson Division.

EPA. 1987., A Compendium of Superfund Field Operations Methods. EPA/540/P-87/001. December 1987.

EPA. 1988. Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA. Interim Final. October.

EPA. 1989. RCRA Facility Investigation Guidance. Interim Final. May.

EPA. 1986 RCRA Groundwater Monitoring Technical Enforcement Guidance Document. OSWER-9950.1.September.

## 6.2 INTERNAL REFERENCES

Related SOPs cross-referenced by this SOP are as follows:

- SOP PWT/GW.103, Monitoring Well and Piezometer Installation
- SOP PWT/GW102, Water Level Measurements in Wells and Piezometers
- SOP PWT/GW105, Investigation Derived Waste Management
- SOP PWT/GW.108, Measurement of Groundwater Field Parameters

# PWT DEVELOPMENT/REDEVELOPMENT LOG FORM PWT/GW.106A

**LOCATION CODE: _____**

**SAMPLE TEAM MEMBERS: _____, _____, _____**

Development Method – Type Used: ☐ Bailer ( ☐ Teflon or ☐ SS ) ☐ Peristaltic Pump ☐ Other _____

## DEVELOPMENT VOLUMES AND FIELD WATER QUALITY MEASUREMENTS

| Date (MM/DD/YY) | Time (24 Hour) | Volume Purged (☐ GAL or ☐ ML) | Temp (°C) | Specific Cond. (☐ mS/cm or ☐ µS/cm) | pH (SU) | Turbidity (☐ FTU or ☐ NTU) | Water Description (Color, Odor) |
|---|---|---|---|---|---|---|---|
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**ALKALINITY DETERMINATION**

pH Offscale, ☐ YES or ☐ NO pH Offscale Reading = _____Checked by (initials)

if YES -- At _____ pH, Total Alkalinity = _____ x 10 = _____ ppm

if NO---- At_____pH, Total Alkalinity (full range)=_____ppm

Completed By: (Print Name) _____ Signature: _____ Date: _____
Checked By: (Print Name) _____ Signature: _____ Date:

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| REVISION LOG | | |
|---|---|---|
| Revision Number | Description | Date |
| 1.0 | Original SOP | July 2011 |
| 2.0 | Revise for Montana Operations | March 2012 |
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## 1.0 PURPOSE AND SCOPE

This Standard Operating Procedure (SOP) provides technical guidance and methods that will be used to measure field parameters in water during environmental investigations. Field parameters will be measured during monitoring well development, purging and sampling, and during surface water sampling. This SOP serves as a supplement to site-wide and investigation area specific workplans and the site-specific Quality Assurance Project Plan (QAPP) and is intended to be used in conjunction with other SOPs.

## 2.0 PERSONNEL QUALIFICATIONS

Personnel performing field parameter measurement activities will have knowledge and experience in the equipment and methods proposed, or will work under the direct field supervision of knowledgeable and experienced personnel. Personnel will also be qualified to perform this work in accordance with the project-specific health and safety plan (HASP).

## 3.0 MATERIALS AND EQUIPMENT

In addition to the equipment cited in the PWT Groundwater Sampling SOP GW.101, and the PWT Surface Water Sampling SOP SW.101, the following materials and equipment may be necessary for measurement of field parameters.

- Portable pH meter and pH 4, 7, and 10 buffer solutions
- Spare pH probe or electrolyte cartridge, as applicable
- pH electrode storage solution
- Conductivity meter and calibration solutions that bracket the expected range of measurements
- Portable dissolved oxygen kit and low and high range dissolved oxygen AccuVac ampuls (or equivalent)
- Portable Eh tester electrode
- Portable turbidity meter
- In-flow multi-measurement meter
- Tygon™ or silicone tubing
- Peristaltic pump, bladder pump, or other appropriate pump
- 12-volt battery
- Extra batteries for all instruments
- Beakers of assorted sizes
- Deionized or distilled water
- Wash bottle
- Kimwipes® or equivalent.

## 4.0 PROCEDURES

Several of the field parameters are physically or chemically unstable and may be tested using either an in-flow multi-measurement system or a field test kit or instrument immediately after sample collection.

Examples of unstable parameters include pH, temperature, Eh, and dissolved oxygen. Although the conductivity of a substance is relatively stable, it is recommended that this characteristic be measured in the field. Most instruments measuring conductivity require temperature compensation; therefore, the temperature of the samples should be measured at the time the conductivity is measured. The specific field parameters to be measured will be specified in the site-specific QAPP.

An unfiltered water grab sample (if not using an in-flow multi-measurement system) will be collected for measuring field parameters. Field parameter measurements should be obtained immediately after sample collection. The same grab sample can be used to measure all field parameters, but should not be used for laboratory analysis.

Field parameters commonly measured are as follows:

1. Dissolved oxygen
2. Oxidation/reduction potential (ORP)/Eh
3. pH
4. Specific conductivity
5. Turbidity
6. Temperature
7. Time

4.1 In-Flow Multi-Parameter System

The in-flow multi-parameter monitoring system or similar multi-parameter instruments, may be used for measuring pH, temperature, conductivity, ORP/Eh, and dissolved oxygen. The instrument operation and maintenance manual shall be followed when operating or calibrating the instrument.

4.2 pH

Determine the pH from a water sample as soon as possible after collecting it, or use an in-flow multi-measurement system. Determine the pH by the electrometric method. The electrometric method is the preferred method because of its greater accuracy and ease of measurement. Either a glass electrode and a reference electrode, or a combination electrode, which combines the glass membrane electrode and the reference electrode, will be used. The procedures described in this section are generic; they were generally written for HACH EC10 and EC20 (or equivalent) pH meters.

4.2.1 pH Meter Calibration Procedure

The pH meter shall automatically compensate for temperature and be capable of calibration with a two-point (using two buffers) slope adjustment method. The meter shall have a precision of at least 0.05 pH units.

Before collecting samples, calibrate the pH meter in accordance with the manufacturer's instructions using standard buffer solutions. Field sampling personnel will record all pH measurement data, including calibration dates and times, readings, the meter number, and sample temperatures on either surface water or ground water field data sheets or in the field logbook.

Calibrate the pH meter daily prior to field activities. Verify the pH calibration using a pH 7 buffer solution before each sampling location, and recalibrate as necessary. Thoroughly document all calibrations and verification pH readings and temperature, in the field logbook and on field data sheets.

Sampling personnel will calibrate the pH meter as follows:

1. Before immersing the probe(s) into the buffer solution or sample, rinse the probe with deionized or distilled water.
2. Calibrate the meter with two buffer solutions (two-point slope adjustment). One of the buffer solutions used for the slope adjustment should approximate the anticipated pH of the sample, and the other buffer should always have a pH of 7. Ensure that the buffer solutions are at the same temperature and are as close as practical to the temperature of the water to be measured.
3. Record the results of the calibration.
4. Decontaminate the pH meter and associated equipment in accordance with the PWT Decontamination of Personnel and Equipment SOP ES.103.

4.2.2 pH Measurement Procedure

Field sampling personnel will measure pH as follows:

1. If the pH is measured in a container, rinse the sample container with deionized or distilled water and then rinse it three times with the sample water prior to measurement. If using an in-flow multi-measurement system, measurements are continuously displayed.
2. Rinse the pH probe with deionized or distilled water. Be sure to protect the fragile glass bulb at the end of the probe from damage.
3. Immerse the electrode in the water, allow the pH reading to stabilize, and monitor the drift of the instrument. Do not immerse the electrode above the top of the pH probe.
4. When the pH reading stabilizes (i.e., the meter beeps), record the temperature to the nearest 0.1ºC and the pH reading to the nearest 0.01 unit.
5. Between measurements, store the electrode in pH electrode storage solution or equivalent solution, if possible, or put a cotton swab soaked in electrode solution in the protective cap of the electrode.
6. Decontaminate pH meter/in-flow multi-measurement system and associated equipment in accordance with the PWT SOP GW.101, Groundwater Sampling.

4.3 <u>Conductivity</u>

Electrical conductivity, or specific conductance, is the ability of water to conduct an electric current and depends on the concentration of ions in solution. The relationship between conductivity and the concentration of dissolved solids is approximately linear for most natural waters. Changes in this relationship indicate changes in the proportions of different salts and, therefore, changes in the sources of dissolved substances that enter the water body.

For measuring conductivity in the field, the meter shall have an automatic temperature compensator and shall display conductivity directly in units of microsiemens per centimeter (µS/cm) for samples with a conductivity less than 2,000 µS/cm, or in millisiemens per centimeter (mS/cm) for samples with a conductivity greater than 2.00 mS/cm, corrected to a temperature of 25ºC.

4.3.1 Conductivity Meter Calibration Procedure

Before collecting samples, calibrate the conductivity meter using calibration solutions in accordance with the manufacturer's instructions. Sampling personnel will record all conductivity measurement data,

including calibration dates, readings, the meter number, and sample temperatures on a field data sheet or in a field logbook.

Reagent-grade potassium chloride (KCl) or other equivalent solutions are universally used as reference solutions to calibrate conductivity equipment. The reference solutions are also used to check the accuracy of the meter. The conductivity of the reference solutions that are used to calibrate the meter should bracket the expected range of the conductivity of the water samples. Commercially prepared calibration standards are available from laboratory suppliers at many standard concentrations.

Field sampling personnel will calibrate the conductivity meter as follows:

1. Calibrate the meter according to the manufacturer's instructions.
2. Prepare or obtain standard reference solutions of a known value at a known temperature. Adjust the meter or the calibration solution to the correct temperature.
3. Adjust the meter to read the reference conductivity.
4. Rinse the probe with deionized or distilled water.
5. Re-immerse the probe in the reference solution and read the measured value to validate the corrected conductivity.
6. Record the results of the calibration.
7. Decontaminate conductivity meter/in-flow multi-measurement system and associated equipment in accordance with the PWT SOP GW.101, Groundwater Sampling.

Check the calibration of the conductivity meter against a known standard prior to sampling at each location and recalibrate as necessary.

4.3.2 Conductivity Measurement Procedure

Measure conductivity immediately after a field parameter grab sample is collected. Record conductivity readings to the nearest 1 µS/cm (for samples with conductivities less than 2,000 µS/cm) or 0.01 mS/cm (for samples with conductivities greater than 2.00 mS/cm).

Field sampling personnel will measure conductivity as follows:

1. Rinse the probe with deionized or distilled water. If using an in-flow multi-measurement system, measurements are continuously displayed.
2. Insert the probe into the sample and agitate the probe vertically.
3. Allow the reading to stabilize before recording measurements.
4. Record the conductivity and temperature of the sample.
5. During normal use, rinse the probe thoroughly with deionized or distilled water between measurements to minimize the buildup of interfering substances on the probe element.
6. Decontaminate conductivity meter/ in-flow multi-measurement system and associated equipment in accordance with the PWT SOP GW.101, Groundwater Sampling.

4.4 <u>Dissolved Oxygen</u>

The dissolved oxygen (DO) concentration may be measured with an in-flow multi-measurement system at the time of parameter sample collection or using an in situ probe.

This method for DO measurement is appropriate for qualitative assessment only (e.g., assessing field stabilization). It is not appropriate as a quantitative measure of DO for assessing natural attenuation.

The DO meter is factory calibrated; the factory calibration shall be confirmed before the DO meter is sent to the field. Each day before collecting samples and as applicable for the instrument, the in-flow DO probe shall be calibrated according to the manufacturers suggested procedures for altitude. The in situ DO probe, which may be used for parameter measurements of surface water, will be calibrated daily before sample collection in accordance with manufacturer's instructions.

Inflow DO concentrations are continuously displayed with the multi-measurement system. All DO measurements should be recorded along with temperature readings.

4.5 Eh

Eh may be measured in the field at selected locations for some projects at the time of water sample collection. Either an in situ probe or inflow multi-measurement water will be used for Eh measurement.

The Eh meter shall be calibrated prior to being sent to the field. Check the calibration of the Eh meter against a known standard daily, and recalibrate as necessary. Additionally, an Eh sensitivity verification will be completed each day before collection of samples. Sensitivity verification will be demonstrated by a reduction in Eh with an increase in pH. Consult the manufacturer's instruction manual for proper use.

Field sampling personnel will measure Eh as follows:

1. At the start of each day, measure the Eh and temperature of the standard solution and record results in the field logbook.
2. Remove the Eh electrode cap and turn on the meter
3. Dip the electrode 1/2 to 1 inch into the sample and stir once. The electrode should stabilize within 2 to 5 minutes. When stable, take a reading and record it on the sample data sheet. Any instability will be noted and recorded on the sample data sheet.
4. Decontaminate the Eh meter probe and associated equipment in accordance with the PWT SOP GW.101, Groundwater Sampling.

4.6 Turbidity

The turbidity will be measured at the time of sample collection. A colorimeter (HACH DR700 or equivalent) and ampules (AccuVac) containing the appropriate reagents or a portable turbidity meter will be used for field determination of turbidity in the parameter samples.

The turbidity meter is factory calibrated and requires no field calibration. The factory calibration shall be checked before the turbidity meter is sent to the field. Additionally, the calibration of the turbidity meter will be checked daily before collection of samples against a known formazin standard. The instrument will be recalibrated as necessary based on the daily check. Refer to the manufacturer's instruction manual for proper use.

The turbidity test measures an optical property of the water sample that results from the scattering and absorbing of light by the particulate matter present. The amount of turbidity registered is dependent on such variables as the size, shape, and refractive properties of the particles. This procedure is commonly calibrated using formazin turbidity standards, and the readings are in terms of nephelometric turbidity units (NTUs).

4.7 Temperature

Temperature measurements will be made with a high quality mercury-filled thermometer or in-flow multi-measurement system having an analog or digital readout device. This thermometer is to have been standardized by comparison with a thermometer calibrated against a National Institute of Standards and Technology (NIST) calibrated thermometer. All temperature-measuring devices will be scaled to indicate degrees Celsius and marked as appropriate to meet data quality objectives. Glass thermometers will be transported in a protective case to prevent breakage.

Temperature measurements made for the purpose of providing adjustment factors for other field parameters will be conducted simultaneously with those related measurements. Volumes and methods of collection will be determined by the procedural requirements of the primary field measurement taken.

Field sampling personnel will measure temperature as follows:

1. Inspect the thermometer daily before each field trip to ensure that there are neither cracks in the glass nor air spaces or bubbles in the mercury.
2. Allow the thermometer or in-flow multi-measurement system enough time to equilibrate to outside temperature when removed from a field vehicle.
3. Insert the thermometer into the parameter sample. Swirl the thermometer if the medium is calm and take the temperature reading when the reading stabilizes. If using an in-flow multi-measurement system, readings will be continuously displayed.
4. Record the temperature reading in the field logbook to the nearest ±0.5ºC.
5. Decontaminate the thermometer/in-flow multi-measurement system and associated equipment in accordance with the PWT SOP GW.101, Groundwater Sampling.

## 5.0 DOCUMENTATION

Field sampling personnel will document field parameter instrument calibration procedures and measurements in the field logbook and appropriate field data sheets. Information to be documented includes calibration checks, verifications, calibrations, factory calibration records, and field parameter measurements.

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**List of Attachments**


Attachment A Sediment Sample Field Data Sheet


| REVISION LOG | | |
|---|---|---|
| Revision Number | Description | Date |
| 1.0 | Original SOP | July 2011 |
| 2.0 | Revise for Montana Operations | March 2012 |

## 1.0 PURPOSE AND SCOPE

This Standard Operating Procedure (SOP) provides technical guidance and methods that will be used to collect surface and near surface sediment samples in streams, ditches, and at seeps and springs. Pond sediment sampling is not addressed in this SOP. This SOP serves as a supplement to site-wide and investigation area specific workplans and the site-specific Quality Assurance Project Plan (QAPP) and may be used in conjunction with other SOPs.

The SOP describes procedures for collection of discrete samples (i.e., samples collected at a single point for chemical analysis), and composite samples (i.e., samples composed of multiple increment samples collected at several points within the area to be characterized). The goal of sediment sampling in drainages, ditches, and at seeps is to collect samples of the sediment only, not the underlying soil.

## 2.0 PERSONNEL QUALIFICATIONS

Personnel performing sediment sampling activities will have knowledge and experience in the sampling methods proposed, or will work under the direct field supervision of knowledgeable and experienced personnel. Personnel will also be qualified to perform this work in accordance with the project-specific health and safety plan (HASP).

## 3.0 MATERIALS AND EQUIPMENT

The following materials and equipment may be needed for sediment sampling:

- Sample containers
- Field logbook
- Sediment sample field data sheets (Attachment A)
- Plastic flagging
- Monitoring equipment and personal protective equipment (PPE), as outlined in the HASP
- Decontamination equipment and supplies (e.g., high pressure sprayer/washer, wash/rinse tubs, brushes, Alconox, plastic sheeting, paper towels, sponges, baby wipes, garden-type water sprayers, large plastic bags, potable water, distilled water and/or deionized water)
- Stainless steel drive sampler with stainless steel liners
- Sledgehammer or slide hammer drive device
- Stainless steel scoop or spoon, knife, and mixing bowl
- Sample collection supplies (e.g., appropriate laboratory-supplied sample containers, plastic recloseable plastic bags or equivalent, waterproof markers, sample labels, chain of custody [COC] forms, cooler for sample storage, ice or ice substitute, clear plastic and strapping tape, custody seals, trash bags)
- Drums or other approved containers for containing soil

## 4.0 PROCEDURES

### 4.1 Discreet Samples

Discrete samples consist of samples collected for chemical analysis from a single location. Samples for VOC analysis must be collected as discrete samples.

Sampling sites specified in the site-specific QAPP will be located and marked using surveying stakes, lath, or flags. Utility clearance will have been accomplished according to the PWT Utility Clearance SOP.

Discrete sediment samples will be collected as follows:

1. At each location, clear an area approximately 12 inches in diameter of surface vegetation and debris.
2. Use a decontaminated stainless steel spoon to collect the sediment to the desired depth. A stainless steel pick may be used as needed to loosen the soil. To the extent possible, eliminate gravel size or larger particles or debris based on visual observation. Be sure to collect sufficient sample volume to meet analytical requirements.
3. If VOC and SVOC analyses are to be performed, immediately fill the VOC and SVOC sample containers fully to eliminate head space. Tightly seal the containers with the appropriate lids. Label and handle the VOC and SVOC analysis containers as specified in the PWT Sample Handling SOP.
4. Place the remainder of the sample in a stainless steel bowl. To the extent possible, eliminate gravel size or larger particles or debris based on visual observation.
5. If the sample is to be homogenized, thoroughly mix the non-VOC/SVOC sample material in the stainless steel bowl using a decontaminated stainless steel spoon. To homogenize, divide the sample into four quarters and mix each quarter, then combine the four quarters and mix the entire sample.
6. Immediately fill the appropriate sample containers. Label and handle the containers as specified in the PWT Sample Handling SOP.
7. Decontaminate the sampling equipment in accordance with the PWT Personnel and Equipment Decontamination SOP.

An alternate method for collection of discrete sediment samples involves the use of a decontaminated drive sampler with stainless steel liners. Depending on the depth of the sediment, several drives of the sampler at adjacent locations may be necessary to obtain sufficient volume of material to meet analytical requirements.

1. Clear the sampling area, as per Step 1 above.
2. Using a sledgehammer or slide hammer drive device, drive a decontaminated drive sampler or other appropriate device containing stainless steel liners into the ground to the desired depth.
3. Remove and open the sampler.
4. Screen the breaks between the liners for the presence of VOCs using a PID/FID.
5. Log the sample in accordance with the PWT Borehole Logging SOP.
6. Select and remove the liner(s) for VOC/SVOC analysis. One liner must be collected for VOC analysis and one for SVOC analysis. Typically adjacent liners will be selected from the middle of the sampler. If insufficient sediment depth is present to collect the necessary volume of material, additional drives at adjacent locations will be required. Cap the ends with teflon sheeting and plastic end caps and label the liner(s).
7. Extrude the remaining sample from the non-VOC/SVOC liners into a decontaminated stainless steel bowl. If necessary, collect additional sample material by driving successive drive samples at the surface at adjacent locations until sufficient sample material is collected. If QA/QC duplicate samples are required by the FSP, also collect these at adjacent surface locations.

8. If the non-VOC/SVOC sample is to be homogenized, thoroughly mix the sample material in the stainless steel bowl using a decontaminated stainless steel spoon. To homogenize, divide the sample into four quarters and mix each quarter, then combine the four quarters and mix the entire sample.
9. Immediately fill the appropriate sample containers. Label and handle the liners and containers as specified in the PWT Sample Handling SOP.
10. Decontaminate the sampling equipment in accordance with the PWT Personnel and Equipment Decontamination SOP.

### 4.2 Composite Samples

Composite samples are comprised of multiple increment samples collected at several points. All or a portion of the increment samples are mixed together to create a composite sample representative of average constituent concentrations within the area to be characterized. Composite samples cannot be used for VOC/SVOC analysis. However, the VOC/SVOC samples may be collected as discrete samples at one of the increment locations. VOC/SVOC samples should be collected as specified in the previous section.

Prior to sampling, it is important to calculate the volume of sample material to be collected at each increment sample location to ensure that the necessary amount of composite sample will be obtained. Required volumes of composite samples are analysis-specific and will be specified in the FSP. For a given composite sample, the volume of each increment sample must be the same, and must equal 1/n of the required composite sample volume, where n equals the number of increment samples making up the composite sample.

Increment sampling locations specified in the FSP will be laid out and marked using surveying stakes, lath, or flags. This may involve laying out a rectangular grid of points. Utility clearance will have been accomplished according to the PWT Utility Clearance SOP.

Each composite sediment sample will be collected as follows:

1. At each increment sample location, clear an area approximately 12 inches in diameter of surface vegetation and debris.
2. Use a decontaminated stainless steel spoon to collect sediment to the desired depth. A stainless steel pick may be used as needed to loosen the soil. To the extent possible, eliminate gravel-size or larger particles and debris based on visual observation. Important: Be sure to collect a sufficient volume of increment sample. The volume of increment sample collected at each location must be the same.
3. Place the increment sample into a decontaminated stainless steel mixing bowl. Mix thoroughly.
4. Decontaminate the sampling equipment in accordance with the PWT Personnel and Equipment Decontamination SOP.
5. Repeat Steps 1 through 4 at each increment sample location for a given composite sample, adding each successive increment sample to the mixing bowl.
6. Thoroughly mix the sample material in the stainless steel bowl using a decontaminated stainless steel spoon. To homogenize, divide the sample into four quarters and mix each quarter, then combine the four quarters and mix the entire sample. Place mixture into appropriate laboratory-supplied sample containers.
7. Label and handle the containers as specified in the PWT Sample Handling SOP.

## 5.0 DOCUMENTATION

Personnel collecting samples are responsible for documenting sampling activities in the field logbook and on the Sediment Sample Field Data Sheet (Attachment A). Discussions of sample documentation are provided in the PWT Borehole Logging SOP.

# ATTACHMENT A

# SEDIMENT SAMPLE FIELD DATA SHEET

**Pacific Western Technologies Sediment Sample Field Data Sheet**

**Sample Identification No.** _____

**Project Information**

Project Name: _____

RFI Contractor: _____ **Sample Tech.:** _____

**Location Information**

Location ID No. _____

**Sample Information**

Date and Time of Sample Collection: _____

Sample Collection Method (circle): Scoop/Spoon/Trowel Drive Sampler Liners Used

Sample Type (circle): Discrete Composite

**Discrete (circle):** VOC/SVOC Sample Collected? Y or N Collection Method: Liner Grab

Non-VOC/SVOC Sample Homogenized? Y or N Volume of non-VOC sample_____

**Composite:** VOC/SVOC Sample Collected? Y or N Collection Method: Liner Grab

Non-VOC/SVOC Sample: Total Volume of Sample Required _____ No. of Increments _____

Required Volume of Each Increment _____

Volume Collected at Each Increment_____

Sample Lithologic Description:

_____

_____

_____

PID/FID Measurements _____

_____

| Sample Containers | Number | Preservatives | Analyses |
|---|---|---|---|
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |

Associated QA/QC Sample Nos.: _____

_____

**Comments/Observations**

_____

_____

Sampler's Name and Signature:_____

## Standard Operating Procedure
## For
## BOREHOLE LOGGING

**Prepared by:**

PACIFIC WESTERN TECHNOLOGIES, LTD.

**July 2011**

**Revision 1.0**

# SOP BOREHOLE LOGGING

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|---|---|---|
| Revision Number | Description | Date |
| 1.0 | Original SOP | July 2011 |
| | | |
| | | |
| | | |
| | | |
| | | |

# SOP BOREHOLE LOGGING

## 1.0 PURPOSE AND SCOPE

This Standard Operating Procedure (SOP) provides technical guidance and methods that will be used to log boreholes drilled in unconsolidated and weathered bedrock during environmental investigations. This SOP serves as a supplement to site-wide and investigation area specific work plans and the site-specific Quality Assurance Project Plan (QAPP) and is intended to be used in conjunction with other SOPs.

## 2.0 PERSONNEL QUALIFICATIONS

Personnel responsible for logging boreholes in unconsolidated and consolidated geologic material will be appropriately trained individuals with a minimum of a bachelor's degree in geology or a related field and have applicable field experience. Other qualified personnel may include geotechnical engineers or field technicians with an appropriate amount of applicable field experience or on-the-job training under the supervision of another qualified person. Personnel will also be qualified to perform this work in accordance with the project-specific health and safety plan (HASP).

## 3.0 MATERIALS AND EQUIPMENT

The following materials and equipment may be needed for borehole logging:

- Boring log forms (Attachment A)
- Bound field notebook
- Waterproof pens
- Hand lens (10x magnification or higher)
- Latex or nitrile gloves and other required PPE
- Tape measure
- Stainless steel knife, screwdriver, rock hammer
- Decontamination equipment and supplies (e.g., wash/rinse tubs, brushes, Alconox, plastic sheeting, paper towels, sponges, baby wipes, garden-type water sprayers, large plastic bags, potable water, distilled water and/or deionized water)
- Electronic water level meter
- Appropriate field monitoring instruments (e.g., photoionization detector [PID], flame ionization detector [FID], combustible gas indicator [CGI]), as required by the HASP
- Reference tables listing ASTM and/or USCS codes and descriptions
- Munsel color chart

Other materials and equipment may be needed based on field conditions.

## 4.0 PROCEDURES

## 4.1 BORING LOG

The boring log is the primary record of observations of physical conditions encountered during borehole drilling. The primary purpose of the boring log is to document all pertinent information that may be necessary for someone other than the rig geologist to understand and interpret the geologic and hydrogeologic conditions observed during drilling. At some sites, a critical issue is the contact between the unconsolidated material and the weathered bedrock, which may be readily apparent based on textural or color indications, or may be difficult to discern, requiring determination based on mineralogical properties. The boring log must provide sufficient textural, color, and mineralogical information so that someone other than the rig geologist can understand the basis for identification of those items, conditions or locations which are critical to the specific investigation or project.

Each borehole will be drilled and sampled in accordance with an appropriate Drilling and Sampling SOP. The rig geologist will be responsible for preparing detailed, complete, and accurate boring logs in the field using the boring log form (Attachment A) as drilling progresses. The preparation of legible and complete boring logs during drilling is necessary so that the borehole and geologic conditions are properly documented.

At a minimum, the following information will be documented on the boring log:

- Project name / Investigation name
- Supervising contractor name
- Boring identification number
- Start date and time
- End date and time
- Rig geologist name
- Drilling subcontractor and personnel
- Drill rig type
- Drilling method
- Bit diameter (and borehole diameter, if different)
- Auger external and internal diameter
- Sampling method
- Total depth of borehole recorded to the nearest 0.1 feet
- Ground surface elevation (recorded on log following surveying)
- Surveyed horizontal coordinates (recorded on log following surveying). If surveyed horizontal coordinates are not available at the time of drilling, location sketches referencing measured distances to prominent surface features (e.g., building corners, existing wells, fence corners) shall be recorded in the geologist's field log book.
- Sample depths or intervals recorded to the nearest 0.1 feet
- Blow counts

- Sample recovery
- USCS or USDA classification for unconsolidated materials
- Rock type classification for consolidated materials
- Graphic representation of material
- Detailed lithologic description. For unconsolidated materials the description should address the parameters listed in Table 1, including compaction/consistency, water content, color, texture (grain sizes, sorting, and shapes) and plasticity, major and minor constituents (e.g., gravel, sand silt, clay), and major mineralogy (as identifiable from the sample). For rock materials the description should address the parameters listed in Table 2, including weathering classification, color, texture, hardness, rock type and major mineralogy, and presence and orientation of fractures, staining, and bedding.
- Stratigraphic/lithologic changes. Where distinct lithologic changes are directly observed, they will be identified on the boring log by a solid horizontal line. Gradational transitions and changes identified indirectly from cuttings or methods other than direct observation and measurement will be identified by a horizontal dashed line.
- Detailed description of basis for identification of top of weathered bedrock and top of unweathered bedrock.
- Depth at which water is first encountered, the depth of water at the completion of drilling, and the static depth to water (if possible). Static water level data will include time allowed for levels to stabilize. The absence of water in borings will also be indicated.
- Borehole field meter readings (e.g., PID, FID, CGI, radioactivity meter)
- Other drilling, sampling, and borehole observations as appropriate (e.g., resistant layers, typical or unusual odors or other indications of potential contamination)

## 4.2 FIELD LOGBOOK

In addition to the boring log, the geologist will also maintain a bound field logbook. The purpose of the field logbook is to document a semi-narrative record of the field conditions, activities, and events relevant to the field program on a daily basis. The field logbook constitutes the daily written record of the field activities, while the boring log constitutes the written record of the borehole conditions. The following information shall be recorded daily in the bound field logbook if approved field forms are not used:

- Arrival time at site
- Names and affiliations of personnel working at the drilling location
- Equipment used at the drilling location (drill rig, field screening equipment)
- Names of visitors to the drilling location
- Health and safety and field procedure briefings and attendees
- Weather conditions

- Chronological record of drilling and sampling activities documenting times and drilling subcontractor rates and material quantities
- Significant events, such as equipment breakdown, health and safety problems, drill crew standby
- Location and sample station number (including sketches showing measurements from prominent surface features (e.g., building corners, existing wells, fence corners)
- Sample documentation, disposition, and cross references to sampling forms and chain-of-custody records
- Decontamination activities
- Investigation Derived Waste handling activities
- Field screening instrument calibration information and measurements
- Other health and safety observations or concerns
- Significant deviations from the QAPP or SOPs
- Other applicable information
- Departure time from site

**Table 1**
**LOG DESCRIPTORS FOR UNCONSOLIDATED SOIL**

| Parameter | Example |
|---|---|
| Depositional environment and formation, (if named and if known). | Alluvium; Piney Creek |
| Unified Soil Classification System and designation. | Clayey sand (SC), sandy clay (CL) |
| Secondary components and estimated quantities either by percentages or by descriptive percentage ranges (note: terms used to indicate ranges should be described on the log or in a general legend). | Sand: fine, with trace of med. trace gravel |
| Color. May use Munsel color chart. | Gray, brown, yellowish, 5YR 3/2, 5YR 4/4 |
| Consistency (cohesive soil). Use relative term. | Very soft, soft, medium, stiff, very stiff, hard |
| Density (non-cohesive soil). Use relative term. | Loose, medium, dense, very dense |
| Moisture content. Use relative term. Do not express as a percentage unless a value has been measured. | Dry, damp, moist, wet, saturated |
| Texture/fabric/bedding | No apparent bedding, thinly bedded |
| Grain angularity | Rounded, subangular |
| Sorting (sands) | Poorly sorted, well graded |
| Grain or fragment size | Coarse, very fine |
| Mineralogical indicators | Quartz, feldspar grains |
| Note "fill", "top of natural ground", "top of weathered bedrock", and “top of unweathered bedrock” where appropriate | |

**Table 2**
**LOG DESCRIPTORS FOR CONSOLIDATED ROCK**

| Parameter | Example |
|---|---|
| Formation name (if known) | Denver Formation |
| Rock type | Sandstone, shale, siltstone |
| Modifier denoting variety | Shaly, calcareous, siliceous, argillaceous, sandy, micaceous |
| Hardness | Very soft, soft, moderately hard, hard, very hard |
| Color | Medium brown, bluish-gray |
| Bedding | Parting band, thin bedded, medium bedded, thick bedded, massive, structureless, interbedded (Note: provide thickness range of each in legend) |
| Texture | Poorly cemented, well cemented, fine, coarse |
| Degree of weathering | Unweathered, intensely weathered |
| Degree of fracturing, fracture staining or filling | Highly fractured, limonite staining in fractures, MnO staining, calcite or zeolite fracture filling |
| Fracture orientation | Inclined 30º, horizontal |
| Structure and Orientation | Dipping beds at 10º |
| Mineralogical indicators | Andesite, volcanic grains, mafic minerals |
| Moisture content | Dry, damp, moist, wet, saturated |

# ATTACHMENT A

# BORING LOG FORM

# SOIL BOREHOLE LOG

| | | | |
|---|---|---|---|
| SITE NAME AND LOCATION: | DRILLING METHOD: | BORING NO. | |
| | | SHEET ___ OF ___ | |
| | SAMPLING METHOD | DRILLING | |
| | | START | FINSH |
| NORTHING: | COMMENTS | TIME | TIME |
| EASTING: ELEVATION: | | DATE | DATE |
| DRILL RIG | SURFACE CONDITIONS | | |
| ANGLE BEARING | | | |
| SAMPLE HAMMER | | | |

| DEPTH IN FEET (ELEVATION) | Blow/ 6 in on sampler | RECOVERY | SYMBOL | SAMPLE NUMBER AND DESCRIPTION OF MATERIAL | SAMPLER TYPE | REMARKS |
|---|---|---|---|---|---|---|
| 1 | | | | | | |
| 2 | | | | | | |
| 3 | | | | | | |
| 4 | | | | | | |
| 5 | | | | | | |
| 6 | | | | | | |
| 7 | | | | | | |
| 8 | | | | | | |
| 9 | | | | | | |
| 10 | | | | | | |
| 11 | | | | | | |
| 12 | | | | | | |
| 13 | | | | | | |

DRILLING CONTRACTOR: _____ DRILLER NAME: _____

LOGGED BY: _____ CHECKED BY: _____

PROJECT NUMBER: _____ PROJECT NAME: _____

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3.0 METHODOLOGY ..... 1

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| REVISION LOG | | |
|---|---|---|
| Revision Number | Description | Date |
| 1.0 | Original SOP | July 2011 |
| 2.0 | Revise for Montana Operations | March 2012 |

## 1.0 PURPOSE AND SCOPE

Direct push technology (DPT) will be used to rapidly collect soil samples. This technique provides for collection of undisturbed samples and does not generate soil cuttings. This SOP discusses the DPT method only; sampling of soil should be conducted in accordance with the sampling procedures outlined in the PWT SOP for sample handling.

## 2.0 EQUIPMENT AND MATERIAL NEEDS

The Contractor will need a copy of the subcontractor work plan, waste containers (as specified in the PWT Investigation Derived Waste Management SOP), field documentation forms, a field logbook and appropriate health and safety gear. All additional equipment and materials will be provided by the DPT subcontractor. The DPT subcontractor should be equipped with a rig capable of pushing 40 ft. and collecting soil samples from any interval within that depth. Equipment should include at minimum the following items:

- Hydraulic ram with hammer assembly;
- to 1.5-inch diameter drill rods;
- Piston-type, split-spoon, or equivalent soil sampling device that allows for lithologic characterization and retrieval of at least 400 milliliter (mL) of sample volume;
- GeoProbe, Hydrocone, bailer, Teflon tubing and peristaltic pump, or equivalent water sampling device;
- Decontamination equipment; and
- Health and safety equipment, as outlined in the subcontractor's Health and Safety Plan.

## 3.0 METHODOLOGY

1. Verify that the subcontractor has the necessary drilling and sampling equipment, as well as proper decontamination supplies.
2. Confirm that sampling locations are staked and that the clearances from all utilities have been obtained in accordance with the PWT Utility Clearance SOP. Do not begin the sampling until proper digging permits have been obtained and all of the utilities have been marked.
3. Locate the sample location and position the DPT rig. If the sample point is on thick asphalt or concrete, the DPT subcontractor will use hammer-drill or equivalent to drill a hole through the pavement.
4. Verify that the sampling tip has been properly decontaminated, as specified in the PWT Sample Handling SOP before beginning penetration.
5. Hydraulically advance the sampler to above the target sample interval, unlock the piston point, and advance the sampling device through the sampling interval:
   - Pull the rods using the hydraulic apparatus and remove the sample insert or split spoon.
   - Log the soil and collect the required samples as specified in the QAPP and the PWT Borehole Logging SOP.
6. Continue sampling at additional depth intervals or abandon the borehole, as appropriate for the location.

7. Collect and manage all wastes as specified in the PWT Investigation-Derived Waste Management SOP.
8. Before moving to a new site, abandon all boreholes and repair ground cover as specified in the PWT Borehole Abandonment SOP.

## 4.0 COMMENTS

- If a buried object impedes the DPT sampler or if an insufficient sample volume is recovered, reposition the rig in a location to satisfy the intent of the original sample point and try again. Note this on the borehole logging form (found in the PWT Borehole logging SOP).
- If the total recovered sample volume is insufficient for both screening (if applicable) and laboratory analysis, a second hole will be pushed as close as possible to the original hole and an additional sample will be taken from the same depth interval. Provided that the samples are NOT being analyzed for either VOCs or SVOCs, the two samples should be composited prior to sampling for chemical analysis. Compositing increases the potential for volatilization, VOCs and SVOCs will be collected as discrete samples to reduce contaminant loss through volatilization.

# PWT STANDARD OPERATING PROCEDURE



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Surface Soil Sample Field Data Sheet

| REVISION LOG | | |
|---|---|---|
| Revision Number | Description | Date |
| 1.0 | Original SOP | July 2011 |
| 2.0 | Revise for Montana Operations | March 2012 |

## 1.0 PURPOSE AND SCOPE

This Standard Operating Procedure (SOP) provides technical guidance and methods that will be used to collect surface soil samples for chemical analysis during environmental investigations. This SOP serves as a supplement to site-wide and investigation area specific workplans and the site-specific Quality Assurance Project Plan (QAPP). This SOP may be used in conjunction with other SOPs.

The SOP describes procedures for collection of discrete samples (i.e., samples collected at a single point for chemical analysis), and composite samples (i.e., composed of multiple increment samples collected at several points within the area to be characterized). Unless otherwise specified by the QAPP, the term "surface soil" refers to the top six inches of soil following removal of surface vegetation and other debris from the sampling area.

## 2.0 PERSONNEL QUALIFICATIONS

Personnel performing surface soil sampling activities will have knowledge and experience in the sampling methods proposed, or will work under the direct field supervision of knowledgeable and experienced personnel. Personnel will also be qualified to perform this work in accordance with the project-specific health and safety plan (HASP).

## 3.0 MATERIALS AND EQUIPMENT

The following materials and equipment may be necessary for surface soil sampling:

- Laboratory-supplied sample containers
- Nitrile disposable gloves
- Bound field logbook
- Sampling site location maps
- 100-foot tape measure
- Soil sample field data sheets (Attachment A)
- Surveying stakes or flags for marking of grid nodes and/or sampling locations
- Monitoring equipment and personal protective equipment (PPE) as outlined in the HSP.
- Decontamination equipment and supplies (e.g., high pressure sprayer/washer, wash/rinse tubs, brushes, Alconox, plastic sheeting, paper towels, sponges, baby wipes, garden-type water sprayers, large plastic bags, potable water, distilled water and/or deionized water)
- Stainless steel scoop or spoon, knife, pick, and mixing bowl
- Decontaminated drive sampler device with stainless steel liners

- Sledgehammer or slide hammer drive device
- Sample collection supplies (e.g., plastic recloseable plastic bags or equivalent, waterproof markers, sample labels, chain of custody [COC] forms, cooler for sample storage, ice or ice substitute, clear plastic and strapping tape, custody seals, trash bags)
- Drums or other approved containers for containing soil and water

Other materials and equipment may be needed based on field conditions.

## 4.0 PROCEDURES

### 4.1 Discrete Samples

Discrete samples consist of samples collected for chemical analysis from a single location. Samples for VOC analysis must be collected as discrete samples.

Sampling sites specified in the QAPP will be located and marked using surveying stakes, lath, or flags. Utility clearance will have been accomplished according to PWT's Utility Clearance SOP.

Discrete surface soil samples will be collected as follows:

1. At each location, clear an area approximately 12 inches in diameter of surface vegetation and debris.
2. Use a decontaminated stainless steel spoon to collect the surface soil to a depth of six inches. A stainless steel pick may be used as needed to loosen the soil. To the extent possible, eliminate gravel size or larger particles or debris based on visual observation. Be sure to collect sufficient sample volume to meet analytical requirements.
3. If VOC and SVOC analyses are to be performed, immediately fill the VOC and SVOC sample containers fully to eliminate head space. Tightly seal the containers with the appropriate lids. Label and handle the VOC and SVOC analysis containers as specified in PWT's Sample Handling SOP.
4. Place the remainder of the sample in a stainless steel bowl. To the extent possible, eliminate gravel size or larger particles or debris based on visual observation.
5. If the non-VOC/SVOC sample is to be homogenized, thoroughly mix the sample material in the stainless steel bowl using a decontaminated stainless steel spoon. To homogenize, divide the sample into four quarters and mix each quarter, then combine the four quarters and mix the entire sample.
6. Immediately fill the appropriate sample containers. Label and handle the containers as specified in PWT's Sample Handling SOP.
7. Decontaminate the sampling equipment in accordance with PWT's Personnel and Equipment Decontamination SOP.

An alternate method for collection of discrete surface soil samples involves the use of a decontaminated drive sampler with stainless steel liners. Because only one 6-inch liner can be filled at a drive location, this method will require several drives at adjacent locations to obtain the necessary volume of sample material to meet typical analysis requirements.

1. Clear the sampling area, as per Step 1 above.

2. Using a sledgehammer or slide hammer drive device, drive a decontaminated drive sampler or other appropriate device containing stainless steel liners into the ground to a depth of six inches.

3. Remove and open the sampler.

4. Screen the ends of the liner for the presence of VOCs using a PID/FID.

5. Log the sample in accordance with PWT's Borehole Logging SOP.

6. Remove the liner for VOC analysis. Cap the ends with teflon sheeting and plastic end caps and label the liner.

7. Drive an adjacent sample for SVOC analysis by repeating steps 1 through 6.

8. Drive additional samples at adjacent locations to collect sufficient material for the non-VOC/SVOC analyses by repeating steps 1 through 5. Extrude the sample material from each liner for non-VOC/SVOC analysis into a decontaminated stainless steel bowl.

9. Once all the non-VOC/SVOC material is collected, thoroughly mix the non-VOC/SVOC sample material in the stainless steel bowl using a decontaminated stainless steel spoon. To homogenize, divide the sample into four quarters and mix each quarter, then combine the four quarters and mix the entire sample.

10. Immediately fill the appropriate sample containers. Label and handle the containers as specified in PWT's Sample Handling SOP.

11. Decontaminate the sampling equipment in accordance with PWT's Personnel and Equipment Decontamination SOP.

### 4.2 Composite Samples

Composite samples are comprised of multiple increment samples collected at several points. All or a portion of the increment samples are mixed together to create a composite sample representative of average constituent concentrations within the area to be characterized. Composite samples cannot be used for VOC/SVOC analysis. However, the VOC/SVOC samples may be collected as discrete samples at one of the increment locations. VOC/SVOC samples should be collected as specified in the previous section.

Prior to sampling, it is important to calculate the volume of non-VOC/SVOC sample material to be collected at each increment sample location to ensure that the necessary amount of composite sample will be obtained. Required volumes of composite samples are analysis-specific and will be specified in the QAPP. For a given composite sample, the volume of each increment sample must be the same, and must

equal 1/n of the required composite sample volume, where n equals the number of increment samples making up the composite sample.

Increment sampling locations specified in the QAPP will be laid out and marked using surveying stakes, lath, or flags. This may involve laying out a rectangular grid of points. Utility clearance will have been accomplished according to PWT's Utility Clearance SOP.

Each composite surface soil sample will be collected as follows:

1. At each increment sample location, clear an area approximately 12 inches in diameter of surface vegetation and debris.

2. Use a decontaminated stainless steel spoon to collect surface soil to a depth of six inches. A stainless steel pick may be used as needed to loosen the soil. To the extent possible, eliminate gravel-size or larger particles and debris based on visual observation. **Important: Be sure to collect a sufficient volume of increment sample. The volume of increment sample collected at each location must be the same.**

3. Place the increment sample into a decontaminated stainless steel mixing bowl. Mix thoroughly.

4. Decontaminate the sampling equipment in accordance with PWT's Personnel and Equipment Decontamination SOP.

5. Repeat Steps 1 through 4 at each increment sample location for a given composite sample, adding each successive increment sample to the mixing bowl.

6. Thoroughly mix the sample material in the stainless steel bowl using a decontaminated stainless steel spoon. To homogenize, divide the sample into four quarters and mix each quarter, then combine the four quarters and mix the entire sample. Place mixture into appropriate laboratory-supplied sample containers.

7. Label and handle the containers as specified in PWT's Sample Handling SOP.

## 5.0 DOCUMENTATION

Personnel collecting samples are responsible for documenting sampling activities in the field logbook and on the Surface Soil Sample Field Data Sheet (Attachment A). Discussions of sample documentation are provided in the PWT Sample Handling SOP and PWT's Borehole Logging SOP.

**Sample Identification No.** _____

**Project Information**

Project Name: _____

Contractor: _____ Sample Tech.: _____

**Location Information**

Location ID No. _____

**Sample Information**

Date and Time of Sample Collection: _____

Sample Collection Method (circle): Scoop/Spoon/Trowel Drive Sampler Liners Used

Sample Type (circle): Discrete Composite

**Discrete**: VOC/SVOC Sample Collected? Y or N Collection Method: Liner or Grab

Non-VOC/SVOC Sample Homogenized? Y or N Volume of non-VOC/SVOC sample_____

**Composite:** VOC/SVOC Sample Collected? Y or N Collection Method: Liner Method Grab Method

Non-VOC/SVOC Sample: Total Volume of Sample Required _____ No. of Increments _____

Required Volume of Each Increment _____

Volume Collected at Each Increment_____

Sample Lithologic Description:_____

_____

PID/FID Measurements _____

_____

| Sample Containers | Number | Preservatives | Analyses |
|---|---|---|---|
| _____ | _____ | _____ | _____ |
| _____ | _____ | _____ | _____ |
| _____ | _____ | _____ | _____ |

Associated QA/QC Sample Nos.: _____

**Comments/Observations**_____

Sampler's Name and Signature:_____

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Surface Water Sample Field Data Sheet


| REVISION LOG | | |
|---|---|---|
| Revision Number | Description | Date |
| 1.0 | Original SOP | July 2011 |
| 2.0 | Revise for Montana Operations | March 2012 |

## 1.0 PURPOSE AND SCOPE

This Standard Operating Procedure (SOP) provides technical guidance and methods that will be used to conduct surface water sampling in streams, ditches, and at seeps and springs. Pond surface water sampling is not addressed in this SOP. This SOP serves as a supplement to site-wide and investigation area specific workplans and the site-specific Quality Assurance Project Plan (QAPP) and may be used in conjunction with other SOPs.

## 2.0 PERSONNEL QUALIFICATIONS

Personnel performing surface water sampling activities will have knowledge and experience in the sampling methods proposed, or will work under the direct field supervision of knowledgeable and experienced personnel. Personnel will also be qualified to perform this work in accordance with the project-specific health and safety plan (HASP).

## 3.0 MATERIALS AND EQUIPMENT

The following materials and equipment may be needed for surface water sampling:

- Sample bottles (with preservatives added) obtained from the analytical laboratory. Several extra sample bottles will be obtained in case of breakage and for quality assurance/quality control (QA/QC) samples.
- Sample transfer containers of assorted sizes (extra sample bottles [without preservatives] from the analytical laboratory are acceptable)
- Field logbook
- Surface Water Data Field Sheets (Attachment A)
- Stopwatch
- Plastic flagging
- Disposable latex or nitrile gloves
- Appropriate health and safety equipment
- Peristaltic pump and battery
- Tygon® or silicone tubing
- Disposable 0.45-micron filters
- Sample labels
- Appropriate preservatives
- Chain-of-custody (COC) forms
- Clear plastic tape
- Fiber tape
- Custody seals
- Large (30 gallon) trash bag
- 1 Gallon Ziploc® freezer bags
- Cooler

- Ice or ice substitute
- Shipping documentation

## 4.0 PROCEDURES

Surface water flow conditions may vary geographically and seasonally. Some flow conditions that may be encountered:

1. Areas of standing water (other than ponds)
2. Flowing streams or ditches
3. Low flow seeps and springs

Separate sampling procedures are specified for each of the three flow condition types.

Note: If sediment samples are to be co-located with surface water samples, always collect surface water samples first to avoid affects from sediment disturbance.

### 4.1 Standing Water Sampling Procedures

Samples may be collected by direct submersion of the sample bottle in the standing water if the sample bottles supplied by the laboratory do not contain preservatives. If the bottles contain preservatives, a transfer container must be used to initially collect the sample of the standing water and then transfer the water to the bottle.

1. Rinse laboratory-supplied sample bottle or transfer device three times with standing water before collecting the sample (discard rinse water well away from sample location).
2. Submerge the laboratory-supplied sample bottle or decontaminated transfer container below the water surface taking care to minimize disturbance of bottom materials. If possible, the sample should be collected from at least six inches below the water surface.
3. Fill the laboratory-supplied sample bottle to the required volume (either by submersion or from the transfer container).
4. Preserve the sample, if necessary (as specified in the project-specific QAPP).
5. Cap the container and handle in accordance with the PWT Sample Handling SOP.
6. Collect a sample of the standing water in the transfer container and measure field parameters in accordance with the site-specific QAPP and the PWT Field Parameter Measurements SOP. Record measurements in logbook. Discard water.

### 4.2 Flowing Water Sampling Procedures

If surface water flow rate is to be measured, collect samples at the same location as the flow measurement, if possible. Always collect the samples for chemical analysis before measuring flow rate.

Samples may be collected by direct submersion of the sample bottle in the flowing water if the sample bottles supplied by the laboratory do not contain preservatives. If the bottles contain preservatives, a transfer container must be used to initially collect the sample of the flowing water and transfer it to the sample bottle. If VOC analyses are to be performed, the sample should be collected from a slower-flowing portion of the stream to minimize aeration.

1. To avoid disturbing stream sediments that may affect the sample, approach the sampling location from the downstream. Always stand downstream of the sampling location while collecting the sample. When collecting samples at successive locations in a stream or ditch, always proceed from downstream to upstream locations.

2. If a transfer container is to be used, triple rinse the container with flowing water prior to collection of the sample. Discard the rinse water downstream of the sampling location.
3. Fill the laboratory-supplied sample bottle to the required volume (either by submersion or from the transfer container). If possible, the sample should be collected from at least six inches below the water surface.
4. Preserve the sample, if necessary (as specified in the project-specific QAPP).
5. Cap the container and handle in accordance with the PWT Sample Handling SOP.
6. Collect a sample of the flowing water in the transfer container and measure field parameters in accordance with the PWT Field Parameter Measurements SOP and record those measurements in the logbook. Discard water.

### 4.3 Low Flow Sampling Procedures

1. Dig a small depression in the soil within the path of the flow.
2. Place a decontaminated stainless steel bowl in the depression, with the rim of the bowl positioned to intercept the flow.
3. Allow the bowl to fill and to overflow for several minutes (preferably until the water is no longer turbid).
4. Obtain water samples from the stainless steel bowl by submerging the sample bottle or using a decontaminated transfer container (triple rinse the sample container prior to collection of the sample).
5. Preserve the sample, if necessary (as specified in the QAPP).
6. Cap the container and handle in accordance with the PWT Sample Handling SOP.
7. Collect a sample of the flowing water in the transfer container and measure field parameters in accordance with the PWT Field Parameter Measurements SOP. Record the measurements in the logbook. Discard the water.

### 4.4 Field Filtering of Samples

Field filtering methods are described in the PWT Groundwater Sampling in Monitoring Wells SOP.

### 4.5 Field QA/QC Sample Collection

Field QA/QC samples may be collected during surface water sampling in accordance with specifications in the project-specific QAPP. Collection of field QA/QC samples is discussed in the PWT Groundwater Sampling in Monitoring Wells SOP.

## 5.0 DOCUMENTATION

Personnel collecting surface water samples are responsible for documenting sampling activities in the field logbook and on the Surface Water Sample Field Data Sheet (Attachment A).

### 5.1 Surface Water Sample Field Data Sheet

Sampling activities and observations will be documented on the Surface Water Sample Field Data Sheet (Attachment A). Items not applicable to the sampling will be labeled as not applicable (NA). The information on the data sheet includes the following:

- Sampling location number
- Sample identification number

- Date and time of sampling
- Weather conditions
- Sampling personnel names, affiliations, and signatures
- Field parameter measurements
- Sample collection method(s) (e.g., submersion, transfer container)
- Number and types of sample containers obtained for each analyses
- Preservation of samples
- Associated field QA/QC samples
- Observations of conditions which may affect sample quality

**5.2 Field Notes**

- Field procedures and observations will be documented in the field logbook. The following information will be recorded using water proof ink:
- Names of sampling personnel
- Weather conditions
- Date and time of sampling
- Sample location number
- Description of sampling location (e.g., flow conditions, surrounding site description and sketch, observation of staining, odors, or organisms)
- Decontamination information
- Sampling method
- Calibration information
- Field parameter measurements
- Sampler's signature
- Observations of conditions that may affect sample quality

**Pacific Western Technologies Surface Water Sample Field Data Sheet**

**Sample Identification No.** _____

**Project Information**

Project Name: _____

Contractor: _____ Sample Tech.:_____

**Location Information**

Location ID No: _____

**Sample Collection Information**

Date and Time of Sample Collection: _____

**Field Water Quality Parameters:**

| | Sample |
|---|---|
| Time | _____ |
| Volume (gallons) | _____ |
| pH (SI units) | _____ |
| Temperature (°C) | _____ |
| SC (umhos/cm) | _____ |
| Salinity (%) | _____ |
| DO (mg/l) | _____ |
| Turbidity (NTU) | _____ |
| Color | _____ |

Sampling Method (circle): Transfer Device Bottle Submersion Field Filtering

| Containers | Number | Preservatives | Analyses |
|---|---|---|---|
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |

Associated QA/QC Samples: _____

_____

**Comments/Observations**

_____

_____

_____

_____

# Disposable En Core® Sampler

**En Novative Technologies, Inc.**
1795 Industrial Drive
Green Bay, WI 54302
Phone: 920-465-3960 • Fax: 920-465-3963
Toll Free: 888-411-0757
*www.ennovativetech.com*

## Sampling Procedures

## Using The En Core® T-Handle

*NOTE:*

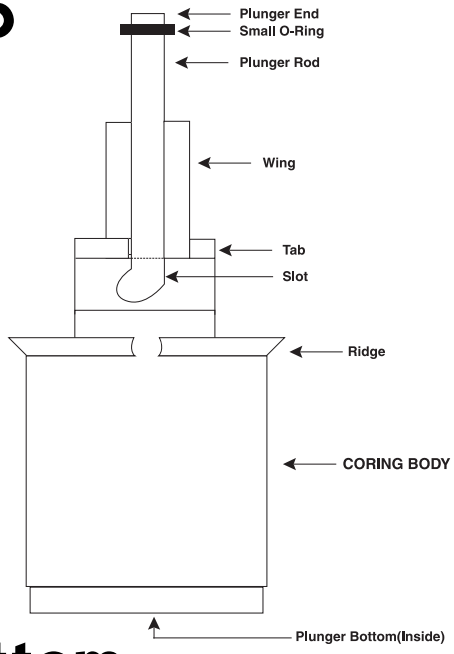
1. En Core® Sampler is a SINGLE USE device. It cannot be cleaned and/or reused.

2. En Core® Sampler is designed to store soil. Do not use En Core Sampler to store solvent or free product!

3. En Core® Sampler must be used with En Core® T-Handle and/or En Core® Extrusion Tool exclusively. (These items are sold separately.)

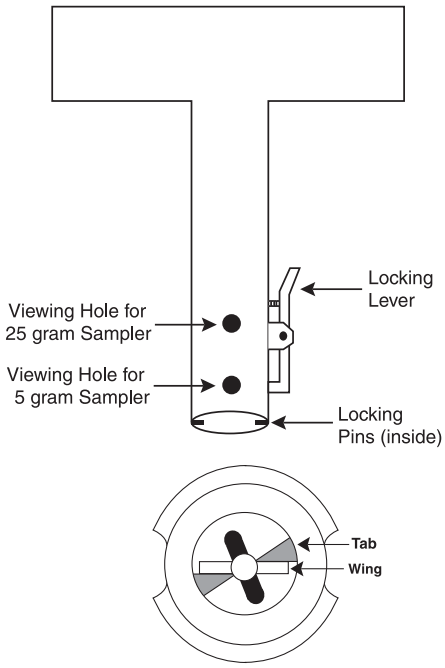
### En Core®

**Top**



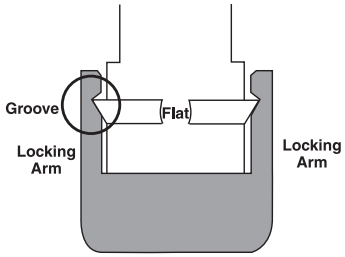

**Bottom**

### En Core® T-Handle



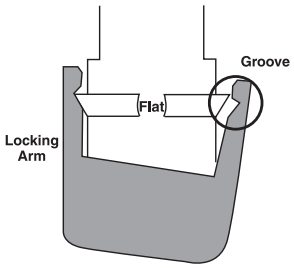

### Sampler Correctly Capped

(Locking arm grooves seated over coring body ridge.)




### Sampler Incorrectly Capped

(Cap appears crooked; locking arm grooves not fully seated over coring body ridge.)




**BEFORE TAKING SAMPLE:**

1. Hold **coring body** and push **plunger rod** down until **small o-ring** rests against **tabs**. This will assure that plunger moves freely.

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

**TAKING SAMPLE:**

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

4. Cap coring body while it is still on T-handle. *Push* **cap** over **flat** area of **ridge** *and twist* to lock **cap** in place. **CAP MUST BE SEATED TO SEAL SAMPLER (see diagram)**.

**PREPARING SAMPLER FOR SHIPMENT:**

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

6. Lock plunger by rotating extended plunger rod fully counter-clockwise until **wings** rest firmly against tabs (see plunger diagram).

7. Attach completed tear-off label (from En Core Sampler bag) to cap on coring body.

8. Return full En Core Sampler to zipper bag. Seal bag and put on ice.

# Disposable En Core® Sampler

## EXTRUSION PROCEDURES

## USING THE En Core® EXTRUSION TOOL

***CAUTION! Always use the Extrusion Tool to extrude soil from the En Core Sampler. If the Extrusion Tool is not used, the Sampler may fragment, causing injury.***

1. To attach En Core Sampler to En Core Extrusion Tool: Depress locking lever on Extrusion Tool and place Sampler, plunger end first, into open end of Extrusion Tool, aligning slots on coring body with pins in Extrusion Tool. Turn coring body clockwise until it locks into place. Release locking lever.

2. Rotate and gently push Extrusion Tool plunger knob clockwise until plunger slides over wings of coring body. (When properly positioned plunger will not rotate further.)

3. Hold Extrusion Tool with capped Sampler pointed upward so soil does not fall out when cap is removed. Remove cap from Sampler by rotating cap until locking arms are aligned with the flat area of ridge and pull cap off. To release soil core push down on plunger knob of En Core Extrusion Tool. Remove and properly dispose of En Core Sampler.

## Warranty and Disclaimers

IMPORTANT: FAILURE TO USE THE EN CORE® SAMPLER IN COMPLIANCE WITH THE WRITTEN INSTRUCTIONS PROVIDED HEREIN VOIDS ALL EXPRESS AND IMPLIED WARRANTIES, INCLUDING WARRANTY OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.

**PRINCIPLE OF USE.** The En Core Sampler Cartridge System is a volumetric sampling system designed to collect, store and deliver a soil sample. The En Core Sampler comes in two sizes for sample volumes of approximately 25 or 5 grams. There are four components: the cartridge with a movable plunger; a cap with two locking arms; a T-handle (purchased separately); and an extrusion handle (purchased separately). NOTE: The En Core Sampler is designed to store soil. It is not designed to store solvent or free product.

The soil is stored in a sealed headspace-free state. The seals are achieved by three special Viton® * o-rings, two located on the plunger and one on the cap of the Sampler. At no time and under no condition should these o-rings be removed or disturbed.

**QUALITY CONTROL**. The cartridge is sealed in an airtight package to prevent contamination prior to use. Due to the stringent quality control requirements associated with the use of this system, the disposable cartridge is designed to be used only once.

**WARRANTY**. En Novative Technologies, Inc. ("En Novative Technologies") warrants that the En Core Sampler shall perform consistent with the research conducted under En Novative Technologies' approval, within thirty (30) days from the date of delivery, provided that the Customer gives En Novative Technologies prompt notice of any defect or failure to perform and satisfactory proof thereof. THIS WARRANTY DOES NOT APPLY TO THE FOLLOWING, AS SOLELY DETERMINED BY EN NOVATIVE TECHNOLOGIES: (a) Damage caused by accident, abuse, mishandling or dropping; (b)Samplers that have been opened, taken apart or mishandled; (c)Samplers not used in accordance with the directions; and (d)Damages exceeding the cost of the sampler. Seller warrants that all En Core Samplers shall be free from defects in title. THE FOREGOING WARRANTIES ARE IN LIEU OF ALL OTHER WARRANTIES, WHETHER ORAL, WRITTEN, EXPRESSED, IMPLIED OR STATUTORY, INCLUDING ANY INFORMATION PROVIDED BY SALES REPRESENTATIVES OR IN MARKETING LITERATURE. IMPLIED WARRANTIES OF FITNESS AND MERCHANTABILITY SHALL NOT APPLY. En Novative Technologies' warranty obligations and Customer's remedies, except as to title, are solely and exclusively as stated herein.

**LIMITATION OF LIABILITY.** IN NO EVENT SHALL EN NOVATIVE TECHNOLOGIES BE LIABLE FOR ANTICIPATED PROFITS, INCIDENTAL, SPECIAL OR CONSEQUENTIAL DAMAGES, INCLUDING, BUT NOT LIMITED TO, DAMAGES FOR LOSS OF REVENUE, DOWN TIME, REMEDIATION ACTIVITIES, REMOBILIZATION OR RESAMPLING, COST OF CAPITAL, SERVICE INTERRUPTION OR FAILURE OF SUPPLY, LIABILITY OF CUSTOMER TO A THIRD PARTY, OR FOR LABOR, OVERHEAD, TRANSPORTATION, SUBSTITUTE SUPPLY SOURCES OR ANY OTHER EXPENSE, DAMAGE OR LOSS, INCLUDING PERSONAL INJURY OR PROPERTY DAMAGE. En Novative Technologies' liability on any claim of any kind shall be replacement of the En Core Sampler or refund of the purchase price. En Novative Technologies shall not be liable for penalties of any description whatsoever. In the event the En Core Sampler will be utilized by Customer on behalf of a third party, such third party shall not occupy the position of a third-party beneficiary of the obligation or warranty provided by En Novative Technologies, and no such third party shall have the right to enforce same. All claims must be brought within one (1) year of shipment, regardless of their nature.

**En Novative Technologies, Inc.**
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*www.ennovativetech.com*

The En Core™ Sampler is covered by One or More of the Following U.S. Patents: 5,343,771; 5,505,098; 5,517,868; 5,522,271. Other U.S. and Foreign Patents Pending.

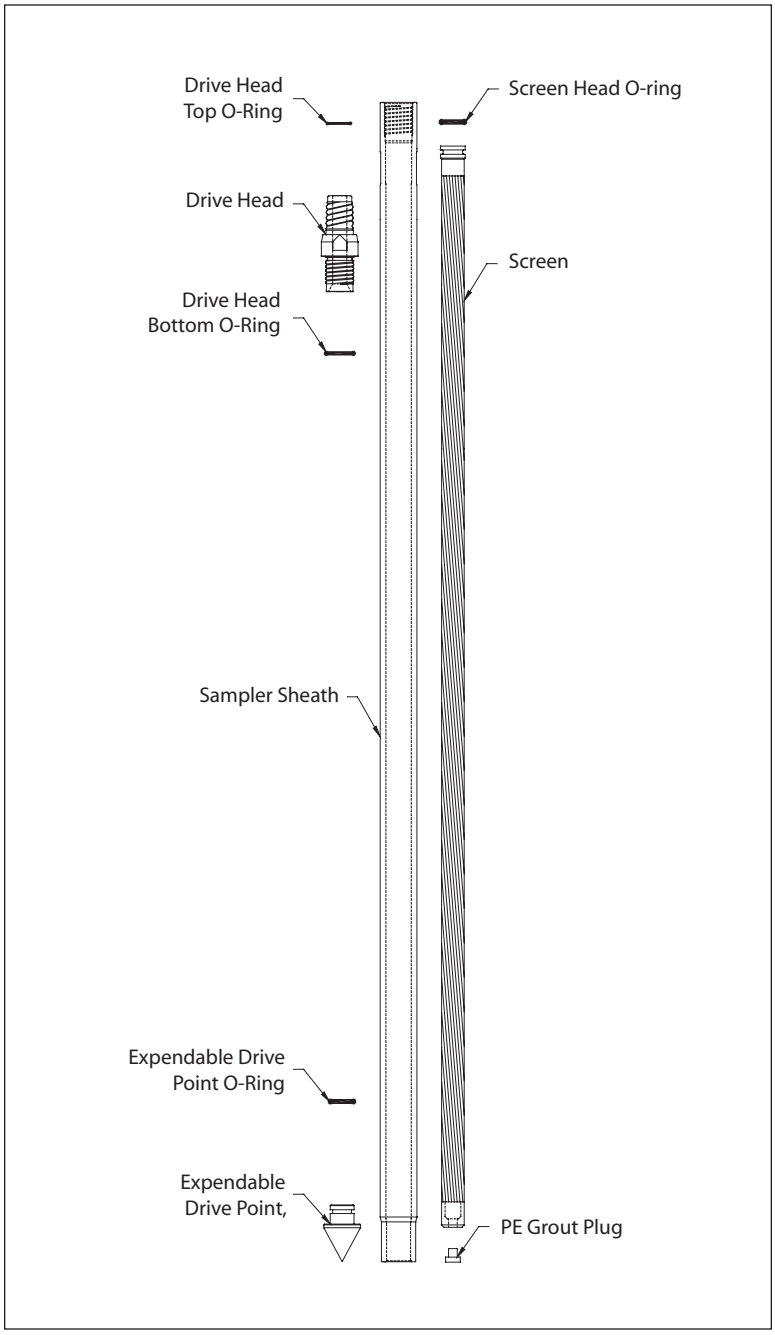
* Viton® is a registered trademark of DuPont Dow Elastomers.

# GEOPROBE® SCREEN POINT 16 GROUNDWATER SAMPLER

## STANDARD OPERATING PROCEDURE

**Technical Bulletin No. MK3142**

**PREPARED: November, 2006**




**GEOPROBE® SCREEN POINT 16 GROUNDWATER SAMPLER PARTS**

**Geoprobe® and Geoprobe Systems®, Macro-Core® and Direct Image® are Registered Trademarks of Kejr, Inc., Salina, Kansas**

**Screen Point 16 Groundwater Sampler is manufactured under U.S. Patent 5,612,498**

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## 1.0 OBJECTIVE

The objective of this procedure is to drive a sealed stainless steel or PVC screen to depth, deploy the screen, obtain a representative water sample from the screen interval, and grout the probe hole during abandonment. The Screen Point 16 Groundwater Sampler enables the operator to conduct abandonment grouting that meets American Society for Testing and Materials (ASTM) Method D 5299 requirements for decommissioning wells and borings for environmental activities (ASTM 1993).

## 2.0 BACKGROUND

### 2.1 Definitions

**Geoprobe®:** A brand name of high quality, hydraulically powered machines that utilize both static force and percussion to advance sampling and logging tools into the subsurface. The Geoprobe® brand name refers to both machines and tools manufactured by Geoprobe Systems®, Salina, Kansas. Geoprobe® tools are used to perform soil core and soil gas sampling, groundwater sampling and monitoring, soil conductivity and contaminant logging, grouting, and materials injection.

**Screen Point 16 (SP16) Groundwater Sampler:** A direct push device consisting of a PVC or stainless steel screen that is driven to depth within a sealed, steel sheath and then deployed for the collection of representative groundwater samples. The assembled SP16 Sampler is approximately 51.5 inches (1308 mm) long with an OD of 1.625 inches (41 mm). Upon deployment, up to 41 inches (1041 mm) of screen can be exposed to the formation. The Screen Point 16 Groundwater Sampler is designed for use with 1.5-inch probe rods and machines equipped with the more powerful GH60 Hydraulic Hammer. Operators with GH40 Series hammers may chose to use this sampler in soils where driving is difficult.

**Rod Grip Pull System:** An attachment mounted on the hydraulic hammer of a direct push machine which makes it possible to retract the tool string with extension rods or flexible tubing protruding from the top of the probe rods. The Rod Grip Pull System includes a pull block with rod grip jaws that are bolted directly to the machine. A removable handle assembly straddles the tool string while hooking onto the pull block to effectively grip the probe rods as the hammer is raised. A separate handle assembly is required for each probe rod diameter.

### 2.2 Discussion

In this procedure, the assembled Screen Point 16 Groundwater Sampler (Fig. 2.1A) is threaded onto the leading end of a Geoprobe® probe rod and advanced into the subsurface with a Geoprobe® direct push machine. Additional probe rods are added incrementally and advanced until the desired sampling interval is reached. While the sampler is advanced to depth, O-ring seals at each rod joint, the drive head, and the expendable drive point provide a watertight system. This system eliminates the threat of formation fluids entering the screen before deployment and assures sample integrity.

Once at the desired sampling interval, extension rods are sent downhole until the leading rod contacts the bottom of the sampler screen. The tool string is then retracted approximately 44 inches (1118 mm) while the screen is held in place with the extension rods (Fig. 2.1B). As the tool string is retracted, the expendable point is released from the sampler sheath. The tool string and sheath may be retracted the full length of the screen or as little as a few inches if a small sampling interval is desired.

There are three types of screens that can be used in the Screen Point 16 Groundwater Sampler. Two of the these, a stainless steel screen with a standard slot size of 0.004 inches (0.10 mm) and a PVC screen with a standard slot size of 0.010 inches (0.25 mm), are recovered with the tool string after sampling. The third screen is also manufactured from PVC with a standard slot size of 0.010 inches (0.25 mm), but is designed to be left downhole when sampling is complete. This disposable screen has an exposed screen length of approximately 43 inches (1092 mm). The two screens that are recovered with the sampler both have an exposed screen length of approximately 41 inches (1041 mm).

**(continued on following page)**

An O-ring on the head of the stainless steel screens maintains a seal at the top of the screen. As a result, any liquid entering the sampler during screen deployment must first pass through the screen. PVC screens do not require an O-ring because the tolerance between the screen head and sampler sheath is near that of the screen slot size.

The screens are constructed such that flexible tubing, a mini-bailer, or a small-diameter bladder pump can be inserted into the screen cavity. This makes direct sampling possible from anywhere within the saturated zone. A removable plug in the lower end of the screens allows the user to grout as the sampler is extracted for further use.

Groundwater samples can be obtained in a number of ways. A common method utilizes polyethylene (TB25L) or Teflon® (TB25T) tubing and a Check Valve Assembly (GW4210). The check valve (with check ball) is attached to one end of the tubing and inserted down the casing until it is immersed in groundwater. Water is pumped through the tubing and to the ground surface by oscillating the tubing up and down.

An alternative means of collecting groundwater samples is to attach a peristaltic or vacuum pump to the tubing. This method is limited in that water can be pumped to the surface from a maximum depth of approximately 26 feet (8 m). Another technique for groundwater sampling is to use a stainless steel Mini-Bailer Assembly (GW41). The mini-bailer is lowered down the inside of the casing below the water level where it fills with water and is then retrieved from the casing.

The latest option for collecting groundwater from the SP16 sampler is to utilize a Geoprobe® MB470 Series Mechanical Bladder Pump (MBP)*. The MBP may be used to meet requirements of the low-flow sampling protocol (Puls and Barcelona 1996, ASTM 2003). Through participation in a U.S. EPA Environmental Technology Verification study, it was confirmed that the MB470 can provide representative samples (EPA 2003).

**The Mechanical Bladder Pump is manufactured under U.S. Patent No. 6,877,965 issued April 12, 2005.*

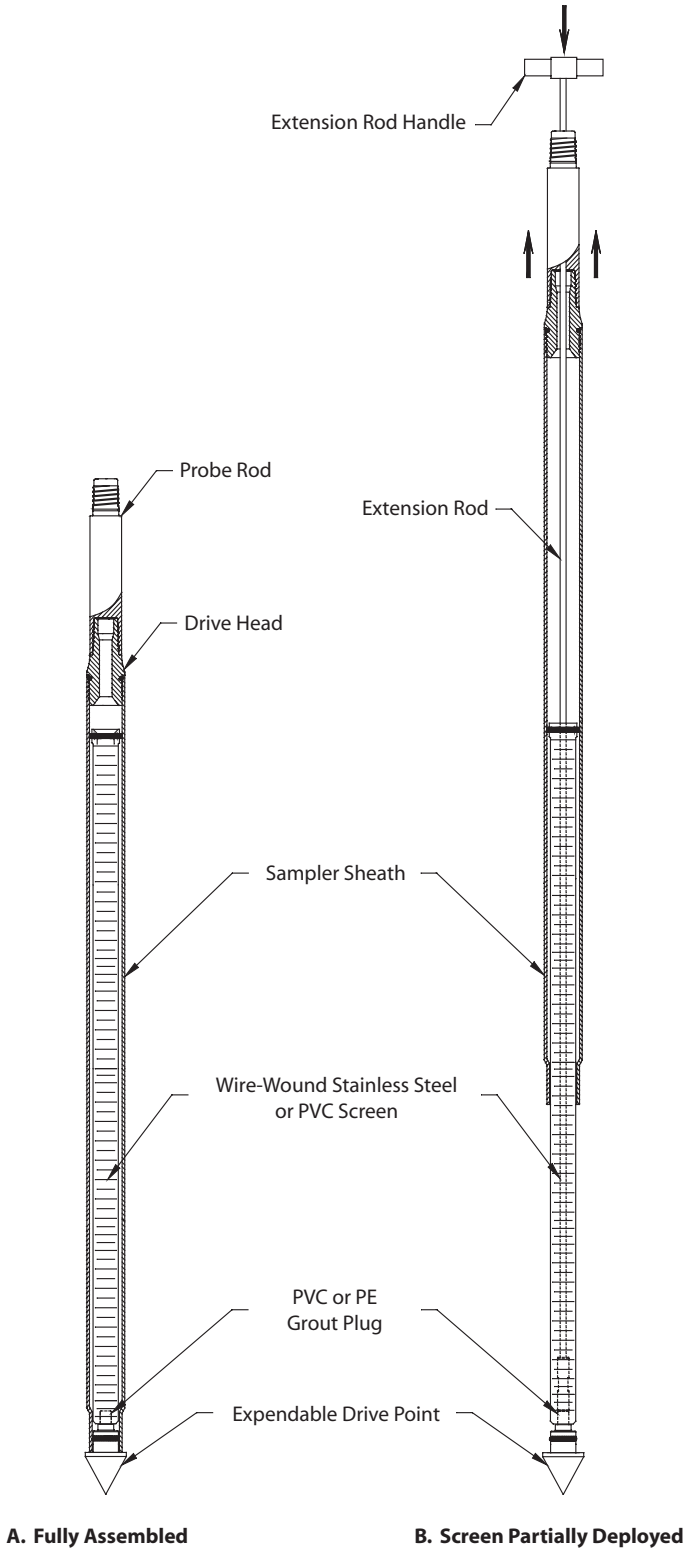



**FIGURE 2.1**
**Screen Point 16 Groundwater Sampler**

## 3.0 TOOLS AND EQUIPMENT

The following tools and equipment can be used to successfully recover representative groundwater samples with the Geoprobe® Screen Point 16 Groundwater Sampler. Refer to Figures 3.1 and 3.2 for identification of the specified parts. Tools are listed below for the most common SP16 / 1.5-inch probe rod configurations. Additional parts for optional rod sizes and accessories are listed in Appendix A.

| **SP16 Sampler Parts** | **Part Number** |
|---|---|
| SP16 Sampler Sheath | 15187 |
| SP16 Drive Head, 0.5-inch bore, 1.5-inch rods* | 18307 |
| SP16 O-ring Service Kit, 1.5-inch rods *(includes 4 each of the O-ring packets below)* | 15844 |
| *O-rings for Top of SP16 Drive Head, 1.5-inch rods only (Pkt. of 25)* | *15389* |
| *O-rings for Bottom of SP16 Drive Head (Pkt. of 25)* | *13196* |
| *O-rings for GW1520 Screen Head (Pkt. of 25)* | *GW1520R* |
| *O-rings for SP16 Expendable Drive Point (Pkt. of 25)* | *GW1555R* |
| Screen, Wire-Wound Stainless Steel, 4-Slot* | GW1520 |
| Grout Plugs, PE (Pkg. of 25) | GW1552K |
| Expendable Drive Points, steel, 1.625-inch OD (Pkg. of 25)* | GW1555K |
| Screen Point 16 Groundwater Sampler Kit, 1.5-inch Probe Rods *(includes 1 each of: 15187, 18307, 15844, GW1520, GW1535, GW1540, GW1555K, and GW1552K)* | 15770 |

| **Probe Rods and Probe Rod Accessories** | **Part Number** |
|---|---|
| Drive Cap, 1.5-inch probe rods, threadless, (for GH60 Hammer) | 12787 |
| Pull Cap, 1.5-inch probe rods | 15090 |
| Probe Rod, 1.5-inch x 60-inch* | 11121 |

| **Extension Rods and Extension Rod Accessories** | **Part Number** |
|---|---|
| Screen Push Adapter | GW1535 |
| Grout Plug Push Adapter | GW1540 |
| Extension Rod, 60-inch* | 10073 |
| Extension Rod Coupler | AT68 |
| Extension Rod Handle | AT69 |
| Extension Rod Jig | AT690 |
| Extension Rod Quick Link Coupler, pin | AT695 |
| Extension Rod Quick Link Coupler, box | AT696 |

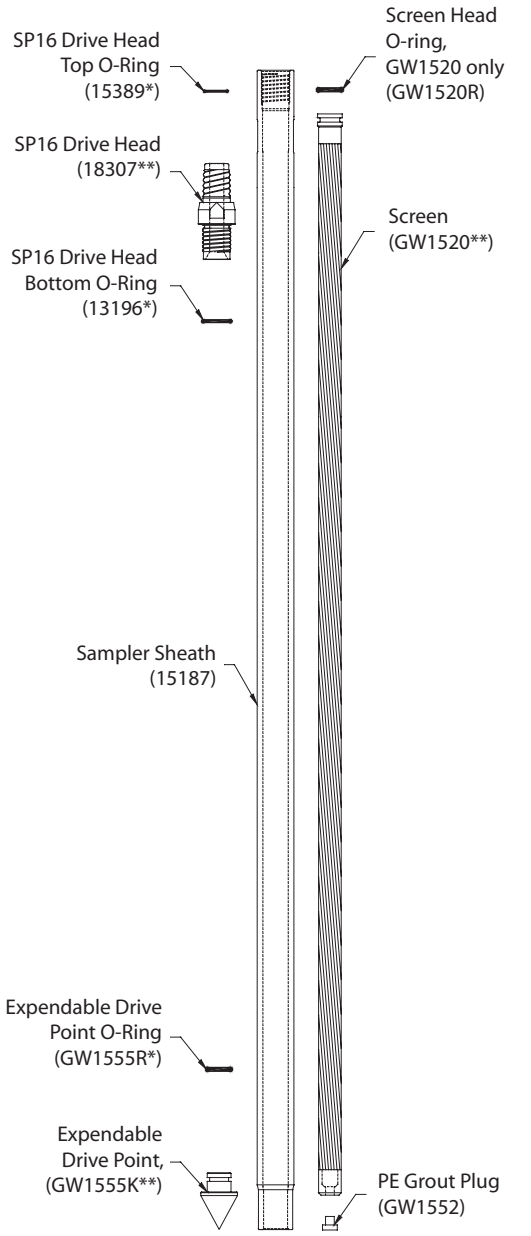
| **Grout Accessories** | **Part Number** |
|---|---|
| Grout Nozzle, for 0.375-inch OD tubing | GW1545 |
| High-Pressure Nylon Tubing, 0.375-inch OD / 0.25-inch ID, 100-ft. (30 m) | 11633 |
| Grout Machine, self-contained* | GS1000 |
| Grout System Accossories Package, 1.5-inch rods | GS1015 |

| **Groundwater Purging and Sampling Accessories** | **Part Number** |
|---|---|
| Polyethylene Tubing, 0.375-inch OD, 500 ft.* | TB25L |
| Check Valve Assembly, 0.375-inch OD Tubing* | GW4210 |
| Water Level Meter, 0.438-inch OD Probe, 100 ft. cable* | GW2000 |
| Mechanical Bladder Pump** | MB470 |
| Mini Bailer Assembly, stainless steel | GW41 |

| **Additional Tools** | **Part Number** |
|---|---|
| Adjustable Wrench, 6.0-inch | FA200 |
| Adjustable Wrench, 10.0-inch | FA201 |
| Pipe Wrenches | NA |

* See Appendix A for additional tooling options.

** Refer to the Standard Operating Procedure (SOP) for the Mechanical Bladder Pump (Technical Bulletin No. MK3013) for additional tooling needs.




* Included in the SP16 O-ring Service Kit (15844)
** Part numbers show most common tool configuration. See Appendix A for alternative parts.

**FIGURE 3.1**
**SP16 Sampler Parts**

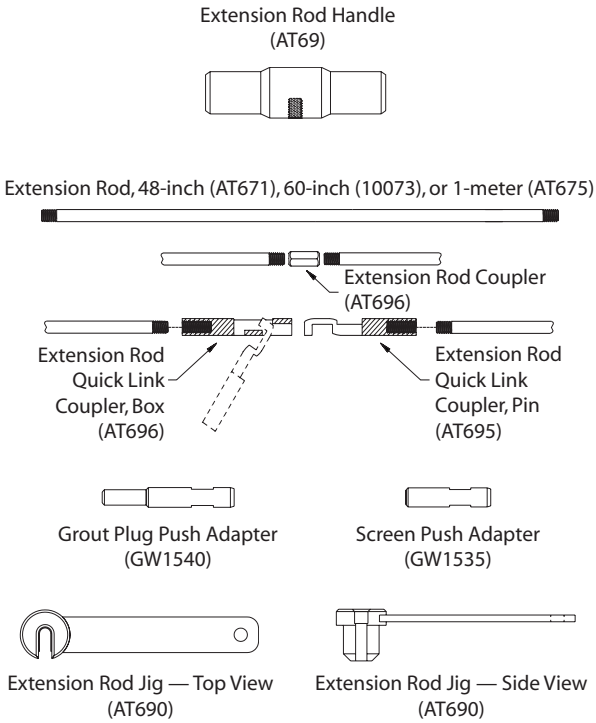



**FIGURE 3.2**
**Geoprobe® Extension Rods and Accessories**

# 4.0 OPERATION

## 4.1 Basic Operation

The SP16 sampler utilize a stainless steel or PVC screen which is encased in an alloy steel sampler sheath. An expendable drive point is placed in the lower end of the sheath while a drive head is attached to the top. O-rings on the drive head and expendable point provide a watertight sheath which keeps contaminants out of the system as the sampler is driven to depth.

Once the sampling interval is reached, extension rods equipped with a screen push adapter are inserted down the ID of the probe rods. The tool string is then retracted up to 44 inches (1118 mm) while the screen is held in place with the extension rods. The system is now ready for groundwater sampling. When sampling is complete, a removable plug in the bottom of the screen allows for grouting below the sampler as the tool string is retrieved.

## 4.2 Sampler Options

The Screen Point 15 and Screen Point 16 Groundwater Samplers are nearly identical. Subtle differences in the design of the SP16 sampler make it more durable than the earlier SP15 system. Operators of GH60-equipped machines should always utilize SP16 tooling. Operators of machines equipped with GH40 Series hammers may also choose SP16 tooling when sampling in difficult probing conditions.

A 1.75-inch OD Expendable Drive Point (17066K) and Disposable PVC Screen (16089) provide two useful options for the SP16 sampler. The 1.75-inch drive point may be used when soil conditions make it difficult to remove the sampler after driving to depth. The disposable PVC screen may be left downhole after sampling (when regulations permit) to eliminate the time required for screen decontamination.

## 4.3 Decontamination

In order to collect representative groundwater samples, all sampler parts must be thoroughly cleaned before and after each use. Scrub all metal parts using a stiff brush and a nonphosphate soap solution. Steam cleaning may be substituted for hand-washing if available. Rinse with distilled water and allow to air-dry before assembly.

## 4.4 SP16 Sampler Assembly (Figure 4.1)

Part numbers are listed for a standard SP16 sampler using 1.5-inch probe rods. Refer to Page 6 for screen and drive head alternatives.

1. Place an O-ring on a steel expendable drive point (GW1555K). Firmly seat the expendable point in the necked end of a sampler sheath (15187).

2. Install a PE Grout Plug (GW1552) in the bottom end of a Wire-wound Stainless Steel Screen (GW1520). Place a GW1520R O-ring in the groove on the top end of the screen.

3. Slide the screen inside of the sampler sheath with the grout plug toward the bottom of the sampler. Ensure that the expendable point was not displaced by the screen.

4. Install a bottom O-ring (13196) on a Drive Head (18307 or 15188). Thread the drive head into the sampler sheath using an adjustable wrench if necessary to ensure complete engagement of the threads. Attach a Drive Cap (12787 or 15590) to the top of the drive head.

   **NOTE:** The 18307 drive head should be used whenever possible as the smaller 0.5-inch ID provides a greater material cross-section for increased durability.

**Sampler assembly is complete.**

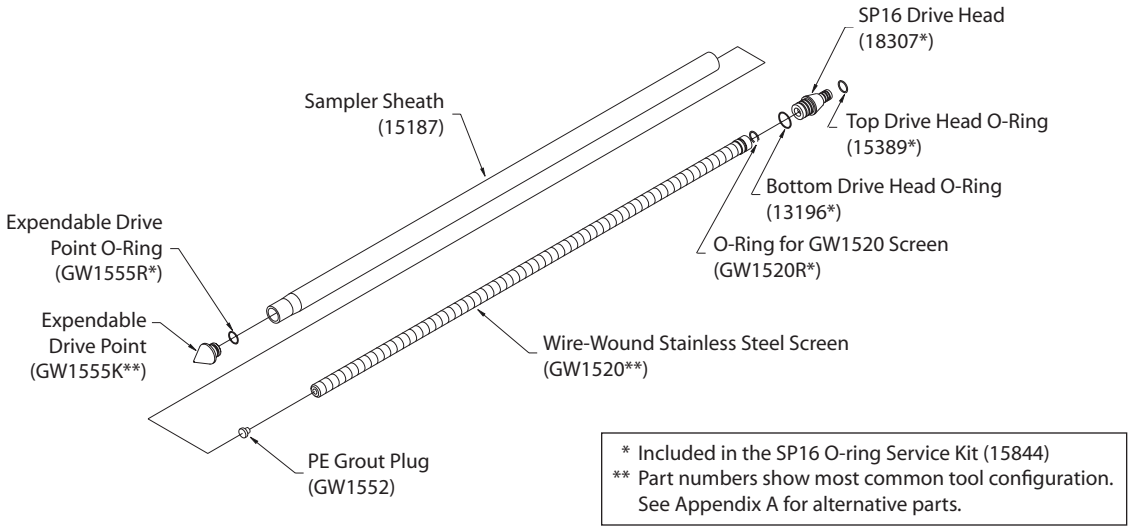



**FIGURE 4.1**
**Screen Point 16 Groundwater Sampler Assembly**

## 4.5 Advancing the SP16 Sampler

To provide adequate room for screen deployment with the Rod Grip Pull System, the probe derrick should be extended a little over halfway out of the carrier vehicle when positioning for operation.

1. Begin by placing the assembled sampler (Fig. 2.1.A) in the driving position beneath the hydraulic hammer of the direct push machine as shown in Figure 4.2.

2. Advance the sampler with the throttle control at slow speed for the first few feet to ensure that the sampler is aligned properly. Switch to fast speed for the remainder of the probe stroke.

3. Completely raise the hammer assembly. Remove the drive cap and place an O-ring in the top groove of the drive head. Distilled water may be used to lubricate the O-ring if needed.

   Add a probe rod (length to be determined by operator) and reattach the drive cap to the rod string. Drive the sampler the entire length of the new rod with the throttle control at fast speed.

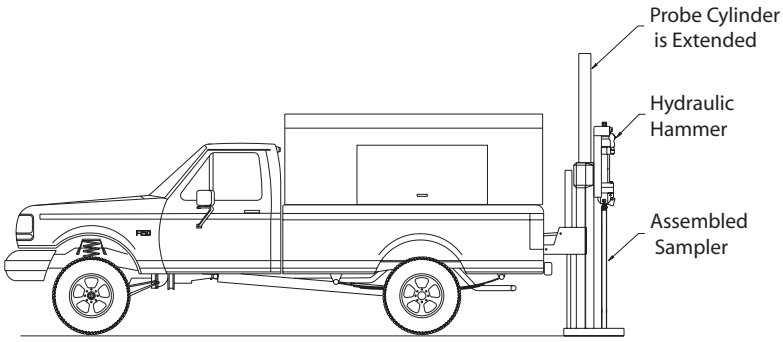



**FIGURE 4.2**
**Screen Point 16 Groundwater Sampler in Driving Position**

4. Repeat Step 3 until the desired sampling interval is reached. Approximately 12 inches (305 mm) of the last probe rod must extend above the ground surface to allow attachment of the puller assembly. A 12-inch (305 mm) rod may be added if the tool string is over-driven.

5. Remove the drive cap and retract the probe derrick away from the tool string.

### 4.6 Screen Deployment

1. Thread a screen push adapter (GW1535) on an extension rod of suitable length (AT671, 10073, or AT675). Attach a threaded coupler (AT68) to the other end of the extension rod. Lower the extension rod inside of the probe rod taking care not to drop it down the tool string. An extension rod jig (AT690) may be used to hold the rods.

2. Add extension rods until the adapter contacts the bottom of the screen. To speed up this step, it is recommended that Extension Rod Quick Links (AT695 and AT696) are used at every other rod joint.

3. Ensure that at least 48 inches (1219 mm) of extension rod protrudes from the probe rod. Thread an extension rod handle (AT69) on the top extension rod.

4. Maneuver the probe assembly into position for pulling.

5. Raise (pull) the tool string while physically holding the screen in place with the extension rods (Fig. 4.3.B). A slight knock with the extension rod string will help to dislodge the expendable point and start the screen moving inside the sheath.

   Raise the hammer and tool string about 44 inches (1118 cm) if using a GW1520 or GW1530 screen. At this point the screen head will contact the necked portion of the sampler sheath (Fig. 4.3.C.) and the extension rods will rise with the probe rods. Use care when deploying a PVC screen so as not to break the screen when it contacts the bottom of the sampler sheath.

   The Disposable Screen (16089) will extend completely out of the sheath if the tool string is raised more than 45 inches (1143 mm). Measure and mark this distance on the top extension rod to avoid losing the screen during deployment.

6. Remove the rod grip handle, lower the hammer assembly, and retract the probe derrick. Remove the top extension rod (with handle) and top probe rod. Finally, extract all extension rods.

7. Groundwater samples can now be collected with a mini-bailer, peristaltic or vacuum pump, tubing bottom check valve assembly, bladder pump, or other acceptable small diameter sampling device.

   When inserting tubing or a bladder pump down the rod string, ensure that it enters the screen interval. The leading end of the tubing or bladder pump will sometimes catch at the screen head giving the illusion that the bottom of the screen has been reached. An up-and-down motion combined with rotation helps move the tubing or bladder pump past the lip and into the screen.

### 4.7 Abandonment Grouting for GW1520 and GW1530 Screens

The SP16 Sampler can meet ASTM D 5299 requirements for abandoning environmental wells or borings when grouting is conducted properly. A removable grout plug makes it possible to deploy tubing through the bottom of GW1520 and GW1530 screens. A GS500 or GS1000 Grout Machine is then used to pump grout into the open probe hole as the sampler is withdrawn. The following procedure is presented as an example only and should be modified to satisfy local abandonment grouting regulations.

1. Maneuver the probe assembly into position for pulling. Attach the rod grip puller to the top probe rod. Raise the tool string approximately 4 to 6 inches (102 to 152 cm) to allow removal of the grout plug.

2. Thread the Grout Plug Push Adapter (GW1540) onto an extension rod. Insert the adapter and extension rod inside the probe rod string. Add extension rods until the adapter contacts the grout plug at the bottom of the screen. Attach the handle to the top extension rod. When the extension rods are slightly raised and lowered, a relatively soft rebound should be felt as the adapter contacts the grout plug. This is especially true when using a PVC screen.

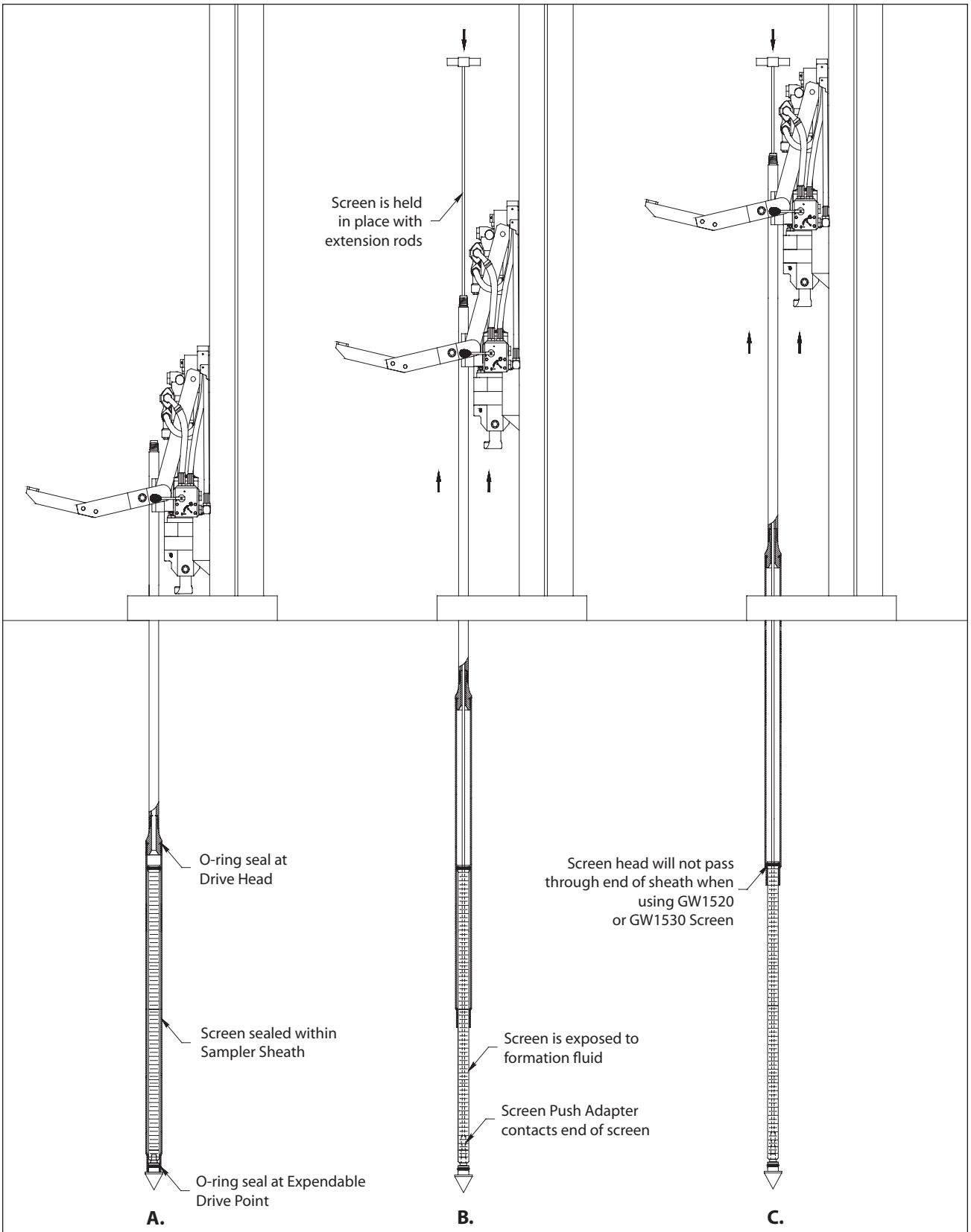



**FIGURE 4.3**
**Screen Deployment for SP16 Sampler**

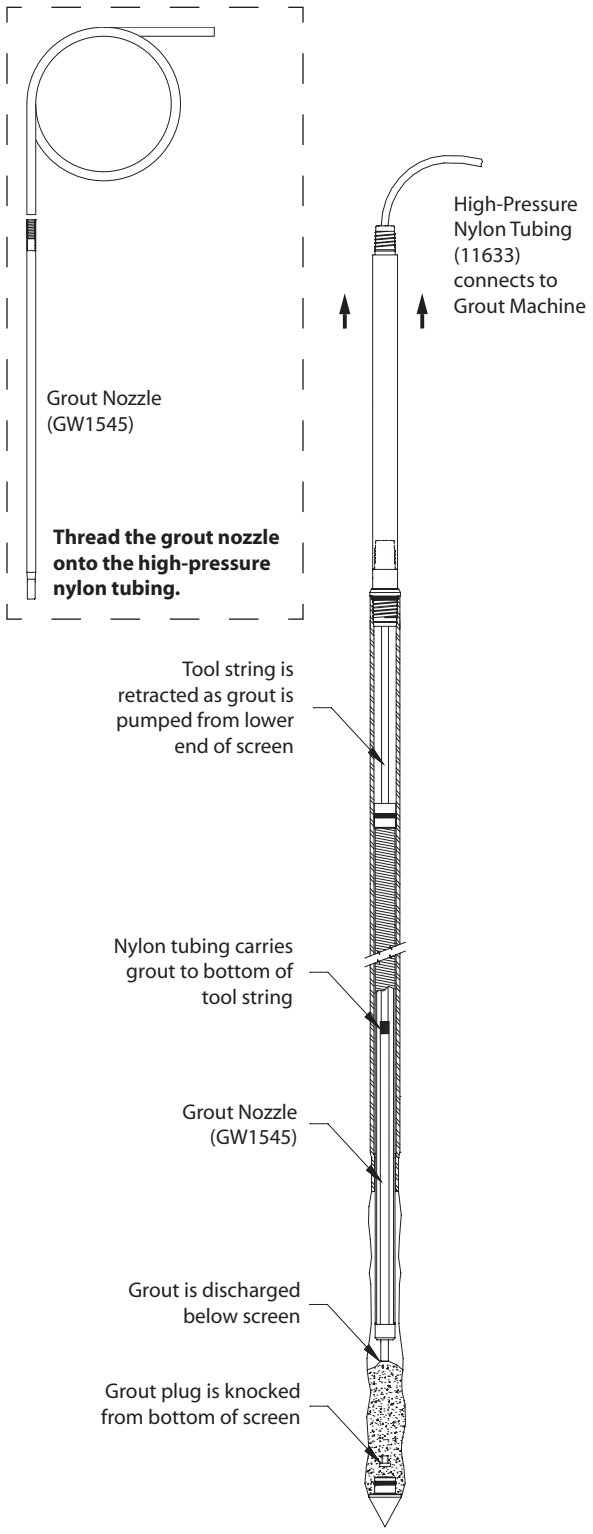



**FIGURE 4.4**
**Grouting the SP16 Sampler With a GW1520 or GW1530 Screen**

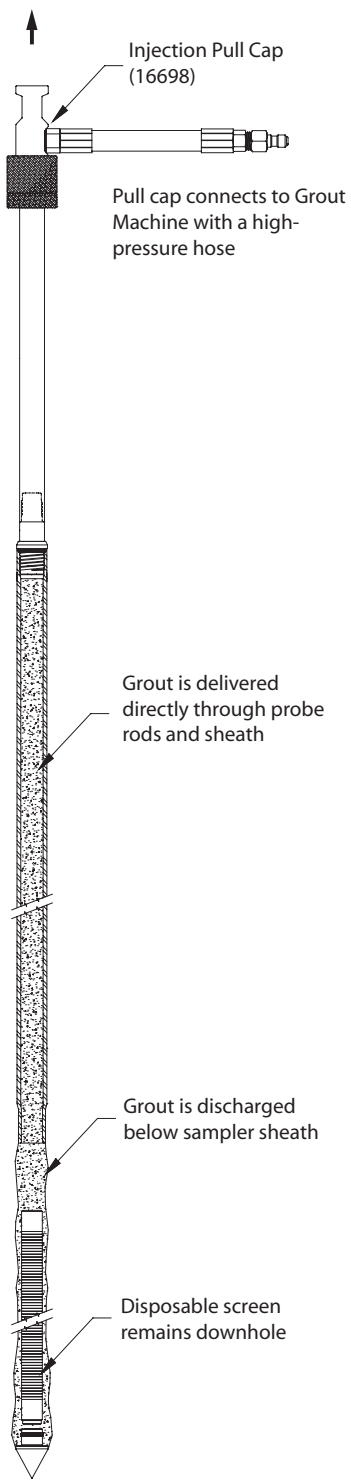



**FIGURE 4.5**
**Grouting the SP16 Sampler With a 16089 Disposable Screen**

3. Place a mark on the extension rod even with the top of the probe rod. Apply downward pressure on the extension rods and push the grout plug out of the screen. The mark placed on the extension rod should now be below the top of the probe rod. Remove all extension rods.

   **Note:** When working with a stainless steel screen, it may be necessary to raise and quickly lower the extension rods to jar the grout plug free. When the plug is successfully removed, a metal-on-metal sensation may be noted as the extension rods are gently "bounced" within the probe rods.

4. A Grout Nozzle (GW1545) is now connected to High-Pressure Nylon Tubing (11633) and inserted down through the probe rods to the bottom of the screen (Fig. 4.4). It may be necessary to pump a small amount of clean water through the tubing during deployment to jet out sediments that settled in the bottom of the screen. Resistance will sometimes be felt as the grout nozzle passes through the drive head. Rotate the tubing while moving it up-and-down to ensure that the nozzle has reached the bottom of the screen and is not hung up on the drive head.

   ***Note:*** *All probe rods remain strung on the tubing as the tool string is pulled. Provide extra tubing length to allow sufficient room to lay the rods on the ground as they are removed. An additional 20 feet is generally enough.*

5. Operate the grout pump while pulling the first rod with the rod grip pull system. Coordinate pumping and pulling rates so that grout fills the void left by the sampler. After pulling the first rod, release the rod grip handle, fully lower the hammer, and regrip the tool string. Unthread the top probe and slide it over the tubing placing it on the ground near the end of the tubing.

6. Repeat Step 5 until the sampler is retrieved. Do not bend or kink the tubing when pulling and laying out the probe rods. Sharp bends create weak spots in the tubing which may burst when pumping grout. Remember to operate the grout pump only when pulling the rod string. The probe hole is thus filled with grout from the bottom up as the rods are extracted.

7. Promptly clean all probe rods and sampler parts before the grout sets up and clogs the equipment.

### 4.8 Abandonment Grouting for the 16089 Disposable Screen

ASTM D 5299 requirements can also be met for the SP16 samplers when using the 16089 disposable screen. Because the screen remains downhole after sampling, the operator may choose either to deliver grout to the bottom of the tool string with nylon tubing or pump grout directly through the probe rods using an Injection Pull Cap (16698). A GS500 or GS1000 Grout Machine is needed to pump grout into the open probe hole as the sampler is withdrawn. The following procedure is presented as an example only and should be modified to satisfy local abandonment grouting regulations.

1. Maneuver the probe assembly into position for pulling with the rod grip puller.

2. Thread the screen push adapter onto an extension rod. Insert the adapter and extension rod inside the probe rod string. Add extension rods until the adapter contacts the bottom of the screen. Attach the handle to the top extension rod.

3. The disposable screen must be extended at least 46 inches (1168 mm) to clear the bottom of the sampler sheath. Considering the length of screen deployed in Section 4.7, determine the remaining distance required to fully extend the screen from the sheath. Mark this distance on the top extension rod.

4. Pull the tool string up to the mark on the top extension rod while holding the disposable screen in place.

   The screen is now fully deployed and the sampler is ready for abandonment grouting. Apply grout to the bottom of the tool string during retrieval using either flexible tubing (as described in Section 4.7) or an injection pull cap (Fig. 4.5). This section continues with a description of grouting with a pull cap.

5. Remove the rod grip handle and maneuver the probe assembly directly over the tool string. Thread an Injection Pull Cap (16698) onto the top probe rod and close the hammer pull latch over the top of the pull cap.

6. Connect the pull cap to a Geoprobe® grout machine using a high-pressure grout hose.

7. Operate the pump to fill the entire tool string with grout. When a sufficient volume has been pumped to fill the tool string, begin pulling the rods and sampler while continuing to operate the grout pump. Considering the known pump volume and sampler cross-section, time tooling withdrawal to slightly "overpump" grout into the subsurface. This will ensure that all voids are filled during sampler retrieval.

   The grouting process can lubricate the probe hole sufficiently to cause the tool string to slide back downhole when disconnected from the pull cap. Prevent this by withdrawing the tool string with the rod grip puller while maintaining a connection to the grout machine with the pull cap.

### 4.9 Retrieving the Screen Point 16 Sampler

If grouting is not required, the Screen Point 16 Sampler can be retrieved by pulling the probe rods as with most other Geoprobe® applications. The Rod Grip Pull System should be used for this process as it allows the operator to remove rods without completely releasing the tool string. This avoids having the probe rods fall back downhole when released during the pulling procedure. A standard Pull Cap (15164) may still be used if preferred. Refer to the Owner's Manual for your Geoprobe® direct push machine for specific instructions on pulling the tool string.

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## Appendix A
## ALTERNATIVE PARTS

The following parts are available to meet unique soil conditions. See section 3.0 for a complete listing of the common tool configurations for the Geoprobe® Screen Point 16 Groundwater Sampler.

| **SP16 Sampler Parts and Accessories** | **Part Number** |
|---|---|
| SP16 Drive Head, 0.625-inch bore, 1.5-inch rods | 15188 |
| Expendable Drive Points, aluminum, 1.625-inch OD (Pkg. of 25) | GW1555ALK |
| Expendable Drive Points, steel, 1.75-inch OD (Pkg. of 25) | 17066K |
| Screen, PVC, 10-Slot | GW1530 |
| Screen, Disposable, PVC, 10-Slot | 16089 |

| **Groundwater Purging and Sampling Accessories** | **Part Number** |
|---|---|
| Polyethylene Tubing, 0.25-inch OD, 500 ft. | TB17L |
| Polyethylene Tubing, 0.5-inch OD, 500 ft. | TB37L |
| Polyethylene Tubing, 0.625-inch OD, 50 ft. | TB50L |
| Check Valve Assembly, 0.25-inch OD Tubing | GW4240 |
| Check Valve Assembly, 0.5-inch OD Tubing | GW4220 |
| Check Valve Assembly, 0.625-inch OD Tubing | GW4230 |
| Water Level Meter, 0.375-inch OD Probe, 100-ft. cable | GW2001 |
| Water Level Meter, 0.438-inch OD Probe, 200-ft. cable | GW2002 |
| Water Level Meter, 0.375-inch OD Probe, 200-ft. cable | GW2003 |
| Water Level Meter, 0.438-inch OD Probe, 30-m cable | GW2005 |
| Water Level Meter, 0.438-inch OD Probe, 60-m cable | GW2007 |
| Water Level Meter, 0.375-inch OD Probe, 60-m cable | GE2008 |

| **Grouting Accessories** | **Part Number** |
|---|---|
| Grout Machine, auxiliary-powered | GS500 |

| **Probe Rods, Extension Rods, and Accessories** | **Part Number** |
|---|---|
| Probe Rod, 1.5-inch x 1-meter | 17899 |
| Probe Rod, 1.5-inch x 48-inch | 13359 |
| Drive Cap, 1.5-inch rods (for GH40 Series Hammer) | 15590 |
| Rod Grip Pull Handle, 1.5-inch Probe Rods (for GH40 Series Hammer) | GH1555 |
| Extension Rod, 48-inch | AT671 |
| Extension Rod, 1-meter | AT675 |

Equipment and tool specifications, including weights, dimensions, materials, and operating specifications included in this brochure are subject to change without notice. Where specifications are critical to your application, please consult Geoprobe Systems®.

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# APPENDIX B

## COMMERCIAL LABORATORY QUALITY ASSURANCE PROGRAMS AND CERTIFICATIONS

**QUALITY ASSURANCE PLAN FOR**
**MSE LAB SERVICES**

DRAFT

**Prepared by:**

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February 2012

DRAFT

**REVIEWS AND APPROVALS (MSE-111R5):**

Prepared by: _____

Laboratory Manager

Reviewed by: _____

Quality Assurance Officer

Approved by: _____

Operations Manager

# SIGNATURES

The undersigned have read this Quality Assurance Plan (QAP) and understand the requirements set forth in it. By signing this document, these individuals acknowledge their responsibility to follow the procedures outlined within the QAP. The annual review of this QAP is mandatory for all employees and will be construed as training for all matters contained within.

| Name | Signature | Initials | Date |
|---|---|---|---|
| Kitrina Wilkins | | | |
| Betty O'Donnell | | | |
| Dan Kindred | | | |
| Jonathan Cloonan | | | |
| Tyler Johnson | | | |
| Tyler Rye | | | |
| Jim Ruark | | | |
| Yan Fang | | | |
| Donna Francisco | | | |
| | | | |
| | | | |
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# ACRONYMS

| | |
|---|---|
| A | analytical spike |
| ASTM | American Society for Testing and Materials |
| BOD | biochemical oxygen demand |
| C | carbon |
| Ca | calcium |
| CAR | corrective action report |
| CCB | continuing calibration blank |
| CCV | continuing calibration verification |
| CLP | Contract Laboratory Program |
| CN | cyanide |
| COA | certificate of analysis |
| COC | chain of custody |
| COD | chemical oxygen demand |
| Cr | chromium |
| CVAAS | cold vapor atomic absorption spectrophotometer |
| D | laboratory duplicate sample |
| DI | deionized water |
| DMRQA | Discharge Monitoring Report-Quality Assurance |
| DPHHS | Department of Public Health and Human Services |
| DQO | data quality objectives |
| DTPA | diethylenetriaminepentaacetic acid |
| EPA | U.S. Environmental Protection Agency |
| FSO | Facility Support Office |
| GLP | good laboratory practices |
| H&S | health and safety |
| $H_2SO_4$ | sulfuric acid |
| HCl | hydrochloric acid |
| HDPE | high-density polyethylene |
| Hg | mercury |
| $HNO_3$ | nitric acid |
| HR | Human Resources |
| IC | ion chromatograph |
| ICB | instrument calibration blank |
| ICP-AES | inductively coupled plasma-atomic emission spectrometer |
| ICP-MS | inductively coupled plasma-mass spectrometer |
| ICSA | interference check solution A |
| ICSAB | interference check solution AB |
| ICSB | interference check solution B |
| ICV | instrument calibration verification |
| IDC | Initial Demonstration of Capabilities |
| IDL | instrument detection limit |
| IPC | instrument performance check |
| K | potassium |
| L | serial dilution |
| LAN | Local Area Network |
| LCS | laboratory control sample |
| LCSD | laboratory control sample duplicate |
| LFB | laboratory fortified blank |
| LFM | laboratory fortified matrix |
| LIMS | laboratory information management system |

# ACRONYMS (CONT'D)

| | |
|---|---|
| LLCCV | low level CCV |
| LRB | laboratory reagent blank |
| MCL | maximum contaminant level |
| MDL | method detection limit |
| Mg | magnesium |
| MS | matrix spike |
| MSD | matrix spike duplicate |
| MSE | MSE Technology Applications, Inc. |
| MST | matrix spike triplicate |
| N | nitrogen |
| Na | sodium |
| NaOH | sodium hydroxide |
| NELAC | National Environmental Laboratory Accreditation Conference |
| NIST | National Institute of Standards and Technology |
| NT | expected number of measurement |
| NTU | turbidity |
| NV | number of valid measurements |
| NVLAP | National Voluntary Laboratory Accreditation Program |
| PB | preparation blank |
| PQL | practical quantitation limit |
| QA | quality assurance |
| QAP | quality assurance plan |
| QAPP | quality assurance project plan |
| QC | quality control |
| QCS | quality control sample |
| R | laboratory replicate sample |
| RL | reporting limit |
| RPD | relative percent difference |
| S | first (original) sample value |
| SA | spike added |
| SDG | Sample Delivery Group |
| SOP | Standard Operating Procedure |
| SOW | Statement of Work |
| SR | reported sample result |
| SRM | standard reference material |
| SSR | spiked sample recovery |
| SSV | reported spiked sample value |
| TC | total cyanide |
| TDS | total dissolved solids |
| TOC | total organic carbon |
| TS | total solids |
| TSA | Technical Systems Audit |
| TSS | total suspended solids |
| TVS | total volatile solids |
| VOA | volatile organic analysis |
| VOC | volatile organic compound |
| WAD | weak acid dissociable |
| WS | water supply |
| WP | water pollution |

# 1. QUALITY ASSURANCE PLAN OVERVIEW

## 1.1 POLICY AND OBJECTIVES

The general quality assurance (QA) policy of the MSE Technology Applications, Inc. (MSE) Lab Services (MSE Lab) is to ensure that all data generated and processed will be scientifically valid and of known and documented quality. All data generated by the MSE Lab, unless acknowledged and authorized by the client, will be of known precision and accuracy and will be legally defensible. All data reported by the MSE Lab meets the applicable requirements for State of Montana and/or U.S. Environmental Protection Agency (EPA) specific methods followed. All laboratory staff are required to read and adhere to the requirements and specifications outlined in the QAP. The emphasis of the QAP is to define quality control (QC) procedures for all activities that take place in the MSE Lab and to characterize the documentation practices used in all facets of the MSE Lab process.

This QAP addresses all of the minimum required elements described in the *Guidelines and Specifications for Preparing Quality Assurance Program Plans (QAMS-004/80)* and *Guidance on Preparation of Laboratory Quality Assurance Plans (EPA 910/9-92-0332)*.

## 1.2 QUALITY ASSURANCE POLICY STATEMENT

The purpose of this QAP is to specify general practices and procedures that ensure MSE Lab data are of a known and documented quality. All data reported meets the applicable requirements for EPA and/or any State specific methods used. Quality assurance activities are designed in the most cost-effective way possible without compromising data quality objectives (DQOs). Detailed specifications and standard operating procedures (SOPs) are to be found in separate documentation for each type of analysis performed by the MSE Lab. An SOP directory is provided in Appendix A.

## 1.3 LABORATORY CODE OF ETHICS

The MSE Lab operates as a team, and each team member is expected to maintain a certain level of professionalism. All employees are expected to perform their duties with excellence, to contribute to an environment where their coworkers can efficiently perform their duties, and maintain focus on the overall benefit of the MSE Lab team. The MSE Lab is committed to providing its clients with accurate and defensible data and meeting all client requirements for data quality and integrity. To achieve this commitment, and as a condition for employment, all employees agree to follow the MSE Lab's policy regarding ethics and data integrity outlined in the MSE Lab Services Ethics and Data Integrity Agreement (see Appendix B).

- All work performed shall be in accordance with appropriate work order agreements, specified methods, SOPs, contracts, etc.
- All data values reported (e.g., sample results), including analysis dates and time, represent actual values obtained and are not modified or manipulated in any manner that is not described in the reference method.
- Instrument runs shall NOT be deleted from the instrument computer unless it is properly backed-up AND under the instruction of the Laboratory Manager or QA Officer.
- Analysts performing technical methods shall not represent work that was performed by other individuals as their own.
- Client results shall be kept strictly confidential and released to a third party only upon consent of the client.

Violation of these standards is grounds for disciplinary action that may include termination. Each MSE Lab employee is required to read and sign a Code of Ethics (Appendix B) within 30 days of their initial employment.

## 1.4 RECORDS

Additionally, this QAP and MSE Lab policy requires that all activities associated with analytical procedures be clearly documented in an easily retrievable form. This is accomplished by using analysis-specific bench sheets, logbooks, spreadsheets, instrument run logs, and other documentation as required. All records must be recorded in indelible ink, free of whiteout or erasures, and each page must be initialed and dated by the person performing the work. All corrections to records must be made by drawing a single line through the incorrect entry, writing the correct information, and initialing the correction. The purpose of the documentation is to ensure that all MSE Lab activities can be completely and accurately reconstructed after substantial time has passed without reliance on memory.

## 1.5 QUALITY SYSTEM COMPONENTS

Components of the MSE Lab's quality system include:

- QAP;
- SOPs;
- workload scheduling;
- quality system audits;
- performance evaluations;
- corrective action reports (CARs); and
- data validation.

## 1.6 POLICY ON REVIEW OF QUALITY ASSURANCE PLAN AND QUALITY SYSTEM

Responsible personnel will review this QAP annually to ensure this document is current and relevant. Reviewers will use MSE's document revision procedures as outlined in the MSE Facility Manual, Section 1.3.2.1.

## 1.7 MSE LAB ORGANIZATION

The MSE Lab Organization Chart is shown in Figure 1-1.

## 1.8 PERSONNEL RESPONSIBILITIES AND QUALIFICATIONS

### 1.8.1 Laboratory Manager

The Laboratory Manager is designated by the Operations Manager and is responsible for overseeing the daily operations of the MSE Lab and its professional staff, with the goal of efficiently producing high-quality data within required timeframes. The Laboratory Manager also provides technical direction and business leadership.

The Laboratory Manager is the primary point-of-contact for customers and coordinates with the QA Officer to ensure that MSE Lab certifications are maintained and that necessary QA proficiency programs are accomplished.

The Laboratory Manager is responsible for the maintenance of standards and materials in accordance with the QAP to ensure uninterrupted operation of the laboratory.

In events where employee scheduling or current workload is such that new work cannot be incorporated without missing holding times or DQOs, the Laboratory Manager has the authority to refuse samples, modify employee scheduling, or reschedule projects.

The Laboratory Manager, in coordination with QA/QC managers, is responsible for determining in which Proficiency Programs the laboratory will participate, and which accreditations the laboratory will pursue. It is the responsibility of the Laboratory Manager to ensure that the laboratory sections perform the tasks necessary to complete the proficiency testing required to maintain certification and accreditation.

The Laboratory Manager can act as Analyst or Technician if, for any reason, the positions are not filled.

The Laboratory Manager must have as a minimum a B.S. in a science or engineering field and 2 years of managerial experience in an environmental laboratory, or an equivalent combination of education and experience.

### 1.8.2 QA Officer

The QA Officer is designated by the Operations Manager, and is responsible for auditing QA activities to ensure compliance with the QAP on an annual basis. The QA Officer reports to MSE's Operations Manager. The QA Officer assists with development and implementation of SOPs for activities occurring within the MSE Lab and reviews and approves all QA activities associated with specific projects. The QA Officer periodically reviews data reports prior to their submittal to clients but has no data generation duties. The QA Officer also coordinates all QA activities undertaken by the MSE Lab staff, including data review functions performed by qualified MSE Lab staff (i.e., Laboratory Manager, Chief Analytical Chemist).

The QA Officer must have as a minimum a B.S. in a science or engineering field and 2 years experience in QA, or an equivalent combination of education and experience.

### 1.8.3 QA/Health and Safety Office

The MSE QA and Health and Safety (H&S) Offices are responsible for ensuring that all MSE Lab activities are conducted in a safe manner in compliance with the MSE Chemical Hygiene Plan and MSE's Health and Safety Program Manual. The QA and/or H&S Offices document any violations and identify appropriate corrective actions.

### 1.8.4 Environmental Office

The MSE Environmental Coordinator is responsible for safely and legally disposing of any wastes generated in the MSE Lab and constantly focuses on waste minimization.

### 1.8.5 Technical Staff

The MSE Lab has technical staff that report to the Laboratory Manager. The technical staff are responsible for peer reviewing primary analyst data; performing sample analysis in a timely manner; using approved SOPs for all analytical work; and communicating with the QA Officer regarding scientific and technical issues, such as deviation from SOPs.

#### 1.8.5.1 Chief Analytical Chemist

The Chief Analytical Chemist is responsible for ensuring that all instruments are operating correctly and that all analysts maintain proficiency with instrumental analysis. The Chief Analytical Chemist also assists with reviewing and reporting data. The Chief Analytical Chemist reports daily to the Laboratory Manager and will inform the Laboratory Manager as to the material needs of the laboratory, specifically pertaining to analyses performed by the Chief Analytical Chemist.

Additional duties of the Chief Analytical Chemist may include, but not be limited to, preparation of samples for analysis, maintenance of lab equipment, and providing technical assistance to lower level laboratory staff. The Chief Analytical Chemist may be asked to perform supervisory duties as related to operational aspects of the lab. The Chief Analytical Chemist may perform all of the duties of a Laboratory Technician.

The position of Chemist or Chief Analytical Chemist is a full-time salaried position and requires the equivalent of a Bachelors degree in Chemistry or a closely related science as well as at least 2 years of environmental or closely related laboratory experience.

#### 1.8.5.2 Laboratory Technicians

Laboratory Technicians are responsible for a particular operational area within the laboratory and are primarily responsible for completing sample analysis for that area in either a primary or secondary capacity. These operational areas include bacteriological, metals, wet chemistry, soils analysis, sample preparation, and field sampling.

In each area these individuals are responsible for:

- identifying work to be accomplished based on communication with the Production Manager, setting short-term priorities, and reporting problems in the technical area;
- recommending remedies on processes or QC to the Laboratory Manager or QA Officer as appropriate;
- tracking and monitoring weekly workload projections and notifying the Production Manager of problems or deviations from anticipated deadlines;
- working with the QA Officer to develop and ensure that current SOPs are used for specific technical areas and identifying SOPs that need to be developed or modified;
- ensuring QC criteria are regularly maintained within the team; and
- performing analytical work as experts within their team.

Laboratory Technicians often cross over functional areas and perform multiple roles in the laboratory as dictated by shifting workloads.

The position of Laboratory Technician is a full- or part-time hourly position and requires a high school diploma or equivalent. In certain circumstances, a high school senior with completed chemistry courses may be considered.

#### 1.8.5.3 Certified Analyst – Bacteriological Lab

Certified Analysts are responsible for a particular operational area within the laboratory and are primarily responsible for completing sample analysis for that area in either a primary or secondary capacity.

These individuals are responsible for:

- performing bacteriological analyses according to approved methods;
- identifying and reporting maximum contaminant level (MCL) exceedences to the client and appropriate State Agency;
- identifying work to be accomplished based on communication with the Production Manager, setting short-term priorities, and reporting problems in the technical area;
- recommending remedies on processes or QC to the Laboratory Manager or QA Officer as appropriate;
- tracking and monitoring weekly workload projections and notifying the Production Manager of problems or deviations from anticipated deadlines;
- working with the QA Officer to develop and ensure that current SOPs are used for specific technical areas and identifying SOPs that need to be developed or modified;
- ensuring QC criteria are regularly maintained; and
- performing analytical work as experts.

Certified Analysts often cross over functional areas and perform multiple roles in the laboratory as dictated by shifting workloads.

The position of Certified Analyst is a full- or part-time hourly position and requires a high school diploma or equivalent. The analyst should also have training at the State of Montana Department of Public Health and Human Services (DPHHS) Lab in Helena in microbiological analysis of drinking water and a minimum of 30 days of on-the-job training in drinking water microbiology under an experienced analyst. The analyst must receive certification from the State of Montana DPHHS Lab prior to reporting bacteriological results.

Currently, Certified Analysts for the MSE Bacteriological Lab are:

- Dan Kindred
- Kitrina Wilkins
- Marcee Cameron

### 1.8.4 Staff

#### 1.8.4.1 Systems Administrator

The Systems Administrator is responsible for overseeing all information systems infrastructure. Infrastructure is defined as all hardware including computer workstations, servers, and information technology support equipment plus all laboratory equipment that interfaces with the network or database as well as all software and applications on the system.

#### 1.8.4.2 Sample Custodian, Shipping/Receiving

The Sample Custodian is responsible for logging and tracking all samples throughout the laboratory. The Sample Custodian is additionally responsible for tracking all samples sent to subcontract laboratories. All shipping and receiving is completed/monitored by the Sample Custodian, to include sampling kits and bottle orders. The Sample Custodian may take customer orders and ensures that incoming samples are correct. If a discrepancy is noted, the Sample Custodian will contact the customer to resolve any questions or problems. The Sample Custodian is an integral part of the customer service team.

The Sample Custodian must have a high school diploma or equivalent.

### 1.8.5 Functional Areas

#### 1.8.5.1 Metals

Metals analysts are responsible for performing analysis of drinking water and solid/aqueous environmental samples for metals using a cold vapor atomic absorption spectrometer (CVAAS), inductively coupled plasma-atomic emission spectrometer (ICP-AES), and inductively coupled plasma-mass spectrometer (ICP-MS).

#### 1.8.5.2 Wet Chemistry

Wet chemistry analysts are responsible for performing analysis of environmental and drinking water samples for physical and chemical analysis of nonmetals using wet chemical methods and instrumental techniques.

#### 1.8.5.3 Soils Analysis

Soils analysis analysts are responsible for preparing environmental samples for sample digestion as well as determination of physical parameters and limited instrumental analysis of soils for nonmetal parameters.

#### 1.8.5.4 Sample Preparation

Sample preparation analysts are responsible for measuring various physical parameters and sample preparation (digestion) of drinking water and solid/aqueous environmental samples.

## 1.9 EMPLOYEE TRAINING

Effective employee training is critical to producing accurate, high-quality analytical data. Prior to performing any work in the MSE Lab, employees are required to complete mandatory MSE safety training and orientation. The MSE Lab requires an Initial Demonstration of Capabilities (IDC) before an employee can independently operate an instrument or perform a method with which he/she is not already familiar. The employee is monitored during the analysis for adherence to the applicable SOP(s), and the generated analytical data is reviewed by a qualified supervisor to ensure that all QA criteria are satisfied and that analytical results are acceptable. This activity is documented in the employee's personnel file and on Form MSE-84, Training Record (Figure 1-2).

Training records of MSE Lab staff are maintained in both the MSE Human Resources (HR) and H&S Offices. It is the responsibility of each staff member to ensure that records of completed training are given to the HR Office or H&S Office for filing.

## 1.10 STANDARD OPERATING PROCEDURES

Standard Operating Procedures are an integral part of consistent quality MSE Lab work. MSE Lab SOP001, "Guidelines for the Preparation and Management of SOPs," describes the process for writing new SOPs, as well as the review and revision procedures for current SOPs. Any changes to SOPs will use MSE's document revision procedures as outlined in MSE's Facility Manual, Section 1.3.2.1. The use of approved SOPs for all routine MSE Lab operations is mandatory. Current versions of all SOPs are maintained on the Local Area Network (LAN) (Misc/Manuals/Lab SOPs) and in hard copy in the Sample Receipt Area. As new versions of the SOPs are approved by the Laboratory Manager, all affected

personnel are issued updated copies. All analysts have access to the SOPs applicable to their analytical duties. All MSE Lab personnel are responsible for destroying old versions of their SOPs. Standard Operating Procedures are required to be reviewed by responsible personnel in each functional area on an annual basis for the purpose of keeping them up to date. Changes to MSE Lab procedures in the interim must be documented in the appropriate SOP(s) as soon as possible.

The MSE Lab strives to perform published methods as described in the method documents. If there is a material deviation from the published method, the method is cited as a "modified" method in the analytical report. Modifications to the published methods are listed in the SOP. Standard Operating Procedures are available to analysts and clients for review. The majority of modifications made at the MSE Lab involve reduced sample size to reduce waste generated during analyses.

## 1.11 QUALITY DOCUMENT CONTROL

All SOPs and the QAP are maintained under the control of the MSE Facility Support Office (FSO). The FSO is responsible for maintaining all official/authorized versions of all SOPs and the QAP. The official, master version of each SOP is maintained by the FSO, and copies are distributed to the Laboratory Manager. All original signatures are maintained on the master copy. Any copies or versions of these documents that are distributed outside the laboratory will not be controlled and updated during annual reviews.

All Instrument Troubleshooting and/or Maintenance Logbooks are maintained by the analysts with the equipment. These logbooks are periodically inspected during logbook reviews to ensure compliance with SOPs. When full, Instrument Troubleshooting and/or Maintenance Logbooks are archived and retired with the piece of equipment.

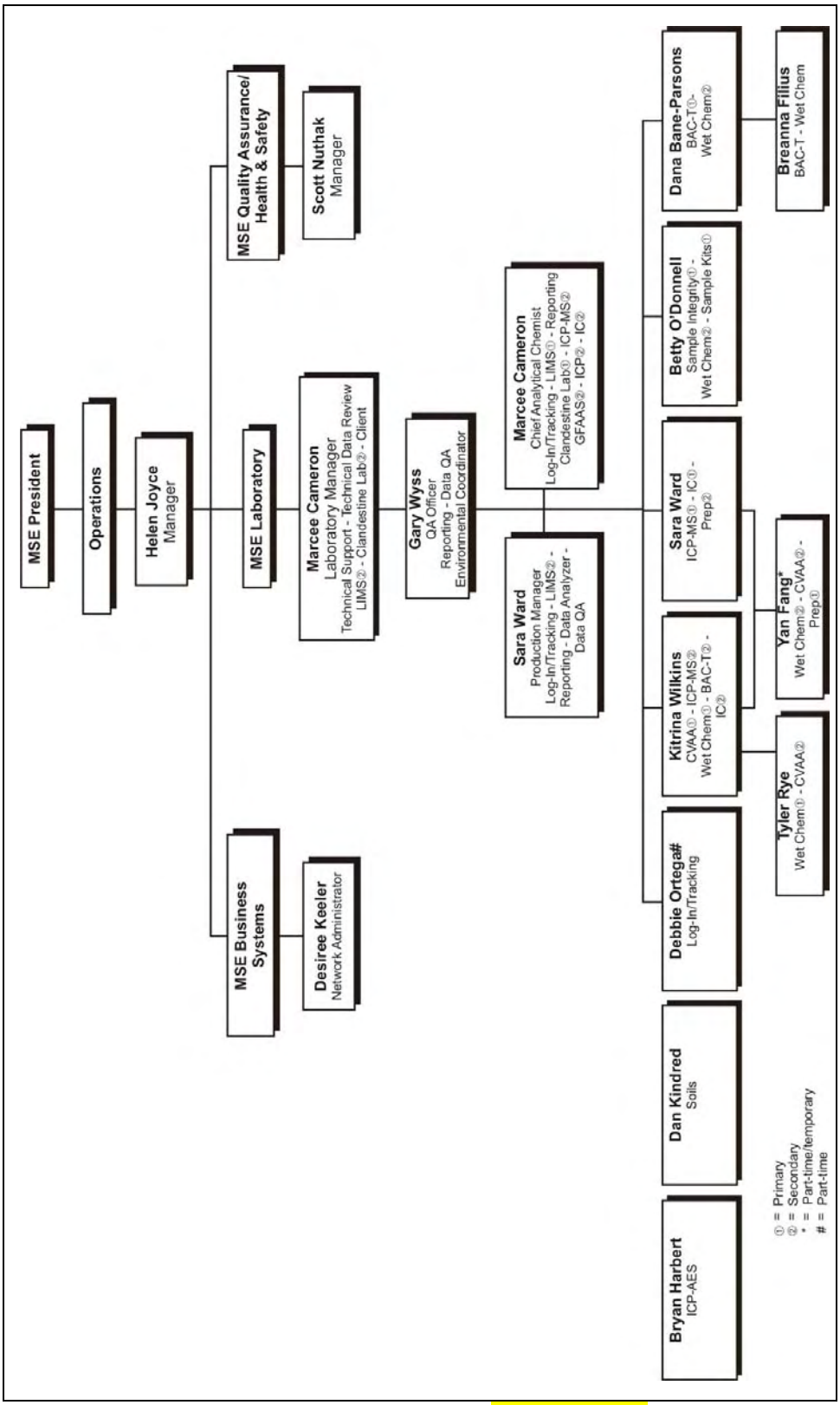


***Figure 1-1. MSE Lab organization chart. <<INSERT NEW>>***

Form MSE-84#
(Rev. 05-08)

# TRAINING RECORD

When you conduct training or receive off-site training, complete this form and send to Human Resources within seven days of the training session.

Page 1 of 2

Title: _____

Certificate Received: ☐ Yes ☐ No (If yes, attach copy)

Course Contents: (Be complete. If more space is required, attach a separate sheet of paper.)

Organization Conducting Training: _____
(name)

_____
(address)

Location of Training: _____

Date(s) of Training: _____

Name(s) and Employee No.(s) of Employee(s) Completing Training (see back for additional space).

| Employee Name | Employee # | Employee Name | Employee # |
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Person Completing Form: _____ Date: _____

***Figure 1-2. MSE Training Record.***

Page 2 of 2

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***Figure 1-2. MSE Training Record (cont'd).***

# 2. QUALITY ASSURANCE DEFINITIONS AND OBJECTIVES FOR DATA MEASUREMENT

## 2.1 STATISTICAL PARAMETER DEFINITIONS

Statistical parameters commonly used to evaluate laboratory data include:

- accuracy;
- precision;
- completeness;
- representativeness; and
- comparability.

Accuracy and precision are quantitative statistical parameters calculated based on characteristics of a given data set, while completeness is calculated based on the overall data recovery percentage of a given data set. Representativeness and comparability are qualitative assessments that are strongly influenced by project-specific objectives.

Each is discussed and defined in the following paragraphs.

### 2.1.1 Accuracy

Accuracy is defined as the degree of agreement of a measurement with the true or accepted value for the measurement. Accuracy can be assessed by analysis of reference or standard samples for which a true concentration or value is known and by analysis of spiked samples in which a known concentration of analyte is added to an analytical sample. Accuracy is typically calculated on the basis of percentage recovery of a given analyte as follows.

#### 2.1.1.1 Standard or Reference Samples are Calculated

$$\% \text{ Recovery} = 100 * \text{Reported Value/True Value}$$

#### 2.1.1.2 Spiked Samples are Calculated

$$\text{SSR } \% \text{ Recovery} = 100 * (\text{SSV-SR})/\text{SA}$$

Where: SSR = spiked sample recovery
SSV = reported spiked sample value
SR = reported sample result
SA = spike added

### 2.1.2 Precision

Precision is defined as the mutual agreement among a set of measurements (duplicate or replicate samples) for the same analytical property under similar conditions without assumption of prior information concerning the true results. It is calculated as relative percent difference (RPD) according to the following equation:

$$RPD\ \% = 100 * 2 * \text{absolute value } (S-D)/(S+D)$$

Where: RPD = relative percent difference
S = first (original) sample value
D = duplicate or replicate sample value

### 2.1.3 Completeness

Completeness is defined as the measure of the amount of valid data obtained from a measurement system compared to the amount expected to be obtained under normal conditions and is expressed algebraically as:

$$Completeness\ \% = 100 * NV/NT$$

Where: NV = number of valid measurements
NT = expected number of measurements

A valid result is an MSE Lab data point that meets the DQO of a given project.

### 2.1.4 Representativeness

This is a qualitative term that expresses the degree to which data accurately and precisely represents a characteristic of a population, variations at a sampling site location, a process condition, or an environmental condition.

Representative data has two important properties:

- it accurately represents a measured parameter, given the system sampled at a particular time and place; and
- there is complete certainty that the measurement can be ascribed to the particular sample rather than to another sample from a different location or time.

In the MSE Lab, the first property is ensured by specifying (in appropriate SOPs or other analysis specifications) the steps for preparing and analyzing each sample and confirming that the steps are followed. The second criterion is satisfied by using defined procedures for MSE Lab recordkeeping and data handling.

Similar procedures must be implemented by the field personnel to ensure collection of representative data when sampling is performed by MSE for laboratory clients. Sampling activities are typically under the auspices of project-specific or client-specific quality assurance project plans (QAPPs).

### 2.1.5 Comparability

This is a qualitative term that expresses the confidence with which one data set can be compared to another. Comparability must be ensured in terms of consistency in sampling plans, analytical methods, QC, data reporting, etc., each of which may be project specific.

## 2.2 QUALITY ASSURANCE/QUALITY CONTROL SAMPLE DEFINITIONS

Numerous QA/QC samples are prepared by the MSE Lab to quantify the accuracy and precision characteristics of individual analytical data sets. Each QA/QC sample type is defined and discussed below. Additionally, unique, project-specific QA/QC samples not explicitly defined below are often prepared and analyzed to address specific client concerns.

### 2.2.1 Analytical Batch

The basic unit for analytical QC is the analytical batch. The overriding principle for describing an analytical batch is that all the samples in a batch, both field samples and QC samples, are to be handled in the same way, and all of the data from each analysis is to be manipulated in exactly the same manner.

The minimum requirements of an analytical batch are:

1. The number of samples in a batch is not to exceed that specified in the SOP for the analysis being performed.
2. All samples in a batch are typically of the same matrix.
3. The QC samples to be processed with the samples typically include:
   a) Method Blank (aka Laboratory Reagent Blank (LRB) or Prep Blank (PB). Function is to identify laboratory contamination.
   b) Laboratory Control Sample (LCS) [aka Laboratory Fortified Blank (LFB)]. Function is to assess the method performance.
   c) Matrix Spiked (field) Sample (MS) [aka spike (S)]. Function is to identify matrix interferences.
   d) Matrix Spiked (field) Sample Duplicate (MSD [aka duplicate (D)]. Function is assessment of batch precision.
4. A single lot of reagents are used to process the batch of samples.
5. Each operation within the analysis is performed by a single analyst/technician/chemist or by a team of analysts/technicians/chemists.
6. The QC samples are to be analyzed in conjunction with the associated field samples prepared with them.
7. Batch QC refers to the QC samples that are analyzed in a batch of field samples.
8. If specific project, program, or method SOP requirements are more stringent that these laboratory minimum requirements, the project, program, or method SOP requirements will take precedence.

### 2.2.2 Method Blank

The method blank is either analyte-free water or analyte-free soil (when available), subjected to the entire analytical process. When analyte-free soil is not available, analyte-free sand or an acceptable substitute may be used. The method blank is analyzed to demonstrate that the analytical system is not contaminated with the analyte of interest. The method blank results should be below the Practical Quantitation Limit (PQL or Reporting Limit) or, if required, less than the method detection limit (MDL) for the analytes being tested; otherwise, corrective action must be taken. At least one method blank is included with the analysis of every analytical batch as stated in the method SOP.

### 2.2.3 Calibration Blank

For some methods, the calibration blanks are prepared along with calibration standards to create a calibration curve. Calibration blanks are free of the analyte of interest and, where applicable, provide the zero point of the calibration curve.

### 2.2.4 Continuing Calibration Blanks

Continuing calibration blanks (CCBs) are solutions of analyte-free water or reagents that are analyzed to verify the system is contamination free when continuing calibration standards are analyzed. The frequency of CCB analysis is either once every 10 samples or as indicated by the method, whichever is greater.

### 2.2.5 Calibration Standards

Calibration standards are solutions of known concentration prepared from primary standard solutions that are, in turn, prepared from stock standard materials. Calibration standards are used to calibrate the instrument response with respect to analyte concentration. Standards are analyzed in accordance with the requirements stated in the particular method being used.

### 2.2.6 Initial Calibration Verification Standards

Initial (or independent) calibration verification standards (ICVs) are standards that are analyzed after calibration with a newly prepared standard (but prior to sample analysis) to verify the validity of the standards used in the calibration. Once it is determined that there is no systematic error in preparation of the calibration standard(s), they are considered valid standards and may be used for subsequent calibrations (as expiration dates and methods allow). The ICV standards are prepped from materials obtained from a source independent of that used for preparing the calibration standards. Initial calibration verification standards are also analyzed in accordance with method-specific requirements.

### 2.2.7 Continuing Calibration Verification Standards

Continuing calibration verification standards (CCVs) are mid-range standards that are analyzed to verify that the calibration of the analytical system is still acceptable. The frequency of the CCV analysis is indicated in the method SOP.

### 2.2.8 Internal Standards

Internal standards consist of known amounts of specific compounds that are added to each sample following sample preparation. Internal standards are generally used for procedures to correct sample results that have been affected by changes in instrument conditions or changes caused by certain matrix effects.

### 2.2.9 Matrix Spikes (aka LFM)

Matrix spiked samples are field samples to which a known amount of the target analyte(s) has been added. The samples are then prepared and analyzed in the same analytical batch in exactly the same manner as routine samples. The spike recovery measures the effects of interferences caused by the sample matrix and reflects the accuracy of the method for the particular matrix in question. Recovery calculations can be found in Section 2.1.1.2. Matrix spiked samples are prepared and analyzed at the levels and frequency noted in the SOP.

### 2.2.10 Laboratory Duplicates and Matrix Spike Duplicates

Duplicates are additional replicates of samples that are subjected to the same preparation and analytical scheme as the original sample. Depending on the method, either a duplicate samples aliquot or a matrix spiked sample that matrix spiked duplicate (MS/MSD) are analyzed. The RPD between duplicate analyses or between an MS and MSD is a measure of the precision for a given method and analytical batch. The RPDs are calculated according to the calculation in Section 2.1.2. Duplicates or MS/MSD analyses are prepared and analyzed at the levels and frequency noted in the SOP. Duplicates or MS/MSDs are selected on the basis of volume or matrix. Samples with enough volume are selected unless a matrix problem is suspected, in which case, a sample with enough volume and an appropriate matrix is selected. Preparation of solid samples routinely includes two "MSDs," referred to as a matrix spike triplicate (MST) as a measure of homogeneity.

### 2.2.11 Laboratory Control Samples (aka LFB or QCS)

The LCS is an aliquot of analyte-free matrix to which known amounts of the target analytes are added. A standard reference material of known matrix type, containing certified amounts of target analytes, may also be used as an LCS. Stock solutions used for LCSs are purchased or prepared independently of calibration standards. Comparison of batch-to-batch LCS analyses enables the lab to evaluate batch-to-batch precision and accuracy. Acceptance criteria for LCS analyses are obtained through the use of control charts. An LCS is prepared and analyzed at the levels and frequency noted in the SOP. If an insufficient quantity of samples is available to perform a laboratory duplicate or MSD, occasionally a duplicate LCS will be prepared and analyzed.

### 2.2.12 Interference Check Samples

Interference check samples (ICSA/ICSAB) are solutions containing interfering elements of known concentration that can be analyzed to verify background and interelement correction factors in metals analyses.

### 2.2.13 Post-Digestion Spikes (Analytical (A) Spikes)

Post-digestion spikes are samples prepared for metals analyses that have an analyte spike added to determine if matrix effects may be a factor in the results. The spike addition should produce a method specified minimum concentration above the instrument detection limit (IDL). A post-digestion spike is analyzed with each batch of samples, and recovery criteria are specified for each method.

## 2.3 SOURCE AND PREPARATION OF STANDARD REFERENCE MATERIALS

All analytical measurements generated by the MSE Lab are performed using materials and/or processes that are traceable to a Standard Reference Material (SRM). All metrology equipment (analytical balances, thermometers, etc.) are calibrated using materials traceable to the National Institute of Standards and Technology (NIST) and maintained on a schedule to ensure accuracy.

All sampling containers provided to the client by the MSE Lab are assured to be free of interfering contaminants by:

- the container is purchased as precleaned (Level 1) with certificates of analyses (COAs) available for each bottle type; or
- the container is cleaned by the MSE Lab using SOPs; or

- the specific bottle type and manufacturer has been proven through study to be free of interfering materials; and/or
- a blank is prepared using laboratory reagent water at the time of sample collection to provide information on possible interferences or contamination resulting from the sample container.

Consumable materials routinely purchased by the laboratory (e.g., analytical standards) are purchased from nationally recognized, reputable vendors. Consumable primary stock standards are obtained from certified commercial sources or from sources referenced in a specific method. VWR, Ultra Scientific, AccuStandard, Chem. Services, Inc., Absolute Standards, Aldrich Chemical Co., J.T. Baker, Spex, E.M. Science, Fisher Scientific, etc. are examples of the vendors used by MSE Lab Services. All reference materials that are received are recorded by the technical staff in the appropriate logbook(s) and are stored under conditions that provide maximum protection against deterioration and contamination. The logbook entry includes such information as an assigned logbook identification code, lot number, matrix (if applicable) and concentration of analyte(s), reference to the COA, date of receipt, and an assigned expiration date. In addition, the date that the standard is received in the laboratory is marked on the container. When the material container is opened for use the first time, the date of opening is recorded on the container. Stock solutions and/or calibration standard solutions are prepared fresh as often as necessary according to SOPs. After preparation, all standard solutions are properly labeled as to analyte concentration, matrix, date, preparatory analyst, and expiration date; these entries are also recorded in the appropriate logbook(s). Prior to introduction into the analytical system/process, all in-house prepared reference materials are verified with a second, independent source of the material. Once the reference material has been verified to be accurate, it may then be used for instrument calibration and subsequent quantitative purposes. In addition, an independent source of reference material is also used to check the calibration standards for signs of deterioration (i.e., ICV or LCS).

## 2.4 CONTROL CHARTING

The generation of control charts is routinely performed by the MSE Lab. Refer to SOP GP002 for specific information on the generation and use of control charts.

## 2.5 METHOD DETECTION LIMITS

The MDL is defined as the minimum concentration of a substance that can be measured and reported with 99% confidence that the analyte concentration is greater than zero. Method detection limits are determined for most analyses performed at the MSE Lab. Refer to SOP GP029 for specific information on development of MDLs.

## 2.6 GLASSWARE WASHING

Glassware washing and maintenance play a crucial role in the daily operation of a laboratory. The glassware used at the MSE Lab undergoes a rigorous cleaning procedure prior to every use. Refer to SOP GP001 and method-specific SOPs for specific glassware cleaning procedures.

## 2.7 QUALITY ASSURANCE/QUALITY CONTROL OBJECTIVES FOR THE MSE LAB

Quality assurance/QC objectives for general chemistry (wet chemistry) analyses (i.e., inorganics other than metals) are discussed in Section 2.3.1. Quality assurance/QC for metals analyses is discussed in Section 2.3.2.

Additionally, the MSE Lab adheres to any special QA/QC requirements that may be specified by individual projects.

### 2.7.1 General Chemistry Parameters

Tables 2-1a and 2-1b summarize, for liquid and solid sample matrices respectively, the general chemistry parameters analyzed by the MSE Lab, including the reference analytical methods.

EPA methods (EPA, 1993) are used for most analyses not associated with drinking water. Some of these EPA methods are also used for drinking water analyses. However, certain types of drinking water analyses require the use of methods specified in Standard Methods for the Examination of Water and Wastewater (APAA, 1995) rather than the corresponding EPA methods. Such analyses are indicated in Table 2-1a by the presence of an entry in the column "Drinking Water Method."

Any modifications to these methods are addressed in the applicable SOPs. More detailed information on general chemistry QA/QC requirements are provided in Appendix C. Quality assurance/QC requirements specific to the ion chromatograph (IC) are shown in Appendix C, Table 3.

### 2.7.2 Metals Analyses

The MSE Lab analyzes samples for numerous metals using several instruments listed below.

- Inductively coupled plasma - atomic emission spectrometer (ICP-AES) for routine analyses of numerous metals, excluding mercury (Hg).
- Inductively coupled plasma - mass spectrometer (ICP-MS) for the routine analysis of trace metals.
- Cold vapor atomic absorption spectrophotometer (CVAAS) for Hg analyses.

Each instrument has its own specific QA/QC requirements. Additionally, these requirements vary according to the regulatory auspices under which particular analyses are being performed, including:

- EPA Contract Laboratory Program (CLP) Statement of Work (SOW) for Multi-Media, Multi-Concentration Inorganic Analysis (ILM05.4) (EPA, 2006);
- EPA Drinking Water Methods (EPA, 1994; EPA, 1999; EPA, 2001a; and EPA, 2001b).
- EPA Office of Solid Waste SW846 Test Methods for Evaluating Solid Waste, Physical/Chemical Methods (EPA, 1983; EPA, 1986; EPA, 1990; EPA, 1991; EPA, 1997; and EPA, 2001).

Thus, for the combinations of the three instruments and three regulatory methods listed above, there are a total of nine sets of QA/QC requirements, detailed in Appendices D, Tables 1 through 9. Table 2-2 provides a directory of these tables.

Many of the QA/QC criteria for a particular instrument vary depending on the analytical method, particularly for blanks (see Appendix D).

### 2.7.3 Bacteriological Analyses

The MSE Lab performs bacteriological analyses for total, E. Coli, and fecal coliforms according to the following methods (APHA, 1995).

- Standard Method 9223B: Presence/Absence Method

- EPA 1603: E. Coli
- Standard Method 9223-Colilert: E. Coli
- Standard Method 5210B-5 Day Biochemical Oxygen Demand (BOD) Test
- Standard Method 9222D:  Fecal Coliform by Membrane Filtration

The associated QA/QC requirements are shown in Appendix E.

***Table 2-1a. Methods for wet chemistry parameters (aqueous).***

| Parameter | Method |
|---|---|
| | |
| **Colorimetric** | |
| Ammonia | EPA 350.2 |
| Chlorine | EPA 330.5/SM 4500-Cl-G |
| Chromium +6 | SM3500-Cr B/SW846 7196A |
| Chemical oxygen demand (COD) | EPA 410.2 |
| Total Cyanide (TC) | EPA 335.2/SM4500-CN E |
| Cyanide weak acid dissociable (WAD) | EPA 335.2/SM4500-CN E |
| Cyanide - Amenible | SM4500-CN G |
| Iron Speciation | SM 3500-Fe D |
| Nitrate/Nitrite | EPA 353.3/SM 4500-NO3 E/EPA 300.0 |
| Nitrite | EPA 354.1/SM 4500-NO3 E/EPA 300.0 |
| Phosphorus – Ortho | EPA 365.3/SM 4500-P E/EPA 300.0 |
| Phosphorus – Total | EPA 365.3 |
| Total Kjeldahl Nitrogen | EPA 351.3 |
| Turbidity | EPA 180.1 |
| **Electrochemical** | |
| Conductivity | EPA 120.1/SM 2510 B |
| pH | EPA 150.1 |
| **Gravimetric** | |
| Sulfide - Acid Volatile | EPA 821/R-91-100 |
| Total Dissolved Solids (TDS) | EPA 160.1/SM 2540C |
| Total Suspended Solids (TSS) | EPA 160.2 |
| Total Volatile Solids (TVS) | EPA 160.4 |
| **Titrimetric** | |
| Acidity | EPA 305.1 |
| Alkalinity | EPA 310.1 |
| Hardness | EPA 130.2 |
| Sulfide | EPA 376.1/SM 4500-$S^{2-}$ F |
| **Ion Chromatography** | |
| Bromide | EPA 300.0 |
| Chloride | EPA 300.0 |
| Fluoride | EPA 300.0 |
| Nitrate | EPA 300.0 |
| Nitrite | EPA 300.0 |
| Sulfate | EPA 300.0 |

*Determination of Acid Volatile Sulfides and Simultaneously Extractable Metals in Sediment, EPA Research Laboratory, April 1991.

***Table 2-1b. Methods for soil, lime, and compost parameters (solids).***

| Parameter | Analysis Method |
|---|---|
| **Acid-Base Accounting** | |
| Acid-Base Accounting | FOB EPA-600/2-78/054 Method 3.2.3 |
| Neutralization Potential | FOB EPA-600/2-78/054 Method 3.2.3 |
| Pyritic Sulfur (nitric acid ($HNO_3$) Extractable) | FOB EPA-600/2-78/054 Method 3.2.6 |
| Water Soluble Sulfur | FOB EPA-600/2-78/054 Method 3.2.6 |
| Sulfate (hydrochloric acid (HCl) Extractable) | FOB EPA-600/2-78/054 Method 3.2.6 |
| Total Sulfur | FOB EPA-600/2-78/054 Method 3.2.6 |
| **Physical Parameters** | |
| Bulk Density | TMECC03.01C/Globe2002/ASTM D2937 |
| Percent Coarse Material | ASTM 421 |
| Texture (Sand, Silt, Clay) | M-ASTM D2487/USDA HB #60 - Texture Classification/SPW S14.10 |
| Particle Size/Grain Size Analysis | M-ASTM D422 |
| **Soil Characterization** | |
| Ammonia | ASA 33-3.2/E351.3 |
| Carbon:Nitrogen (C:N) Ratio | TMECC 05.02-A/EPA 351.3 |
| Calcium Carbonate Equivalent | ASTM C25-99/USDA HB #60 23C |
| Electrical Conductivity | ASA 10-2.3.1& 10-3.3/SPW S2.30 |
| Kjeldahl Nitrogen | TMECC 04.02/EPA 351.3/SPW S8.10 |
| Lime Requirement (SMP Buffer) | FOB EPA/600/2-78/054 3.2.10/SPW S2.50 |
| Loss on Ignition | FOB EPA/600/2-78/054 3.2.14.5/TMECC 05.07/SPW S9.20 |
| Percent Moisture | ASTM D2216/SW846/APHA 2540G |
| Percent Saturation | ASA 10-2.3/USDA HB #60 27A/SPW S1.00 |
| 1:1 pH (slurry) and 1:5 | ASA 10-2.3.2/SW846 9045D |
| pH (saturation extract) | ASA 10-2.3.1& 10-3.2/SPW S1.10 |
| Organic Carbon Content (TOC, Organic Matter) | ASA 29-3.5.2/FOB600/2-78-054/SPW S9.10 |
| **Extractable Constituents** | |
| Available Nitrogen | ASA 33-8.3 |
| Available Phosphorus | ASA 24-5.4.1 |
| Available Potassium | ASA 13-3.3.1 |
| Cation Exchange Capacity | SW846 9081/SPW S10.10, S10.20 |
| Anions by IC (1:10) | EPA 300.0/SPW S1.40, S1.70, S1.80 |
| diethylenetriaminepentaacetic acid (DTPA) Extraction | ASA 3-5.2/SPW S6.10 |
| Saturated Paste Extraction | ASA 10-2.3.1 |
| Sodium Absorption Ratio | EPA-600/2-78/054 3.2.19 |
| Soluble Salts (calcium, magnesium, sodium, potassium) | ASA 10-2.3 & 10-3.4/SPW S4.33 |
| Total Metals Digestion | EPA/ASTM/SPW/SW846, various methods |

**USDA HB #60** - USDA, 1954, USDA Agriculture Handbook No. 60, Diagnosis and Improvement of Saline and Alkali Soils, February 1954.
**ASA** - ASA, 1982a, Methods of Soil Analysis, Part 1: Physical and Mineralogical Properties, American Society of Agronomy, Inc., Second Edition, 1982.
**ASA** - ASA, 1982b, Methods of Soil Analysis, Part 2: Chemical and Microbiological Properties, American Society of Agronomy, Inc., Second Edition, 1982.
**ASTM** - ASTM, 2003, ASTM Method E882 - 03 Standard Guide for Accountability and Quality Control in the Chemical Analysis Laboratory, 2003.
**FOB** - EPA, 1983, EPA 600/4-79-020, Field and Laboratory Methods Applicable to Overburdens & Minesoils, March 1978.
**SW846** - EPA, 1986, EPA 530/SW-846, Test Methods for Evaluating Solid Waste: Physical/Chemical Methods 3rd ed., November 1995.
**SPW** - Soil, Plant, and Water Reference Methods for the Western Region, 2nd ed., WCC-103 Publication, WREP-125, 2nd Edition, 2003.
**APHA** - APHA, 1998, Standard Methods for the Examination of Water and Wastewater, 20th Edition, 1998.

***Table 2-2. Summary of MSE Lab instrument capabilities and methods.***

| Instrument / Model | Method | QA/QC Table |
|---|---|---|
| **ICP-AES**<br>ARL 3560 with Autosampler | EPA 200.7 CLP-M | D-1 |
| | EPA 200.7 (Drinking Water) | D-5 |
| | SW-846 6010C | D-9 |
| **ICP-MS**<br>Perkin Elmer Elan DRC II with Auto Sampler | EPA 200.8 CLP-M | D-4 |
| | EPA 200.8 (Drinking Water) | D-8 |
| | SW-846 6020A | D-12 |
| **CVAAS**<br>CETAC M6100 QuickTrace Mercury Analyzer with Auto Sampler | EPA 245.1 CLP-M | D-3 |
| | EPA 245.1 (Drinking Water) | D-7 |
| | Modified SW-846 7470A/7471B | D-11 |
| | ASTM D3223 | |
| **IC Dionex**<br>ICS 2500 with Autosampler | EPA 300.0 | App. C, Table 2 |
| LECO Sulfur Analyzer; S144-DR | EPA 600/2-78-054 | See method |

# 3. SAMPLE RECEIVING, DOCUMENTATION, AND REPORTING

## 3.1 OVERVIEW

The sample receiving, documentation, and reporting functions are managed by the MSE Lab's Production Manager. The objectives of these activities are to:

- ensure that samples are received at the laboratory in acceptable condition and notify clients if otherwise;
- assign a unique identifier to each sample container so that its progress through the MSE Lab can be tracked;
- schedule and assign sample analyses to appropriate MSE Lab personnel, ensuring that work is completed within client timeframes and that all samples are analyzed within required holding times; and
- ensure that samples are archived and/or disposed of as appropriate once analyses are completed.

## 3.2 SAMPLE COLLECTION

Samples must adhere to requirements for container, preservation, and holding times described in Table 3-1. Consult the SOP, EPA SW846 Manual on Test Methods for Evaluating Solid Waste, the Federal Register on EPA Test Methods Determining Contaminants in Municipal and Industrial Wastes, Standard Methods, or other appropriate documentation for specific instructions on sample collection.

## 3.3 SAMPLE CONTAINERS

Most sampling containers are supplied to the client by the laboratory. Contact the laboratory for the proper container material and size for a specific analysis or project. If the samples are collected and stored for transport in inappropriate types of containers, the MSE Lab may not be able to accurately quantify the amount of the desired analytes, in which case re-sampling may be required.

## 3.4 PRESERVATION METHODS

Samples should be preserved according to the type of matrix, analysis required, and project-specific data objectives. If samples are not properly preserved, the analytical results may be inaccurate due to loss by volatilization and/or degradation. The MSE Lab provides containers with appropriate preservatives. Table 3-1 describes method-appropriate preservation requirements.

## 3.5 TRANSPORTATION

Samples should be transported to the MSE Lab by the quickest means possible.

## 3.6 HAND DELIVERY

Hand delivery of samples is the preferred method of delivery for security reasons. A chain-of-custody (COC) form must accompany the transfer of the sample with the identification information if results will potentially be used as evidentiary. The field sampler is responsible for the proper packaging and dispatch of samples he/she takes, including sample preservation and completion of all necessary shipping documentation.

## 3.7 SHIPPED SAMPLES

A sealed container should be used to ship samples to the MSE Lab via FedEx, USPS, or UPS (or other common carrier). Samples within these containers should also be properly sealed, identified, and accompanied by a COC or test request form.

## 3.8 SAMPLE ACCEPTABILITY/RECEIVING

Incoming samples are delivered to the Sample Receiving Area. Upon receipt, all shipping containers and security seals are inspected for physical damage and evidence of tampering. Aqueous samples are also checked to verify they were received at acceptable temperatures (4°C $\pm$ 2°C). Finally, the client's identification of each sample is verified against COC documents (discussed in detail in Section 4).

Sample inspection is documented on the Sample Receipt Checklist (Figure 3-1). All discrepancies and notes, including conversations with clients, are recorded on this checklist. Samples received after holding times have expired, in inappropriate containers, or lacking appropriate preservatives are generally not accepted for testing. Occasionally, a client will request that a sample be analyzed even if it is received in an unacceptable condition. In such a case, testing will only proceed after the client has provided written or verbal acknowledgement of the unacceptable status of the sample and authorized continued testing. A comment or explanation of possible negative effects of unacceptable sample submission is noted in the report.

## 3.9 SAMPLE NUMBERING

All samples are assigned an MSE Lab number by the Laboratory Information Management System (LIMS). The MSE Lab numbers follow the following format.

YYMMNNN-XXX(A-Z)

Where: YY = year
MM = month
NNN = sequential number designating the order in which the sample group is logged in during the year and month indicated by the first for digits, starting with 001
(A-Z) = single letter corresponding to each sample fraction submitted, for a group of analyses, for each location
XXX = sequential number assigned to individual samples.

The first seven digits of the laboratory sample number comprise the laboratory work order number for a group of samples.

## 3.10 ASSIGNMENT OF SAMPLE ANALYSIS

After each sample is assigned an MSE Lab number, pertinent information is recorded in the LIMS. The LIMS is a Microsoft Access-based database that is used to facilitate sample tracking and reporting. Each sample is logged into the LIMS, which contains the following information:

- client work order number;
- laboratory sample number (see Section 3.3 for details);
- client information;
- sample description (including analyses requested, matrix and bottle type);
- field identification number;

- collection date and time;
- analysis requested;
- date received;
- date reported; and
- date of sample disposal or return to client.

A sample summary is generated from the LIMS and is used to facilitate tracking of all samples from receipt by the MSE Lab through analysis and reporting and ending with disposal or return to the client.

After LIMS data entry, the MSE Lab number is placed on each sample container, the sample pH is checked, and the samples are placed in a 4 °C ± 2 °C cooler in the secured storage area referred to as the Sample Bank. The Sample Bank is locked and/or monitored to prevent unauthorized entry. An important feature is the Sample Bank Logbook, which documents receipt and removal of all samples from the Sample Bank (Figure 3-2).

After delivery to the Sample Bank, the samples are ready for further preparation or analysis.

All additional documentation associated with the samples is initiated at this time, including:

- Work Order Summary Form (Figure 3-3), describing the types of analyses to be performed;
- any time-sensitive requirements (e.g., holding times or client deadlines);
- Computerized Laboratory Tracking Report. This report includes client and/or project name, sample description, work order number, requested analyses, and due dates, and is updated as needed; and separate project or client file for all related data.

## 3.11 SAMPLE STORAGE AND TRACKING

Samples delivered to the MSE Lab are received by the Sample Receiving Area personnel. At this time, verification of sample integrity includes the following activities:

- assessment of custody seal presence/absence, location, and signature;
- temperature of sample containers upon receipt;
- COC documents properly completed;
- sample containers checked for integrity;
- appropriate containers (size/type) are received for the requested analysis;
- sample container labels and/or tags agree with COC information; and
- assessment of proper sample preservation.

No preservative assessment is made for samples being subcontracted to Antek Labs for analysis. Volatile Organic Compound vials are checked to ensure the vials contain zero headspace.

Facility security and access is important in maintaining the integrity of samples received at the MSE Lab. Access to the laboratory is limited to authorized personnel except for the Sample Receiving Area that is staffed during business hours.

Samples are stored appropriate to the analysis requested until they undergo analysis. The MSE Lab stores samples in one of many refrigerators, freezers, or other storage locations, depending on the type of analysis and the matrix of the sample. The temperature of each sample storage unit used at the MSE Lab is monitored daily during operations, and this information is recorded in a logbook for future reference.

Samples are retained for up to 6 weeks and then disposed (unless arrangements have been made in advance). All samples are either returned to the client or disposed of in accordance with approved disposal practices.

## 3.12 SAMPLE PREPARATION

Many samples received by the MSE Lab require additional preparation prior to instrumental analysis, including addition of acids, extractions, etc. This work is performed by the Sample Preparation Technician based on the documentation supplied by the Production Manager. The Sample Preparation Technician removes the samples in question from the Sample Bank (documented in the Sample Bank Logbook), prepares the samples as required, then relinquishes the prepared samples and any unused sample portions back to the Sample Bank. Sample preparation data is entered into the LIMS and documented in the Sample Preparation Logbook.

## 3.13 SAMPLE ANALYSIS

The appropriate analyst(s) removes prepared samples from the Sample Bank and performs the required analyses. After analysis, unused sample portions are returned to the Sample Bank, and all analysis records are given to the Sample Delivery Group (SDG) for processing and reporting.

## 3.14 WASTE DISPOSAL

All samples received at the MSE Lab remain in the ownership of the submitting party. Unless analysis of samples demonstrates hazardous/regulated levels of contaminants, liquid samples are routinely disposed of by disposal in the sanitary sewer after adjustment to a neutral pH. Solid samples are disposed of using the solid waste sanitation services. Samples demonstrated to be inappropriate (hazardous) to be disposed of by routine means are returned to the client for disposal/treatment at the original sampling location or retained in a manner consistent with acid, solvent, or other hazardous materials storage and disposal activities within the MSE Lab.

All mineral acids, solvents, and other hazardous materials used in the daily operation of the MSE Lab are collected in designated areas until sufficient material is collected for cost-effective disposal at a licensed disposal facility.

## 3.15 DATA REPORTING

After reviewing generated data, the analyst or technician enters it into the LIMS. After additional QA review, the Production Manager or designee prints a draft data report. The required format and contents of data reports is generally client specified at the time of initial sample delivery.

The Laboratory Manager, QA Officer, or their designee reviews the draft data report, makes corrections, requests reanalyses as necessary, and authorizes (in writing) release of the final report to the client.

The bacteriological analyses have their own specific data reporting requirements, which are detailed in Bacterial Procedures used for Examination of Potable Water Supplies (MSE, 2012).

## 3.16 NOTIFICATION OF MAXIMUM CONTAMINANT LEVEL VIOLATIONS

The MSE Lab is responsible for reporting public water supply sample results that exceed the MCL for a given analyte listed in Table 3-2 to the Montana Department of Environmental Quality. When an MCL is found exceeded in any public water supply sample, the analyst shall notify the Laboratory QA Manager, QA Officer, or Production Manager who will notify the DEQ and the water supplier as required by the Administrative Rules of Montana. If analysis of a drinking water sample indicates coliform or E. coli results in excess of MCLs, the client and the Montana DEQ shall be notified within 24 hours of the end of the analytical run. For other results exceeding the MCL, notification shall take place within 24 hours or the next business day after validation of the sample result. Notification can be made by emailing results to dpws@mt.gov.

## 3.17 DATA ARCHIVAL

When the report is sent to the client, the Production Manager or designee assembles all associated data for filing, including:

- COC forms;
- analysis request forms;
- any field data sheets supplied by client;
- work order summary forms;
- sample preparation data;
- analysis data; and
- all data reports submitted to client at any stage, including the final report.

The file documents are kept in filing cabinets in the sample receiving office. Private client files are archived for a minimum of 5 years unless prior arrangements are made between the MSE Lab and the client. Drinking water files for chemical analyses are archived for 12 years. Drinking water files for bacteriological analyses are archived for 5 years. Electronic copies of reports are kept indefinitely. The client water system will be notified before disposing of records so they may request copies if needed. This includes all raw data, calculations, and quality control data. In the event that the MSE Lab transfers ownership or goes out of business, the records will be transferred to the new owners or made available to the client, respectively.

## 3.18 LABORATORY NOTEBOOKS

Several different types of laboratory notebooks are maintained at the MSE Lab. These include, but are not limited to, the following:

- Project notebooks
- Instrument/equipment troubleshooting and maintenance notebooks
- Standard preparation logbooks
- Balance calibration logbooks
- Pipette calibration logbooks
- General logbooks

The general purpose of maintaining each of these laboratory notebooks is to record the details that may be important in repeating a procedure, interpreting data, or documenting certain operations. Entries in the

notebook may include data such as standard and sample weights, pH measurements, instrument operating parameters, preparation of calibration curves, analytical run sequences, calculations, recording of instrument operating parameters, sample condition, etc. The analyst's notebook is particularly important in documenting analyses that deviate in any way from routine or standard practices. It can also be an important training record. All pertinent data is to be recorded directly in the notebook. Some notebooks or data records are maintained in electronic format (i.e., LIMS, spreadsheets, or databases). Electronic data records are duplicated using hardcopy and/or alternate electronic backup techniques. It is the responsibility of each analyst to maintain a laboratory notebook according to Good Laboratory Practices (GLP) Guidelines. All laboratory notebooks are assigned a unique logbook control number and are assigned to an analyst or supervisor. Laboratory notebooks remain the responsibility of the lab staff member to whom they are assigned until they are formally transferred to another staff member, are completely filled and returned to the QA Officer for archiving, or the staff member resigns and returns them as a part of the check-out process. Lab staff members, other than the individual to whom the notebook is issued to, may make entries in the notebook as long as those entries are consistent with the intended use of the notebook and such entries are initialed. Supervisors review and approve all laboratory notebook entries. Changes may not be made to the notebook format without the approval of the QA Officer and Lab Manager.

## MSE-TA Analytical Laboratory

### Sample Receipt Checklist

Client Name

Date and Time Received:

Work Order Number **0610153** RcptNo: **1**

Received by

COC_ID: CoolerID:

Checklist completed by _____ Signature _____ Date

Reviewed by _____ Initials _____ Date

Matrix: Carrier name:

| | | | |
|---|---|---|---|
| Shipping container/cooler in good condition? | Yes ☑ | No ☐ | Not Present ☐ |
| Custody seals intact on shippping container/cooler? | Yes ☑ | No ☐ | Not Present ☐ |
| Custody seals intact on sample bottles? | Yes ☑ | No ☐ | Not Present ☐ |
| Chain of custody present? | Yes ☐ | No ☑ | |
| Chain of custody signed when relinquished and received? | Yes ☐ | No ☑ | |
| Chain of custody agrees with sample labels? | Yes ☐ | No ☑ | |
| Samples in proper container/bottle? | Yes ☐ | No ☑ | |
| Sample containers intact? | Yes ☐ | No ☑ | |
| Sufficient sample volume for indicated test? | Yes ☐ | No ☑ | |
| All samples received within holding time? | Yes ☐ | No ☑ | |
| Container/Temp Blank temperature in compliance? | Yes ☐ | No ☑ | |
| Water - VOA vials have zero headspace? | No VOA vials submitted ☐ | Yes ☑ | No ☐ |
| Water - pH acceptable upon receipt? | Yes ☐ | No ☐ | Blank ☐ |

Adjusted? _____ Checked by _____

Any No and/or NA (not applicable) response must be detailed in the comments section be

Client contacted _____ Date contacted: _____ Person contacted _____

Contacted by: _____ Regarding: _____

Comments:

Corrective Action _____

Page 1 of 1

*Figure 3-1. Sample Receipt Checklist.*

| WO # | Laboratory Numbers | Client Name | Analysis/ Extraction/ or Batch # | Log Out | | Log Return | |
|---|---|---|---|---|---|---|---|
| | | | | Date/Initial | Date/Initial | Date/Initial | Date/Initial |
| | | | | | | | |
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*Figure 3-2. Sample Bank Logbook.*

# WorkOrder 0609054

ERA WS122

*20-Oct-06 3:00 pm*

**COMMENTS:** HAROLD/KITRINA/CHUCK/SARA ****DUE 10/16/06****

| WORKORDER/SAMPLE | Collected | Type | Customer/Client Sample ID |
|---|---|---|---|
| **0609054-001A** | 9/5/2006 | **Aqueous** | MSE Analytical Laboratory WS122-C/N 591 |
| Residue, Dissolved | | | |
| **0609054-002A** | 9/5/2006 | **Aqueous** | MSE Analytical Laboratory WS122 C/N 555 |
| Calcium, Hardness (As CaC, Magnesium, Sodium | | | |
| **0609054-003A** | 9/5/2006 | **Aqueous** | MSE Analytical Laboratory WS122 C/N 590 |
| Beryllium, Beryllium, Selenium, Iron, Molybdenum | | | |

| | Date/Time | Location | | Date/Time | Location |
|---|---|---|---|---|---|
| **Sample Relinquished by:** | | | **Received By:** | | |
| **Prep Relinquished by:** | | | **Prep Received by:** | | |
| **Relinquished by:** | | | **Received By:** | | |
| **Relinquished by:** | | | **Received By:** | | |
| **Logged By:** | | | **Reviewed:** | | |

*MSE Analytical Laboratory* *Page 1 of 1*

***Figure 3-3. Work Order Summary.***

***Table 3-1. Sample preservation and holding times.***

| Parameter | Preservative | Holding Time | Minimum Sample Size and Container |
|---|---|---|---|
| **Metals** | | | |
| Total Metals except Chromium $(Cr)^{+6}$, Hg | 4 °C, pH<2 w/$HNO_3$ | 6 months | 200-mL high-density polyethylene (HDPE) or glass |
| Total $Cr^{+6}$ | 4 °C | 24 hours | 100-mL HDPE or glass |
| Total Hg | 4 °C, pH<2 w/$HNO_3$ | 28 days | 100-mL HDPE or glass |
| Dissolved Metals except $Cr^{+6}$ | Filter 0.45µ, 4 °C, pH<2 w/$HNO_3$ | 6 months | 200-mL HDPE or glass |
| Dissolved Chromium$^{+6}$ | Filter 0.45µ, 4 °C | 24 hours | 100-mL HDPE or glass |
| Dissolved Hg | Filter 0.45µ, 4 °C, pH<2 w/$HNO_3$ | 28 days | 100-mL HDPE or glass |
| **General Chemistry** | | | |
| Acidity | 4 °C | 14 days | 100-mL HDPE or glass |
| Alkalinity | 4 °C | 14 days | 100-mL HDPE or glass |
| COD | 4 °C, ph<2 w/sulfuric acid ($H_2$ $SO_4$) | 28 days | 100-mL HDPE or glass |
| Chloride | 4 °C | 28 days | 100-mL HDPE or glass |
| Chlorine, Residual | None | Analyze immediately | 100-mL HDPE or glass |
| Chlorophyll (solid) | -10 °C – 30 mL methanol | 24 hours | wrap in foil |
| Chlorophyll (water) | 4 °C – filter and analyze immediately | 24 hours | 1 L amber |
| Conductivity | 4 °C | 28 days | 100-mL HDPE or glass |
| Cyanide | 4 °C, pH >12 w/sodium hydroxide (NaOH) | 14 days | 100-mL HDPE or glass |
| Fluoride | None | 28 days | 100-mL HDPE or glass |
| Hardness, Calc. (Ca and Mg) | 4 °C | 6 months | 100-mL HDPE or glass |
| Hardness, Titration | 4 °C | 28 days | 100-mL HDPE or glass |
| Nitrate (SM 4500-NO3-E) | 4 °C, pH <2 w/sul$H_2SO_4$ | 28 days | 100-mL HDPE or glass |
| Nitrite (SM 4500-NO3-E) | 4 °C, pH <2 w/$H_2SO_4$ | 28 days | 100-mL HDPE or glass |
| Nitrate and Nitrite (SM-4500-NO3-E) | 4 °C, pH <2 w/$H_2SO_4$ | 28 days | 100-mL HDPE or glass |
| Nitrate (E300.0) | 4 °C | 48 hours | 250-mL HDPE |
| Nitrite (E300.0) | 4 °C | 48 hours | 250-mL HDPE |
| Nitrate and Nitrite (E300) | 4 °C | 48 hours | 250-mL HDPE |
| Nitrogen, Ammonia | 4 °C, pH <2 w/$H_2SO_4$ | 28 days | 100-mL HDPE or glass |
| Nitrogen, Kjeldahl | 4 °C, pH <2 w/$H_2SO_4$ | 28 days | 100-mL HDPE or glass |
| pH | 4 °C | Analyze immediately | 100-mL HDPE or glass |
| Phosphate, Ortho | Filter 0.45µ, 4 °C | 48 hours | 100-mL HDPE or glass |
| Phosphorus, Total | 4 °C, pH <2 w/$H_2SO_4$ | 28 days | 100-mL HDPE or glass |
| TDS | 4 °C | 7 days | 200-mL HDPE or glass |
| TSS | 4 °C | 7 days | 200-mL HDPE or glass |
| Solids, Total (TS) | 4 °C | 7 days | 200-mL HDPE or glass |
| TVS | 4 °C | 7 days | |
| Sulfate | 4 °C | 28 days | 100-mL HDPE or glass |
| Sulfide | 4 °C, 2 mL zinc acetate, pH >9 w/NaOH | 7 days | 100-mL HDPE or glass |
| Turbidity (NTU) | 4 °C | 48 hours | 100-mL HDPE or glass |
| **Organics** | | | |
| Trihalomethane | 3 mg sodium thiosulfate | 14 days | 2-40-mL volatile organic analysis (VOA) |
| Volatile Organic Compounds (VOC) – Chlorinated | 25 mg ascorbic acid, pH<2 w/HCl | 14 days | 2-40-mL VOA |
| VOC – Nonchlorinated | pH<2 w/HCl | 14 days | 2-40-mL VOA |
| **Bacteriological** | | | |
| BOD | 4 °C | 48 hours | 1 L |
| Coliform – Fecal | Sodium thiosulfate, 4 °C | 30 hours | 250 mL |
| Coliform – Total | Sodium thiosulfate, 4 °C | 30 hours | 125 mL |
| E. Coli | Sodium thiosulfate, 4 °C | 6 hours | 125 mL |

***Table 3-2. MCLs and Secondary Standards for contaminants.***

| **Contaminant** | **MCL (mg/L)** |
|---|---|
| Antimony | 0.006 |
| Arsenic | 0.01 |
| Barium | 2 |
| Beryllium | 0.004 |
| Cadmium | 0.002 |
| Chromium (total) | 0.1 |
| Copper | 1.3 |
| Cyanide (as free cyanide) | 0.2 |
| Fluoride | 4 |
| Lead | 0.015 |
| Mercury (inorganic) | 0.002 |
| Nitrate (as N) | 10 |
| Nitrite (as N) | 1 |
| Selenium | 0.05 |
| Thallium | 0.002 |
| Uranium | 0.03 |
| *action level | |
| | |
| **Contaminant** | **Secondary Standard** |
| Aluminum | 0.05 to 0.2 mg/L |
| Chloride | 250 mg/L |
| Copper | 1.0 mg/L |
| Corrosivity | noncorrosive |
| Fluoride | 2.0 mg/L |
| Iron | 0.3 mg/L |
| Manganese | 0.05 mg/L |
| pH | 6.5 to 8.5 |
| Silver | 0.1 mg/L |
| Sulfate | 250 mg/L |
| Total Dissolved Solids | 500 mg/L |
| Zinc | 5 mg/L |

# 4. CHAIN-OF-CUSTODY PROCEDURES

## 4.1 OVERVIEW

The generation of traceable, defensible data requires strict observance of COC procedures, both in the field during sample collection and in the MSE Lab. The objective of COC documentation is to provide an historical record of the location and possession of a sample from the time of collection until disposal. Additionally, the COC provides a record of the analyses requested by the client.

## 4.2 COC FORM

The COC form used by the MSE Lab is shown in Figure 4-1. It is also common practice for clients to provide their own COC forms; this is acceptable provided they include the necessary information. The form is initiated at the time the client transfers custody of the associated samples to the MSE Lab.

The MSE Lab staff member who accepts the incoming sample shipment signs and dates the COC record to acknowledge receipt of the samples. The condition of the samples upon receipt is also noted on the COC. Once this initial sample transfer process is complete, the MSE Lab maintains custody traceability with the COC form and other internal documentation.

## 4.3 TRANSFER OF SAMPLES WITHIN THE MSE LAB

As discussed in Section 3.4, samples are placed in the secured Sample Bank once initial inspection and confirmation has been accomplished. Once samples are placed in the Sample Bank, transfers of samples to and from the Sample Bank (e.g., for preparation, analysis, disposal) are documented in the Sample Bank Logbook. This book documents the dates and times at which samples were retrieved from and delivered back to the Sample Bank, by whom, and for what purpose.

## 4.4 TRANSFER OF SAMPLES OUTSIDE THE MSE LAB

Occasionally, it is necessary to send samples outside the MSE Lab when the MSE Lab does not perform the requested analyses. Subcontracting of laboratory services is done only with the knowledge and approval of the client. Prior to transfer of samples, sample receiving procedures outlined in Section 3.2 are followed (i.e., sample inspection and log in). Next, samples are packed in appropriate shipping containers, including a COC form transferring custody to the party accepting shipment. Shipping containers are secured by placing custody seals across potential openings so that any tampering during transit is evident. A copy of the COC form is retained for the MSE Lab's records. Only laboratories certified to analyze the parameters being subcontracted may be used.

## 4.5 DISCREPANCIES IN COC RECORDS

It is critical that any discrepancies involving COC records be noted and resolved as soon as possible before the beginning of any analytical activities. This is accomplished by comparing the samples received against the listings on the COC form immediately upon sample arrival and notifying the submitter of any deviations. If the problem cannot be resolved among the individuals involved, the Laboratory Manager or QA Officer will be contacted. The involved parties then develop a mutually acceptable course of resolution.

The same approach applies to discrepancies concerning transfers of samples within the MSE Lab, the difference being that these transfers are documented within the Sample Bank Logbook.

## 4.6 DISPUTE RESOLUTION

During the normal course of business, clients may make inquiries or complaints either verbally or in writing. No complaint or inquiry will be taken lightly or dismissed without due consideration. The MSE Lab will respond to all inquiries or complaints within an appropriate timeframe. All inquiries or complaints should be resolved at the lowest management level possible. If unable to resolve complaints through discussion and negotiation, the following dispute resolution procedure shall be followed:

- initiate CAR and include all resolution attempts and corrective actions.
- the Laboratory Manager is notified of the details of the complaint/dispute either verbally or in writing, including a definition of the complaint as well as supporting arguments for both the MSE Lab and the client; and
- within 10 business days, the dispute will be resolved by reprepping or reanalyzing samples as necessary or invoice adjustment as appropriate.

FORM MSE-169
(Rev. 09/08)

MSE Technology Applications, Inc.
Laboratory Services

# CHAIN OF CUSTODY

MSE
WORK
ORDER #

Company Name:
Address:
City: State: Zip:
Phone:
Fax:

Project Manager:
Project Name and Number:
Email Address:
Purchase Order #:
Sampler Name and Phone #:

ANALYSIS REQUESTED

REMARKS

Turnaround Time (TAT) / Reporting

___Standard
___Next Day*
___2nd Day*
___Other*
_____

*All rush order requests must have prior approval

___Phone
___Mail
___Fax
___Email

| SAMPLE ID | LAB ID | DATE | TIME |
|---|---|---|---|
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |

| RELINQUISHED BY (Signature) | DATE | TIME | RECEIVED BY (Signature) | DATE | TIME |
|---|---|---|---|---|---|
| PRINTED NAME | COMPANY | | PRINTED NAME | COMPANY | |
| RELINQUISHED BY (Signature) | DATE | TIME | RECEIVED BY (Signature) | DATE | TIME |
| PRINTED NAME | COMPANY | | PRINTED NAME | COMPANY | |
| RELINQUISHED BY (Signature) | DATE | TIME | RECEIVED BY (Signature) | DATE | TIME |
| PRINTED NAME | COMPANY | | PRINTED NAME | COMPANY | |

Inspection Checklist

| | | |
|---|---|---|
| Received Intact? | Y | N |
| Labels & Chains Agree? | Y | N |
| Containers Sealed? | Y | N |
| Cooler Sealed? | Y | N |

Delivery Method: _____
Temperature (°C): _____
Preservative: _____
Date & Time: _____
Inspected By: _____

MSE LABORATORY SERVICES
200 Technology Way, P.O. Box 4078
Butte, MT 59701
PH: (406) 494-7334 / FAX: (406) 494-7128

*Figure 4-1. Chain-of-Custody form.*

# 5. INSTRUMENT CALIBRATION

## 5.1 OVERVIEW

Accurate calibration of analytical instrumentation is critical to the production of defensible, high-quality data. This generally requires the use of calibration standards that are traceable to the NIST, EPA, ASTM, or some other commonly recognized source. Brief summaries of calibration activities associated with specific MSE Lab analytical instrumentation are provided in the following paragraphs.

## 5.2 ANALYTICAL BALANCES

Analytical balances are checked each business day they are used with a set of Class S weights in a manner that checks each balance's typical operating range. Results of all checks are recorded in balance-specific logbooks. If any reading for a given check does not fall within the balance's tolerance limits, the balance is retared/recalibrated as appropriate, and the check is repeated. If the reading still does not fall within the balance’s tolerance limits, the failure is reported to the Chief Analytical Chemist, who coordinates repair/recalibration of the unit with the QA Officer.

The balance must also be retared/recalibrated whenever it is moved, subjected to rough handling, or cleaned.

The balances also are certified (and recalibrated as appropriate) by an outside contractor annually using NIST-traceable reference standards.

## 5.3 TEMPERATURE CONTROL DEVICES

Temperatures are monitored and recorded for all MSE Lab temperature regulating devices including ovens, incubators, and refrigerators (when in use). Logbooks are maintained containing recorded temperatures, identification and location of equipment, acceptance criteria, and the initials of the technician who performed the check. Thermometers are checked annually using NIST-traceable references and the results contained in a binder labeled "Thermometer and Balance Calibration Reports."

Correction factors are applied to thermometer readings as necessary, depending on the calibration check results, as well as the required accuracy of the temperature check in question.

## 5.4 WATER PURIFICATION SYSTEM

The MSE Lab deionized (DI) water system is designed to meet ASTM Type 2 requirements to ensure that no contamination issues arise. These requirements stipulate that the water supply meet a specific conductivity criterion of less than 1 micro-mhos per centimeter (µmhos/cm). The DI water supply is checked daily, and results are documented in a bound logbook labeled "Daily Water Log (L-GP-DI)."

## 5.5 GENERAL CHEMISTRY INSTRUMENTS

The MSE Lab performs many types of general chemistry analyses, each involving its own specialized instrumentation. The instruments range from fairly complex chemical analyzers, to hand-held meters, to simple titration vessels; consequently, calibration requirements vary greatly depending on the nature and complexity of the instrument in question. Calibration requirements for each analysis are summarized in Appendix C, Table 1 (general chemistry), and Appendix C, Table 2 (IC only). The IC has a preventative maintenance schedule, and maintenance activities are recorded in the appropriate maintenance logbook.

## 5.6 METALS INSTRUMENTS

Instruments used for metals analyses (ICP-AES, ICP-MS, and CVAAS) are calibrated at least daily on operating days or every 12 operating hours, whichever is more frequent. Detailed calibration requirements for each instrument are presented in Appendices C, Tables 1 through 12. Each instrument has a preventative maintenance schedule, and maintenance activities are recorded in the appropriate maintenance logbook.

## 5.7 BACTERIOLOGICAL INSTRUMENTS

The primary instruments associated with bacteriological analyses include autoclaves, incubators, and balances. Additionally, beakers, flasks, petri dishes, and sample containers must be frequently checked for sterility to ensure that sample cultures are not affected by contamination. Quality control and calibration requirements are summarized in Appendix E.

## 5.8 SERVICES AND SUPPLIES

The MSE Lab purchases services and supplies from reputable vendors and ensures that supplies meet or exceed standards established in the analytical methods.

## 5.9 PREVENTATIVE MAINTENANCE

Preventative maintenance is a crucial element of the MSE Lab QA Program. Qualified in-house personnel maintain instruments, spectrometers, and analytical balances. All instruments are operated and maintained according to the instrument operating manuals. All routine and special maintenance activities pertaining to the instruments are recorded in the Instrument Troubleshooting Logbook and/or the Instrument Maintenance Logbook. The Instrument Troubleshooting Logbook and/or the Instrument Maintenance Logbook contain extensive information about the instruments used at the laboratory.

When an instrument is acquired at the MSE Lab, the following information is noted in an Instrument Troubleshooting Logbook and Instrument Maintenance Logbook specifically associated with the new equipment:

- the serial number of the equipment;
- date the equipment was received;
- date the equipment was placed into service;
- condition of equipment when received (new, used, reconditioned); and
- prior history of equipment damage, malfunctions, modification, or repair (if known).

Preventative maintenance schedules, frequencies, etc., are available for each instrument, and a copy is to be placed in the Instrument Troubleshooting Logbook and Instrument Maintenance Logbook (some analysts choose to combine these logbooks). They may also be found in the various SOPs for operation and maintenance of each instrument or maintenance manuals provided with the equipment at the time of purchase. Responsibility for ensuring that routine maintenance is performed lies with the Laboratory Manager. The Laboratory Manager may perform the maintenance, assign the maintenance task to a qualified analyst, or acquire on-site manufacturer repair.

When performing corrective maintenance on an instrument, additional information about the problem (attempted repairs, etc.) is also recorded in the Instrument Troubleshooting Log. Typical logbook entries include:

- details and symptoms of the problem;
- repairs and/or maintenance performed;
- description and/or part number of replaced parts;
- source(s) of the replaced parts; and/or
- analyst's initials and date.

## 5.10 GENERAL CRITERIA FOR ALL CALIBRATION MODELS

Following is a list of general criteria for all calibration models.

- Midpoints cannot be dropped to meet criteria.
- Points can be reanalyzed; however, original run must be discarded.
- Analyzing additional standards and discarding some to achieve a better correlation coefficient is prohibited.
- Narrowing of curve on either end is allowed.
- Initial calibration is performed with a minimum of three concentrations of standards for linear curves, except for ICP-AES analysis, which is calibrated with a blank and one standard.
- Initial calibration is performed with a minimum of five concentrations of standards for nonlinear curves.

# 6. DATA QUALITY/LABORATORY EVALUATION

## 6.1 OVERVIEW

Performance evaluations of the MSE Lab, in terms of both data quality and analytical procedures, are accomplished by:

- internal data review;
- data validation procedures;
- internal and external performance audits; and
- analysis of blind performance samples obtained from National Environmental Laboratory Accreditation Conference (NELAC) certified vendors twice per calendar year.

These performance evaluation activities are discussed further in Sections 6.2, 6.3, 6.4, and 6.5.

## 6.2 INTERNAL DATA REVIEW

All analytical data generated by the MSE Lab undergo a formal review prior to their submittal to clients. There are some differences in the review procedures used for general chemistry data versus metals data, as discussed in the following subsections.

### 6.2.1 General Chemistry Data

General chemistry data are commonly recorded in bound logbooks at the time of analysis. In general, separate logbooks are maintained for each type of analysis performed. The analyst or technician performs the initial data review. Each logbook page is further reviewed by a qualified member of the MSE Lab staff (see Section 1.6.4). These results are reviewed for completeness and also for compliance with the QA Requirements/Control Limits for general chemistry methods (Appendix C, Table 1) and/or IC (Appendix C, Table 2). After the analytical report is completed, a final review process occurs, wherein the data are reviewed for transcription errors and for other more qualitative QA issues.

While each general chemistry analysis is recorded in a bound logbook, several analysis types involving automated methods also generate individual data printouts for each instrument run. These data are reviewed in the same manner as the general chemistry logbooks, with each data printout being dated and initialed by the reviewer, along with any QA issues requiring action.

### 6.2.2 Metals Data

Metals data are produced by the ICP-AES, ICP-MS, and CVAAS. Each instrument generates a separate data printout for each instrument run. The first level of review is performed by the instrument operator, who checks results for compliance with the metals QA Requirements/Control Limits in Section 2.3.2. Any problems are reviewed with the Production Manager or Chief Analytical Chemist to determine whether reanalysis is necessary. The data printouts are then assembled in a draft data report.

Next, the draft report is reviewed by the QA Officer, Laboratory Manager, and/or a qualified staff member (different from the person preparing the report). To facilitate consistency in review procedures, each instrument run is stamped with a review form, which then is completed by the reviewer. The run is reviewed in its entirety for compliance with the metals QA objectives and for any other suspect behavior. Any QA issues are noted below this stamped form. Figure 6-1 shows the stamped data review form for each of the metals analysis instruments.

### 6.2.3 Bacteriological Data

Bacteriological data are reviewed by the MSE Lab's Certified Bacteriological Analyst prior to release.

If results for a public (defined as more than 10 hookups) water supply are found unsatisfactory (above the MCL), the Montana Water Quality Bureau and the public water supply are notified immediately by phone or email. In such cases, additional sampling will be required, as discussed in Bacterial Procedures used for Examination of Potable Water Supplies (MSE, 2012).

## 6.3 CORRECTIVE ACTION

Corrective Action is a function of the laboratory as a whole and is dependent on the nature of the problem. In general, correction action may take several forms. The QA Officer, Laboratory Manager, Laboratory Analyst or external customer may also initiate correction actions. Corrective Actions are actions taken in response to nonconformance reports issued during audits, technical reviews, and findings from a performance evaluation failure or data review finding. All conditions that adversely affect data quality must be identified and corrected. To the extent possible, samples shall be reported only if all QC measures are acceptable. If a QC measure is found to be out of control, and the data is to be reported, all samples associated with the failed QC shall be reported with an appropriate data qualifier. If a potential problem develops that cannot be solved directly by the responsible analyst, the Laboratory Manager or QA Officer may examine and pursue alternative solutions. An assessment will be made to ascertain if contact with the client is necessary.

Corrective Actions are maintained in the LIMS and in the Corrective Action Logbook, which is maintained in the Sample Receiving Area to track data quality problems. The Corrective Action Logbook is a chronological listing of all data quality problems found during review processes that necessitated corrective action. All CARs implemented will be documented in this logbook.

Each entry includes:

- laboratory sample numbers affected by the problem;
- description of the result(s) necessitating the reanalyses;
- original sample analysis date(s);
- corrective action taken;
- date(s) of sample reanalyses; and
- evaluation of whether the corrective action taken yielded satisfactory results.

A sample page from the Corrective Action Logbook is shown in Figure 6-2.

## 6.4 INTERNAL AND EXTERNAL PERFORMANCE AUDITS

The MSE Lab QA Officer conducts an internal Technical Systems Audit (TSA) once per year. Specific issues are addressed as indicated by problems and concerns noted during the preceding year. A formal report/memorandum identifying any deficiencies is issued and distributed to MSE Lab personnel within 2 weeks from the conclusion of the TSA. A follow-up check is performed 1 month afterward to ensure that report findings have been satisfactorily addressed.

Additionally, audits are conducted by the State of Montana's Laboratory Certification Division and also by several of the MSE Lab's primary clients on an as-needed basis. These typically involve:

- advance review of laboratory records by the auditing entity;
- on-site inspection of 1 to 2 days duration;
- preparation of written audit findings/observations report by the auditing entity; and,
- written response by the MSE Lab describing corrective actions to be taken to address any findings/observations.

## 6.5 PERFORMANCE EVALUTION (PE)

As part of the MSE Lab's Montana Drinking Water Certification, blind samples from a NIST/NVLAP certified vendor are analyzed twice per year for Water Supply (WS) and once per year for Water Pollution (WP) and/or Discharge Monitoring Report-Quality Assurance (DMRQA). The analyses include all certified analytical parameters. The vendor then provides results for each analysis type showing the known values, reported laboratory results, and acceptance ranges. These results are also sent to the State certifying agency. Any unacceptable results are reviewed for indications of problems related to analytical standards, instrument performance, and/or other MSE Lab issues until the problem is identified and corrected. Blind studies may be initiated by the lab to verify performance.

**ICP-MS - E200.8**

DATE _____
INITIALS _____
WO # _____
BATCH # _____
IPC _____
QCS _____
CCB/LRB _____
LFB/LFM/DUP _____
SER. DIL. _____
A/R _____
IS _____
RSD _____
COMMENTS:

**CVAAS - CLP**

DATE _____
INITIALS _____
WO # _____
BATCH # _____
CAL-R _____
ICV/CCV _____
CRQL _____
ICB/CCB/PB _____
LCS/S/D _____
SER. DIL. _____
A/R _____
COMMENTS:

**ICP-AES - SW6010**

DATE _____
INITIALS _____
WO # _____
BATCH # _____
ICV/CCV _____
LLCCV _____
ICB/CCB/PB _____
ICSA/ICSAB _____
LCS/MS/MSD _____
SER. DIL. _____
A/R _____
COMMENTS:

**AUTO ANALYZER**

DATE _____
INITIALS _____
WO # _____
IPC _____
QCS _____
CCB/LRB _____
LFB/LFM/DUP _____
COMMENTS:

**IC-E300.0**

DATE _____
INITIALS _____
WO # _____
IPC _____
QCS _____
CCB/LRB _____
LFB/LFM/DUP _____
BLANKS _____
COMMENTS:

***Figure 6-1. Samples of Data Review Forms.***

**MSE Lab Services**

**Corrective Action Report**

Date Initiated: Corrective Action Report ID:

Initiated By: Department:

**Corrective Action Description**

CAR Summary:

Description of Nonconformance:

Description of Corrective Action:

Performed By: Completion Date:

**Client Notification**

Client Notification Required: Notified By:

Comment:

**Quality Assurance Review**

Nonconformance Type:

Further Action required by QA:

**Approval and Closure**

Technical Director / Deputy Tech. Dir.: Close Date:

QA Officer Approval: QA Date:

Last Updated BY Updated: Reported:

*Figure 6-2. Corrective Action Report.*

# 7. LABORATORY STANDARDS AND GENERAL PRACTICES

## 7.1 OVERVIEW

The following sections describe the analytical standards used by the MSE Lab for sample analyses, as well as general laboratory practices that are necessary for the generation of repeatable, high-quality data.

## 7.2 ANALYTICAL STANDARDS

The MSE Lab analytical standards can be divided into:

- general chemistry standards;
- metals standards; and
- bacteriological standards.

Each type of standard is discussed in the following paragraphs.

### 7.2.1 General Chemistry Standards

For general chemistry analyses, the MSE Lab uses numerous inorganic standards that are typically certified to contain a known concentration of a particular ion or to have an otherwise known quantitative chemical or physical property. These standards are either purchased from laboratory suppliers or prepared in the MSE Lab from known standards.

Like the multi-element standards, purchased traceable standards that have a certificate of analysis (COA) are identified by sequential numbers prefaced by a "Q." They are logged in a bound logbook (referred to as the "Q" Book), along with the date of receipt, plus the expiration date. The certification sheets are stored in a designated loose-leaf binder. The "Q" book is labeled "L-GP-QBook," and the COA binders are labeled "Multi-Element COAs." Standards prepared in the laboratory are logged in a bound logbook (labeled “L-WC-CALSTD”) along with the date of preparation, preparer’s initials, and the expiration date.

### 7.2.2 Metals Standards

Stock standard solutions are procured from laboratory suppliers and consist of a known concentration(s) of a single or multi-element in a known medium (usually water plus a small amount of acid). These solutions are usually certified contaminant-free (i.e., contaminant concentrations are below stated threshold values) and are typically certified for 18 months.

All standards are logged in a bound logbook (L-GP-QBOOK), and the original certification sheet is kept in a designated loose-leaf binder (Multi-Element COAs). Each container is assigned a unique, sequential identifying MSE Lab number. The documentation also includes a record of the date the standard was received plus a certification expiration date.

### 7.2.3 Bacteriological Standards

Standards used for bacteriological analyses include a variety of media used to facilitate growth of bacterial cultures. These are certified free of impurities by the manufacturers and undergo continued testing for sterility following their use in bacterial analysis preparations. These media are detailed in Bacterial Procedures used for Examination of Potable Water Supplies (MSE, 2012). All media information is recorded in a bound logbook labeled "L-BT-MEDIA."

## 7.3 GENERAL LABORATORY PRACTICES

### 7.3.1 Preparation of Glassware

The generation of high-quality data requires the use of laboratory glassware that is free of contamination. Glassware is prepared in accordance with SOP No. GP001, "Laboratory Glassware Cleaning Procedures."

### 7.3.2 Laboratory Housekeeping

Each technician/analyst is responsible for keeping his/her immediate work area clean. When sample analyses are complete, the responsible analyst returns the unused portion of the samples to the Sample Bank, replaces reagents and chemicals in the appropriate chemical storage area, and places dirty glassware in the glassware cleaning area. Additionally, key individuals are assigned the responsibility of MSE Lab maintenance of primary work areas (e.g., chemical storage, laboratory equipment storage, inorganic preparation area, Sample Bank, and Sample Receiving Area).

# 8. COMPUTER HARDWARE AND SOFTWARE

## 8.1 COMPUTER HARDWARE AND SOFTWARE POLICY

With computers playing a critical and important role in the daily operations of the MSE Lab, it is essential that the LIMS, LAN, and data systems be adequately and appropriately documented. The MSE Lab is kept up to date with documented operating manuals and instrument maintenance contracts (where applicable). Additionally, the MSE Lab keeps written, hardbound maintenance logbooks for all analytical instruments. Software is purchased with full licenses for all hardware units installed with the software. All computer hardware and software is kept up to date to meet all applicable MSE Engineering standards.

## 8.2 LOCAL AREA NETWORK

The MSE LAN is maintained by the MSE Network Administrator. The LAN is used primarily for data communication and reporting. All LAN issues must be addressed through the MSE Network Administrator.

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Soil, Plant, and Water Reference Methods for the Western Region, 2nd ed., WCC-103 Publication, WREP-125, 2nd Edition, 2003.

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# APPENDIX A

SOP Master List

SUBJECT: Table of Contents


| DOCUMENT NUMBER | TITLE | DATE |
|---|---|---|
| AM001 | Specific Gravity of Water and Brines | 11-08-06 |
| AM002 | Soil and Waste pH (1:5 pH – SW846 9045D) | 04-01-09 |
| AM003 | pH and Electrical Conductivity on Saturation Paste Extracts | 11-08-06 |
| AM004 | Saturation Percentage from Oven-Drying | 11-08-06 |
| AM005 | Sodium Adsorption Ratio | 11-08-06 |
| AM006 | Mercury in Soils, Sludges, and Sediment by CVAAS, EPA CLP SOW ILM05.3/(Draft)ILM06.X | 10-08-07 |
| AM007 | Aqueous Mercury by CVAAS, EPA CLP SOW ILM05.3/ (Draft)ILM06.X | 10-08-07 |
| AM008 | Determination of Percent Solids, SM 2540 G | 10-17-06 |
| AM012 | Leco Sulfur Analyzer Operation and Maintenance | 04-01-09 |
| AM013A | Determination of Arsenic III and Arsenic V in Water Samples - Flicklin | 10-17-06 |
| AM013B | Determination of Iron II and Iron III in Water Samples, SM3500-Fe D. Phenanthroline Method | 10-17-06 |
| AM015 | Acid-Based Accounting (ABA) | 05-19-10 |
| AM016 | Modified Particle Size Analysis by Hydrometer/USDA Texture Classification | 04-01-09 |
| AM017A | Calcium Carbonate Equivalency for Lime Samples | 10-17-06 |
| AM017B | Calcium Carbonate Equivalence of Soils | 04-01-09 |
| AM020 | Total Organic Carbon – Walkley Black Procedure | 04-01-09 |
| AM021 | Total Organic Carbon – Loss on Ignition Procedure Soils | 04-01-09 |
| AM021B | Determination of Percent Moisture on Compost Samples | 04-01-09 |
| AM022 | Dry and Wet Sieve Analysis – ASTM C602-90 | 10-17-06 |
| AM024 | Determination of Inorganic Anions by Ion Chromatography: EPA Method 300.1 | 01-21-11 |
| AM030 | Ignitability of Solids | 11-08-06 |
| AM031 | Limestone Analysis (Mod. ASTM C25 and Mod. ASTM C1301) | 08-20-07 |
| AM032 | EPA Draft Method for Determination of Acid Volatile Sulfide in Sediment – 821/R-91-100 | 04-01-09 |
| AM033 | Garden Soil Analysis – Mehlich 3 Extraction & Analysis | 01-21-11 |


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TITLE: Laboratory Services Standard Operating Procedures – Bacteriological Analysis

SUBJECT: Table of Contents


| DOCUMENT NUMBER | TITLE | DATE |
|---|---|---|
| BCT001 | Enzyme Substrate Coliform Test (Colitag/Colilert/Colisure) - A9223 B. | 01-21-11 |
| BCT002 | *E Coli* in Water by Membrane Filtration – E1603 | 08-20-07 |
| BCT003 | Fecal Coliform Membrane Filtration Method – A9222 D. | 01-21-11 |
| BCT004 | Total and E. Coli by Quantitray – A9223B. Enzyme Substrate Test | 01-21-11 |


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TITLE: Laboratory Services Standard Operating Procedures– General Practice

SUBJECT: Table of Contents


| DOCUMENT NUMBER | TITLE | DATE |
|---|---|---|
| SOP001 | Guidelines for Preparation, Review, Approval, and Management of SOPs | 10-17-06 |
| GP001 | Labware Cleaning Procedures | 08-20-07 |
| GP002 | Quality Control Charts and Determination of Quality Control Criteria for Precision and Accuracy | 10-17-06 |
| GP004 | Analytical Balance Calibration | 03-19-08 |
| GP005 | Procedure for Sample Handling | 08-20-07 |
| GP007 | Raw Data Review, Summary and Reporting | 08-20-07 |
| GP011 | Receipt and Log-In of QA/QC Standards (Liquid and Solid) | 08-20-07 |
| GP012 | Refrigerator Temperature Checks | 02-24-09 |
| GP013 | Gravity Convection Ovens Temperature Check | 02-24-09 |
| GP014 | Deionized Water System Daily Check | 03-19-08 |
| GP018 | Operation, Calibration, and Maintenance of Mechanical Pipettes | 10-08-07 |
| GP025 | Corrective Action Plan | 10-17-06 |
| GP028 | Sample Kit Preparation | 08-20-07 |
| GP029 | Analyst Training Including MDL Studies, Initial Demonstration of Capabilities, and Performance Evaluation Studies | 08-20-07 |
| GP030 | Identification System for Laboratory Documentation | 08-20-07 |
| GP031 | Statistical Identification of Outliers (Extreme Studentizd Deviate) Grubbs' Test | 08-20-07 |
| GP032 | Procedure for Calibration of Laboratory Thermometers | 03-19-08 |


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| DOCUMENT NUMBER | TITLE | DATE |
|---|---|---|
| IM001 | Operation and Maintenance of the ARL 3560 ICP-AES | 02-24-09 |
| IM006 | Inductively Coupled Plasma-Atomic Emission (ICP-AES) Method for Analysis of Water and Wastes (EPA Method 200.7) | 08-20-07 |
| IM007 | Inductively Coupled Plasma-Atomic Emission (ICP-AES) Method for Analysis of Trace Elements in Solution (SW846 Method 6010C) | 08-20-07 |
| IM008 | ICP-AES EPA CLP ILM05.3/Draft ILM06.X | 10-08-07 |
| IM010 | Hardness by Calculation | 11-08-06 |
| IM013 | Operation and Maintenance of the Varian Spectra A-400 Zeeman GFAAS (Graphite Furnace Atomic Absorption Spectrometer) | 03-18-08 |
| IM016 | Centrifuge Use | 03-18-08 |
| IM020 | Operation and Maintenance of the Cetac M6000A CVAA Mercury Analyzer | 02-24-09 |
| IM020A | Determination of Mercury in Water by CVAAS (Cold Vapor Atomic Absorption Spectrometry) – EPA Method 245.1 | 05-27-11 |
| IM020B | Mercury in Aqueous and Sediment Samples by CVAAS, SW846 Methods 7470A and 7471B | 10-08-07 |
| IM022 | Determination of Trace Elements by GFAAS: EPA Method 200.9 | 10-17-06 |
| IM023 | Determination of Trace Elements by GFAAS: SW846 Method 7010 | 03-18-08 |
| IM026 | Standard Operating Procedure for the Operation and Maintenance of the PerkinElmer ELAN 6100 DRC II ICP-MS | 05-21-10 |
| IM026A | Determination of Trace Elements by ICP-MS: EPA Method 200.8 | 05-21-10 |
| IM026B | Determination of Trace Elements by ICP-MS: SW846 Method 6020A | 05-21-10 |
| IM026C | Determination of Trace Elements by ICP-MS: ILM05.3/ILM05.4 | 08-16-10 |
| IM027 | Dionex ICS2500 Ion Chromatograph Operation and Maintenance | 10-08-07 |


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SUBJECT: Table of Contents


| DOCUMENT NUMBER | TITLE | DATE |
|---|---|---|
| SP001A | Total Metals–Water Samples (CLP) ICP-AES, ICP-MS, GFAAS (USEPA ILM05.4) | 03-12-09 |
| SP001B | Modified EPA Method 200.2 (Hot Block Procedure) | 08-20-07 |
| SP001C | Acid Digestion of Waters for Total Recoverable Metals or Dissolved Metals (Modified Method 3005A) | 08-20-07 |
| SP001C-2 | Acid Digestion of Waters for Total Recoverable Metals or Dissolved Metals (Modified (2) Method 3005A) for Analysis by ICP-AES, ICP-MS, and GFAAS | 08-20-07 |
| SP001D | Total Metals Water Samples (Method 3010A) (ICP-AES) | 08-20-07 |
| SP001E | Digestion of Soil Samples for Total Metals (Modified Method 3050B) (ICP-AES) | 03-12-09 |
| SP001F | Digestion of Water Samples for Total Metals (Method 3020A) (GFAAS/ICPMS) | 08-20-07 |
| SP001H | Total Recoverable Metals Modified for TCLP (Modified Method 3005A) | 03-12-09 |
| SP001J | Acid Digestion of Biological Tissues for Total Recoverable Elements (Modified Method 200.3) | 08-20-07 |
| SP001K | Digestion of Soil Samples for Total Metals (Modified Method 3050B) (ICPMS/GFAAS) | 03-12-09 |
| SP002 | Lithium Tetraborate Fusion and Fusion Prep | 03-12-09 |
| SP003B | DTPA Extraction of Soils SP004 Toxicity Characteristic Leach Procedure (SW846 1311-TCLP) | 08-20-07 |
| SP008 | Toxicity Characteristic Leach Procedure (SW846 1311-TCLP) | 08-20-07 |
| SP015 | Cation-Exchange Capacity of Soils (Sodium Acetate) Method 9081 | 03-12-09 |
| SP016B | Available Phosphorus (Sodium Bicarbonate Extraction (Method 24-5.4.2) | 03-18-08 |
| SP017 | Available Potassium (Ammonium Acetate Extraction) (Method 13-3.3) | 03-18-08 |
| SP018 | 1:1 Ph | 03-18-08 |
| SP018A | Soil pH and Lime Requirement 1:1 Ph | 03-18-08 |
| SP018B | Calcium Chloride 1:1 pH ASA Method 12-2.6.5 | 03-18-08 |
| SP020 | Saturated Paste Extract U.S.D.A. Method 10-2.3 | 03-12-09 |
| SP021 | Available Nitrogen (KCl Extraction) (Method 33-3.2) | 03-18-08 |


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TITLE: Laboratory Services Standard Operating Procedures – Wet Chemistry

SUBJECT: Table of Contents


| DOCUMENT NUMBER | TITLE | DATE |
|---|---|---|
| WC001 | Acidity (Titrimetric) EPA Method 305.1 / Standard Method 2310-B | 10-08-07 |
| WC002 | Alkalinity—Forms (Titrimetric) – SM 2320 B | 05-09-07 |
| WC003 | Corrosivity (Langelier's Saturation Index) | 08-20-07 |
| WC005 | Chloride, Automated Ferricyanide, E325.2 and SM4500-Cl E | 10-08-07 |
| WC006 | Chlorine Free and Total Residual SM4500-Cl G | 10-08-07 |
| WC008A | Total Cyanide Distillation EPA 335.2/Standard Methods 4500-C | 10-08-07 |
| WC008B | Weak Acid Dissociable Cyanide Distillation | 10-08-07 |
| WC009 | Fluoride: SM 4500-F C. Ion Selective Electrode Method | 03-13-08 |
| WC010 | Total Hardness Titration EPA Method 130.2 | 05-09-07 |
| WC013 | Nitrogen, Ammonia—EPA 350.2—Colorimetric Method | 08-16-10 |
| WC014 | Total Kjeldahl Nitrogen, EPA/351.3 | 05-09-07 |
| WC015 | Nitrate/Nitrite – Cadmium Reduction Method – A4500-$NO_3^-$ E.* | 01-21-11 |
| WC017 | Oxidation-Reduction Potential-SM 2580 B | 10-17-06 |
| WC018 | Operation and Maintenance of the Orion pH Meter and Electrode | 08-20-07 |
| WC019B | Ortho-Phosphate E365.3 | 05-06-09 |
| WC019C | Phosphorus, Total – by SM-4500-PE, EPA-365.3 | 08-16-10 |
| WC021 | Total Dissolved Solids (Residue, Filterable) EPA Method 160.1/ Standard Method 2540-C | 05-06-09 |
| WC022 | Total Suspended Solids (Residue, Non-Filterable) EPA Method 160.2/ Standard Method 2540-D | 10-17-06 |
| WC023 | Total Solids Standard Method 2540B | 03-13-08 |
| WC024 | Total Volatile Solids (Residue, Volatile) EPA Method 160.4/ Standards Method 2540-E | 10-17-06 |
| WC026 | Sulfate (Colorimetric, Automated, Methlythymol Blue) EPA 375.2 | Deleted |
| WC028 | Operation and Maintenance of the HF Micro 100 Turbidimeter (EPA Method 180.1) | 05-06-09 |
| WC032 | Total Cyanide in Water and Solids Method 335.2 | 10-08-07 |
| WC033 | The Determination of Chemical Oxygen Demand by Semi-Automated Colorimetry and Manual Method (Method 410.4) | 10-08-07 |
| WC034 | Sulfide in Water–Standard Method 4500-S2- F- Iodometric Method | 08-16-10 |
| WC035 | Specific Conductance EPA 120.1/Standard Methods 2510-B | 08-20-07 |
| WC037 | 5-Day BOD Test –SM5210 B | 01-21-11 |
| WC038 | Operation and Maintenance of the Alpkem Segmented Flow Auto Analyzer | Deleted |
| WC039 | EPA Method 446.0 Determination of Chlorophyll-a | 01-21-11 |
| WC040 | Determination of Total Persulfate Nitrogen (TPN): SM4500-N-C | 01-21-11 |


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# APPENDIX B

MSE Lab Services Ethics and Data Integrity Agreement

**MSE LAB SERVICES ETHICS AND DATA INTEGRITY AGREEMENT**

I. 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 the *MSE Lab*.

II. I have read the MSE Lab Quality Assurance Plan and understand all aspects of the Plan that affect the work I will be performing at the MSE Lab.

III. I agree that in the performance of my duties at *MSE Lab:*

a. I shall not intentionally report data values that are not the actual values obtained;

b. I shall not perform unwarranted manipulation of data or computer software to misrepresent actual values;

c. I shall not falsify records to meet laboratory and/or method requirements;

d. I shall not intentionally report the dates and times of data analyses that are not the actual dates and times of data analyses; and

e. I shall not intentionally represent another individual's work as my own.

IV. I agree to inform *MSE Lab* of any accidental reporting of nonauthentic data by myself in a timely manner.

V. I agree to inform *MSE Lab* of any accidental or intentional reporting of nonauthentic data by other employees.

VI. I understand that failure to adhere to the conditions outlined in this Ethics and Data Integrity Agreement will result in unpaid suspension or termination of employment per MSE Human Resources Manual, Section 5.1, Employee Discipline.

_____ *(Signature)*

_____ *(Date)*

# APPENDIX C

Wet Chemistry and Ion Chromatography QA/QC Requirements

## APPENDIX C, TABLE 1. QA/QC FOR WET CHEMISTRY PARAMETERS – DRINKING WATER REQUIREMENTS

| Parameter | Method | Calibration Requirements | QCS | LRB | IPC | CCB | RL | LFB | DUP. | LFM |
|---|---|---|---|---|---|---|---|---|---|---|
| **COLORIMETRIC** | | | | | | | | | | |
| **Ammonia** | **EPA 350.2** | Blank + 5 standards | X | X | X | X | X | X | X | X |
| **Chlorine** | **EPA 330.5/SM4500-CL-G** | Blank + 5 standards | X | X | X | X | X | X | X | X |
| **Cyanide - TC** | **EPA 335.2/SM-4500-CN-E** | Blank + 3 standards | X | X | X | X | X | X | X | X |
| **Cyanide - Amen** | **SM-4500-CN-G** | Blank + 3 standards | X | X | X | X | X | X | X | X |
| **Nitrate/Nitrite** | **EPA 353.3/SM4500-NO3-E** | Blank + 5 standards | X | X | X | X | X | X | X | X |
| **Nitrite** | **EPA 354.1/SM4500-NO3-E** | Blank + 4 standards | X | X | X | X | X | X | X | X |
| **Phosphorus - Ortho** | **EPA 365.3/SM4500-P-E/300.0** | Blank + 5 standards | X | X | X | X | X | X | X | X |
| **Phosphorus - Total** | **EPA 365.3** | Blank + 5 standards | X | X | X | X | X | X | X | X |
| **Total Kjeldahl Nitrogen** | **EPA 351.3** | Blank + 5 standards | X | X | X | X | X | X | X | X |
| **Turbidity** | **EPA 180.1** | 3 Standards | | X | X | X | | X | X | X |
| **ELECTROCHEMICAL** | | | | | | | | | | |
| **Conductivity** | **EPA 120.1/2510B** | None | | X | X | X | | X | X | X |
| **pH** | **EPA 150.1** | Check at pH of 4, 7, 10 | | X | X | X | | X | | X |
| **GRAVIMETRIC** | | | | | | | | | | |
| **TDS** | **EPA 160.1** | Check balance | | X | | | | | X | |
| **TSS** | **EPA 160.2** | Check balance | | X | | | | | X | |
| **TVS** | **EPA 160.4** | Check balance | | X | | | | | X | |
| **TITRIMETRIC** | | | | | | | | | | |
| **Acidity** | **EPA 305.1** | 3 blanks | | X | | | | | X | |
| **Alkalinity** | **EPA 310.1** | None | | X | | | | | X | |
| **Hardness** | **EPA 130.2** | None | | X | | | | | X | X |
| **COD** | **EPA 410.2** | 3 Blanks | | X | | | X | X | X | X |
| **Sulfide** | **EPA 376.1** | 3 iodine blanks | | X | | | | | X | X |
| ***Frequency*** | | | START | D | A | B | START | D | C | C |

***LEGEND***

**X** = Done for all analyses of this parameter

***FREQUENCY NOTES***

**START =** At start of instrument/analysis run

**A** = Once every 10 instrument readings, excluding IPC, CCB, and internal instrument electronics checks.

**B** = Same as A; occurs immediately following IPC

**C** = Once per 10 samples or once per batch, whichever is more frequent

## APPENDIX C, TABLE 2. QA/QC FOR WET CHEMISTRY PARAMETERS – EPA SW-846 REQUIREMENTS

| Parameter | Method | Calibration Requirements | ICV | ICB | PB | CCV | CCB | RL | LCS | DUP. | SPIKE |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **COLORIMETRIC** | | | | | | | | | | | |
| **Ammonia** | **EPA 350.2** | Blank + 5 standards | X | X | X | X | X | X | X | X | X |
| **Chlorine** | **EPA 330.5** | Blank + 5 standards | X | X | X | X | X | X | X | X | X |
| **Chromium +6** | **SM 3500-Cr B** | Blank + 5 standards | X | X | X | X | X | X | X | X | X |
| **COD** | **EPA 410.2** | 3 blanks | | | X | | | X | X | X | X |
| **Cyanide - TC** | **EPA 335.2** | Blank + 3 standards | X | X | X | X | X | X | X | X | X |
| **Cyanide WAD** | **SM 4500I** | Blank + 3 standards | X | X | X | X | X | X | X | X | X |
| **Cyanide AMEN** | **SM 4500G** | Blank + 3 standards | X | X | X | X | X | X | X | X | X |
| **Iron Speciation** | **SM 3500-Fe B** | Blank + 6 standards | X | X | X | X | X | X | X | X | X |
| **Nitrate/Nitrite** | **EPA 353.3** | Blank + 5 standards | X | X | X | X | X | X | X | X | X |
| **Nitrite** | **EPA 354.1** | Blank + 4 standards | X | X | X | X | X | X | X | X | X |
| **Phosphorus - Ortho** | **EPA 365.3** | Blank + 5 standards | X | X | X | X | X | X | X | X | X |
| **Phosphorus - Total** | **EPA 365.3** | Blank + 5 standards | X | X | X | X | X | X | X | X | X |
| **Total Kjeldahl Nitrogen** | **EPA 351.3** | Blank + 5 standards | X | X | X | X | X | X | X | X | X |
| **Turbidity** | **EPA 180.1** | 3 Standards | | | X | X | X | | X | X | |
| **ELECTROCHEMICAL** | | | | | | | | | | | |
| **Conductivity** | **EPA 120.1** | None | | | X | X | X | | X | X | |
| **pH** | **EPA 150.1** | Check at pH of 4, 7, 10 | | | X | X | X | | | X | |
| **GRAVIMETRIC** | | | | | | | | | | | |
| **Sulfide - Acid Volatile** | **EPA 821/R-91-100** | Check balance | | | X | | | | X | X | X |
| **TDS** | **EPA 160.1** | Check balance | | | X | | | | X | X | |
| **TSS** | **EPA 160.2** | Check balance | | | X | | | | X | X | |
| **TVS** | **EPA 160.4** | Check balance | | | X | | | | X | X | |
| **TITRIMETRIC** | | | | | | | | | | | |
| **Acidity** | **EPA 305.1** | 3 blanks | | | X | | | | X | X | |
| **Alkalinity** | **EPA 310.1** | None | | | X | | | | X | X | |
| **Hardness** | **EPA 130.2** | None | | | X | | | | X | X | X |
| **Sulfide** | **EPA 376.1** | 3 iodine blanks | | | X | | | | X | X | X |
| ***Frequency*** | | | START | START | C | A | B | START | C | C | C |

***LEGEND***

X = Done for all analyses of this parameter

***FREQUENCY NOTES***

**START** = At start of instrument/analysis run

**A** = Once every 10 instrument readings, excluding CCV, CCB, and internal instrument electronics checks

**B** = Same as A; occurs immediately following CCV/IPC

**C** = once per 20 samples ; or once per batch, whichever is more frequent

**APPENDIX C, TABLE 3. QA/QC REQUIREMENTS FOR ION CHROMATOGRAPH – METHOD 300.0**

| Parameter (1) | Frequency | Acceptance Criteria | Corrective Action |
|---|---|---|---|
| Laboratory Fortified Blank (LFB) | 1/SDG | 90-110% R | Determine source of problem and correct before continuing with analyses. |
| Laboratory Reagent Blank (LRB) | 1/SDG | <RL | Identify source of contamination and prepare fresh sample aliquots and reanalyze. |
| Laboratory Duplicate Sample (D) | 1/10 samples | ≤ 20% R | Flag/qualify samples as appropriate. |
| Laboratory Fortified Sample Matrix (LFM) | 1/10 samples | 90-110% R (not calc. if spike conc. is <25% of sample conc.)<br>Same concentration as LFB | Flag/qualify samples as appropriate. |
| Quality Control Sample (QCS) | Quarterly | 90-110% R | Determine source of problem and correct before analyzing samples. |
| Instrument Performance Check (IPC) | Initial/Final/ 1/10 samples | 90-110%R | Determine source of problem and correct. Reanalyze IPC. If results still out, recalibrate instrument and rerun all samples since last compliant IPC. |
| Calibration Blank (CB) | After each IPC | <RL | Reanalyze CB. If results still out, determine cause, recalibrate instrument if due to drift, and rerun all samples since last compliant CB. |

INSTRUMENT CALIBRATION REQUIREMENT: Minimum of a blank and five standards.

INITIAL DEMONSTRATION OF CAPABILITIES:
LDR CHECK: Initially, then every 6 months.
QCS: Initially, then quarterly.
MDL: Initially, then every 6 months, also with change in instrument hardware or operating conditions.

NOTES:
SDG = Sample Delivery Group (maximum size = 20 samples).
R denotes recovery, e.g. R of 90% denotes 90% of expected result was obtained.
RL = See Table 3 of SOP #AM024 for reporting limits.

# APPENDIX D

Inorganics, Metals QA/QC Requirements

**APPENDIX D, TABLE 1. QA/QC LIMITS FOR ICP-AES – METHOD 200.7 CLP-M, ILMO5.4**

| Parameter (1) | Frequency | Acceptance Criteria | Corrective Action |
|---|---|---|---|
| Laboratory Control Sample (LCS) | 1/SDG | 80-120% R for water<br>Manufacturer's limits for soil | Redigest/reanalyze all samples associated with LCS. |
| Preparation Blank (PB)<br>Laboratory Reagent Blank (LRB) | 1/SDG | +/- CRQL | If blank > CRQL, redigest/reanalyze all samples associated with PB/LRB, unless sample conc. > 10x blank conc.<br>If blank < -CRQL, redigest/reanalyze all samples < 10X absolute blank value. |
| Laboratory Duplicate Sample (D)<br>Laboratory Replicate Sample (R) | 1/SDG | RPD≤ 20% for sample conc. > 5*CRQL;+/- CRQL for sample conc. < 5*CRQL | Flag/qualify samples as appropriate. |
| Laboratory Matrix Spike (LFM) | 1/SDG | 75-125% R<br>N/A if sample conc. > 4*spike conc. | Flag/qualify samples as appropriate. |
| Instrument Calibration Verification (ICV) | After each calibration | 90-110% R | Recalibrate instrument. |
| Continuing Calibration Verification (CCV) | After ICB, then 1/10 samples | 90-110% R | Recalibrate instrument and rerun all samples since last compliant CCV. |
| Instrument Calibration Blank (ICB) | After each ICV | +/- CRQL | Recalibrate instrument. |
| Continuing Calibration Blank (CCB) | 1/10 samples (after each CCV) | +/- CRQL | Recalibrate instrument and rerun all samples since last compliant CCB. |
| Interference Check Solution A (ICSA) | Beginning and end of run, every 20 samples | +/- CRQL for target analytes | Recalibrate instrument, rerun samples. |
| Interference Check Solution B (ICSAB) | Beginning and end of run, every 20 samples | 80-120% R | Recalibrate instrument and rerun all samples since last compliant interference check. |
| Analytical Spike (A) | 1/SDG | 75-125% R<br>N/A if sample conc. > 4*spike conc. | Flag/qualify samples as appropriate. |
| CRQL Standard | Beginning and end of run | 70-130% R<br>except Sb, Pb, and Tl at 50-150% R.<br>N/A for Al, Ba, Ca, Fe, Mg, Na, K | Used to verify linearity near the CRQL. |
| Serial Dilution (L) | 1/SDG | +/- 10% of original conc.<br>N/A if sample conc. < 50*MDL | Flag/qualify samples as appropriate. |
| INSTRUMENT CALIBRATION REQUIREMENT: Minimum of a blank and one standard. Use 3 integrations for calibration and sample analysis. | | | |

NOTES: (1) Where 2 parameters are listed, the first applies to digested samples, the second to non-digested samples.
SDG = Sample Delivery Group (maximum size = 20 samples).
CRQL = EPA Contract Required Quantitation Limit.
R denotes recovery, e.g. R of 90% denotes 90% of expected result was obtained.

**APPENDIX D, TABLE 2. QA/QC LIMITS FOR CVAAS – METHOD 245.1 SERIES CLP-M, /ILMO5.4**

| Parameter (1) | Frequency | Acceptance Criteria | Corrective Action |
|---|---|---|---|
| Laboratory Control Sample (LCS) | 1/SDG | 80-120% R for water<br>Manufacturer's limits for soil | Redigest/reanalyze all samples associated with LCS. |
| Preparation Blank (PB)<br>Laboratory Reagent Blank (LRB) | 1/SDG | +/- 0.2 μg/L | If blank > CRQL, redigest/reanalyze all samples associated with PB/LRB<br>If blank < -CRQL, redigest/reanalyze all samples. |
| Laboratory Duplicate Sample (D)<br>Laboratory Replicate Sample (S) | 1/SDG | RPD ≤ 20%<br>for sample conc.>1.0 μg/L<br>otherwise +/- 0.2 μg/L | Flag/qualify samples as appropriate. |
| Laboratory Matrix Spike (S) | 1/SDG | 75-125% R<br>N/A if sample conc. > 4*spike conc. | Flag/qualify samples as appropriate. |
| Instrument Calibration Verification (ICV) | After each calibration | 85-115% R | Recalibrate instrument. |
| Continuing Calibration Verification (CCV) | After ICB, then 1/10 samples | 85-115% R | Recalibrate instrument and rerun all samples since last compliant CCV. |
| Instrument Calibration Blank (ICB) | After each ICV | +/- 0.2 μg/L | Recalibrate instrument. |
| Continuing Calibration Blank (CCB) | 1/10 samples (after each CCV) | +/- 0.2 μg/L | Recalibrate instrument and rerun all samples since last compliant CCB. |
| CRQL Standard | 1/SDG | 70-130% R | Used to verify linearity near the CRQL. |
| INSTRUMENT CALIBRATION REQUIREMENT: Minimum of a blank and five standards. | | | |

NOTES: (1) Where 2 parameters are listed, the first applies to digested samples, the second to non-digested samples.

SDG = Sample Delivery Group (maximum size = 20 samples).
CRQL = EPA Contract Required QUANTITATION Limit of 0.2 μg/L (ILMO5.3).
R denotes recovery, e.g. R of 80% denotes 80% of expected result was obtained.

**APPENDIX D, TABLE 3. QA/QC LIMITS FOR ICP-MS – METHOD 200.8 CLP-M, ILMO5.4**

| Parameter (1) | Frequency | Acceptance Criteria | Corrective Action |
|---|---|---|---|
| Internal Standards | Each sample | 60-125%R | Dilute 2X and reanalyze; if still out, flag |
| Laboratory Control Sample (LCS) | 1/SDG | 80-120% R for water<br>Manufacturer's limits for soil | Redigest/reanalyze all samples associated with LCS. |
| Preparation Blank (PB)<br>Laboratory Reagent Blank (LRB) | 1/SDG | +/- CRQL | If blank > CRQL, redigest/reanalyze all associated samples, unless sample conc. > 10x blank.<br>If blank < -CRQL, redigest/reanalyze all samples < 10X absolute value of blank result. |
| Laboratory Duplicate Sample (D) | 1/SDG | RPD ≤ 20% for samp. conc. > 5*CRQL<br>+/- CRQL for sample conc. < 5*CRQL | Flag/qualify samples as appropriate. |
| Laboratory Matrix Spike (S) | 1/SDG | 75-125% R<br>N/A if sample conc. > 4*spike conc. | Flag/qualify samples as appropriate. |
| Instrument Calibration Verification (ICV) | After each calibration | 90-110% R | Recalibrate instrument. |
| Continuing Calibration Verification (CCV) | After ICB, then 1/10 samples | 90-110% R | Recalibrate instrument and rerun all samples since last compliant CCV. |
| Instrument Calibration Blank (ICB) | After each ICV | +/- CRQL | Recalibrate instrument. |
| Continuing Calibration Blank (CCB) | 1/10 samples (after each CCV) | +/- CRQL | Recalibrate instrument and rerun all samples since last compliant CCB. |
| Interference Check Solution A (ICSA) | Beginning and end of run, every 20 samples | Zero +/- 2*CRQL for target analytes w/ CRQL <= 10 µg/L, otherwise +/- 20% | Recalibrate instrument and rerun all samples since last compliant interference check. |
| Interference Check Solution B (ICSB) | Beginning and end of run, every 20 samples | 80-120% R | Recalibrate instrument and rerun all samples since last compliant interference check. |
| Post-Digestion (Analytical) Spike (A) | 1/SDG | 75-125% R<br>N/A if sample conc. > 4*spike conc. | Flag/qualify samples as appropriate. |
| CRQL Standard | Beginning and end of run, plus every 20 samples | 80 - 120% R | Rerun CRI, if still out of compliance, recalibrate and reanalyze since last compliant CRI. |
| Serial Dilution (L) | 1/SDG | +/- 10% of original conc.<br>N/A if sample conc. < 50*MDL | Flag/qualify samples as appropriate. |

INSTRUMENT CALIBRATION REQUIREMENT: Minimum of a blank and one standard. Must analyze tuning solution at least 5 times during precalibration sequence. Daily optimization RSD ≤ 5%. Tuning: Peak width at 5% peak height must be within 0.75 amu.

NOTES: (1) Where 2 parameters are listed, the first applies to digested samples, and the second to non-digested samples.
SDG = Sample Delivery Group (maximum size = 20 samples).
CRQL = EPA Contract Required Quantitation Limit.
R denotes recovery, e.g. R of 90% denotes 90% of expected result was obtained.
Cl- interference corrections must be made on all samples, regardless of HCl addition.

**APPENDIX D, TABLE 4. QA/QC LIMITS FOR ICP-AES – METHOD 200.7**

| Parameter (1) | Frequency | Acceptance Criteria | Corrective Action |
|---|---|---|---|
| Laboratory Fortified Blank (LFB) | 1/SDG | 85-115% R | Determine source of problem and correct before continuing with analyses. |
| Preparation Blank (PB)<br>Laboratory Reagent Blank (LRB) | 1/SDG | +/-RL | Identify source of contamination and prepare fresh sample aliquots and reanalyze. |
| Laboratory Duplicate Sample (D)<br>Laboratory Replicate Sample (R) | 1/10 samples | ≤ 20% RPD for sample conc. > 5*MDL<br>+/- 2*MDL otherwise | Flag/qualify samples as appropriate. |
| Laboratory Fortified Sample Matrix (LFM) | 1/10 samples | 80-120% R<br>Same concentration as for LFB | Flag/qualify samples as appropriate. |
| Instrument Performance Check (IPC) | 1/10 samples | 95-105% R for first IPC<br>90-110% R for subsequent IPCs | Reanalyze IPC. If results still out, determine cause, recalibrate instrument if due to drift, and rerun all samples since last compliant IPC. |
| Quality Control Standard (QCS) | Initially and Quarterly | 95-105% R (mean of triplicate analysis) | Identify and correct source of problem before proceeding with IDC or ongoing analysis. |
| Continuing Calibration Blank (CCB) | After each IPC | +/-RL | Reanalyze CCB. If results still out, determine cause, recalibrate instrument if due to drift, and rerun all samples since last compliant CCB. |
| Spectral Interference Check Solution (ICSA & ICSAB) | Daily | 80-120% R | Update interelement correction factors if necessary. |
| Post-Digestion (Analytical) Spike (A) | 1/10 samples | 75-125% R<br>N/A if sample conc. > 4*spike conc. | Flag/qualify samples as appropriate. |
| Serial Dilution (L) | 1/SDG | +/- 10% of original conc.<br>N/A if sample conc. < 50*MDL | Flag/qualify samples as appropriate. |

INSTRUMENT CALIBRATION REQUIREMENT: Minimum of a blank and one standard.

INITIAL DEMONSTRATION OF CAPABILITIES:
LDR: Initially and annually thereafter.
QCS: Initially, then quarterly or w/new operator
MDL: Initially and annually thereafter, w/new operator, whenever change in instrument hardware or operating conditions.

NOTES: (1) Where 2 parameters are listed, the first applies to digested samples, and the second to non-digested samples.
SDG = Sample Delivery Group (maximum size = 20 samples).
R denotes recovery, e.g. R of 90% denotes 90% of expected result was obtained.

**APPENDIX D, TABLE 5. QA/QC LIMITS FOR CVAAS – METHOD 245.1**

| Parameter (1) | Frequency | Acceptance Criteria | Corrective Action |
|---|---|---|---|
| Laboratory Fortified Blank (LFB) | 1/SDG | 85-115% R<br>(concentration = 1 to 4 μg/L)<br>Same concentration as LFM | Determine source of problem and correct before continuing with analyses. |
| Laboratory Reagent Blank (LRB) | 1/SDG | +/- 0.1 μg/L | Identify source of contamination and prepare fresh sample aliquots and reanalyze. |
| Laboratory Duplicate Sample (D) | 1/10 samples | ≤ 20% for sample conc. > 1.0 μg/L<br>+/- 0.2 μg/L otherwise | Flag/qualify samples as appropriate. |
| Laboratory Fortified Sample Matrix (LFM) | 1/10 samples | 80-120% R<br>Same concentration as LFB & QCS | Flag/qualify samples as appropriate. |
| Quality Control Sample (QCS) | Quarterly | 90-110% R | Determine source of problem and correct before analyzing samples. |
| Instrument Performance Check (IPC) | Initial/Final/<br>1/10 samples | 95-105% R for first IPC<br>90-110%R for subsequent IPCs | Reanalyze IPC. If results still out, determine cause, recalibrate instrument if due to drift, and rerun all samples since last compliant IPC. |
| Continuing Calibration Blank (CCB) | After each IPC | +/- 0.1 μg/L | Reanalyze CCB. If results still out, determine cause, recalibrate instrument if due to drift, and rerun all samples since last compliant CCB. |
| INSTRUMENT CALIBRATION REQUIREMENT: Minimum of a blank and five standards. | | | |
| INITIAL DEMONSTRATION OF CAPABILITIES:<br>LDR: Initially and annually thereafter.<br>QCS: Initially, then quarterly or w/new operator<br>MDL: Initially and annually thereafter, w/new operator, whenever change in instrument hardware or operating conditions. | | | |
| NOTES:<br>SDG = Sample Delivery Group (maximum size = 20 samples).<br>R denotes recovery, e.g. R of 90% denotes 90% of expected result was obtained. | | | |

**APPENDIX D, TABLE 6. QA/QC LIMITS FOR ICP-MS – METHOD 200.8**

| Parameter (1) | Frequency | Acceptance Criteria | Corrective Action |
|---|---|---|---|
| Internal Standards | Each sample | 60-125% R | Recalibrate/reanalyze until acceptable. |
| Laboratory Fortified Blank (LFB) | 1/SDG | 85-115% R | Determine source of problem and correct before continuing with analyses. |
| Preparation Blank (PB)<br>Laboratory Reagent Blank (LRB) | 1/SDG | +/- RL | Identify source of contamination and prepare fresh sample aliquots and reanalyze. |
| Laboratory Duplicate Sample (D)<br>Laboratory Replicate Sample (R) | 1/Batch | ≤ 20% RPD for sample conc. > 5*MDL<br>+/- 2*MDL otherwise | Flag/qualify samples as appropriate. |
| Laboratory Fortified Sample Matrix (LFM) | 1/10 samples | 80-120% R<br>Same concentration as for LFB | Flag/qualify samples as appropriate. |
| Instrument Performance Check (IPC) | 1/10 samples | 95-105% R for first IPC<br>90-110% R for subsequent IPCs | If results fail but are within 85-115%, recalibrate and continue analyses. If results are outside 85-115%, recalibrate and rerun all samples since last good IPC. |
| Quality Control Standard (QCS) | Initially and Quarterly | 90-110% R (mean of triplicate analysis) | Identify and correct source of problem before proceeding with IDC or ongoing analysis. |
| Continuing Calibration Blank (CCB) | 1/10 samples | +/- RL | Reanalyze CCB. If results still out, determine cause, recalibrate instrument if due to drift, and rerun all samples since last compliant CCB. |
| Post-Digestion (Analytical) Spike (A) | 1/SDG | 75-125% R<br>N/A if sample conc. > 4*spike conc. | Flag/qualify samples as appropriate. |
| Serial Dilution (L) | 1/SDG | +/- 10% of original conc.<br>N/A if sample conc. < 50*MDL | Flag/qualify samples as appropriate. |

INSTRUMENT CALIBRATION REQUIREMENT: Minimum of a blank and one standard. Must analyze tuning solution at least 5 times during precalibration sequence.

INITIAL DEMONSTRATION OF CAPABILITIES:
LDR: Initially and annually thereafter.
QCS: Initially, then quarterly or w/new operator.
MDL: Initially and annually thereafter, w/new operator, whenever change in instrument hardware or operating conditions.

NOTES:
SDG = Sample Delivery Group (maximum size = 20 samples).
R denotes recovery, e.g. R of 90% denotes 90% of expected result was obtained.

## APPENDIX D, TABLE 7. QA/QC LIMITS FOR ICP-AES – MOD. SW-846 METHOD 6010C

| Parameter (1) | Frequency | Acceptance Criteria/Comments | Corrective Action |
|---|---|---|---|
| Laboratory Control Sample (LCS) | 1/SDG | 80-120% for water<br>Manufacturer's limits for soil | Rerun once, if still out redigest/reanalyze all samples associated with LCS. |
| Preparation Blank (PB) | 1/SDG | +/- 3*MDL<br><0.1 mg/L Ca, Mg ,Na ,K, Si | Rerun once; if still unacceptable, redigest/reanalyze all samples associated with PB. If all samples in batch are < DQOs, but PB is > limits, data is still considered reportable. |
| Duplicate | 1/SDG may be used instead of MSD | ≤ 20% RPD for sample conc. > 5*MDL<br>+/- 2*MDL otherwise | Flag/qualify samples as appropriate. |
| Laboratory Matrix Spike (MS) | 1/SDG | 75-125% R<br>N/A if sample conc. > 4*spike conc. | Check "A" spike and serial dilution results.<br>Flag/qualify samples as appropriate. |
| Matrix Spike Duplicate (MSD) | | <= 20% RPD; 75- 125% R for spike | Check "A" spike and serial dilution results.<br>Flag/qualify samples as appropriate. |
| Instrument Calibration Verification (ICV) | After each calibration | 90-110% R; RSD<= 5% | Recalibrate instrument. |
| Low Level Continuing Calibration Verification (LLCCV) | Beginning of run | 80-120% R | Recalibrate instrument. |
| Continuing Calibration Verification (CCV) | 1/10 samples | 90-110% R, RSD<=5% | Recalibrate instrument and rerun all samples since last compliant CCV. |
| Continuing Calibration Blank (CCB) | 1/10 samples (after each CCV) | +/- CRQL | Recalibrate instrument and rerun all samples since last compliant CCB. |
| Interference Check Solution A (ICSA) | Beginning and end of run, every 20 samples | Analytes: +/- CRQL<br>Interferents: 80-120 %R | Recalibrate instrument, rerun samples. |
| Interference Check Solution B (ICSAB) | Beginning and end of run, every 20 samples | 80-120% R | Recalibrate instrument and rerun all samples since last compliant interference check. |
| Analytical Spike (A) | 1/SDG | 75-125% R<br>N/A if sample conc. > 4*spike conc. | Investigate/identify source of interference, rerun samples if appropriate. |
| Serial Dilution (L) | 1/SDG | +/- 10% of original conc.<br>N/A if conc. < 10*MDL | Flag/qualify samples as appropriate.<br>Only applies if MS, MSD, A-Spike fail. |
| INSTRUMENT CALIBRATION REQUIREMENT: Minimum of a blank and one standard. | | | |

NOTES: (1) Where 2 parameters are shown, the first applies to digested samples, and the second to non-digested samples.
SDG = Sample Delivery Group (maximum size = 20 samples).
%R denotes percent recovery, e.g. R of 90% denotes 90% of expected result was obtained.
See method specific SOP for summary of Blank Limits
MDL : Determined annually
MDL Check Solution: Analyze after MDL study and quarterly. All analytes must be detected (qualitative test).
LDR: Determined initially, then LDR check verified every 6 months.

**APPENDIX D, TABLE 8. QA/QC LIMITS FOR CVAAS – MOD. SW-846 METHOD 7470A/71B**

| Parameter (1) | Frequency | Acceptance Criteria/Comments | Corrective Action |
|---|---|---|---|
| Laboratory Control Sample (LCS) | 1/SDG | 80-120% R for water<br>Manufacturer's limits for soil | Redigest/reanalyze all samples associated with LCS. |
| Preparation Blank (PB) | 1/SDG | +/- 0.1 µg/L | Redigest/reanalyze all samples associated with PB. |
| Laboratory Matrix Spike (MS) | 1/SDG | No criteria specified – Laboratory criteria is 75-125% R if sample conc. < 4*spike | Flag/qualify samples as appropriate. |
| Matrix Spike Duplicate (MSD | 1/SDG | No criteria specified – Laboratory criteria is ≤ 20% RPD<br>(if sample conc > 10* MDL) | Flag/qualify samples as appropriate. |
| Initial Calibration Verification (ICV) | After each calibration | 90-110% R | Recalibrate instrument. |
| Continuing Calibration Verification (CCV) | 1/10 samples | 80-120% R | Recalibrate instrument and rerun all samples since last compliant CCV. |
| Initial Calibration Blank (ICB) | After each ICV | +/- 0.1 µg/L | Recalibrate instrument. |
| Continuing Calibration Blank (CCB) | 1/10 samples (after each CCV) | +/- 0.1 µg/L | Recalibrate instrument and rerun all samples since last compliant CCB. |
| LLCCV (0.1 µg/L) | After calibration | 80 - 120% R | Recalibrate instrument |
| Analytical Spike (A) | 1/SDG | 85-115% R<br>(spike conc. = 2-5 times sample conc.) | Only necessary if all samples in batch are < 2.5 µg/L. If %R not within 85-115%, do Method of Standard Additions. |
| Dilution Test (L) | | +/- 10% if conc. in sample > 2.5 µg/L | If all conc. <2.5 µg/L, perform "A" spike.<br>Only needed if MS, MSD, A-spike fail. |
| INSTRUMENT CALIBRATION REQUIREMENT: Minimum of 3 levels plus a blank | | | |
| NOTES: (1) Where 2 parameters are shown, the first applies to digested samples, and the second to non-digested samples.<br>SDG = Sample Delivery Group (maximum size = 20 samples).<br>R denotes recovery, e.g. R of 90% denotes 90% of expected result was obtained.<br>See method specific SOP for summary of Blank Limits | | | |

**APPENDIX D, TABLE 9. QA/QC LIMITS FOR ICP-MS – MOD. SW-846 METHOD 6020A**

| Parameter (1) | Frequency | Acceptance Criteria/Comments | Corrective Action |
|---|---|---|---|
| Internal Standards | Each sample | 80-120% R for ICV & CCVs;<br>30-120% R for samples | Dilute sample until internal standards fall within criteria |
| Laboratory Control Sample (LCS) | 1/SDG | No criteria specified in method – Laboratory criteria is 80-120% R. | Redigest/reanalyze all samples associated with LCS. |
| Preparation Blank (PB) | 1/SDG | No criteria specified – Laboratory criteria is +/- 3*MDL | Redigest/reanalyze all samples associated with PB. |
| Laboratory Matrix Spike (MS) | 1/SDG | 75-125% R<br>N/A if sample conc. > 4*spike conc. | Dilute and reanalyze. Flag/qualify samples as appropriate. |
| Laboratory Matrix Spike Duplicate (MSD) | 1/SDG | ≤20% RPD for sample conc.<br>> 100 * MDL | Dilute and rerun – RPD must be +/- 10%. If not, investigate/identify source of interference, rerun samples if appropriate. |
| Instrument Calibration Verification (ICV) | After each calibration | 90-110% R | Recalibrate instrument. |
| Continuing Calibration Verification (CCV) | 1/10 samples | 90-110% R | Recalibrate instrument and rerun all samples since last compliant CCV. |
| Instrument Calibration Blank (ICB) | After each ICV | +/- 3*MDL | Recalibrate instrument. |
| Continuing Calibration Blank (CCB) | 1/10 samples (after each CCV) | +/- 3*MDL | Recalibrate instrument and rerun all samples since last compliant CCB. |
| Interference Check Solution A (ICSA) | Beginning of run, every 12 hours | No criteria specified – Laboratory criteria is 80-120% R | Recalibrate instrument, rerun samples. |
| Interference Check Solution B (ICSAB) | Beginning of run, every 12 hours | No criteria specified – Laboratory criteria is 80-120% R | Recalibrate instrument and rerun all samples since last compliant interference check. |
| | | | |
| LLCCV | After each calibration | +/- 20% | Recalibrate instrument |
| Post-Digestion Spike (A) | 1/SDG | 75-125% R | Correct problem and reanalyze affected samples. |
| Serial Dilution (L) | 1/SDG | +/- 10% of original conc.<br>N/A if conc. < 100*MDL | Flag/qualify samples as appropriate. |
| INSTRUMENT CALIBRATION REQUIREMENT: Minimum of a blank and one standard. Must analyze tuning with at least 4 integrations and concentration RSDs less than 5% during precalibration sequence. Use 3 integrations for calibration & sample analysis. | | | |
| NOTES<br>SDG = Sample Delivery Group (maximum size = 20 samples).<br>R denotes recovery, e.g. R of 90% denotes 90% of expected result was obtained.<br>See method specific SOP for summary of Blank Limits. | | | |

# APPENDIX E

Bacteriological QA/QC Requirements

**Bacteriological QA/QC Requirements**

***Daily or As Applicable***

1. Calibrate pH meter each day used with 2 (pH 4 and 7) buffers.
2. Date reagents and chemicals at time of receipt and opening.
3. Date all solutions with date prepared.
4. Autoclave all incubated tubes and plates with growth for 30 minutes before discarding.
5. Select one random sterilized sample bottle from each autoclave batch and confirm sterility by adding approximately 20 ml of TSB and incubating at 35$^{o}$C+/-0.5$^{o}$C for 24 hours and check for growth. If growth is present, corrective action must be taken and retesting must be accomplished.
6. Check each batch of media for sterility by incubating 24 hours; check pH after incubation and record.
7. Check each batch of dilution/rinse water for sterility by adding 50 ml of autoclaved water to 50 ml of 2xTSB; incubate at 35$^{o}$C+/-0.5$^{o}$C for 24 hours and check for growth. Record sterility on autoclave chart.
8. Use Steri-strips or tape in every autoclave load. List all runs on the autoclave chart, recording date, load, length of run.
9. Date all prepared media with pull date and discard when too old.
10. Check sterilized pipets by filling and emptying into a sterile TSB tube; incubate the tube for 24 hours at 35$^{o}$C+/-0.5$^{o}$C and check for growth.
11. For each lot of enzyme substrate, dissolve a packet of the medium in sterile water in a non-fluorescing bottle and check it under the UV light for fluorescence. If faint fluorescence is observed, the lot should be discarded. Document the lot check.

***Monthly***

1. A culture of Bacillus stearothermophilus (BBL Kilit Ampules #12018) is run monthly in autoclave along with the maximum recording thermometer. Results are recorded on the autoclave sheet.
2. When there is more than one analyst, analysts will count the same LCS plate with fecal colonies and compare results. Results of duplicate count should be within 10% of each other.
3. Balances are checked monthly with weights of 50, 5, 1, 0.1 and 0.05 g. The 0.1 g and 0.05 g weights are checked by adding to the 50 g weight.

***Quarterly***

1. The autoclave timer is checked with a stopwatch/timer to make sure the autoclave cycles are accurate.
2. Check for alkaline or acid residual on glassware as follows:
   a. Choose a sample container (i.e. beaker) that has been washed and rinsed according to routine procedure. (Wash, 6 tap water rinses and 3 deionized water rinses.)
   b. Add deionized water to container and check pH of water.
   c. Let set for 24-48 hours.
   d. Recheck pH of water.
   e. Changes in pH over 0.2 indicate a residual on the glassware and the cleaning procedure must be checked and pH pretested until the pH remains within 0.2.

***Annual***

1. O'Haus balance is on an annual service contract with QC Services.
2. Deionized water will be analyzed for bactericidal properties by a Laboratory approved by MDPHHS (not required for ASTM Type II water per J. Halm on April 3, 2009).
3. Incubator and refrigerator thermometers are checked against the certified thermometer. The thermometers are tagged with the date for the check and any corrections.
4. A detergent suitability test is run on all detergents as follows:
    a. Wash and rinse 3 petri dishes in usual manner, 6 tap and 3 deionized rinses.
    b. Rinse 3 petri dishes in 6 rinses of deionized water.
    c. Wash some with detergent wash water (in use concentration) and drain dry without rinsing.
    d. Sterilize all three groups.
    e. Pour triplicate plates with same sample (20-60 colonies/plate) for each of 1.2. and 3 above and incubate as usual.
    f. If plates are rinsed (3) show a lowered count (15% or more) the detergent contains bacteriostatic substance and another detergent should be selected.
    g. If plates in group 1 show a lowered count (15% or more), toxic residues are left on glassware during routine washing procedure and a nontoxic detergent must be substituted for the one in use.

# PIONEER TECHNICAL SERVICES' MATERIALS FIELD AND LABORATORY TESTING QUALITY CONTROL PLAN

Our technician and engineering staff for the materials laboratory and field inspections receive training and refreshing to become certified in various areas Our technicians are certified through NICET, ACI, and WAQTC. Our lab and field testing equipment is regularly calibrated following our internal QC audits and by having a calibration firm, such as CAL-CERT, verify our calibrations annually.

Our Quality Control Plan requires the checking and reviewing of all testing data in their final format before they are submitted to the client.

## A. ACCOUNTABILITY

Our responsibility for the accuracy and completeness of testing reports requires that they be checked accordingly. The plan includes a process whereby reports and calculations are independently checked and reviewed. Reports and calculations will be fully reviewed and checked by a qualified individual other than the originator.

## B. OVERVIEW OF QUALITY CONTROL PLAN

The Quality Control Plan includes, but is not limited to, the following activities:

1. Checking and reviewing of computations and report for accuracy
2. Training of the technician team in the Quality Control procedures to assure complete and accurate reports
3. Internal monitoring and audits of testing and checking activities of the technician team
4. Filing of relevant quality control material
5. Management review of reports prior to submittal

## C. QUALITY CONTROL INTENT

The intent of this Quality Control program is to ensure that the project quality meets "standards-of-the-industry" and to produce quality deliverables that satisfy our client's requirements and reduce the risk of errors.

## D. QUALITY CONTROL PHILOSOPHY

This Quality Control program is based on the philosophy that Quality is:

1. Achieved by individuals performing work functions carefully
2. Controlled by adequate training, planning, coordination, supervision, and technical direction; proper definition of job requirements and procedures; and the use of appropriately skilled personnel
3. Verified through checking, reviewing, and surveillance of work activities with documentation by individuals who are not directly responsible for performing the initial work activity
4. Assured by assigning a manager or designee to perform Quality Control functions consisting of surveillance and auditing of the work and the procedures following when performing the work

## E. PROJECT TEAM RESPONSIBILITIES

1. Lab/Project Manager shall:
   a. Provide complete direction of the project
   b. Prepare and maintain project schedule
   c. Establish the project filing system for retention of correspondence, calculations, reports, plans, specifications, and quality control documentation

d. Assign all work activities to various team members
e. Keep all team members advised of project requirements, status, and schedule
f. Ensure coordination, communications, and dissemination of project information

2. QC Engineer shall:
   a. Review documents prior to submittal
   b. Discuss project requirements with Lab/Project Manager prior to start of task
   c. Review project problems, conditions, and assumptions with the Project Manager

## F. PROCEDURES

**Field Construction Inspection and Materials Lab Testing Data**

The field construction inspection includes, but is not limited to, such activities as fresh concrete sampling and testing, rebar and weld inspections, compaction testing, and asphalt sampling. The materials lab testing includes soil, aggregate, concrete strength, and asphalt mix design property testing. This data is compiled through the collection and measurement of data from a field investigation. The quality control of this type of work is much more subjective since the field tests are generally limited in scope and nature and do not include the collection of "extra" or redundant data for validation purposes. However, this type of work still requires a certain process of quality control as described below.

Field Construction Inspection

1. A certified staff member will be present during the collection of field construction data in order to ensure that the procedures used to obtain the data are indicative of "industry-standards" and meet with the intent of the scope of work
2. The data collected is compared to data previously collected near the project site, if available
3. The data collected is reviewed to ensure that the values are reasonable and within the anticipated range of values
4. The data collection instruments are calibrated as necessary, based on the sensitivity of the instrument
5. The tabulation or compilation of the field data for delivery to the client is checked against the actual field data
6. Quality Control Deliverable: completed and signed Field Data Review Checklist

Materials Lab Testing

1. A lab technician trained in the testing of materials will perform the tests according to the Agency standards i.e. AASHTO, ASTM, ACI, USACOE
2. The data collected is compared to data previously collected near the project site, if available
3. The data collected is reviewed to ensure that the values are reasonable and within the anticipated range of values
4. The testing equipment and instruments are calibrated as necessary, based on the sensitivity of the instrument
5. The tabulation or compilation of the lab data for delivery to the client is checked against the actual lab data
6. Quality Control Deliverable: completed and signed Lab Data Review Checklist

**Reports**

1. Report Review
   a. Upon completion of the report, it will be reviewed by the QC Engineer for accuracy and adequacy of content, and for compatibility with the scope. All notes, tables, and supporting data shall be reviewed for correctness and cross-checked to other sections of the report as appropriate. The reviewer shall:

1) Be provided a print of the report to be reviewed
2) Enter a check mark against each item on the report. Upon completion of the review, the reviewer shall sign and date the report and forward it to the author

2. Quality Control Deliverable: competed and signed Report

*Environmental Laboratory Certification Program*
*Scope of Certification*
*Certified Minnesota Environmental Laboratories*

THIS LISTING OF CERTIFIED FIELDS OF TESTING MUST BE ACCOMPANIED BY CERTIFICATE NUMBER: 377778

State Laboratory ID: 027-053-137 EPA Lab Code: MN00064 Expiration Date: 12/31/2012
Issue Date: 1/4/2012

Pace Analytical Services, Inc - Mpls
1700 Elm Street SE, Suite 200
Minneapolis, MN 55414

## Clean Air Act

**EPA RSK-175 (GC/FID)**

Preparation Techniques: N/A

| Program | Method | Analyte | Matrix | Primary | SOP |
|---|---|---|---|---|---|
| CAA | EPA RSK-175 (GC/FID) | Ethane | AIR | MN | |
| CAA | EPA RSK-175 (GC/FID) | Ethene | AIR | MN | |
| CAA | EPA RSK-175 (GC/FID) | Methane | AIR | MN | |
| CAA | EPA RSK-175 (GC/FID) | n-Propane | AIR | MN | |

**EPA TO-13A**

Preparation Techniques: N/A

| Program | Method | Analyte | Matrix | Primary | SOP |
|---|---|---|---|---|---|
| CAA | EPA TO-13A | 2-Methylnaphthalene | AIR | MN | |
| CAA | EPA TO-13A | Acenaphthene | AIR | MN | |
| CAA | EPA TO-13A | Acenaphthylene | AIR | MN | |
| CAA | EPA TO-13A | Anthracene | AIR | MN | |
| CAA | EPA TO-13A | Benzo(a)anthracene | AIR | MN | |
| CAA | EPA TO-13A | Benzo(a)pyrene | AIR | MN | |
| CAA | EPA TO-13A | Benzo(e)pyrene | AIR | MN | |

| Program | Method | Analyte | Matrix | Primary | SOP |
|---|---|---|---|---|---|
| CAA | EPA TO-13A | Benzo(g,h,i)perylene | AIR | MN | |
| CAA | EPA TO-13A | Benzo(k)fluoranthene | AIR | MN | |
| CAA | EPA TO-13A | Benzo[b]fluoranthene | AIR | MN | |
| CAA | EPA TO-13A | Benzyl chloride | AIR | MN | |
| CAA | EPA TO-13A | Chrysene | AIR | MN | |
| CAA | EPA TO-13A | Dibenz(a,h) anthracene | AIR | MN | |
| CAA | EPA TO-13A | Fluoranthene | AIR | MN | |
| CAA | EPA TO-13A | Fluorene | AIR | MN | |
| CAA | EPA TO-13A | Indeno(1,2,3-cd) pyrene | AIR | MN | |
| CAA | EPA TO-13A | Methylnapthalene | AIR | MN | |
| CAA | EPA TO-13A | Naphthalene | AIR | MN | |
| CAA | EPA TO-13A | Phenanthrene | AIR | MN | |
| CAA | EPA TO-13A | Pyrene | AIR | MN | |

**EPA TO-14A**

Preparation Techniques: N/A

| Program | Method | Analyte | Matrix | Primary | SOP |
|---|---|---|---|---|---|
| CAA | EPA TO-14A | 1,1,1-Trichloroethane | AIR | MN | |
| CAA | EPA TO-14A | 1,1,2,2-Tetrachloroethane | AIR | MN | |
| CAA | EPA TO-14A | 1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113) | AIR | MN | |
| CAA | EPA TO-14A | 1,1,2-Trichloroethane | AIR | MN | |
| CAA | EPA TO-14A | 1,1-Dichloroethane | AIR | MN | |
| CAA | EPA TO-14A | 1,1-Dichloroethylene | AIR | MN | |
| CAA | EPA TO-14A | 1,2,4-Trichlorobenzene | AIR | MN | |
| CAA | EPA TO-14A | 1,2,4-Trimethylbenzene | AIR | MN | |
| CAA | EPA TO-14A | 1,2-Dibromoethane (EDB, Ethylene dibromide) | AIR | MN | |
| CAA | EPA TO-14A | 1,2-Dichloro-1,1,2,2-tetrafluoroethane (Freon-114) | AIR | MN | |
| CAA | EPA TO-14A | 1,2-Dichlorobenzene | AIR | MN | |
| CAA | EPA TO-14A | 1,2-Dichloroethane (Ethylene dichloride) | AIR | MN | |
| CAA | EPA TO-14A | 1,2-Dichloroethene (total) | AIR | MN | |
| CAA | EPA TO-14A | 1,2-Dichloropropane | AIR | MN | |
| CAA | EPA TO-14A | 1,3,5-Trichlorobenzene | AIR | MN | |
| CAA | EPA TO-14A | 1,3-Dichlorobenzene | AIR | MN | |

| Program | Method | Analyte | Matrix | Primary | SOP |
|---|---|---|---|---|---|
| CAA | EPA TO-14A | 1,4-Dichlorobenzene | AIR | MN | |
| CAA | EPA TO-14A | Benzene | AIR | MN | |
| CAA | EPA TO-14A | Benzyl chloride | AIR | MN | |
| CAA | EPA TO-14A | Bromomethane | AIR | MN | |
| CAA | EPA TO-14A | Carbon tetrachloride | AIR | MN | |
| CAA | EPA TO-14A | Chlorobenzene | AIR | MN | |
| CAA | EPA TO-14A | Chloroethane (Ethyl chloride) | AIR | MN | |
| CAA | EPA TO-14A | Chloroform | AIR | MN | |
| CAA | EPA TO-14A | cis-1,2-Dichloroethylene | AIR | MN | |
| CAA | EPA TO-14A | cis-1,3-Dichloropropene | AIR | MN | |
| CAA | EPA TO-14A | Dichlorodifluoromethane (Freon-12) | AIR | MN | |
| CAA | EPA TO-14A | Ethylbenzene | AIR | MN | |
| CAA | EPA TO-14A | Hexachloro-1,3-butadiene | AIR | MN | |
| CAA | EPA TO-14A | m+p-xylene | AIR | MN | |
| CAA | EPA TO-14A | Methyl chloride (Chloromethane) | AIR | MN | |
| CAA | EPA TO-14A | Methyl tert-butyl ether (MTBE) | AIR | MN | |
| CAA | EPA TO-14A | Methylene chloride (Dichloromethane) | AIR | MN | |
| CAA | EPA TO-14A | n-Hexane | AIR | MN | |
| CAA | EPA TO-14A | o-Xylene | AIR | MN | |
| CAA | EPA TO-14A | Styrene | AIR | MN | |
| CAA | EPA TO-14A | Tetrachloroethene | AIR | MN | |
| CAA | EPA TO-14A | THC as Gas | AIR | MN | |
| CAA | EPA TO-14A | Toluene | AIR | MN | |
| CAA | EPA TO-14A | trans-1,2-Dichloroethylene | AIR | MN | |
| CAA | EPA TO-14A | trans-1,3-Dichloropropylene | AIR | MN | |
| CAA | EPA TO-14A | Trichloroethene (Trichloroethylene) | AIR | MN | |
| CAA | EPA TO-14A | Trichlorofluoromethane (Fluorotrichloromethane, Freon 11) | AIR | MN | |
| CAA | EPA TO-14A | Vinyl chloride | AIR | MN | |
| CAA | EPA TO-14A | Xylene (total) | AIR | MN | |

**EPA TO-17**

Preparation Techniques: N/A

| Program | Method | Analyte | Matrix | Primary | SOP |
|---|---|---|---|---|---|
| CAA | EPA TO-17 | 1,1,1-Trichloroethane | AIR | MN | User Defined S-MN-A-018 Rev. Rev.00 |

| Program | Method | Analyte | Matrix | Primary | SOP |
|---|---|---|---|---|---|
| CAA | EPA TO-17 | 1,1,2,2-Tetrachloroethane | AIR | MN | User Defined S-MN-A-018 Rev. Rev.00 |
| CAA | EPA TO-17 | 1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113) | AIR | MN | User Defined S-MN-A-018 Rev. Rev.00 |
| CAA | EPA TO-17 | 1,1,2-Trichloroethane | AIR | MN | User Defined S-MN-A-018 Rev. Rev.00 |
| CAA | EPA TO-17 | 1,1-Dichloroethane | AIR | MN | User Defined S-MN-A-018 Rev. Rev.00 |
| CAA | EPA TO-17 | 1,1-Dichloroethylene | AIR | MN | User Defined S-MN-A-018 Rev. Rev.00 |
| CAA | EPA TO-17 | 1,2,4-Trichlorobenzene | AIR | MN | User Defined S-MN-A-018 Rev. Rev.00 |
| CAA | EPA TO-17 | 1,2,4-Trimethylbenzene | AIR | MN | User Defined S-MN-A-018 Rev. Rev.00 |
| CAA | EPA TO-17 | 1,2,4-Trimethylbenzene | AIR | MN | User Defined S-MN-A-017 Rev. Rev.00 |
| CAA | EPA TO-17 | 1,2-Dibromoethane (EDB, Ethylene dibromide) | AIR | MN | User Defined S-MN-A-018 Rev. Rev.00 |
| CAA | EPA TO-17 | 1,2-Dichlorobenzene | AIR | MN | User Defined S-MN-A-018 Rev. Rev.00 |
| CAA | EPA TO-17 | 1,2-Dichloroethane (Ethylene dichloride) | AIR | MN | User Defined S-MN-A-018 Rev. Rev.00 |
| CAA | EPA TO-17 | 1,2-Dichloropropane | AIR | MN | User Defined S-MN-A-018 Rev. Rev.00 |
| CAA | EPA TO-17 | 1,3,5-Trimethylbenzene | AIR | MN | User Defined S-MN-A-018 Rev. Rev.00 |
| CAA | EPA TO-17 | 1,3,5-Trimethylbenzene | AIR | MN | User Defined S-MN-A-017 Rev. Rev.00 |
| CAA | EPA TO-17 | 1,3-Butadiene | AIR | MN | User Defined S-MN-A-018 Rev. Rev.00 |
| CAA | EPA TO-17 | 1,3-Dichlorobenzene | AIR | MN | User Defined S-MN-A-018 Rev. Rev.00 |
| CAA | EPA TO-17 | 1,4-Dichlorobenzene | AIR | MN | User Defined S-MN-A-018 Rev. Rev.00 |
| CAA | EPA TO-17 | 1-Propene | AIR | MN | User Defined S-MN-A-018 Rev. Rev.00 |
| CAA | EPA TO-17 | 2-Butanone (Methyl ethyl ketone, MEK) | AIR | MN | User Defined S-MN-A-018 Rev. Rev.00 |
| CAA | EPA TO-17 | 2-Hexanone | AIR | MN | User Defined S-MN-A-018 Rev. Rev.00 |
| CAA | EPA TO-17 | 4-Ethyltoluene | AIR | MN | User Defined S-MN-A-018 Rev. Rev.00 |
| CAA | EPA TO-17 | 4-Methyl-2-pentanone (MIBK) | AIR | MN | User Defined S-MN-A-018 Rev. Rev.00 |
| CAA | EPA TO-17 | Acetone | AIR | MN | User Defined S-MN-A-018 Rev. Rev.00 |
| CAA | EPA TO-17 | Acrolein (Propenal) | AIR | MN | User Defined S-MN-A-018 Rev. Rev.00 |
| CAA | EPA TO-17 | Acrylonitrile | AIR | MN | User Defined S-MN-A-018 Rev. Rev.00 |
| CAA | EPA TO-17 | Benzene | AIR | MN | User Defined S-MN-A-018 Rev. Rev.00 |
| CAA | EPA TO-17 | Benzene | AIR | MN | User Defined S-MN-A-017 Rev. Rev.00 |
| CAA | EPA TO-17 | Benzyl chloride | AIR | MN | User Defined S-MN-A-018 Rev. Rev.00 |
| CAA | EPA TO-17 | Bromodichloromethane | AIR | MN | User Defined S-MN-A-018 Rev. Rev.00 |
| CAA | EPA TO-17 | Bromoform | AIR | MN | User Defined S-MN-A-018 Rev. Rev.00 |
| CAA | EPA TO-17 | Bromomethane | AIR | MN | User Defined S-MN-A-018 Rev. Rev.00 |
| CAA | EPA TO-17 | Carbon disulfide | AIR | MN | User Defined S-MN-A-018 Rev. Rev.00 |
| CAA | EPA TO-17 | Carbon tetrachloride | AIR | MN | User Defined S-MN-A-018 Rev. Rev.00 |
| CAA | EPA TO-17 | Chlorobenzene | AIR | MN | User Defined S-MN-A-018 Rev. Rev.00 |
| CAA | EPA TO-17 | Chloroethane (Ethyl chloride) | AIR | MN | User Defined S-MN-A-018 Rev. Rev.00 |

| Program | Method | Analyte | Matrix | Primary | SOP |
|---|---|---|---|---|---|
| CAA | EPA TO-17 | Chloroform | AIR | MN | User Defined S-MN-A-018 Rev. Rev.00 |
| CAA | EPA TO-17 | cis-1,2-Dichloroethylene | AIR | MN | User Defined S-MN-A-018 Rev. Rev.00 |
| CAA | EPA TO-17 | cis-1,2-Dichloroethylene | AIR | MN | User Defined S-MN-A-017 Rev. Rev.00 |
| CAA | EPA TO-17 | cis-1,3-Dichloropropene | AIR | MN | User Defined S-MN-A-018 Rev. Rev.00 |
| CAA | EPA TO-17 | Cyclohexane | AIR | MN | User Defined S-MN-A-018 Rev. Rev.00 |
| CAA | EPA TO-17 | Dibromochloromethane | AIR | MN | User Defined S-MN-A-018 Rev. Rev.00 |
| CAA | EPA TO-17 | Dichlorodifluoromethane (Freon-12) | AIR | MN | User Defined S-MN-A-018 Rev. Rev.00 |
| CAA | EPA TO-17 | Dichlorotetrafluoroethane | AIR | MN | User Defined S-MN-A-018 Rev. Rev.00 |
| CAA | EPA TO-17 | Ethanol | AIR | MN | User Defined S-MN-A-018 Rev. Rev.00 |
| CAA | EPA TO-17 | Ethyl acetate | AIR | MN | User Defined S-MN-A-018 Rev. Rev.00 |
| CAA | EPA TO-17 | Ethylbenzene | AIR | MN | User Defined S-MN-A-018 Rev. Rev.00 |
| CAA | EPA TO-17 | Ethylbenzene | AIR | MN | User Defined S-MN-A-017 Rev. Rev.00 |
| CAA | EPA TO-17 | Hexachloro-1,3-butadiene | AIR | MN | User Defined S-MN-A-018 Rev. Rev.00 |
| CAA | EPA TO-17 | Isopropyl alcohol (2-Propanol, Isopropanol) | AIR | MN | User Defined S-MN-A-018 Rev. Rev.00 |
| CAA | EPA TO-17 | Isopropylbenzene | AIR | MN | User Defined S-MN-A-017 Rev. Rev.00 |
| CAA | EPA TO-17 | m+p-xylene | AIR | MN | User Defined S-MN-A-018 Rev. Rev.00 |
| CAA | EPA TO-17 | m-Xylene | AIR | MN | User Defined S-MN-A-017 Rev. Rev.00 |
| CAA | EPA TO-17 | Methyl chloride (Chloromethane) | AIR | MN | User Defined S-MN-A-018 Rev. Rev.00 |
| CAA | EPA TO-17 | Methyl tert-butyl ether (MTBE) | AIR | MN | User Defined S-MN-A-018 Rev. Rev.00 |
| CAA | EPA TO-17 | Methyl tert-butyl ether (MTBE) | AIR | MN | User Defined S-MN-A-017 Rev. Rev.00 |
| CAA | EPA TO-17 | Methylene chloride (Dichloromethane) | AIR | MN | User Defined S-MN-A-018 Rev. Rev.00 |
| CAA | EPA TO-17 | n-Heptane | AIR | MN | User Defined S-MN-A-018 Rev. Rev.00 |
| CAA | EPA TO-17 | n-Hexane | AIR | MN | User Defined S-MN-A-018 Rev. Rev.00 |
| CAA | EPA TO-17 | Naphthalene | AIR | MN | User Defined S-MN-A-018 Rev. Rev.00 |
| CAA | EPA TO-17 | Naphthalene | AIR | MN | User Defined S-MN-A-017 Rev. Rev.00 |
| CAA | EPA TO-17 | o-Xylene | AIR | MN | User Defined S-MN-A-018 Rev. Rev.00 |
| CAA | EPA TO-17 | o-Xylene | AIR | MN | User Defined S-MN-A-017 Rev. Rev.00 |
| CAA | EPA TO-17 | p-Xylene | AIR | MN | User Defined S-MN-A-017 Rev. Rev.00 |
| CAA | EPA TO-17 | Styrene | AIR | MN | User Defined S-MN-A-018 Rev. Rev.00 |
| CAA | EPA TO-17 | Tetrachloroethene | AIR | MN | User Defined S-MN-A-018 Rev. Rev.00 |
| CAA | EPA TO-17 | Tetrachloroethene | AIR | MN | User Defined S-MN-A-017 Rev. Rev.00 |
| CAA | EPA TO-17 | Tetrahydrofuran (THF) | AIR | MN | User Defined S-MN-A-018 Rev. Rev.00 |
| CAA | EPA TO-17 | Toluene | AIR | MN | User Defined S-MN-A-018 Rev. Rev.00 |
| CAA | EPA TO-17 | Toluene | AIR | MN | User Defined S-MN-A-017 Rev. Rev.00 |
| CAA | EPA TO-17 | trans-1,2-Dichloroethylene | AIR | MN | User Defined S-MN-A-018 Rev. Rev.00 |
| CAA | EPA TO-17 | trans-1,2-Dichloroethylene | AIR | MN | User Defined S-MN-A-017 Rev. Rev.00 |

| Program | Method | Analyte | Matrix | Primary | SOP |
|---|---|---|---|---|---|
| CAA | EPA TO-17 | trans-1,3-Dichloropropylene | AIR | MN | User Defined S-MN-A-018 Rev. Rev.00 |
| CAA | EPA TO-17 | Trichloroethene (Trichloroethylene) | AIR | MN | User Defined S-MN-A-018 Rev. Rev.00 |
| CAA | EPA TO-17 | Trichloroethene (Trichloroethylene) | AIR | MN | User Defined S-MN-A-017 Rev. Rev.00 |
| CAA | EPA TO-17 | Trichlorofluoromethane (Fluorotrichloromethane, Freon 11) | AIR | MN | User Defined S-MN-A-018 Rev. Rev.00 |
| CAA | EPA TO-17 | Vinyl acetate | AIR | MN | User Defined S-MN-A-018 Rev. Rev.00 |
| CAA | EPA TO-17 | Vinyl chloride | AIR | MN | User Defined S-MN-A-018 Rev. Rev.00 |
| CAA | EPA TO-17 | Vinyl chloride | AIR | MN | User Defined S-MN-A-017 Rev. Rev.00 |

**EPA TO-3**

Preparation Techniques: N/A

| Program | Method | Analyte | Matrix | Primary | SOP |
|---|---|---|---|---|---|
| CAA | EPA TO-3 | 1,2,4-Trimethylbenzene | AIR | MN | |
| CAA | EPA TO-3 | 1,3,5-Trichlorobenzene | AIR | MN | |
| CAA | EPA TO-3 | Benzene | AIR | MN | |
| CAA | EPA TO-3 | Ethane | AIR | MN | |
| CAA | EPA TO-3 | Ethene | AIR | MN | |
| CAA | EPA TO-3 | Ethylbenzene | AIR | MN | |
| CAA | EPA TO-3 | m+p-xylene | AIR | MN | |
| CAA | EPA TO-3 | Methane | AIR | MN | |
| CAA | EPA TO-3 | Methyl tert-butyl ether (MTBE) | AIR | MN | |
| CAA | EPA TO-3 | n-Hexane | AIR | MN | |
| CAA | EPA TO-3 | o-Xylene | AIR | MN | |
| CAA | EPA TO-3 | THC as C1-C4 | AIR | MN | |
| CAA | EPA TO-3 | THC as Gas | AIR | MN | |
| CAA | EPA TO-3 | Toluene | AIR | MN | |
| CAA | EPA TO-3 | Total BTEX | AIR | MN | |
| CAA | EPA TO-3 | Xylene (total) | AIR | MN | |

**EPA TO-9A**

Preparation Techniques: N/A

| Program | Method | Analyte | Matrix | Primary | SOP |
|---|---|---|---|---|---|
| CAA | EPA TO-9A | 1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD) | AIR | MN | |

| Program | Method | Analyte | Matrix | Primary | SOP |
|---|---|---|---|---|---|
| CAA | EPA TO-9A | 1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF) | AIR | MN | |
| CAA | EPA TO-9A | 1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (1,2,3,4,6,7,8-hpcdd) | AIR | MN | |
| CAA | EPA TO-9A | 1,2,3,4,6,7,8-Heptachlorodibenzofuran (1,2,3,4,6,7,8-hpcdf) | AIR | MN | |
| CAA | EPA TO-9A | 1,2,3,4,7,8,9-Heptachlorodibenzofuran (1,2,3,4,7,8,9-hpcdf) | AIR | MN | |
| CAA | EPA TO-9A | 1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (1,2,3,4,7,8-Hxcdd) | AIR | MN | |
| CAA | EPA TO-9A | 1,2,3,4,7,8-Hexachlorodibenzofuran (1,2,3,4,7,8-Hxcdf) | AIR | MN | |
| CAA | EPA TO-9A | 1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin(1,2,3,6,7,8-Hxcdd) | AIR | MN | |
| CAA | EPA TO-9A | 1,2,3,6,7,8-Hexachlorodibenzofuran (1,2,3,6,7,8-Hxcdf) | AIR | MN | |
| CAA | EPA TO-9A | 1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (1,2,3,7,8,9-Hxcdd) | AIR | MN | |
| CAA | EPA TO-9A | 1,2,3,7,8,9-Hexachlorodibenzofuran (1,2,3,7,8,9-Hxcdf) | AIR | MN | |
| CAA | EPA TO-9A | 1,2,3,7,8-Pentachlorodibenzo-p-dioxin (1,2,3,7,8-Pecdd) | AIR | MN | |
| CAA | EPA TO-9A | 1,2,3,7,8-Pentachlorodibenzofuran (1,2,3,7,8-Pecdf) | AIR | MN | |
| CAA | EPA TO-9A | 2,3,4,6,7,8-Hexachlorodibenzofuran | AIR | MN | |
| CAA | EPA TO-9A | 2,3,4,7,8-Pentachlorodibenzofuran | AIR | MN | |
| CAA | EPA TO-9A | 2,3,7,8-Tetrachlorodibenzo- p-dioxin (2,3,7,8-TCDD) | AIR | MN | |
| CAA | EPA TO-9A | 2,3,7,8-Tetrachlorodibenzofuran | AIR | MN | |

**Method 23**

Preparation Techniques: N/A

| Program | Method | Analyte | Matrix | Primary | SOP |
|---|---|---|---|---|---|
| CAA | Method 23 | 1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD) | AIR | MN | |
| CAA | Method 23 | 1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF) | AIR | MN | |
| CAA | Method 23 | 1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (1,2,3,4,6,7,8-hpcdd) | AIR | MN | |
| CAA | Method 23 | 1,2,3,4,6,7,8-Heptachlorodibenzofuran (1,2,3,4,6,7,8-hpcdf) | AIR | MN | |
| CAA | Method 23 | 1,2,3,4,7,8,9-Heptachlorodibenzofuran (1,2,3,4,7,8,9-hpcdf) | AIR | MN | |
| CAA | Method 23 | 1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (1,2,3,4,7,8-Hxcdd) | AIR | MN | |

| Program | Method | Analyte | Matrix | Primary | SOP |
|---|---|---|---|---|---|
| CAA | Method 23 | 1,2,3,4,7,8-Hexachlorodibenzofuran (1,2,3,4,7,8-Hxcdf) | AIR | MN | |
| CAA | Method 23 | 1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin(1,2,3,6,7,8-Hxcdd) | AIR | MN | |
| CAA | Method 23 | 1,2,3,6,7,8-Hexachlorodibenzofuran (1,2,3,6,7,8-Hxcdf) | AIR | MN | |
| CAA | Method 23 | 1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (1,2,3,7,8,9-Hxcdd) | AIR | MN | |
| CAA | Method 23 | 1,2,3,7,8,9-Hexachlorodibenzofuran (1,2,3,7,8,9-Hxcdf) | AIR | MN | |
| CAA | Method 23 | 1,2,3,7,8-Pentachlorodibenzo-p-dioxin (1,2,3,7,8-Pecdd) | AIR | MN | |
| CAA | Method 23 | 1,2,3,7,8-Pentachlorodibenzofuran (1,2,3,7,8-Pecdf) | AIR | MN | |
| CAA | Method 23 | 2,3,4,6,7,8-Hexachlorodibenzofuran | AIR | MN | |
| CAA | Method 23 | 2,3,4,7,8-Pentachlorodibenzofuran | AIR | MN | |
| CAA | Method 23 | 2,3,7,8-Tetrachlorodibenzo- p-dioxin (2,3,7,8-TCDD) | AIR | MN | |
| CAA | Method 23 | 2,3,7,8-Tetrachlorodibenzofuran | AIR | MN | |

### Method 3C

Preparation Techniques: N/A

| Program | Method | Analyte | Matrix | Primary | SOP |
|---|---|---|---|---|---|
| CAA | Method 3C | Carbon dioxide | AIR | MN | |
| CAA | Method 3C | Carbon monoxide | AIR | MN | |
| CAA | Method 3C | Methane | AIR | MN | |
| CAA | Method 3C | Nitrogen | AIR | MN | |
| CAA | Method 3C | Oxygen | AIR | MN | |

## Clean Water Program

### ASTM D516-90

Preparation Techniques: N/A

| Program | Method | Analyte | Matrix | Primary | SOP |
|---|---|---|---|---|---|
| CWP | ASTM D516-90 | Sulfate | NPW | MN | |

**EPA 120.1**

Preparation Techniques: N/A

| Program | Method | Analyte | Matrix | Primary | SOP |
|---|---|---|---|---|---|
| CWP | EPA 120.1 | Conductivity | NPW | MN | |

**EPA 160.4**

Preparation Techniques: N/A

| Program | Method | Analyte | Matrix | Primary | SOP |
|---|---|---|---|---|---|
| CWP | EPA 160.4 | Residue-volatile | NPW | MN | |

**EPA 1613B**

Preparation Techniques: Extraction, automated soxhlet; Extraction, solid phase (SPE); Extraction, separatory funnel liquid-liquid (LLE);

| Program | Method | Analyte | Matrix | Primary | SOP |
|---|---|---|---|---|---|
| CWP | EPA 1613B | 1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD) | NPW | MN | |
| CWP | EPA 1613B | 1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF) | NPW | MN | |
| CWP | EPA 1613B | 1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (1,2,3,4,6,7,8-hpcdd) | NPW | MN | |
| CWP | EPA 1613B | 1,2,3,4,6,7,8-Heptachlorodibenzofuran (1,2,3,4,6,7,8-hpcdf) | NPW | MN | |
| CWP | EPA 1613B | 1,2,3,4,7,8,9-Heptachlorodibenzofuran (1,2,3,4,7,8,9-hpcdf) | NPW | MN | |
| CWP | EPA 1613B | 1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (1,2,3,4,7,8-Hxcdd) | NPW | MN | |
| CWP | EPA 1613B | 1,2,3,4,7,8-Hexachlorodibenzofuran (1,2,3,4,7,8-Hxcdf) | NPW | MN | |
| CWP | EPA 1613B | 1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin(1,2,3,6,7,8-Hxcdd) | NPW | MN | |
| CWP | EPA 1613B | 1,2,3,6,7,8-Hexachlorodibenzofuran (1,2,3,6,7,8-Hxcdf) | NPW | MN | |
| CWP | EPA 1613B | 1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (1,2,3,7,8,9-Hxcdd) | NPW | MN | |
| CWP | EPA 1613B | 1,2,3,7,8,9-Hexachlorodibenzofuran (1,2,3,7,8,9-Hxcdf) | NPW | MN | |
| CWP | EPA 1613B | 1,2,3,7,8-Pentachlorodibenzo-p-dioxin (1,2,3,7,8-Pecdd) | NPW | MN | |
| CWP | EPA 1613B | 1,2,3,7,8-Pentachlorodibenzofuran (1,2,3,7,8-Pecdf) | NPW | MN | |

| Program | Method | Analyte | Matrix | Primary | SOP |
|---|---|---|---|---|---|
| CWP | EPA 1613B | 2,3,4,6,7,8-Hexachlorodibenzofuran | NPW | MN | |
| CWP | EPA 1613B | 2,3,4,7,8-Pentachlorodibenzofuran | NPW | MN | |
| CWP | EPA 1613B | 2,3,7,8-Tetrachlorodibenzo- p-dioxin (2,3,7,8-TCDD) | NPW | MN | |
| CWP | EPA 1613B | 2,3,7,8-Tetrachlorodibenzofuran | NPW | MN | |
| CWP | EPA 1613B | Total HpCDD | NPW | MN | |
| CWP | EPA 1613B | Total HpCDF | NPW | MN | |
| CWP | EPA 1613B | Total HxCDD | NPW | MN | |
| CWP | EPA 1613B | Total HxCDF | NPW | MN | |
| CWP | EPA 1613B | Total PeCDD | NPW | MN | |
| CWP | EPA 1613B | Total PeCDF | NPW | MN | |
| CWP | EPA 1613B | Total TCDD | NPW | MN | |
| CWP | EPA 1613B | Total TCDF | NPW | MN | |

**EPA 1664A (HEM)**

Preparation Techniques: Extraction, separatory funnel liquid-liquid (LLE);

| Program | Method | Analyte | Matrix | Primary | SOP |
|---|---|---|---|---|---|
| CWP | EPA 1664A (HEM) | Oil & Grease | NPW | MN | |

**EPA 1664A (SGT-HEM)**

Preparation Techniques: Extraction, solid phase (SPE);

| Program | Method | Analyte | Matrix | Primary | SOP |
|---|---|---|---|---|---|
| CWP | EPA 1664A (SGT-HEM) | Oil & Grease | NPW | MN | |

**EPA 1668A**

Preparation Techniques: N/A

| Program | Method | Analyte | Matrix | Primary | SOP |
|---|---|---|---|---|---|
| CWP | EPA 1668A | 2,2',3,3',4,4',5,5',6-Nonachlorobiphenyl (BZ-206) | NPW | MN | |
| CWP | EPA 1668A | 2,2',3,3',4,4',5,5'-Octachlorobiphenyl (BZ-194) | NPW | MN | |
| CWP | EPA 1668A | 2,2',3,3',4,4',5,6'-Octachlorobiphenyl (BZ-196) | NPW | MN | |

| Program | Method | Analyte | Matrix | Primary | SOP |
|---|---|---|---|---|---|
| CWP | EPA 1668A | 2,2',3,3',4,4',5,6,6'-Nonachlorobiphenyl (BZ-207) | NPW | MN | |
| CWP | EPA 1668A | 2,2',3,3',4,4',5,6-Octachlorobiphenyl (BZ-195) | NPW | MN | |
| CWP | EPA 1668A | 2,2',3,3',4,4',5-Heptachlorobiphenyl (BZ-170) | NPW | MN | |
| CWP | EPA 1668A | 2,2',3,3',4,5',6'-Heptachlorobiphenyl (BZ-177) | NPW | MN | |
| CWP | EPA 1668A | 2,2',3,3',4,5',6,6'-Octachlorobiphenyl (BZ-201) | NPW | MN | |
| CWP | EPA 1668A | 2,2',3,3',4,5',6-Heptachlorobiphenyl (BZ-175) | NPW | MN | |
| CWP | EPA 1668A | 2,2',3,3',4,5'-Hexachlorobiphenyl (BZ-130) | NPW | MN | |
| CWP | EPA 1668A | 2,2',3,3',4,5,5',6,6'-Nonachlorobiphenyl (BZ-208) | NPW | MN | |
| CWP | EPA 1668A | 2,2',3,3',4,5,5'-Heptachlorobiphenyl (BZ-172) | NPW | MN | |
| CWP | EPA 1668A | 2,2',3,3',4,5,6'-Heptachlorobiphenyl (BZ-174) | NPW | MN | |
| CWP | EPA 1668A | 2,2',3,3',4,6'-Hexachlorobiphenyl (BZ-132) | NPW | MN | |
| CWP | EPA 1668A | 2,2',3,3',4,6,6'-Heptachlorobiphenyl (BZ-176) | NPW | MN | |
| CWP | EPA 1668A | 2,2',3,3',4,6-Hexachlorobiphenyl (BZ-131) | NPW | MN | |
| CWP | EPA 1668A | 2,2',3,3',4-Pentachlorobiphenyl (BZ-82) | NPW | MN | |
| CWP | EPA 1668A | 2,2',3,3',5,5',6,6'-Octachlorobiphenyl (BZ-202) | NPW | MN | |
| CWP | EPA 1668A | 2,2',3,3',5,5',6-Heptachlorobiphenyl (BZ-178) | NPW | MN | |
| CWP | EPA 1668A | 2,2',3,3',5,5'-Hexachlorobiphenyl (BZ-133) | NPW | MN | |
| CWP | EPA 1668A | 2,2',3,3',5,6,6'-Heptachlorobiphenyl (BZ-179) | NPW | MN | |
| CWP | EPA 1668A | 2,2',3,3',5-Pentachlorobiphenyl (BZ-83) | NPW | MN | |
| CWP | EPA 1668A | 2,2',3,3',6,6'-Hexachlorobiphenyl (BZ-136) | NPW | MN | |
| CWP | EPA 1668A | 2,2',3,3',6-Pentachlorobiphenyl (BZ-84) | NPW | MN | |
| CWP | EPA 1668A | 2,2',3,4',5,5'-Hexachlorobiphenyl (BZ-146) | NPW | MN | |
| CWP | EPA 1668A | 2,2',3,4',5,6'-Hexachlorobiphenyl (BZ-148) | NPW | MN | |
| CWP | EPA 1668A | 2,2',3,4',5,6,6'-Heptachlorobiphenyl (BZ-188) | NPW | MN | |
| CWP | EPA 1668A | 2,2',3,4',6,6'-Hexachlorobiphenyl (BZ-150) | NPW | MN | |
| CWP | EPA 1668A | 2,2',3,4'-Tetrachlorobiphenyl (BZ-42) | NPW | MN | |

| Program | Method | Analyte | Matrix | Primary | SOP |
|---|---|---|---|---|---|
| CWP | EPA 1668A | 2,2',3,4,4',5,5',6-Octachlorobiphenyl (BZ-203) | NPW | MN | |
| CWP | EPA 1668A | 2,2',3,4,4',5,6'-Heptachlorobiphenyl (BZ-182) | NPW | MN | |
| CWP | EPA 1668A | 2,2',3,4,4',5,6,6'-Octachlorobiphenyl (BZ-204) | NPW | MN | |
| CWP | EPA 1668A | 2,2',3,4,4',5,6-Heptachlorobiphenyl (BZ-181) | NPW | MN | |
| CWP | EPA 1668A | 2,2',3,4,4',5-Hexachlorobiphenyl (BZ-137) | NPW | MN | |
| CWP | EPA 1668A | 2,2',3,4,4',6,6'-Heptachlorobiphenyl (BZ-184) | NPW | MN | |
| CWP | EPA 1668A | 2,2',3,4,5',6-Hexachlorobiphenyl (BZ-144) | NPW | MN | |
| CWP | EPA 1668A | 2,2',3,4,5,5'-Hexachlorobiphenyl (BZ-141) | NPW | MN | |
| CWP | EPA 1668A | 2,2',3,4,5,6,6'-Heptachlorobiphenyl (BZ-186) | NPW | MN | |
| CWP | EPA 1668A | 2,2',3,4,5,6-Hexachlorobiphenyl (BZ-142) | NPW | MN | |
| CWP | EPA 1668A | 2,2',3,4,6'-Pentachlorobiphenyl (BZ-89) | NPW | MN | |
| CWP | EPA 1668A | 2,2',3,4,6,6'-Hexachlorobiphenyl (BZ-145) | NPW | MN | |
| CWP | EPA 1668A | 2,2',3,5',6-Pentachlorobiphenyl (BZ-95) | NPW | MN | |
| CWP | EPA 1668A | 2,2',3,5,5'-Pentachlorobiphenyl (BZ-92) | NPW | MN | |
| CWP | EPA 1668A | 2,2',3,5,6'-Pentachlorobiphenyl (BZ-94) | NPW | MN | |
| CWP | EPA 1668A | 2,2',3,5,6,6'-Hexachlorobiphenyl (BZ-152) | NPW | MN | |
| CWP | EPA 1668A | 2,2',3,6'-Tetrachlorobiphenyl (BZ-46) | NPW | MN | |
| CWP | EPA 1668A | 2,2',3,6,6'-Pentachlorobiphenyl (BZ-96) | NPW | MN | |
| CWP | EPA 1668A | 2,2',3-Trichlorobiphenyl (BZ-16) | NPW | MN | |
| CWP | EPA 1668A | 2,2',4,4',5,6'-Hexachlorobiphenyl (BZ-154) | NPW | MN | |
| CWP | EPA 1668A | 2,2',4,4',5-Pentachlorobiphenyl (BZ-99) | NPW | MN | |
| CWP | EPA 1668A | 2,2',4,4',6,6'-Hexachlorobiphenyl (BZ-155) | NPW | MN | |
| CWP | EPA 1668A | 2,2',4,5',6-Pentachlorobiphenyl (BZ-103) | NPW | MN | |
| CWP | EPA 1668A | 2,2',4,5-Tetrachlorobiphenyl (BZ-48) | NPW | MN | |
| CWP | EPA 1668A | 2,2',4,6,6'-Pentachlorobiphenyl (BZ-104) | NPW | MN | |
| CWP | EPA 1668A | 2,2',4-Trichlorobiphenyl (BZ-17) | NPW | MN | |
| CWP | EPA 1668A | 2,2',5,5'-Tetrachlorobiphenyl (BZ-52) | NPW | MN | |
| CWP | EPA 1668A | 2,2',6,6'-Tetrachlorobiphenyl (BZ-54) | NPW | MN | |
| CWP | EPA 1668A | 2,2',6-Trichlorobiphenyl (BZ-19) | NPW | MN | |
| CWP | EPA 1668A | 2,2'-Dichlorobiphenyl (BZ-4) | NPW | MN | |

| Program | Method | Analyte | Matrix | Primary | SOP |
|---|---|---|---|---|---|
| CWP | EPA 1668A | 2,3',4,4',5'-Pentachlorobiphenyl (BZ-123) | NPW | MN | |
| CWP | EPA 1668A | 2,3',4,4',5,5'-Hexachlorobiphenyl (BZ-167) | NPW | MN | |
| CWP | EPA 1668A | 2,3',4,4',5-Pentachlorobiphenyl (BZ-118) | NPW | MN | |
| CWP | EPA 1668A | 2,3',4,4'-Tetrachlorobiphenyl (BZ-66) | NPW | MN | |
| CWP | EPA 1668A | 2,3',4,5',6-Pentachlorobiphenyl (BZ-121) | NPW | MN | |
| CWP | EPA 1668A | 2,3',4,5'-Tetrachlorobiphenyl (BZ-68) | NPW | MN | |
| CWP | EPA 1668A | 2,3',4,5,5'-Pentachlorobiphenyl (BZ-120) | NPW | MN | |
| CWP | EPA 1668A | 2,3',4,5-Tetrachlorobiphenyl (BZ-67) | NPW | MN | |
| CWP | EPA 1668A | 2,3',4-Trichlorobiphenyl (BZ-25) | NPW | MN | |
| CWP | EPA 1668A | 2,3',5'-Trichlorobiphenyl (BZ-34) | NPW | MN | |
| CWP | EPA 1668A | 2,3',5,5'-Tetrachlorobiphenyl (BZ-72) | NPW | MN | |
| CWP | EPA 1668A | 2,3',6-Trichlorobiphenyl (BZ-27) | NPW | MN | |
| CWP | EPA 1668A | 2,3'-Dichlorobiphenyl (BZ-6) | NPW | MN | |
| CWP | EPA 1668A | 2,3,3',4',5',6-Hexachlorobiphenyl (BZ-164) | NPW | MN | |
| CWP | EPA 1668A | 2,3,3',4',5'-Pentachlorobiphenyl (BZ-122) | NPW | MN | |
| CWP | EPA 1668A | 2,3,3',4',5,5'-Hexachlorobiphenyl (BZ-162) | NPW | MN | |
| CWP | EPA 1668A | 2,3,3',4'-Tetrachlorobiphenyl (BZ-56) | NPW | MN | |
| CWP | EPA 1668A | 2,3,3',4,4',5',6-Heptachlorobiphenyl (BZ-191) | NPW | MN | |
| CWP | EPA 1668A | 2,3,3',4,4',5,5',6-Octachlorobiphenyl (BZ-205) | NPW | MN | |
| CWP | EPA 1668A | 2,3,3',4,4',5,5'-Heptachlorobiphenyl (BZ-189) | NPW | MN | |
| CWP | EPA 1668A | 2,3,3',4,4',5,6-Heptachlorobiphenyl (BZ-190) | NPW | MN | |
| CWP | EPA 1668A | 2,3,3',4,4',6-Hexachlorobiphenyl (BZ-158) | NPW | MN | |
| CWP | EPA 1668A | 2,3,3',4,4'-Pentachlorobiphenyl (BZ-105) | NPW | MN | |
| CWP | EPA 1668A | 2,3,3',4,5',6-Hexachlorobiphenyl (BZ-161) | NPW | MN | |
| CWP | EPA 1668A | 2,3,3',4,5,5',6-Heptachlorobiphenyl (BZ-192) | NPW | MN | |
| CWP | EPA 1668A | 2,3,3',4,5,5'-Hexachlorobiphenyl (BZ-159) | NPW | MN | |
| CWP | EPA 1668A | 2,3,3',4,5,6-Hexachlorobiphenyl (BZ-160) | NPW | MN | |
| CWP | EPA 1668A | 2,3,3',4,5-Pentachlorobiphenyl (BZ-106) | NPW | MN | |
| CWP | EPA 1668A | 2,3,3',4,6-Pentachlorobiphenyl (BZ-109) | NPW | MN | |
| CWP | EPA 1668A | 2,3,3',4-Tetrachlorobiphenyl (BZ-55) | NPW | MN | |

| Program | Method | Analyte | Matrix | Primary | SOP |
|---|---|---|---|---|---|
| CWP | EPA 1668A | 2,3,3',5'-Tetrachlorobiphenyl (BZ-58) | NPW | MN | |
| CWP | EPA 1668A | 2,3,3',5,5',6-Hexachlorobiphenyl (BZ-165) | NPW | MN | |
| CWP | EPA 1668A | 2,3,3',5,5'-Pentachlorobiphenyl (BZ-111) | NPW | MN | |
| CWP | EPA 1668A | 2,3,3',5,6-Pentachlorobiphenyl (BZ-112) | NPW | MN | |
| CWP | EPA 1668A | 2,3,3',5-Tetrachlorobiphenyl (BZ-57) | NPW | MN | |
| CWP | EPA 1668A | 2,3,4',5-Tetrachlorobiphenyl (BZ-63) | NPW | MN | |
| CWP | EPA 1668A | 2,3,4',6-Tetrachlorobiphenyl (BZ-64) | NPW | MN | |
| CWP | EPA 1668A | 2,3,4'-Trichlorobiphenyl (BZ-22) | NPW | MN | |
| CWP | EPA 1668A | 2,3,4,4',5-Pentachlorobiphenyl (BZ-114) | NPW | MN | |
| CWP | EPA 1668A | 2,3,4,4'-Tetrachlorobiphenyl (BZ-60) | NPW | MN | |
| CWP | EPA 1668A | 2,3,5-Trichlorobiphenyl (BZ-23) | NPW | MN | |
| CWP | EPA 1668A | 2,3,6-Trichlorobiphenyl (BZ-24) | NPW | MN | |
| CWP | EPA 1668A | 2,3-Dichlorobiphenyl (BZ-5) | NPW | MN | |
| CWP | EPA 1668A | 2,4',5-Trichlorobiphenyl (BZ-31) | NPW | MN | |
| CWP | EPA 1668A | 2,4',6-Trichlorobiphenyl (BZ-32) | NPW | MN | |
| CWP | EPA 1668A | 2,4'-Dichlorobiphenyl (BZ-8) | NPW | MN | |
| CWP | EPA 1668A | 2,4-Dichlorobiphenyl (BZ-7) | NPW | MN | |
| CWP | EPA 1668A | 2,5-Dichlorobiphenyl (BZ-9) | NPW | MN | |
| CWP | EPA 1668A | 2,6-Dichlorobiphenyl (BZ-10) | NPW | MN | |
| CWP | EPA 1668A | 2-Chlorobiphenyl (BZ-1) | NPW | MN | |
| CWP | EPA 1668A | 3,3',4,4',5,5'-Hexachlorobiphenyl (BZ-169) | NPW | MN | |
| CWP | EPA 1668A | 3,3',4,4',5-Pentachlorobiphenyl (BZ-126) | NPW | MN | |
| CWP | EPA 1668A | 3,3',4,4'-Tetrachlorobiphenyl (BZ-77) | NPW | MN | |
| CWP | EPA 1668A | 3,3',4,5'-Tetrachlorobiphenyl (BZ-79) | NPW | MN | |
| CWP | EPA 1668A | 3,3',4,5,5'-Pentachlorobiphenyl (BZ-127) | NPW | MN | |
| CWP | EPA 1668A | 3,3',4,5-Tetrachlorobiphenyl (BZ-78) | NPW | MN | |
| CWP | EPA 1668A | 3,3',4-Trichlorobiphenyl (BZ-35) | NPW | MN | |
| CWP | EPA 1668A | 3,3',5,5'-Tetrachlorobiphenyl (BZ-80) | NPW | MN | |
| CWP | EPA 1668A | 3,3',5-Trichlorobiphenyl (BZ-36) | NPW | MN | |
| CWP | EPA 1668A | 3,3'-Dichlorobiphenyl (BZ-11) | NPW | MN | |
| CWP | EPA 1668A | 3,4',5-Trichlorobiphenyl (BZ-39) | NPW | MN | |
| CWP | EPA 1668A | 3,4,4',5-Tetrachlorobiphenyl (BZ-81) | NPW | MN | |
| CWP | EPA 1668A | 3,4,4'-Trichlorobiphenyl (BZ-37) | NPW | MN | |
| CWP | EPA 1668A | 3,4,5-Trichlorobiphenyl (BZ-38) | NPW | MN | |
| CWP | EPA 1668A | 3,5-Dichlorobiphenyl (BZ-14) | NPW | MN | |

| Program | Method | Analyte | Matrix | Primary | SOP |
|---|---|---|---|---|---|
| CWP | EPA 1668A | 3-Chlorobiphenyl (BZ-2) | NPW | MN | |
| CWP | EPA 1668A | 4,4'-Dichlorobiphenyl (BZ-15) | NPW | MN | |
| CWP | EPA 1668A | 4-Chlorobiphenyl (BZ-3) | NPW | MN | |
| CWP | EPA 1668A | Decachlorobiphenyl (BZ-209) | NPW | MN | |
| CWP | EPA 1668A | PCB-(100/93/102/98) | NPW | MN | |
| CWP | EPA 1668A | PCB-(107/124) | NPW | MN | |
| CWP | EPA 1668A | PCB-(108/119/86/97/125/87) | NPW | MN | |
| CWP | EPA 1668A | PCB-(110/115) | NPW | MN | |
| CWP | EPA 1668A | PCB-(113/90/101) | NPW | MN | |
| CWP | EPA 1668A | PCB-(117/116/85) | NPW | MN | |
| CWP | EPA 1668A | PCB-(128/166) | NPW | MN | |
| CWP | EPA 1668A | PCB-(13/12) | NPW | MN | |
| CWP | EPA 1668A | PCB-(134/143) | NPW | MN | |
| CWP | EPA 1668A | PCB-(138/163/129) | NPW | MN | |
| CWP | EPA 1668A | PCB-(139/140) | NPW | MN | |
| CWP | EPA 1668A | PCB-(147/149) | NPW | MN | |
| CWP | EPA 1668A | PCB-(151/135) | NPW | MN | |
| CWP | EPA 1668A | PCB-(153/168) | NPW | MN | |
| CWP | EPA 1668A | PCB-(156/157) | NPW | MN | |
| CWP | EPA 1668A | PCB-(171/173) | NPW | MN | |
| CWP | EPA 1668A | PCB-(180/193) | NPW | MN | |
| CWP | EPA 1668A | PCB-(183/185) | NPW | MN | |
| CWP | EPA 1668A | PCB-(197/200) | NPW | MN | |
| CWP | EPA 1668A | PCB-(198/199) | NPW | MN | |
| CWP | EPA 1668A | PCB-(21/33) | NPW | MN | |
| CWP | EPA 1668A | PCB-(26/29) | NPW | MN | |
| CWP | EPA 1668A | PCB-(28/20) | NPW | MN | |
| CWP | EPA 1668A | PCB-(30/18) | NPW | MN | |
| CWP | EPA 1668A | PCB-(41/40/71) | NPW | MN | |
| CWP | EPA 1668A | PCB-(44/47/65) | NPW | MN | |
| CWP | EPA 1668A | PCB-(45/51) | NPW | MN | |
| CWP | EPA 1668A | PCB-(50/53) | NPW | MN | |
| CWP | EPA 1668A | PCB-(59/62/75) | NPW | MN | |
| CWP | EPA 1668A | PCB-(61/70/74/76) | NPW | MN | |
| CWP | EPA 1668A | PCB-(69/49) | NPW | MN | |
| CWP | EPA 1668A | PCB-(73/43) | NPW | MN | |

| Program | Method | Analyte | Matrix | Primary | SOP |
|---|---|---|---|---|---|
| CWP | EPA 1668A | PCB-(88/91) | NPW | MN | |

**EPA 180.1**

Preparation Techniques: N/A

| Program | Method | Analyte | Matrix | Primary | SOP |
|---|---|---|---|---|---|
| CWP | EPA 180.1 | Turbidity | NPW | MN | |

**EPA 200.7**

Preparation Techniques: Digestion, hotplate or HotBlock;

| Program | Method | Analyte | Matrix | Primary | SOP |
|---|---|---|---|---|---|
| CWP | EPA 200.7 | Aluminum | NPW | MN | |
| CWP | EPA 200.7 | Antimony | NPW | MN | |
| CWP | EPA 200.7 | Arsenic | NPW | MN | |
| CWP | EPA 200.7 | Barium | NPW | MN | |
| CWP | EPA 200.7 | Beryllium | NPW | MN | |
| CWP | EPA 200.7 | Boron | NPW | MN | |
| CWP | EPA 200.7 | Cadmium | NPW | MN | |
| CWP | EPA 200.7 | Calcium | NPW | MN | |
| CWP | EPA 200.7 | Cobalt | NPW | MN | |
| CWP | EPA 200.7 | Copper | NPW | MN | |
| CWP | EPA 200.7 | Iron | NPW | MN | |
| CWP | EPA 200.7 | Lead | NPW | MN | |
| CWP | EPA 200.7 | Magnesium | NPW | MN | |
| CWP | EPA 200.7 | Manganese | NPW | MN | |
| CWP | EPA 200.7 | Molybdenum | NPW | MN | |
| CWP | EPA 200.7 | Nickel | NPW | MN | |
| CWP | EPA 200.7 | Potassium | NPW | MN | |
| CWP | EPA 200.7 | Selenium | NPW | MN | |
| CWP | EPA 200.7 | Silver | NPW | MN | |
| CWP | EPA 200.7 | Sodium | NPW | MN | |
| CWP | EPA 200.7 | Thallium | NPW | MN | |
| CWP | EPA 200.7 | Tin | NPW | MN | |
| CWP | EPA 200.7 | Total chromium | NPW | MN | |

| Program | Method | Analyte | Matrix | Primary | SOP |
|---|---|---|---|---|---|
| CWP | EPA 200.7 | Vanadium | NPW | MN | |
| CWP | EPA 200.7 | Zinc | NPW | MN | |

**EPA 200.7**

Preparation Techniques: Digestion, hotplate or HotBlock;

| Program | Method | Analyte | Matrix | Primary | SOP |
|---|---|---|---|---|---|
| CWP | EPA 200.7 | Total hardness as CaCO3 | NPW | MN | |

**EPA 200.8**

Preparation Techniques: Digestion, hotplate or HotBlock;

| Program | Method | Analyte | Matrix | Primary | SOP |
|---|---|---|---|---|---|
| CWP | EPA 200.8 | Aluminum | NPW | MN | |
| CWP | EPA 200.8 | Antimony | NPW | MN | |
| CWP | EPA 200.8 | Arsenic | NPW | MN | |
| CWP | EPA 200.8 | Barium | NPW | MN | |
| CWP | EPA 200.8 | Beryllium | NPW | MN | |
| CWP | EPA 200.8 | Cadmium | NPW | MN | |
| CWP | EPA 200.8 | Cobalt | NPW | MN | |
| CWP | EPA 200.8 | Copper | NPW | MN | |
| CWP | EPA 200.8 | Lead | NPW | MN | |
| CWP | EPA 200.8 | Manganese | NPW | MN | |
| CWP | EPA 200.8 | Molybdenum | NPW | MN | |
| CWP | EPA 200.8 | Nickel | NPW | MN | |
| CWP | EPA 200.8 | Selenium | NPW | MN | |
| CWP | EPA 200.8 | Silver | NPW | MN | |
| CWP | EPA 200.8 | Thallium | NPW | MN | |
| CWP | EPA 200.8 | Total chromium | NPW | MN | |
| CWP | EPA 200.8 | Vanadium | NPW | MN | |
| CWP | EPA 200.8 | Zinc | NPW | MN | |

**EPA 200.8**

Preparation Techniques: Digestion, hotplate or HotBlock;

| Program | Method | Analyte | Matrix | Primary | SOP |
|---|---|---|---|---|---|
| CWP | EPA 200.8 | Mercury | NPW | MN | |

**EPA 245.1**

Preparation Techniques: N/A

| Program | Method | Analyte | Matrix | Primary | SOP |
|---|---|---|---|---|---|
| CWP | EPA 245.1 | Mercury | NPW | MN | |

**EPA 350.1**

Preparation Techniques: Distillation, MIDI;

| Program | Method | Analyte | Matrix | Primary | SOP |
|---|---|---|---|---|---|
| CWP | EPA 350.1 | Ammonia as N | NPW | MN | |

**EPA 353.2**

Preparation Techniques: N/A

| Program | Method | Analyte | Matrix | Primary | SOP |
|---|---|---|---|---|---|
| CWP | EPA 353.2 | Nitrate-nitrite | NPW | MN | |
| CWP | EPA 353.2 | Nitrite as N | NPW | MN | |

**EPA 353.2 (calc.)**

Preparation Techniques: N/A

| Program | Method | Analyte | Matrix | Primary | SOP |
|---|---|---|---|---|---|
| CWP | EPA 353.2 (calc.) | Nitrate as N | NPW | MN | |

**EPA 410.4**

Preparation Techniques: Digestion, hotplate or HotBlock;

| Program | Method | Analyte | Matrix | Primary | SOP |
|---|---|---|---|---|---|
| CWP | EPA 410.4 | Chemical oxygen demand | NPW | MN | |

**EPA 420.1**

Preparation Techniques: Distillation, MIDI;

| Program | Method | Analyte | Matrix | Primary | SOP |
|---|---|---|---|---|---|
| CWP | EPA 420.1 | Total Phenolics | NPW | MN | |

**EPA 420.4**

Preparation Techniques: Distillation, MIDI;

| Program | Method | Analyte | Matrix | Primary | SOP |
|---|---|---|---|---|---|
| CWP | EPA 420.4 | Total Phenolics | NPW | MN | |

**EPA 624**

Preparation Techniques: Purge and trap;

| Program | Method | Analyte | Matrix | Primary | SOP |
|---|---|---|---|---|---|
| CWP | EPA 624 | 1,1,1-Trichloroethane | NPW | MN | |
| CWP | EPA 624 | 1,1,2,2-Tetrachloroethane | NPW | MN | |
| CWP | EPA 624 | 1,1,2-Trichloroethane | NPW | MN | |
| CWP | EPA 624 | 1,1-Dichloroethane | NPW | MN | |
| CWP | EPA 624 | 1,1-Dichloroethylene | NPW | MN | |
| CWP | EPA 624 | 1,2-Dichlorobenzene | NPW | MN | |
| CWP | EPA 624 | 1,2-Dichloroethane (Ethylene dichloride) | NPW | MN | |
| CWP | EPA 624 | 1,2-Dichloropropane | NPW | MN | |
| CWP | EPA 624 | 1,3-Dichlorobenzene | NPW | MN | |
| CWP | EPA 624 | 1,4-Dichlorobenzene | NPW | MN | |
| CWP | EPA 624 | 2-Chloroethyl vinyl ether | NPW | MN | |
| CWP | EPA 624 | Acrolein (Propenal) | NPW | MN | |
| CWP | EPA 624 | Acrylonitrile | NPW | MN | |
| CWP | EPA 624 | Benzene | NPW | MN | |
| CWP | EPA 624 | Bromodichloromethane | NPW | MN | |
| CWP | EPA 624 | Bromoform | NPW | MN | |

| Program | Method | Analyte | Matrix | Primary | SOP |
|---|---|---|---|---|---|
| CWP | EPA 624 | Carbon tetrachloride | NPW | MN | |
| CWP | EPA 624 | Chlorobenzene | NPW | MN | |
| CWP | EPA 624 | Chlorodibromomethane | NPW | MN | |
| CWP | EPA 624 | Chloroethane (Ethyl chloride) | NPW | MN | |
| CWP | EPA 624 | Chloroform | NPW | MN | |
| CWP | EPA 624 | cis-1,3-Dichloropropene | NPW | MN | |
| CWP | EPA 624 | Ethylbenzene | NPW | MN | |
| CWP | EPA 624 | Isopropylbenzene | NPW | MN | |
| CWP | EPA 624 | Methyl bromide (Bromomethane) | NPW | MN | |
| CWP | EPA 624 | Methylene chloride (Dichloromethane) | NPW | MN | |
| CWP | EPA 624 | Tetrachloroethylene (Perchloroethylene) | NPW | MN | |
| CWP | EPA 624 | Toluene | NPW | MN | |
| CWP | EPA 624 | trans-1,2-Dichloroethylene | NPW | MN | |
| CWP | EPA 624 | trans-1,3-Dichloropropylene | NPW | MN | |
| CWP | EPA 624 | Trichloroethene (Trichloroethylene) | NPW | MN | |
| CWP | EPA 624 | Trichlorofluoromethane (Fluorotrichloromethane, Freon 11) | NPW | MN | |
| CWP | EPA 624 | Vinyl chloride | NPW | MN | |

**EPA 625**

Preparation Techniques: Extraction, separatory funnel liquid-liquid (LLE); Extraction, continuous liquid-liquid (LLE);

| Program | Method | Analyte | Matrix | Primary | SOP |
|---|---|---|---|---|---|
| CWP | EPA 625 | 2,4,5-Trichlorophenol | NPW | MN | |
| CWP | EPA 625 | 2,4,6-Trichlorophenol | NPW | MN | |
| CWP | EPA 625 | 2,4-Dichlorophenol | NPW | MN | |
| CWP | EPA 625 | 2,4-Dimethylphenol | NPW | MN | |
| CWP | EPA 625 | 2,4-Dinitrophenol | NPW | MN | |
| CWP | EPA 625 | 2,4-Dinitrotoluene (2,4-DNT) | NPW | MN | |
| CWP | EPA 625 | 2,6-Dinitrotoluene (2,6-DNT) | NPW | MN | |
| CWP | EPA 625 | 2-Chloronaphthalene | NPW | MN | |
| CWP | EPA 625 | 2-Chlorophenol | NPW | MN | |
| CWP | EPA 625 | 2-Methyl-4,6-dinitrophenol (4,6-Dinitro-2-methylphenol) | NPW | MN | |
| CWP | EPA 625 | 2-Nitrophenol | NPW | MN | |
| CWP | EPA 625 | 3,3'-Dichlorobenzidine | NPW | MN | |

| Program | Method | Analyte | Matrix | Primary | SOP |
|---|---|---|---|---|---|
| CWP | EPA 625 | 4-Bromophenyl phenyl ether | NPW | MN | |
| CWP | EPA 625 | 4-Chloro-3-methylphenol | NPW | MN | |
| CWP | EPA 625 | 4-Chlorophenyl phenylether | NPW | MN | |
| CWP | EPA 625 | 4-Nitrophenol | NPW | MN | |
| CWP | EPA 625 | Acenaphthene | NPW | MN | |
| CWP | EPA 625 | Acenaphthylene | NPW | MN | |
| CWP | EPA 625 | Anthracene | NPW | MN | |
| CWP | EPA 625 | Benzidine | NPW | MN | |
| CWP | EPA 625 | Benzo(a)anthracene | NPW | MN | |
| CWP | EPA 625 | Benzo(a)pyrene | NPW | MN | |
| CWP | EPA 625 | Benzo(g,h,i)perylene | NPW | MN | |
| CWP | EPA 625 | Benzo(k)fluoranthene | NPW | MN | |
| CWP | EPA 625 | Benzo[b]fluoranthene | NPW | MN | |
| CWP | EPA 625 | bis(2-Chloroethoxy)methane | NPW | MN | |
| CWP | EPA 625 | bis(2-Chloroethyl) ether | NPW | MN | |
| CWP | EPA 625 | bis(2-Chloroisopropyl) ether | NPW | MN | |
| CWP | EPA 625 | Butyl benzyl phthalate | NPW | MN | |
| CWP | EPA 625 | Chrysene | NPW | MN | |
| CWP | EPA 625 | Di(2-ethylhexyl) phthalate (bis(2-Ethylhexyl)phthalate, DEHP) | NPW | MN | |
| CWP | EPA 625 | Di-n-butyl phthalate | NPW | MN | |
| CWP | EPA 625 | Di-n-octyl phthalate | NPW | MN | |
| CWP | EPA 625 | Dibenz(a,h) anthracene | NPW | MN | |
| CWP | EPA 625 | Diethyl phthalate | NPW | MN | |
| CWP | EPA 625 | Dimethyl phthalate | NPW | MN | |
| CWP | EPA 625 | Fluoranthene | NPW | MN | |
| CWP | EPA 625 | Fluorene | NPW | MN | |
| CWP | EPA 625 | Hexachlorobenzene | NPW | MN | |
| CWP | EPA 625 | Hexachlorobutadiene | NPW | MN | |
| CWP | EPA 625 | Hexachlorocyclopentadiene | NPW | MN | |
| CWP | EPA 625 | Hexachloroethane | NPW | MN | |
| CWP | EPA 625 | Indeno(1,2,3-cd) pyrene | NPW | MN | |
| CWP | EPA 625 | Isophorone | NPW | MN | |
| CWP | EPA 625 | n-Nitrosodi-n-propylamine | NPW | MN | |
| CWP | EPA 625 | n-Nitrosodimethylamine | NPW | MN | |
| CWP | EPA 625 | n-Nitrosodiphenylamine | NPW | MN | |
| CWP | EPA 625 | Naphthalene | NPW | MN | |

| Program | Method | Analyte | Matrix | Primary | SOP |
|---|---|---|---|---|---|
| CWP | EPA 625 | Nitrobenzene | NPW | MN | |
| CWP | EPA 625 | Pentachlorophenol | NPW | MN | |
| CWP | EPA 625 | Phenanthrene | NPW | MN | |
| CWP | EPA 625 | Phenol | NPW | MN | |
| CWP | EPA 625 | Pyrene | NPW | MN | |

**Hach 10360**

Preparation Techniques: N/A

| Program | Method | Analyte | Matrix | Primary | SOP |
|---|---|---|---|---|---|
| CWP | Hach 10360 | Biochemical oxygen demand | NPW | MN | |
| CWP | Hach 10360 | Carbonaceous BOD, CBOD | NPW | MN | |
| CWP | Hach 10360 | Oxygen, dissolved | NPW | MN | |

**SM 2320 B-97**

Preparation Techniques: N/A

| Program | Method | Analyte | Matrix | Primary | SOP |
|---|---|---|---|---|---|
| CWP | SM 2320 B-97 | Alkalinity as CaCO3 | NPW | MN | |

**SM 2340 B-97**

Preparation Techniques: N/A

| Program | Method | Analyte | Matrix | Primary | SOP |
|---|---|---|---|---|---|
| CWP | SM 2340 B-97 | Total hardness as CaCO3 | NPW | MN | |

**SM 2540 B-97**

Preparation Techniques: N/A

| Program | Method | Analyte | Matrix | Primary | SOP |
|---|---|---|---|---|---|
| CWP | SM 2540 B-97 | Residue-total | NPW | MN | |

**SM 2540 C-97**

Preparation Techniques: N/A

| Program | Method | Analyte | Matrix | Primary | SOP |
|---|---|---|---|---|---|
| CWP | SM 2540 C-97 | Residue-filterable (TDS) | NPW | MN | |

**SM 2540 D-97**

Preparation Techniques: N/A

| Program | Method | Analyte | Matrix | Primary | SOP |
|---|---|---|---|---|---|
| CWP | SM 2540 D-97 | Residue-nonfilterable (TSS) | NPW | MN | |

**SM 2540 F-97**

Preparation Techniques: N/A

| Program | Method | Analyte | Matrix | Primary | SOP |
|---|---|---|---|---|---|
| CWP | SM 2540 F-97 | Residue-settleable | NPW | MN | |

**SM 3500-Cr B-97**

Preparation Techniques: N/A

| Program | Method | Analyte | Matrix | Primary | SOP |
|---|---|---|---|---|---|
| CWP | SM 3500-Cr B-97 | Chromium VI | NPW | MN | |

**SM 4500-Cl G-93**

Preparation Techniques: N/A

| Program | Method | Analyte | Matrix | Primary | SOP |
|---|---|---|---|---|---|
| CWP | SM 4500-Cl G-93 | Total residual chlorine | NPW | MN | |

**SM 4500-$Cl^-$ E-97**

Preparation Techniques: N/A

| Program | Method | Analyte | Matrix | Primary | SOP |
|---|---|---|---|---|---|
| CWP | SM 4500-$Cl^-$ E-97 | Chloride | NPW | MN | |

**SM 4500-$CN^-$ E-97**

Preparation Techniques: Distillation, MIDI; Distillation, macro; Distillation, micro;

| Program | Method | Analyte | Matrix | Primary | SOP |
|---|---|---|---|---|---|
| CWP | SM 4500-$CN^-$ E-97 | Total Cyanide | NPW | MN | |

**SM 4500-$CN^-$ G-97**

Preparation Techniques: Distillation, MIDI; Distillation, macro; Distillation, micro;

| Program | Method | Analyte | Matrix | Primary | SOP |
|---|---|---|---|---|---|
| CWP | SM 4500-$CN^-$ G-97 | Free cyanide | NPW | MN | |

**SM 4500-H+ B-96**

Preparation Techniques: N/A

| Program | Method | Analyte | Matrix | Primary | SOP |
|---|---|---|---|---|---|
| CWP | SM 4500-H+ B-96 | pH | NPW | MN | |

**SM 4500-$NO2^-$ B-93**

Preparation Techniques: N/A

| Program | Method | Analyte | Matrix | Primary | SOP |
|---|---|---|---|---|---|
| CWP | SM 4500-$NO2^-$ B-93 | Nitrite as N | NPW | MN | |

**SM 4500-$NO3^-$ H-97**

Preparation Techniques: N/A

| Program | Method | Analyte | Matrix | Primary | SOP |
|---|---|---|---|---|---|
| CWP | SM 4500-$NO3^-$ H-97 | Nitrate-nitrite | NPW | MN | |

**SM 4500-O G-93**

Preparation Techniques: N/A

| Program | Method | Analyte | Matrix | Primary | SOP |
|---|---|---|---|---|---|
| CWP | SM 4500-O G-93 | Oxygen, dissolved | NPW | MN | |

**SM 4500-P E-97**

Preparation Techniques: N/A

| Program | Method | Analyte | Matrix | Primary | SOP |
|---|---|---|---|---|---|
| CWP | SM 4500-P E-97 | Orthophosphate as P | NPW | MN | |
| CWP | SM 4500-P E-97 | Total Phosphorus | NPW | MN | |

**SM 5210 B-97**

Preparation Techniques: N/A

| Program | Method | Analyte | Matrix | Primary | SOP |
|---|---|---|---|---|---|
| CWP | SM 5210 B-97 | Biochemical oxygen demand | NPW | MN | |
| CWP | SM 5210 B-97 | Carbonaceous BOD, CBOD | NPW | MN | |

**SM 5220 D-97**

Preparation Techniques: Digestion, hotplate or HotBlock;

| Program | Method | Analyte | Matrix | Primary | SOP |
|---|---|---|---|---|---|
| CWP | SM 5220 D-97 | Chemical oxygen demand | NPW | MN | |

**SM 9222 B (LES Endo)-97**

Preparation Techniques: N/A

| Program | Method | Analyte | Matrix | Primary | SOP |
|---|---|---|---|---|---|
| CWP | SM 9222 B (LES Endo)-97 | Total coliforms | NPW | MN | |

**SM 9222 D (m-FC)-97**

Preparation Techniques: N/A

| Program | Method | Analyte | Matrix | Primary | SOP |
|---|---|---|---|---|---|
| CWP | SM 9222 D (m-FC)-97 | Fecal coliforms | NPW | MN | |

## Resource Conservation Recovery Program

**EPA 1613B**

Preparation Techniques: Extraction, automated soxhlet; Extraction, solid phase (SPE); Extraction, separatory funnel liquid-liquid (LLE);

| Program | Method | Analyte | Matrix | Primary | SOP |
|---|---|---|---|---|---|
| RCRP | EPA 1613B | 1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD) | SCM | MN | |
| RCRP | EPA 1613B | 1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD) | TISSUE | MN | |
| RCRP | EPA 1613B | 1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF) | SCM | MN | |
| RCRP | EPA 1613B | 1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF) | TISSUE | MN | |
| RCRP | EPA 1613B | 1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (1,2,3,4,6,7,8-hpcdd) | SCM | MN | |
| RCRP | EPA 1613B | 1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (1,2,3,4,6,7,8-hpcdd) | TISSUE | MN | |
| RCRP | EPA 1613B | 1,2,3,4,6,7,8-Heptachlorodibenzofuran (1,2,3,4,6,7,8-hpcdf) | TISSUE | MN | |
| RCRP | EPA 1613B | 1,2,3,4,6,7,8-Heptachlorodibenzofuran (1,2,3,4,6,7,8-hpcdf) | SCM | MN | |
| RCRP | EPA 1613B | 1,2,3,4,7,8,9-Heptachlorodibenzofuran (1,2,3,4,7,8,9-hpcdf) | SCM | MN | |
| RCRP | EPA 1613B | 1,2,3,4,7,8,9-Heptachlorodibenzofuran (1,2,3,4,7,8,9-hpcdf) | TISSUE | MN | |
| RCRP | EPA 1613B | 1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (1,2,3,4,7,8-Hxcdd) | TISSUE | MN | |
| RCRP | EPA 1613B | 1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (1,2,3,4,7,8-Hxcdd) | SCM | MN | |
| RCRP | EPA 1613B | 1,2,3,4,7,8-Hexachlorodibenzofuran (1,2,3,4,7,8-Hxcdf) | TISSUE | MN | |
| RCRP | EPA 1613B | 1,2,3,4,7,8-Hexachlorodibenzofuran (1,2,3,4,7,8-Hxcdf) | SCM | MN | |
| RCRP | EPA 1613B | 1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin(1,2,3,6,7,8-Hxcdd) | TISSUE | MN | |
| RCRP | EPA 1613B | 1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin(1,2,3,6,7,8-Hxcdd) | SCM | MN | |
| RCRP | EPA 1613B | 1,2,3,6,7,8-Hexachlorodibenzofuran (1,2,3,6,7,8-Hxcdf) | SCM | MN | |

| Program | Method | Analyte | Matrix | Primary | SOP |
|---|---|---|---|---|---|
| RCRP | EPA 1613B | 1,2,3,6,7,8-Hexachlorodibenzofuran (1,2,3,6,7,8-Hxcdf) | TISSUE | MN | |
| RCRP | EPA 1613B | 1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (1,2,3,7,8,9-Hxcdd) | TISSUE | MN | |
| RCRP | EPA 1613B | 1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (1,2,3,7,8,9-Hxcdd) | SCM | MN | |
| RCRP | EPA 1613B | 1,2,3,7,8,9-Hexachlorodibenzofuran (1,2,3,7,8,9-Hxcdf) | TISSUE | MN | |
| RCRP | EPA 1613B | 1,2,3,7,8,9-Hexachlorodibenzofuran (1,2,3,7,8,9-Hxcdf) | SCM | MN | |
| RCRP | EPA 1613B | 1,2,3,7,8-Pentachlorodibenzo-p-dioxin (1,2,3,7,8-Pecdd) | TISSUE | MN | |
| RCRP | EPA 1613B | 1,2,3,7,8-Pentachlorodibenzo-p-dioxin (1,2,3,7,8-Pecdd) | SCM | MN | |
| RCRP | EPA 1613B | 1,2,3,7,8-Pentachlorodibenzofuran (1,2,3,7,8-Pecdf) | TISSUE | MN | |
| RCRP | EPA 1613B | 1,2,3,7,8-Pentachlorodibenzofuran (1,2,3,7,8-Pecdf) | SCM | MN | |
| RCRP | EPA 1613B | 2,3,4,6,7,8-Hexachlorodibenzofuran | SCM | MN | |
| RCRP | EPA 1613B | 2,3,4,6,7,8-Hexachlorodibenzofuran | TISSUE | MN | |
| RCRP | EPA 1613B | 2,3,4,7,8-Pentachlorodibenzofuran | SCM | MN | |
| RCRP | EPA 1613B | 2,3,4,7,8-Pentachlorodibenzofuran | TISSUE | MN | |
| RCRP | EPA 1613B | 2,3,7,8-Tetrachlorodibenzo- p-dioxin (2,3,7,8-TCDD) | SCM | MN | |
| RCRP | EPA 1613B | 2,3,7,8-Tetrachlorodibenzo- p-dioxin (2,3,7,8-TCDD) | TISSUE | MN | |
| RCRP | EPA 1613B | 2,3,7,8-Tetrachlorodibenzofuran | TISSUE | MN | |
| RCRP | EPA 1613B | 2,3,7,8-Tetrachlorodibenzofuran | SCM | MN | |
| RCRP | EPA 1613B | Total HpCDD | TISSUE | MN | |
| RCRP | EPA 1613B | Total HpCDD | SCM | MN | |
| RCRP | EPA 1613B | Total HpCDF | TISSUE | MN | |
| RCRP | EPA 1613B | Total HpCDF | SCM | MN | |
| RCRP | EPA 1613B | Total HxCDD | TISSUE | MN | |
| RCRP | EPA 1613B | Total HxCDD | SCM | MN | |
| RCRP | EPA 1613B | Total HxCDF | TISSUE | MN | |
| RCRP | EPA 1613B | Total HxCDF | SCM | MN | |
| RCRP | EPA 1613B | Total PeCDD | SCM | MN | |
| RCRP | EPA 1613B | Total PeCDD | TISSUE | MN | |
| RCRP | EPA 1613B | Total PeCDF | SCM | MN | |
| RCRP | EPA 1613B | Total PeCDF | TISSUE | MN | |
| RCRP | EPA 1613B | Total TCDD | TISSUE | MN | |
| RCRP | EPA 1613B | Total TCDD | SCM | MN | |

| Program | Method | Analyte | Matrix | Primary | SOP |
|---|---|---|---|---|---|
| RCRP | EPA 1613B | Total TCDF | TISSUE | MN | |
| RCRP | EPA 1613B | Total TCDF | SCM | MN | |

**EPA 1668A**

Preparation Techniques: N/A

| Program | Method | Analyte | Matrix | Primary | SOP |
|---|---|---|---|---|---|
| RCRP | EPA 1668A | 2,2',3,3',4,4',5,5',6-Nonachlorobiphenyl (BZ-206) | SCM | MN | |
| RCRP | EPA 1668A | 2,2',3,3',4,4',5,5',6-Nonachlorobiphenyl (BZ-206) | TISSUE | MN | |
| RCRP | EPA 1668A | 2,2',3,3',4,4',5,5'-Octachlorobiphenyl (BZ-194) | TISSUE | MN | |
| RCRP | EPA 1668A | 2,2',3,3',4,4',5,5'-Octachlorobiphenyl (BZ-194) | SCM | MN | |
| RCRP | EPA 1668A | 2,2',3,3',4,4',5,6'-Octachlorobiphenyl (BZ-196) | TISSUE | MN | |
| RCRP | EPA 1668A | 2,2',3,3',4,4',5,6'-Octachlorobiphenyl (BZ-196) | SCM | MN | |
| RCRP | EPA 1668A | 2,2',3,3',4,4',5,6,6'-Nonachlorobiphenyl (BZ-207) | TISSUE | MN | |
| RCRP | EPA 1668A | 2,2',3,3',4,4',5,6,6'-Nonachlorobiphenyl (BZ-207) | SCM | MN | |
| RCRP | EPA 1668A | 2,2',3,3',4,4',5,6-Octachlorobiphenyl (BZ-195) | TISSUE | MN | |
| RCRP | EPA 1668A | 2,2',3,3',4,4',5,6-Octachlorobiphenyl (BZ-195) | SCM | MN | |
| RCRP | EPA 1668A | 2,2',3,3',4,4',5-Heptachlorobiphenyl (BZ-170) | SCM | MN | |
| RCRP | EPA 1668A | 2,2',3,3',4,4',5-Heptachlorobiphenyl (BZ-170) | TISSUE | MN | |
| RCRP | EPA 1668A | 2,2',3,3',4,5',6'-Heptachlorobiphenyl (BZ-177) | SCM | MN | |
| RCRP | EPA 1668A | 2,2',3,3',4,5',6'-Heptachlorobiphenyl (BZ-177) | TISSUE | MN | |
| RCRP | EPA 1668A | 2,2',3,3',4,5',6,6'-Octachlorobiphenyl (BZ-201) | SCM | MN | |
| RCRP | EPA 1668A | 2,2',3,3',4,5',6,6'-Octachlorobiphenyl (BZ-201) | TISSUE | MN | |
| RCRP | EPA 1668A | 2,2',3,3',4,5',6-Heptachlorobiphenyl (BZ-175) | SCM | MN | |
| RCRP | EPA 1668A | 2,2',3,3',4,5',6-Heptachlorobiphenyl (BZ-175) | TISSUE | MN | |
| RCRP | EPA 1668A | 2,2',3,3',4,5'-Hexachlorobiphenyl (BZ-130) | TISSUE | MN | |
| RCRP | EPA 1668A | 2,2',3,3',4,5'-Hexachlorobiphenyl (BZ-130) | SCM | MN | |

| Program | Method | Analyte | Matrix | Primary | SOP |
|---|---|---|---|---|---|
| RCRP | EPA 1668A | 2,2',3,3',4,5,5',6,6'-Nonachlorobiphenyl (BZ-208) | TISSUE | MN | |
| RCRP | EPA 1668A | 2,2',3,3',4,5,5',6,6'-Nonachlorobiphenyl (BZ-208) | SCM | MN | |
| RCRP | EPA 1668A | 2,2',3,3',4,5,5'-Heptachlorobiphenyl (BZ-172) | SCM | MN | |
| RCRP | EPA 1668A | 2,2',3,3',4,5,5'-Heptachlorobiphenyl (BZ-172) | TISSUE | MN | |
| RCRP | EPA 1668A | 2,2',3,3',4,5,6'-Heptachlorobiphenyl (BZ-174) | TISSUE | MN | |
| RCRP | EPA 1668A | 2,2',3,3',4,5,6'-Heptachlorobiphenyl (BZ-174) | SCM | MN | |
| RCRP | EPA 1668A | 2,2',3,3',4,6'-Hexachlorobiphenyl (BZ-132) | SCM | MN | |
| RCRP | EPA 1668A | 2,2',3,3',4,6'-Hexachlorobiphenyl (BZ-132) | TISSUE | MN | |
| RCRP | EPA 1668A | 2,2',3,3',4,6,6'-Heptachlorobiphenyl (BZ-176) | TISSUE | MN | |
| RCRP | EPA 1668A | 2,2',3,3',4,6,6'-Heptachlorobiphenyl (BZ-176) | SCM | MN | |
| RCRP | EPA 1668A | 2,2',3,3',4,6-Hexachlorobiphenyl (BZ-131) | TISSUE | MN | |
| RCRP | EPA 1668A | 2,2',3,3',4,6-Hexachlorobiphenyl (BZ-131) | SCM | MN | |
| RCRP | EPA 1668A | 2,2',3,3',4-Pentachlorobiphenyl (BZ-82) | SCM | MN | |
| RCRP | EPA 1668A | 2,2',3,3',4-Pentachlorobiphenyl (BZ-82) | TISSUE | MN | |
| RCRP | EPA 1668A | 2,2',3,3',5,5',6,6'-Octachlorobiphenyl (BZ-202) | SCM | MN | |
| RCRP | EPA 1668A | 2,2',3,3',5,5',6,6'-Octachlorobiphenyl (BZ-202) | TISSUE | MN | |
| RCRP | EPA 1668A | 2,2',3,3',5,5',6-Heptachlorobiphenyl (BZ-178) | TISSUE | MN | |
| RCRP | EPA 1668A | 2,2',3,3',5,5',6-Heptachlorobiphenyl (BZ-178) | SCM | MN | |
| RCRP | EPA 1668A | 2,2',3,3',5,5'-Hexachlorobiphenyl (BZ-133) | TISSUE | MN | |
| RCRP | EPA 1668A | 2,2',3,3',5,5'-Hexachlorobiphenyl (BZ-133) | SCM | MN | |
| RCRP | EPA 1668A | 2,2',3,3',5,6,6'-Heptachlorobiphenyl (BZ-179) | TISSUE | MN | |
| RCRP | EPA 1668A | 2,2',3,3',5,6,6'-Heptachlorobiphenyl (BZ-179) | SCM | MN | |
| RCRP | EPA 1668A | 2,2',3,3',5-Pentachlorobiphenyl (BZ-83) | TISSUE | MN | |
| RCRP | EPA 1668A | 2,2',3,3',5-Pentachlorobiphenyl (BZ-83) | SCM | MN | |
| RCRP | EPA 1668A | 2,2',3,3',6,6'-Hexachlorobiphenyl (BZ-136) | TISSUE | MN | |
| RCRP | EPA 1668A | 2,2',3,3',6,6'-Hexachlorobiphenyl (BZ-136) | SCM | MN | |

| Program | Method | Analyte | Matrix | Primary | SOP |
|---|---|---|---|---|---|
| RCRP | EPA 1668A | 2,2',3,3',6-Pentachlorobiphenyl (BZ-84) | SCM | MN | |
| RCRP | EPA 1668A | 2,2',3,3',6-Pentachlorobiphenyl (BZ-84) | TISSUE | MN | |
| RCRP | EPA 1668A | 2,2',3,4',5,5'-Hexachlorobiphenyl (BZ-146) | SCM | MN | |
| RCRP | EPA 1668A | 2,2',3,4',5,5'-Hexachlorobiphenyl (BZ-146) | TISSUE | MN | |
| RCRP | EPA 1668A | 2,2',3,4',5,6'-Hexachlorobiphenyl (BZ-148) | SCM | MN | |
| RCRP | EPA 1668A | 2,2',3,4',5,6'-Hexachlorobiphenyl (BZ-148) | TISSUE | MN | |
| RCRP | EPA 1668A | 2,2',3,4',5,6,6'-Heptachlorobiphenyl (BZ-188) | TISSUE | MN | |
| RCRP | EPA 1668A | 2,2',3,4',5,6,6'-Heptachlorobiphenyl (BZ-188) | SCM | MN | |
| RCRP | EPA 1668A | 2,2',3,4',6,6'-Hexachlorobiphenyl (BZ-150) | TISSUE | MN | |
| RCRP | EPA 1668A | 2,2',3,4',6,6'-Hexachlorobiphenyl (BZ-150) | SCM | MN | |
| RCRP | EPA 1668A | 2,2',3,4'-Tetrachlorobiphenyl (BZ-42) | TISSUE | MN | |
| RCRP | EPA 1668A | 2,2',3,4'-Tetrachlorobiphenyl (BZ-42) | SCM | MN | |
| RCRP | EPA 1668A | 2,2',3,4,4',5,5',6-Octachlorobiphenyl (BZ-203) | TISSUE | MN | |
| RCRP | EPA 1668A | 2,2',3,4,4',5,5',6-Octachlorobiphenyl (BZ-203) | SCM | MN | |
| RCRP | EPA 1668A | 2,2',3,4,4',5,6'-Heptachlorobiphenyl (BZ-182) | SCM | MN | |
| RCRP | EPA 1668A | 2,2',3,4,4',5,6'-Heptachlorobiphenyl (BZ-182) | TISSUE | MN | |
| RCRP | EPA 1668A | 2,2',3,4,4',5,6,6'-Octachlorobiphenyl (BZ-204) | SCM | MN | |
| RCRP | EPA 1668A | 2,2',3,4,4',5,6,6'-Octachlorobiphenyl (BZ-204) | TISSUE | MN | |
| RCRP | EPA 1668A | 2,2',3,4,4',5,6-Heptachlorobiphenyl (BZ-181) | SCM | MN | |
| RCRP | EPA 1668A | 2,2',3,4,4',5,6-Heptachlorobiphenyl (BZ-181) | TISSUE | MN | |
| RCRP | EPA 1668A | 2,2',3,4,4',5-Hexachlorobiphenyl (BZ-137) | SCM | MN | |
| RCRP | EPA 1668A | 2,2',3,4,4',5-Hexachlorobiphenyl (BZ-137) | TISSUE | MN | |
| RCRP | EPA 1668A | 2,2',3,4,4',6,6'-Heptachlorobiphenyl (BZ-184) | SCM | MN | |
| RCRP | EPA 1668A | 2,2',3,4,4',6,6'-Heptachlorobiphenyl (BZ-184) | TISSUE | MN | |
| RCRP | EPA 1668A | 2,2',3,4,5',6-Hexachlorobiphenyl (BZ-144) | TISSUE | MN | |
| RCRP | EPA 1668A | 2,2',3,4,5',6-Hexachlorobiphenyl (BZ-144) | SCM | MN | |

| Program | Method | Analyte | Matrix | Primary | SOP |
|---|---|---|---|---|---|
| RCRP | EPA 1668A | 2,2',3,4,5,5'-Hexachlorobiphenyl (BZ-141) | SCM | MN | |
| RCRP | EPA 1668A | 2,2',3,4,5,5'-Hexachlorobiphenyl (BZ-141) | TISSUE | MN | |
| RCRP | EPA 1668A | 2,2',3,4,5,6,6'-Heptachlorobiphenyl (BZ-186) | SCM | MN | |
| RCRP | EPA 1668A | 2,2',3,4,5,6,6'-Heptachlorobiphenyl (BZ-186) | TISSUE | MN | |
| RCRP | EPA 1668A | 2,2',3,4,5,6-Hexachlorobiphenyl (BZ-142) | SCM | MN | |
| RCRP | EPA 1668A | 2,2',3,4,5,6-Hexachlorobiphenyl (BZ-142) | TISSUE | MN | |
| RCRP | EPA 1668A | 2,2',3,4,6'-Pentachlorobiphenyl (BZ-89) | SCM | MN | |
| RCRP | EPA 1668A | 2,2',3,4,6'-Pentachlorobiphenyl (BZ-89) | TISSUE | MN | |
| RCRP | EPA 1668A | 2,2',3,4,6,6'-Hexachlorobiphenyl (BZ-145) | SCM | MN | |
| RCRP | EPA 1668A | 2,2',3,4,6,6'-Hexachlorobiphenyl (BZ-145) | TISSUE | MN | |
| RCRP | EPA 1668A | 2,2',3,5',6-Pentachlorobiphenyl (BZ-95) | SCM | MN | |
| RCRP | EPA 1668A | 2,2',3,5',6-Pentachlorobiphenyl (BZ-95) | TISSUE | MN | |
| RCRP | EPA 1668A | 2,2',3,5,5'-Pentachlorobiphenyl (BZ-92) | SCM | MN | |
| RCRP | EPA 1668A | 2,2',3,5,5'-Pentachlorobiphenyl (BZ-92) | TISSUE | MN | |
| RCRP | EPA 1668A | 2,2',3,5,6'-Pentachlorobiphenyl (BZ-94) | SCM | MN | |
| RCRP | EPA 1668A | 2,2',3,5,6'-Pentachlorobiphenyl (BZ-94) | TISSUE | MN | |
| RCRP | EPA 1668A | 2,2',3,5,6,6'-Hexachlorobiphenyl (BZ-152) | TISSUE | MN | |
| RCRP | EPA 1668A | 2,2',3,5,6,6'-Hexachlorobiphenyl (BZ-152) | SCM | MN | |
| RCRP | EPA 1668A | 2,2',3,6'-Tetrachlorobiphenyl (BZ-46) | SCM | MN | |
| RCRP | EPA 1668A | 2,2',3,6'-Tetrachlorobiphenyl (BZ-46) | TISSUE | MN | |
| RCRP | EPA 1668A | 2,2',3,6,6'-Pentachlorobiphenyl (BZ-96) | SCM | MN | |
| RCRP | EPA 1668A | 2,2',3,6,6'-Pentachlorobiphenyl (BZ-96) | TISSUE | MN | |
| RCRP | EPA 1668A | 2,2',3-Trichlorobiphenyl (BZ-16) | SCM | MN | |
| RCRP | EPA 1668A | 2,2',3-Trichlorobiphenyl (BZ-16) | TISSUE | MN | |
| RCRP | EPA 1668A | 2,2',4,4',5,6'-Hexachlorobiphenyl (BZ-154) | SCM | MN | |
| RCRP | EPA 1668A | 2,2',4,4',5,6'-Hexachlorobiphenyl (BZ-154) | TISSUE | MN | |
| RCRP | EPA 1668A | 2,2',4,4',5-Pentachlorobiphenyl (BZ-99) | TISSUE | MN | |
| RCRP | EPA 1668A | 2,2',4,4',5-Pentachlorobiphenyl (BZ-99) | SCM | MN | |
| RCRP | EPA 1668A | 2,2',4,4',6,6'-Hexachlorobiphenyl (BZ-155) | TISSUE | MN | |
| RCRP | EPA 1668A | 2,2',4,4',6,6'-Hexachlorobiphenyl (BZ-155) | SCM | MN | |

| Program | Method | Analyte | Matrix | Primary | SOP |
|---|---|---|---|---|---|
| RCRP | EPA 1668A | 2,2',4,5',6-Pentachlorobiphenyl (BZ-103) | SCM | MN | |
| RCRP | EPA 1668A | 2,2',4,5',6-Pentachlorobiphenyl (BZ-103) | TISSUE | MN | |
| RCRP | EPA 1668A | 2,2',4,5-Tetrachlorobiphenyl (BZ-48) | TISSUE | MN | |
| RCRP | EPA 1668A | 2,2',4,5-Tetrachlorobiphenyl (BZ-48) | SCM | MN | |
| RCRP | EPA 1668A | 2,2',4,6,6'-Pentachlorobiphenyl (BZ-104) | TISSUE | MN | |
| RCRP | EPA 1668A | 2,2',4,6,6'-Pentachlorobiphenyl (BZ-104) | SCM | MN | |
| RCRP | EPA 1668A | 2,2',4-Trichlorobiphenyl (BZ-17) | TISSUE | MN | |
| RCRP | EPA 1668A | 2,2',4-Trichlorobiphenyl (BZ-17) | SCM | MN | |
| RCRP | EPA 1668A | 2,2',5,5'-Tetrachlorobiphenyl (BZ-52) | TISSUE | MN | |
| RCRP | EPA 1668A | 2,2',5,5'-Tetrachlorobiphenyl (BZ-52) | SCM | MN | |
| RCRP | EPA 1668A | 2,2',6,6'-Tetrachlorobiphenyl (BZ-54) | TISSUE | MN | |
| RCRP | EPA 1668A | 2,2',6,6'-Tetrachlorobiphenyl (BZ-54) | SCM | MN | |
| RCRP | EPA 1668A | 2,2',6-Trichlorobiphenyl (BZ-19) | SCM | MN | |
| RCRP | EPA 1668A | 2,2',6-Trichlorobiphenyl (BZ-19) | TISSUE | MN | |
| RCRP | EPA 1668A | 2,2'-Dichlorobiphenyl (BZ-4) | SCM | MN | |
| RCRP | EPA 1668A | 2,2'-Dichlorobiphenyl (BZ-4) | TISSUE | MN | |
| RCRP | EPA 1668A | 2,3',4,4',5'-Pentachlorobiphenyl (BZ-123) | NPW | MN | |
| RCRP | EPA 1668A | 2,3',4,4',5'-Pentachlorobiphenyl (BZ-123) | SCM | MN | |
| RCRP | EPA 1668A | 2,3',4,4',5'-Pentachlorobiphenyl (BZ-123) | TISSUE | MN | |
| RCRP | EPA 1668A | 2,3',4,4',5,5'-Hexachlorobiphenyl (BZ-167) | NPW | MN | |
| RCRP | EPA 1668A | 2,3',4,4',5,5'-Hexachlorobiphenyl (BZ-167) | SCM | MN | |
| RCRP | EPA 1668A | 2,3',4,4',5,5'-Hexachlorobiphenyl (BZ-167) | TISSUE | MN | |
| RCRP | EPA 1668A | 2,3',4,4',5-Pentachlorobiphenyl (BZ-118) | SCM | MN | |
| RCRP | EPA 1668A | 2,3',4,4',5-Pentachlorobiphenyl (BZ-118) | NPW | MN | |
| RCRP | EPA 1668A | 2,3',4,4',5-Pentachlorobiphenyl (BZ-118) | TISSUE | MN | |
| RCRP | EPA 1668A | 2,3',4,4'-Tetrachlorobiphenyl (BZ-66) | SCM | MN | |
| RCRP | EPA 1668A | 2,3',4,4'-Tetrachlorobiphenyl (BZ-66) | TISSUE | MN | |
| RCRP | EPA 1668A | 2,3',4,5',6-Pentachlorobiphenyl (BZ-121) | TISSUE | MN | |
| RCRP | EPA 1668A | 2,3',4,5',6-Pentachlorobiphenyl (BZ-121) | SCM | MN | |
| RCRP | EPA 1668A | 2,3',4,5'-Tetrachlorobiphenyl (BZ-68) | TISSUE | MN | |
| RCRP | EPA 1668A | 2,3',4,5'-Tetrachlorobiphenyl (BZ-68) | SCM | MN | |
| RCRP | EPA 1668A | 2,3',4,5,5'-Pentachlorobiphenyl (BZ-120) | TISSUE | MN | |
| RCRP | EPA 1668A | 2,3',4,5,5'-Pentachlorobiphenyl (BZ-120) | SCM | MN | |

| Program | Method | Analyte | Matrix | Primary | SOP |
|---|---|---|---|---|---|
| RCRP | EPA 1668A | 2,3',4,5-Tetrachlorobiphenyl (BZ-67) | SCM | MN | |
| RCRP | EPA 1668A | 2,3',4,5-Tetrachlorobiphenyl (BZ-67) | TISSUE | MN | |
| RCRP | EPA 1668A | 2,3',4-Trichlorobiphenyl (BZ-25) | SCM | MN | |
| RCRP | EPA 1668A | 2,3',4-Trichlorobiphenyl (BZ-25) | TISSUE | MN | |
| RCRP | EPA 1668A | 2,3',5'-Trichlorobiphenyl (BZ-34) | TISSUE | MN | |
| RCRP | EPA 1668A | 2,3',5'-Trichlorobiphenyl (BZ-34) | SCM | MN | |
| RCRP | EPA 1668A | 2,3',5,5'-Tetrachlorobiphenyl (BZ-72) | TISSUE | MN | |
| RCRP | EPA 1668A | 2,3',5,5'-Tetrachlorobiphenyl (BZ-72) | SCM | MN | |
| RCRP | EPA 1668A | 2,3',6-Trichlorobiphenyl (BZ-27) | TISSUE | MN | |
| RCRP | EPA 1668A | 2,3',6-Trichlorobiphenyl (BZ-27) | SCM | MN | |
| RCRP | EPA 1668A | 2,3'-Dichlorobiphenyl (BZ-6) | SCM | MN | |
| RCRP | EPA 1668A | 2,3'-Dichlorobiphenyl (BZ-6) | TISSUE | MN | |
| RCRP | EPA 1668A | 2,3,3',4',5',6-Hexachlorobiphenyl (BZ-164) | SCM | MN | |
| RCRP | EPA 1668A | 2,3,3',4',5',6-Hexachlorobiphenyl (BZ-164) | TISSUE | MN | |
| RCRP | EPA 1668A | 2,3,3',4',5'-Pentachlorobiphenyl (BZ-122) | SCM | MN | |
| RCRP | EPA 1668A | 2,3,3',4',5'-Pentachlorobiphenyl (BZ-122) | TISSUE | MN | |
| RCRP | EPA 1668A | 2,3,3',4',5,5'-Hexachlorobiphenyl (BZ-162) | SCM | MN | |
| RCRP | EPA 1668A | 2,3,3',4',5,5'-Hexachlorobiphenyl (BZ-162) | TISSUE | MN | |
| RCRP | EPA 1668A | 2,3,3',4'-Tetrachlorobiphenyl (BZ-56) | SCM | MN | |
| RCRP | EPA 1668A | 2,3,3',4'-Tetrachlorobiphenyl (BZ-56) | TISSUE | MN | |
| RCRP | EPA 1668A | 2,3,3',4,4',5',6-Heptachlorobiphenyl (BZ-191) | SCM | MN | |
| RCRP | EPA 1668A | 2,3,3',4,4',5',6-Heptachlorobiphenyl (BZ-191) | TISSUE | MN | |
| RCRP | EPA 1668A | 2,3,3',4,4',5'-Hexachlorobiphenyl (BZ-157) | NPW | MN | |
| RCRP | EPA 1668A | 2,3,3',4,4',5'-Hexachlorobiphenyl (BZ-157) | SCM | MN | |
| RCRP | EPA 1668A | 2,3,3',4,4',5,5',6-Octachlorobiphenyl (BZ-205) | TISSUE | MN | |
| RCRP | EPA 1668A | 2,3,3',4,4',5,5',6-Octachlorobiphenyl (BZ-205) | SCM | MN | |
| RCRP | EPA 1668A | 2,3,3',4,4',5,5'-Heptachlorobiphenyl (BZ-189) | TISSUE | MN | |
| RCRP | EPA 1668A | 2,3,3',4,4',5,5'-Heptachlorobiphenyl (BZ-189) | NPW | MN | |
| RCRP | EPA 1668A | 2,3,3',4,4',5,5'-Heptachlorobiphenyl (BZ-189) | SCM | MN | |

| Program | Method | Analyte | Matrix | Primary | SOP |
|---|---|---|---|---|---|
| RCRP | EPA 1668A | 2,3,3',4,4',5,6-Heptachlorobiphenyl (BZ-190) | SCM | MN | |
| RCRP | EPA 1668A | 2,3,3',4,4',5,6-Heptachlorobiphenyl (BZ-190) | TISSUE | MN | |
| RCRP | EPA 1668A | 2,3,3',4,4',5-Hexachlorobiphenyl (BZ-156) | NPW | MN | |
| RCRP | EPA 1668A | 2,3,3',4,4',5-Hexachlorobiphenyl (BZ-156) | SCM | MN | |
| RCRP | EPA 1668A | 2,3,3',4,4',6-Hexachlorobiphenyl (BZ-158) | TISSUE | MN | |
| RCRP | EPA 1668A | 2,3,3',4,4',6-Hexachlorobiphenyl (BZ-158) | SCM | MN | |
| RCRP | EPA 1668A | 2,3,3',4,4'-Pentachlorobiphenyl (BZ-105) | SCM | MN | |
| RCRP | EPA 1668A | 2,3,3',4,4'-Pentachlorobiphenyl (BZ-105) | TISSUE | MN | |
| RCRP | EPA 1668A | 2,3,3',4,4'-Pentachlorobiphenyl (BZ-105) | NPW | MN | |
| RCRP | EPA 1668A | 2,3,3',4,5',6-Hexachlorobiphenyl (BZ-161) | SCM | MN | |
| RCRP | EPA 1668A | 2,3,3',4,5',6-Hexachlorobiphenyl (BZ-161) | TISSUE | MN | |
| RCRP | EPA 1668A | 2,3,3',4,5,5',6-Heptachlorobiphenyl (BZ-192) | SCM | MN | |
| RCRP | EPA 1668A | 2,3,3',4,5,5',6-Heptachlorobiphenyl (BZ-192) | TISSUE | MN | |
| RCRP | EPA 1668A | 2,3,3',4,5,5'-Hexachlorobiphenyl (BZ-159) | TISSUE | MN | |
| RCRP | EPA 1668A | 2,3,3',4,5,5'-Hexachlorobiphenyl (BZ-159) | SCM | MN | |
| RCRP | EPA 1668A | 2,3,3',4,5,6-Hexachlorobiphenyl (BZ-160) | SCM | MN | |
| RCRP | EPA 1668A | 2,3,3',4,5,6-Hexachlorobiphenyl (BZ-160) | TISSUE | MN | |
| RCRP | EPA 1668A | 2,3,3',4,5-Pentachlorobiphenyl (BZ-106) | TISSUE | MN | |
| RCRP | EPA 1668A | 2,3,3',4,5-Pentachlorobiphenyl (BZ-106) | SCM | MN | |
| RCRP | EPA 1668A | 2,3,3',4,6-Pentachlorobiphenyl (BZ-109) | TISSUE | MN | |
| RCRP | EPA 1668A | 2,3,3',4,6-Pentachlorobiphenyl (BZ-109) | SCM | MN | |
| RCRP | EPA 1668A | 2,3,3',4-Tetrachlorobiphenyl (BZ-55) | SCM | MN | |
| RCRP | EPA 1668A | 2,3,3',4-Tetrachlorobiphenyl (BZ-55) | TISSUE | MN | |
| RCRP | EPA 1668A | 2,3,3',5'-Tetrachlorobiphenyl (BZ-58) | TISSUE | MN | |
| RCRP | EPA 1668A | 2,3,3',5'-Tetrachlorobiphenyl (BZ-58) | SCM | MN | |
| RCRP | EPA 1668A | 2,3,3',5,5',6-Hexachlorobiphenyl (BZ-165) | SCM | MN | |
| RCRP | EPA 1668A | 2,3,3',5,5',6-Hexachlorobiphenyl (BZ-165) | TISSUE | MN | |
| RCRP | EPA 1668A | 2,3,3',5,5'-Pentachlorobiphenyl (BZ-111) | TISSUE | MN | |
| RCRP | EPA 1668A | 2,3,3',5,5'-Pentachlorobiphenyl (BZ-111) | SCM | MN | |

| Program | Method | Analyte | Matrix | Primary | SOP |
|---|---|---|---|---|---|
| RCRP | EPA 1668A | 2,3,3',5,6-Pentachlorobiphenyl (BZ-112) | SCM | MN | |
| RCRP | EPA 1668A | 2,3,3',5,6-Pentachlorobiphenyl (BZ-112) | TISSUE | MN | |
| RCRP | EPA 1668A | 2,3,3',5-Tetrachlorobiphenyl (BZ-57) | SCM | MN | |
| RCRP | EPA 1668A | 2,3,3',5-Tetrachlorobiphenyl (BZ-57) | TISSUE | MN | |
| RCRP | EPA 1668A | 2,3,4',5-Tetrachlorobiphenyl (BZ-63) | TISSUE | MN | |
| RCRP | EPA 1668A | 2,3,4',5-Tetrachlorobiphenyl (BZ-63) | SCM | MN | |
| RCRP | EPA 1668A | 2,3,4',6-Tetrachlorobiphenyl (BZ-64) | TISSUE | MN | |
| RCRP | EPA 1668A | 2,3,4',6-Tetrachlorobiphenyl (BZ-64) | SCM | MN | |
| RCRP | EPA 1668A | 2,3,4'-Trichlorobiphenyl (BZ-22) | TISSUE | MN | |
| RCRP | EPA 1668A | 2,3,4'-Trichlorobiphenyl (BZ-22) | SCM | MN | |
| RCRP | EPA 1668A | 2,3,4,4',5-Pentachlorobiphenyl (BZ-114) | NPW | MN | |
| RCRP | EPA 1668A | 2,3,4,4',5-Pentachlorobiphenyl (BZ-114) | SCM | MN | |
| RCRP | EPA 1668A | 2,3,4,4',5-Pentachlorobiphenyl (BZ-114) | TISSUE | MN | |
| RCRP | EPA 1668A | 2,3,4,4'-Tetrachlorobiphenyl (BZ-60) | SCM | MN | |
| RCRP | EPA 1668A | 2,3,4,4'-Tetrachlorobiphenyl (BZ-60) | TISSUE | MN | |
| RCRP | EPA 1668A | 2,3,5-Trichlorobiphenyl (BZ-23) | TISSUE | MN | |
| RCRP | EPA 1668A | 2,3,5-Trichlorobiphenyl (BZ-23) | SCM | MN | |
| RCRP | EPA 1668A | 2,3,6-Trichlorobiphenyl (BZ-24) | SCM | MN | |
| RCRP | EPA 1668A | 2,3,6-Trichlorobiphenyl (BZ-24) | TISSUE | MN | |
| RCRP | EPA 1668A | 2,3-Dichlorobiphenyl (BZ-5) | SCM | MN | |
| RCRP | EPA 1668A | 2,3-Dichlorobiphenyl (BZ-5) | TISSUE | MN | |
| RCRP | EPA 1668A | 2,4',5-Trichlorobiphenyl (BZ-31) | TISSUE | MN | |
| RCRP | EPA 1668A | 2,4',5-Trichlorobiphenyl (BZ-31) | SCM | MN | |
| RCRP | EPA 1668A | 2,4',6-Trichlorobiphenyl (BZ-32) | SCM | MN | |
| RCRP | EPA 1668A | 2,4',6-Trichlorobiphenyl (BZ-32) | TISSUE | MN | |
| RCRP | EPA 1668A | 2,4'-Dichlorobiphenyl (BZ-8) | TISSUE | MN | |
| RCRP | EPA 1668A | 2,4'-Dichlorobiphenyl (BZ-8) | SCM | MN | |
| RCRP | EPA 1668A | 2,4-Dichlorobiphenyl (BZ-7) | TISSUE | MN | |
| RCRP | EPA 1668A | 2,4-Dichlorobiphenyl (BZ-7) | SCM | MN | |
| RCRP | EPA 1668A | 2,5-Dichlorobiphenyl (BZ-9) | SCM | MN | |
| RCRP | EPA 1668A | 2,5-Dichlorobiphenyl (BZ-9) | TISSUE | MN | |
| RCRP | EPA 1668A | 2,6-Dichlorobiphenyl (BZ-10) | SCM | MN | |
| RCRP | EPA 1668A | 2,6-Dichlorobiphenyl (BZ-10) | TISSUE | MN | |
| RCRP | EPA 1668A | 2-Chlorobiphenyl (BZ-1) | SCM | MN | |
| RCRP | EPA 1668A | 2-Chlorobiphenyl (BZ-1) | TISSUE | MN | |
| RCRP | EPA 1668A | 3,3',4,4',5,5'-Hexachlorobiphenyl (BZ-169) | TISSUE | MN | |

| Program | Method | Analyte | Matrix | Primary | SOP |
|---|---|---|---|---|---|
| RCRP | EPA 1668A | 3,3',4,4',5,5'-Hexachlorobiphenyl (BZ-169) | NPW | MN | |
| RCRP | EPA 1668A | 3,3',4,4',5,5'-Hexachlorobiphenyl (BZ-169) | SCM | MN | |
| RCRP | EPA 1668A | 3,3',4,4',5-Pentachlorobiphenyl (BZ-126) | TISSUE | MN | |
| RCRP | EPA 1668A | 3,3',4,4',5-Pentachlorobiphenyl (BZ-126) | NPW | MN | |
| RCRP | EPA 1668A | 3,3',4,4',5-Pentachlorobiphenyl (BZ-126) | SCM | MN | |
| RCRP | EPA 1668A | 3,3',4,4'-Tetrachlorobiphenyl (BZ-77) | NPW | MN | |
| RCRP | EPA 1668A | 3,3',4,4'-Tetrachlorobiphenyl (BZ-77) | SCM | MN | |
| RCRP | EPA 1668A | 3,3',4,4'-Tetrachlorobiphenyl (BZ-77) | TISSUE | MN | |
| RCRP | EPA 1668A | 3,3',4,5'-Tetrachlorobiphenyl (BZ-79) | SCM | MN | |
| RCRP | EPA 1668A | 3,3',4,5'-Tetrachlorobiphenyl (BZ-79) | TISSUE | MN | |
| RCRP | EPA 1668A | 3,3',4,5,5'-Pentachlorobiphenyl (BZ-127) | SCM | MN | |
| RCRP | EPA 1668A | 3,3',4,5,5'-Pentachlorobiphenyl (BZ-127) | TISSUE | MN | |
| RCRP | EPA 1668A | 3,3',4,5-Tetrachlorobiphenyl (BZ-78) | SCM | MN | |
| RCRP | EPA 1668A | 3,3',4,5-Tetrachlorobiphenyl (BZ-78) | TISSUE | MN | |
| RCRP | EPA 1668A | 3,3',4-Trichlorobiphenyl (BZ-35) | TISSUE | MN | |
| RCRP | EPA 1668A | 3,3',4-Trichlorobiphenyl (BZ-35) | SCM | MN | |
| RCRP | EPA 1668A | 3,3',5,5'-Tetrachlorobiphenyl (BZ-80) | SCM | MN | |
| RCRP | EPA 1668A | 3,3',5,5'-Tetrachlorobiphenyl (BZ-80) | TISSUE | MN | |
| RCRP | EPA 1668A | 3,3',5-Trichlorobiphenyl (BZ-36) | TISSUE | MN | |
| RCRP | EPA 1668A | 3,3',5-Trichlorobiphenyl (BZ-36) | SCM | MN | |
| RCRP | EPA 1668A | 3,3'-Dichlorobiphenyl (BZ-11) | TISSUE | MN | |
| RCRP | EPA 1668A | 3,3'-Dichlorobiphenyl (BZ-11) | SCM | MN | |
| RCRP | EPA 1668A | 3,4',5-Trichlorobiphenyl (BZ-39) | TISSUE | MN | |
| RCRP | EPA 1668A | 3,4',5-Trichlorobiphenyl (BZ-39) | SCM | MN | |
| RCRP | EPA 1668A | 3,4,4',5-Tetrachlorobiphenyl (BZ-81) | NPW | MN | |
| RCRP | EPA 1668A | 3,4,4',5-Tetrachlorobiphenyl (BZ-81) | TISSUE | MN | |
| RCRP | EPA 1668A | 3,4,4',5-Tetrachlorobiphenyl (BZ-81) | SCM | MN | |
| RCRP | EPA 1668A | 3,4,4'-Trichlorobiphenyl (BZ-37) | TISSUE | MN | |
| RCRP | EPA 1668A | 3,4,4'-Trichlorobiphenyl (BZ-37) | SCM | MN | |
| RCRP | EPA 1668A | 3,4,5-Trichlorobiphenyl (BZ-38) | TISSUE | MN | |
| RCRP | EPA 1668A | 3,4,5-Trichlorobiphenyl (BZ-38) | SCM | MN | |
| RCRP | EPA 1668A | 3,5-Dichlorobiphenyl (BZ-14) | TISSUE | MN | |
| RCRP | EPA 1668A | 3,5-Dichlorobiphenyl (BZ-14) | SCM | MN | |
| RCRP | EPA 1668A | 3-Chlorobiphenyl (BZ-2) | TISSUE | MN | |
| RCRP | EPA 1668A | 3-Chlorobiphenyl (BZ-2) | SCM | MN | |

| Program | Method | Analyte | Matrix | Primary | SOP |
|---|---|---|---|---|---|
| RCRP | EPA 1668A | 4,4'-Dichlorobiphenyl (BZ-15) | SCM | MN | |
| RCRP | EPA 1668A | 4,4'-Dichlorobiphenyl (BZ-15) | TISSUE | MN | |
| RCRP | EPA 1668A | 4-Chlorobiphenyl (BZ-3) | SCM | MN | |
| RCRP | EPA 1668A | 4-Chlorobiphenyl (BZ-3) | TISSUE | MN | |
| RCRP | EPA 1668A | Decachlorobiphenyl (BZ-209) | SCM | MN | |
| RCRP | EPA 1668A | Decachlorobiphenyl (BZ-209) | TISSUE | MN | |
| RCRP | EPA 1668A | PCB-(100/93/102/98) | SCM | MN | |
| RCRP | EPA 1668A | PCB-(100/93/102/98) | TISSUE | MN | |
| RCRP | EPA 1668A | PCB-(107/124) | TISSUE | MN | |
| RCRP | EPA 1668A | PCB-(107/124) | SCM | MN | |
| RCRP | EPA 1668A | PCB-(108/119/86/97/125/87) | TISSUE | MN | |
| RCRP | EPA 1668A | PCB-(108/119/86/97/125/87) | SCM | MN | |
| RCRP | EPA 1668A | PCB-(110/115) | TISSUE | MN | |
| RCRP | EPA 1668A | PCB-(110/115) | SCM | MN | |
| RCRP | EPA 1668A | PCB-(113/90/101) | SCM | MN | |
| RCRP | EPA 1668A | PCB-(113/90/101) | TISSUE | MN | |
| RCRP | EPA 1668A | PCB-(117/116/85) | TISSUE | MN | |
| RCRP | EPA 1668A | PCB-(117/116/85) | SCM | MN | |
| RCRP | EPA 1668A | PCB-(128/166) | TISSUE | MN | |
| RCRP | EPA 1668A | PCB-(128/166) | SCM | MN | |
| RCRP | EPA 1668A | PCB-(13/12) | SCM | MN | |
| RCRP | EPA 1668A | PCB-(13/12) | TISSUE | MN | |
| RCRP | EPA 1668A | PCB-(134/143) | SCM | MN | |
| RCRP | EPA 1668A | PCB-(134/143) | TISSUE | MN | |
| RCRP | EPA 1668A | PCB-(138/163/129) | SCM | MN | |
| RCRP | EPA 1668A | PCB-(138/163/129) | TISSUE | MN | |
| RCRP | EPA 1668A | PCB-(139/140) | SCM | MN | |
| RCRP | EPA 1668A | PCB-(139/140) | TISSUE | MN | |
| RCRP | EPA 1668A | PCB-(147/149) | SCM | MN | |
| RCRP | EPA 1668A | PCB-(147/149) | TISSUE | MN | |
| RCRP | EPA 1668A | PCB-(151/135) | TISSUE | MN | |
| RCRP | EPA 1668A | PCB-(151/135) | SCM | MN | |
| RCRP | EPA 1668A | PCB-(153/168) | TISSUE | MN | |
| RCRP | EPA 1668A | PCB-(153/168) | SCM | MN | |
| RCRP | EPA 1668A | PCB-(156/157) | TISSUE | MN | |
| RCRP | EPA 1668A | PCB-(156/157) | SCM | MN | |

| Program | Method | Analyte | Matrix | Primary | SOP |
|---|---|---|---|---|---|
| RCRP | EPA 1668A | PCB-(171/173) | SCM | MN | |
| RCRP | EPA 1668A | PCB-(171/173) | TISSUE | MN | |
| RCRP | EPA 1668A | PCB-(180/193) | TISSUE | MN | |
| RCRP | EPA 1668A | PCB-(180/193) | SCM | MN | |
| RCRP | EPA 1668A | PCB-(183/185) | SCM | MN | |
| RCRP | EPA 1668A | PCB-(183/185) | TISSUE | MN | |
| RCRP | EPA 1668A | PCB-(197/200) | TISSUE | MN | |
| RCRP | EPA 1668A | PCB-(197/200) | SCM | MN | |
| RCRP | EPA 1668A | PCB-(198/199) | TISSUE | MN | |
| RCRP | EPA 1668A | PCB-(198/199) | SCM | MN | |
| RCRP | EPA 1668A | PCB-(21/33) | SCM | MN | |
| RCRP | EPA 1668A | PCB-(21/33) | TISSUE | MN | |
| RCRP | EPA 1668A | PCB-(26/29) | SCM | MN | |
| RCRP | EPA 1668A | PCB-(26/29) | TISSUE | MN | |
| RCRP | EPA 1668A | PCB-(28/20) | TISSUE | MN | |
| RCRP | EPA 1668A | PCB-(28/20) | SCM | MN | |
| RCRP | EPA 1668A | PCB-(30/18) | SCM | MN | |
| RCRP | EPA 1668A | PCB-(30/18) | TISSUE | MN | |
| RCRP | EPA 1668A | PCB-(41/40/71) | TISSUE | MN | |
| RCRP | EPA 1668A | PCB-(41/40/71) | SCM | MN | |
| RCRP | EPA 1668A | PCB-(44/47/65) | SCM | MN | |
| RCRP | EPA 1668A | PCB-(44/47/65) | TISSUE | MN | |
| RCRP | EPA 1668A | PCB-(45/51) | SCM | MN | |
| RCRP | EPA 1668A | PCB-(45/51) | TISSUE | MN | |
| RCRP | EPA 1668A | PCB-(50/53) | SCM | MN | |
| RCRP | EPA 1668A | PCB-(50/53) | TISSUE | MN | |
| RCRP | EPA 1668A | PCB-(59/62/75) | TISSUE | MN | |
| RCRP | EPA 1668A | PCB-(59/62/75) | SCM | MN | |
| RCRP | EPA 1668A | PCB-(61/70/74/76) | SCM | MN | |
| RCRP | EPA 1668A | PCB-(61/70/74/76) | TISSUE | MN | |
| RCRP | EPA 1668A | PCB-(69/49) | TISSUE | MN | |
| RCRP | EPA 1668A | PCB-(69/49) | SCM | MN | |
| RCRP | EPA 1668A | PCB-(73/43) | SCM | MN | |
| RCRP | EPA 1668A | PCB-(73/43) | TISSUE | MN | |
| RCRP | EPA 1668A | PCB-(88/91) | SCM | MN | |
| RCRP | EPA 1668A | PCB-(88/91) | TISSUE | MN | |

**EPA 6010B**

Preparation Techniques: Digestion, hotplate or HotBlock; Extraction, EPA 1311 TCLP, non-volatiles; Extraction, EPA 1312 SPLP, non-volatiles;

| Program | Method | Analyte | Matrix | Primary | SOP |
|---|---|---|---|---|---|
| RCRP | EPA 6010B | Aluminum | SCM | MN | |
| RCRP | EPA 6010B | Aluminum | NPW | MN | |
| RCRP | EPA 6010B | Antimony | NPW | MN | |
| RCRP | EPA 6010B | Antimony | SCM | MN | |
| RCRP | EPA 6010B | Arsenic | SCM | MN | |
| RCRP | EPA 6010B | Arsenic | NPW | MN | |
| RCRP | EPA 6010B | Barium | SCM | MN | |
| RCRP | EPA 6010B | Barium | NPW | MN | |
| RCRP | EPA 6010B | Beryllium | NPW | MN | |
| RCRP | EPA 6010B | Beryllium | SCM | MN | |
| RCRP | EPA 6010B | Boron | SCM | MN | |
| RCRP | EPA 6010B | Boron | NPW | MN | |
| RCRP | EPA 6010B | Cadmium | SCM | MN | |
| RCRP | EPA 6010B | Cadmium | NPW | MN | |
| RCRP | EPA 6010B | Calcium | NPW | MN | |
| RCRP | EPA 6010B | Calcium | SCM | MN | |
| RCRP | EPA 6010B | Chromium | SCM | MN | |
| RCRP | EPA 6010B | Cobalt | NPW | MN | |
| RCRP | EPA 6010B | Cobalt | SCM | MN | |
| RCRP | EPA 6010B | Copper | SCM | MN | |
| RCRP | EPA 6010B | Copper | NPW | MN | |
| RCRP | EPA 6010B | Iron | NPW | MN | |
| RCRP | EPA 6010B | Iron | SCM | MN | |
| RCRP | EPA 6010B | Lead | SCM | MN | |
| RCRP | EPA 6010B | Lead | NPW | MN | |
| RCRP | EPA 6010B | Magnesium | NPW | MN | |
| RCRP | EPA 6010B | Magnesium | SCM | MN | |
| RCRP | EPA 6010B | Manganese | NPW | MN | |
| RCRP | EPA 6010B | Manganese | SCM | MN | |
| RCRP | EPA 6010B | Molybdenum | SCM | MN | |
| RCRP | EPA 6010B | Molybdenum | NPW | MN | |
| RCRP | EPA 6010B | Nickel | NPW | MN | |
| RCRP | EPA 6010B | Nickel | SCM | MN | |

| Program | Method | Analyte | Matrix | Primary | SOP |
|---|---|---|---|---|---|
| RCRP | EPA 6010B | Potassium | SCM | MN | |
| RCRP | EPA 6010B | Potassium | NPW | MN | |
| RCRP | EPA 6010B | Selenium | NPW | MN | |
| RCRP | EPA 6010B | Selenium | SCM | MN | |
| RCRP | EPA 6010B | Silver | SCM | MN | |
| RCRP | EPA 6010B | Silver | NPW | MN | |
| RCRP | EPA 6010B | Sodium | SCM | MN | |
| RCRP | EPA 6010B | Sodium | NPW | MN | |
| RCRP | EPA 6010B | Thallium | NPW | MN | |
| RCRP | EPA 6010B | Thallium | SCM | MN | |
| RCRP | EPA 6010B | Tin | NPW | MN | |
| RCRP | EPA 6010B | Tin | SCM | MN | |
| RCRP | EPA 6010B | Titanium | NPW | MN | |
| RCRP | EPA 6010B | Titanium | SCM | MN | |
| RCRP | EPA 6010B | Total chromium | NPW | MN | |
| RCRP | EPA 6010B | Vanadium | NPW | MN | |
| RCRP | EPA 6010B | Vanadium | SCM | MN | |
| RCRP | EPA 6010B | Zinc | SCM | MN | |
| RCRP | EPA 6010B | Zinc | NPW | MN | |

**EPA 6010C**

Preparation Techniques: Extraction, EPA 1312 SPLP, non-volatiles; Digestion, hotplate or HotBlock; Extraction, EPA 1311 TCLP, non-volatiles;

| Program | Method | Analyte | Matrix | Primary | SOP |
|---|---|---|---|---|---|
| RCRP | EPA 6010C | Aluminum | NPW | MN | |
| RCRP | EPA 6010C | Aluminum | SCM | MN | |
| RCRP | EPA 6010C | Antimony | SCM | MN | |
| RCRP | EPA 6010C | Antimony | NPW | MN | |
| RCRP | EPA 6010C | Arsenic | NPW | MN | |
| RCRP | EPA 6010C | Arsenic | SCM | MN | |
| RCRP | EPA 6010C | Barium | NPW | MN | |
| RCRP | EPA 6010C | Barium | SCM | MN | |
| RCRP | EPA 6010C | Beryllium | NPW | MN | |
| RCRP | EPA 6010C | Beryllium | SCM | MN | |
| RCRP | EPA 6010C | Boron | NPW | MN | |

| Program | Method | Analyte | Matrix | Primary | SOP |
|---|---|---|---|---|---|
| RCRP | EPA 6010C | Boron | SCM | MN | |
| RCRP | EPA 6010C | Cadmium | NPW | MN | |
| RCRP | EPA 6010C | Cadmium | SCM | MN | |
| RCRP | EPA 6010C | Calcium | SCM | MN | |
| RCRP | EPA 6010C | Calcium | NPW | MN | |
| RCRP | EPA 6010C | Chromium | NPW | MN | |
| RCRP | EPA 6010C | Chromium | SCM | MN | |
| RCRP | EPA 6010C | Cobalt | SCM | MN | |
| RCRP | EPA 6010C | Cobalt | NPW | MN | |
| RCRP | EPA 6010C | Copper | NPW | MN | |
| RCRP | EPA 6010C | Copper | SCM | MN | |
| RCRP | EPA 6010C | Iron | SCM | MN | |
| RCRP | EPA 6010C | Iron | NPW | MN | |
| RCRP | EPA 6010C | Lead | SCM | MN | |
| RCRP | EPA 6010C | Lead | NPW | MN | |
| RCRP | EPA 6010C | Magnesium | SCM | MN | |
| RCRP | EPA 6010C | Magnesium | NPW | MN | |
| RCRP | EPA 6010C | Manganese | SCM | MN | |
| RCRP | EPA 6010C | Manganese | NPW | MN | |
| RCRP | EPA 6010C | Molybdenum | SCM | MN | |
| RCRP | EPA 6010C | Molybdenum | NPW | MN | |
| RCRP | EPA 6010C | Nickel | SCM | MN | |
| RCRP | EPA 6010C | Nickel | NPW | MN | |
| RCRP | EPA 6010C | Potassium | SCM | MN | |
| RCRP | EPA 6010C | Potassium | NPW | MN | |
| RCRP | EPA 6010C | Selenium | NPW | MN | |
| RCRP | EPA 6010C | Selenium | SCM | MN | |
| RCRP | EPA 6010C | Silver | SCM | MN | |
| RCRP | EPA 6010C | Silver | NPW | MN | |
| RCRP | EPA 6010C | Sodium | NPW | MN | |
| RCRP | EPA 6010C | Sodium | SCM | MN | |
| RCRP | EPA 6010C | Thallium | NPW | MN | |
| RCRP | EPA 6010C | Thallium | SCM | MN | |
| RCRP | EPA 6010C | Tin | NPW | MN | |
| RCRP | EPA 6010C | Tin | SCM | MN | |
| RCRP | EPA 6010C | Titanium | NPW | MN | |

| Program | Method | Analyte | Matrix | Primary | SOP |
|---|---|---|---|---|---|
| RCRP | EPA 6010C | Titanium | SCM | MN | |
| RCRP | EPA 6010C | Vanadium | SCM | MN | |
| RCRP | EPA 6010C | Vanadium | NPW | MN | |
| RCRP | EPA 6010C | Zinc | NPW | MN | |
| RCRP | EPA 6010C | Zinc | SCM | MN | |

**EPA 6020**

Preparation Techniques: Digestion, hotplate or HotBlock; Extraction, EPA 1312 SPLP, non-volatiles; Extraction, EPA 1311 TCLP, non-volatiles;

| Program | Method | Analyte | Matrix | Primary | SOP |
|---|---|---|---|---|---|
| RCRP | EPA 6020 | Aluminum | NPW | MN | |
| RCRP | EPA 6020 | Aluminum | SCM | MN | |
| RCRP | EPA 6020 | Antimony | SCM | MN | |
| RCRP | EPA 6020 | Antimony | NPW | MN | |
| RCRP | EPA 6020 | Arsenic | NPW | MN | |
| RCRP | EPA 6020 | Arsenic | SCM | MN | |
| RCRP | EPA 6020 | Barium | SCM | MN | |
| RCRP | EPA 6020 | Barium | NPW | MN | |
| RCRP | EPA 6020 | Beryllium | NPW | MN | |
| RCRP | EPA 6020 | Beryllium | SCM | MN | |
| RCRP | EPA 6020 | Cadmium | SCM | MN | |
| RCRP | EPA 6020 | Cadmium | NPW | MN | |
| RCRP | EPA 6020 | Calcium | NPW | MN | User Defined S-MN-I-492 Rev. 16 |
| RCRP | EPA 6020 | Calcium | SCM | MN | User Defined S-MN-I-492 Rev. 16 |
| RCRP | EPA 6020 | Chromium | SCM | MN | |
| RCRP | EPA 6020 | Cobalt | SCM | MN | |
| RCRP | EPA 6020 | Cobalt | NPW | MN | |
| RCRP | EPA 6020 | Copper | SCM | MN | |
| RCRP | EPA 6020 | Copper | NPW | MN | |
| RCRP | EPA 6020 | Iron | SCM | MN | User Defined S-MN-I-492 Rev. 16 |
| RCRP | EPA 6020 | Iron | NPW | MN | User Defined S-MN-I-492 Rev. 16 |
| RCRP | EPA 6020 | Lead | NPW | MN | |
| RCRP | EPA 6020 | Lead | SCM | MN | |
| RCRP | EPA 6020 | Magnesium | SCM | MN | User Defined S-MN-I-492 Rev. 16 |
| RCRP | EPA 6020 | Magnesium | NPW | MN | User Defined S-MN-I-492 Rev. 16 |

| Program | Method | Analyte | Matrix | Primary | SOP |
|---|---|---|---|---|---|
| RCRP | EPA 6020 | Manganese | SCM | MN | |
| RCRP | EPA 6020 | Manganese | NPW | MN | |
| RCRP | EPA 6020 | Molybdenum | NPW | MN | User Defined S-MN-I-492 Rev. 16 |
| RCRP | EPA 6020 | Molybdenum | SCM | MN | User Defined S-MN-I-492 Rev. 16 |
| RCRP | EPA 6020 | Nickel | NPW | MN | |
| RCRP | EPA 6020 | Nickel | SCM | MN | |
| RCRP | EPA 6020 | Potassium | SCM | MN | User Defined S-MN-I-492 Rev. 16 |
| RCRP | EPA 6020 | Potassium | NPW | MN | User Defined S-MN-I-492 Rev. 16 |
| RCRP | EPA 6020 | Selenium | NPW | MN | User Defined S-MN-I-492 Rev. 16 |
| RCRP | EPA 6020 | Selenium | SCM | MN | User Defined S-MN-I-492 Rev. 16 |
| RCRP | EPA 6020 | Silver | SCM | MN | |
| RCRP | EPA 6020 | Silver | NPW | MN | |
| RCRP | EPA 6020 | Sodium | SCM | MN | User Defined S-MN-I-492 Rev. 16 |
| RCRP | EPA 6020 | Sodium | NPW | MN | User Defined S-MN-I-492 Rev. 16 |
| RCRP | EPA 6020 | Strontium | SCM | MN | User Defined S-MN-I-492 Rev. 16 |
| RCRP | EPA 6020 | Strontium | NPW | MN | User Defined S-MN-I-492 Rev. 16 |
| RCRP | EPA 6020 | Thallium | NPW | MN | |
| RCRP | EPA 6020 | Thallium | SCM | MN | |
| RCRP | EPA 6020 | Tin | SCM | MN | User Defined S-MN-I-492 Rev. 16 |
| RCRP | EPA 6020 | Tin | NPW | MN | User Defined S-MN-I-492 Rev. 16 |
| RCRP | EPA 6020 | Titanium | SCM | MN | User Defined S-MN-I-492 Rev. 16 |
| RCRP | EPA 6020 | Titanium | NPW | MN | User Defined S-MN-I-492 Rev. 16 |
| RCRP | EPA 6020 | Total chromium | NPW | MN | |
| RCRP | EPA 6020 | Vanadium | SCM | MN | User Defined S-MN-I-492 Rev. 16 |
| RCRP | EPA 6020 | Vanadium | NPW | MN | User Defined S-MN-I-492 Rev. 16 |
| RCRP | EPA 6020 | Zinc | SCM | MN | |
| RCRP | EPA 6020 | Zinc | NPW | MN | |

**EPA 6020A**

Preparation Techniques: Extraction, EPA 1312 SPLP, non-volatiles; Digestion, hotplate or HotBlock; Extraction, EPA 1311 TCLP, non-volatiles;

| Program | Method | Analyte | Matrix | Primary | SOP |
|---|---|---|---|---|---|
| RCRP | EPA 6020A | Aluminum | NPW | MN | |
| RCRP | EPA 6020A | Aluminum | SCM | MN | |
| RCRP | EPA 6020A | Antimony | NPW | MN | |

| Program | Method | Analyte | Matrix | Primary | SOP |
|---|---|---|---|---|---|
| RCRP | EPA 6020A | Antimony | SCM | MN | |
| RCRP | EPA 6020A | Arsenic | NPW | MN | |
| RCRP | EPA 6020A | Arsenic | SCM | MN | |
| RCRP | EPA 6020A | Barium | NPW | MN | |
| RCRP | EPA 6020A | Barium | SCM | MN | |
| RCRP | EPA 6020A | Beryllium | NPW | MN | |
| RCRP | EPA 6020A | Beryllium | SCM | MN | |
| RCRP | EPA 6020A | Cadmium | SCM | MN | |
| RCRP | EPA 6020A | Cadmium | NPW | MN | |
| RCRP | EPA 6020A | Calcium | SCM | MN | User Defined S-MN-I-492 Rev. 16 |
| RCRP | EPA 6020A | Calcium | NPW | MN | User Defined S-MN-I-492 Rev. 16 |
| RCRP | EPA 6020A | Chromium | SCM | MN | |
| RCRP | EPA 6020A | Chromium | NPW | MN | |
| RCRP | EPA 6020A | Cobalt | NPW | MN | |
| RCRP | EPA 6020A | Cobalt | SCM | MN | |
| RCRP | EPA 6020A | Copper | SCM | MN | |
| RCRP | EPA 6020A | Copper | NPW | MN | |
| RCRP | EPA 6020A | Iron | NPW | MN | User Defined S-MN-I-492 Rev. 16 |
| RCRP | EPA 6020A | Iron | SCM | MN | User Defined S-MN-I-492 Rev. 16 |
| RCRP | EPA 6020A | Lead | NPW | MN | |
| RCRP | EPA 6020A | Lead | SCM | MN | |
| RCRP | EPA 6020A | Magnesium | SCM | MN | User Defined S-MN-I-492 Rev. 16 |
| RCRP | EPA 6020A | Magnesium | NPW | MN | User Defined S-MN-I-492 Rev. 16 |
| RCRP | EPA 6020A | Manganese | NPW | MN | |
| RCRP | EPA 6020A | Manganese | SCM | MN | |
| RCRP | EPA 6020A | Molybdenum | SCM | MN | User Defined S-MN-I-492 Rev. 16 |
| RCRP | EPA 6020A | Molybdenum | NPW | MN | User Defined S-MN-I-492 Rev. 16 |
| RCRP | EPA 6020A | Nickel | NPW | MN | |
| RCRP | EPA 6020A | Nickel | SCM | MN | |
| RCRP | EPA 6020A | Potassium | NPW | MN | User Defined S-MN-I-492 Rev. 16 |
| RCRP | EPA 6020A | Potassium | SCM | MN | User Defined S-MN-I-492 Rev. 16 |
| RCRP | EPA 6020A | Selenium | NPW | MN | User Defined S-MN-I-492 Rev. 16 |
| RCRP | EPA 6020A | Selenium | SCM | MN | User Defined S-MN-I-492 Rev. 16 |
| RCRP | EPA 6020A | Silver | SCM | MN | |
| RCRP | EPA 6020A | Silver | NPW | MN | |
| RCRP | EPA 6020A | Sodium | SCM | MN | User Defined S-MN-I-492 Rev. 16 |

| Program | Method | Analyte | Matrix | Primary | SOP |
|---|---|---|---|---|---|
| RCRP | EPA 6020A | Sodium | NPW | MN | User Defined S-MN-I-492 Rev. 16 |
| RCRP | EPA 6020A | Srontium | SCM | MN | User Defined S-MN-I-492 Rev. 16 |
| RCRP | EPA 6020A | Srontium | NPW | MN | User Defined S-MN-I-492 Rev. 16 |
| RCRP | EPA 6020A | Thallium | SCM | MN | |
| RCRP | EPA 6020A | Thallium | NPW | MN | |
| RCRP | EPA 6020A | Tin | SCM | MN | User Defined S-MN-I-492 Rev. 16 |
| RCRP | EPA 6020A | Tin | NPW | MN | User Defined S-MN-I-492 Rev. 16 |
| RCRP | EPA 6020A | Titanium | SCM | MN | User Defined S-MN-I-492 Rev. 16 |
| RCRP | EPA 6020A | Titanium | NPW | MN | User Defined S-MN-I-492 Rev. 16 |
| RCRP | EPA 6020A | Vanadium | NPW | MN | User Defined S-MN-I-492 Rev. 16 |
| RCRP | EPA 6020A | Vanadium | SCM | MN | User Defined S-MN-I-492 Rev. 16 |
| RCRP | EPA 6020A | Zinc | SCM | MN | |
| RCRP | EPA 6020A | Zinc | NPW | MN | |

**EPA 7196A**

Preparation Techniques: N/A

| Program | Method | Analyte | Matrix | Primary | SOP |
|---|---|---|---|---|---|
| RCRP | EPA 7196A | Chromium VI | NPW | MN | |

**EPA 7470A**

Preparation Techniques: N/A

| Program | Method | Analyte | Matrix | Primary | SOP |
|---|---|---|---|---|---|
| RCRP | EPA 7470A | Mercury | NPW | MN | |

**EPA 7471A**

Preparation Techniques: N/A

| Program | Method | Analyte | Matrix | Primary | SOP |
|---|---|---|---|---|---|
| RCRP | EPA 7471A | Mercury | SCM | MN | |

**EPA 7471B**

Preparation Techniques: N/A

| Program | Method | Analyte | Matrix | Primary | SOP |
|---|---|---|---|---|---|
| RCRP | EPA 7471B | Mercury | SCM | MN | |

**EPA 8015B**

Preparation Techniques: Extraction, ultrasonic; Purge and trap; Extraction, separatory funnel liquid-liquid (LLE);

| Program | Method | Analyte | Matrix | Primary | SOP |
|---|---|---|---|---|---|
| RCRP | EPA 8015B | Diesel range organics (DRO) | SCM | MN | User Defined S-MN-O-489 Rev. 14 |
| RCRP | EPA 8015B | Diesel range organics (DRO) | NPW | MN | User Defined S-MN-O-489 Rev. 14 |
| RCRP | EPA 8015B | Gasoline range organics (GRO) | NPW | MN | User Defined S-MN-O-525 Rev. Rev.11 |
| RCRP | EPA 8015B | Gasoline range organics (GRO) | SCM | MN | User Defined S-MN-O-525 Rev. Rev.11 |

**EPA 8015C**

Preparation Techniques: Extraction, ultrasonic; Purge and trap; Extraction, separatory funnel liquid-liquid (LLE);

| Program | Method | Analyte | Matrix | Primary | SOP |
|---|---|---|---|---|---|
| RCRP | EPA 8015C | Diesel range organics (DRO) | SCM | MN | User Defined S-MN-O-489 Rev. 14 |
| RCRP | EPA 8015C | Diesel range organics (DRO) | NPW | MN | User Defined S-MN-O-489 Rev. 14 |
| RCRP | EPA 8015C | Gasoline range organics (GRO) | SCM | MN | User Defined S-MN-O-525 Rev. Rev.11 |
| RCRP | EPA 8015C | Gasoline range organics (GRO) | NPW | MN | User Defined S-MN-O-525 Rev. Rev.11 |

**EPA 8021B**

Preparation Techniques: Purge and trap;

| Program | Method | Analyte | Matrix | Primary | SOP |
|---|---|---|---|---|---|
| RCRP | EPA 8021B | 1,2,4-Trimethylbenzene | NPW | MN | |
| RCRP | EPA 8021B | 1,2,4-Trimethylbenzene | SCM | MN | |
| RCRP | EPA 8021B | 1,3,5-Trimethylbenzene | SCM | MN | |
| RCRP | EPA 8021B | 1,3,5-Trimethylbenzene | NPW | MN | |
| RCRP | EPA 8021B | Benzene | NPW | MN | |
| RCRP | EPA 8021B | Benzene | SCM | MN | |
| RCRP | EPA 8021B | Ethylbenzene | NPW | MN | |

| Program | Method | Analyte | Matrix | Primary | SOP |
|---|---|---|---|---|---|
| RCRP | EPA 8021B | Ethylbenzene | SCM | MN | |
| RCRP | EPA 8021B | m+p-xylene | SCM | MN | |
| RCRP | EPA 8021B | m+p-xylene | NPW | MN | |
| RCRP | EPA 8021B | Methyl tert-butyl ether (MTBE) | SCM | MN | |
| RCRP | EPA 8021B | o-Xylene | SCM | MN | |
| RCRP | EPA 8021B | o-Xylene | NPW | MN | |
| RCRP | EPA 8021B | Toluene | NPW | MN | |
| RCRP | EPA 8021B | Toluene | SCM | MN | |

**EPA 8082**

Preparation Techniques: Extraction, soxhlet; Extraction, separatory funnel liquid-liquid (LLE); Extraction, ultrasonic;

| Program | Method | Analyte | Matrix | Primary | SOP |
|---|---|---|---|---|---|
| RCRP | EPA 8082 | Aroclor-1016 (PCB-1016) | NPW | MN | |
| RCRP | EPA 8082 | Aroclor-1016 (PCB-1016) | SCM | MN | |
| RCRP | EPA 8082 | Aroclor-1221 (PCB-1221) | NPW | MN | |
| RCRP | EPA 8082 | Aroclor-1221 (PCB-1221) | SCM | MN | |
| RCRP | EPA 8082 | Aroclor-1232 (PCB-1232) | SCM | MN | |
| RCRP | EPA 8082 | Aroclor-1232 (PCB-1232) | NPW | MN | |
| RCRP | EPA 8082 | Aroclor-1242 (PCB-1242) | SCM | MN | |
| RCRP | EPA 8082 | Aroclor-1242 (PCB-1242) | NPW | MN | |
| RCRP | EPA 8082 | Aroclor-1248 (PCB-1248) | NPW | MN | |
| RCRP | EPA 8082 | Aroclor-1248 (PCB-1248) | SCM | MN | |
| RCRP | EPA 8082 | Aroclor-1254 (PCB-1254) | NPW | MN | |
| RCRP | EPA 8082 | Aroclor-1254 (PCB-1254) | SCM | MN | |
| RCRP | EPA 8082 | Aroclor-1260 (PCB-1260) | SCM | MN | |
| RCRP | EPA 8082 | Aroclor-1260 (PCB-1260) | NPW | MN | |
| RCRP | EPA 8082 | PCBs | SCM | MN | |

**EPA 8082A**

Preparation Techniques: Extraction, soxhlet; Extraction, separatory funnel liquid-liquid (LLE); Extraction, ultrasonic;

| Program | Method | Analyte | Matrix | Primary | SOP |
|---|---|---|---|---|---|
| RCRP | EPA 8082A | Aroclor-1016 (PCB-1016) | SCM | MN | |
| RCRP | EPA 8082A | Aroclor-1016 (PCB-1016) | NPW | MN | |

| Program | Method | Analyte | Matrix | Primary | SOP |
|---|---|---|---|---|---|
| RCRP | EPA 8082A | Aroclor-1221 (PCB-1221) | NPW | MN | |
| RCRP | EPA 8082A | Aroclor-1221 (PCB-1221) | SCM | MN | |
| RCRP | EPA 8082A | Aroclor-1232 (PCB-1232) | NPW | MN | |
| RCRP | EPA 8082A | Aroclor-1232 (PCB-1232) | SCM | MN | |
| RCRP | EPA 8082A | Aroclor-1242 (PCB-1242) | SCM | MN | |
| RCRP | EPA 8082A | Aroclor-1242 (PCB-1242) | NPW | MN | |
| RCRP | EPA 8082A | Aroclor-1248 (PCB-1248) | SCM | MN | |
| RCRP | EPA 8082A | Aroclor-1248 (PCB-1248) | NPW | MN | |
| RCRP | EPA 8082A | Aroclor-1254 (PCB-1254) | SCM | MN | |
| RCRP | EPA 8082A | Aroclor-1254 (PCB-1254) | NPW | MN | |
| RCRP | EPA 8082A | Aroclor-1260 (PCB-1260) | NPW | MN | |
| RCRP | EPA 8082A | Aroclor-1260 (PCB-1260) | SCM | MN | |

**EPA 8260B**

Preparation Techniques: Extraction, EPA 1312 SPLP, zero headspace (ZHE); Extraction, EPA 1311 TCLP, zero headspace (ZHE); Purge and trap;

| Program | Method | Analyte | Matrix | Primary | SOP |
|---|---|---|---|---|---|
| RCRP | EPA 8260B | 1,1,1,2-Tetrachloroethane | SCM | MN | |
| RCRP | EPA 8260B | 1,1,1,2-Tetrachloroethane | NPW | MN | |
| RCRP | EPA 8260B | 1,1,1-Trichloroethane | NPW | MN | |
| RCRP | EPA 8260B | 1,1,1-Trichloroethane | SCM | MN | |
| RCRP | EPA 8260B | 1,1,2,2-Tetrachloroethane | SCM | MN | |
| RCRP | EPA 8260B | 1,1,2,2-Tetrachloroethane | NPW | MN | |
| RCRP | EPA 8260B | 1,1,2-Trichloroethane | SCM | MN | |
| RCRP | EPA 8260B | 1,1,2-Trichloroethane | NPW | MN | |
| RCRP | EPA 8260B | 1,1-Dichloroethane | SCM | MN | |
| RCRP | EPA 8260B | 1,1-Dichloroethane | NPW | MN | |
| RCRP | EPA 8260B | 1,1-Dichloroethylene | NPW | MN | |
| RCRP | EPA 8260B | 1,1-Dichloroethylene | SCM | MN | |
| RCRP | EPA 8260B | 1,1-Dichloropropene | SCM | MN | |
| RCRP | EPA 8260B | 1,1-Dichloropropene | NPW | MN | |
| RCRP | EPA 8260B | 1,2,3-Trichlorobenzene | NPW | MN | |
| RCRP | EPA 8260B | 1,2,3-Trichlorobenzene | SCM | MN | |
| RCRP | EPA 8260B | 1,2,3-Trichloropropane | SCM | MN | |
| RCRP | EPA 8260B | 1,2,3-Trichloropropane | NPW | MN | |

| Program | Method | Analyte | Matrix | Primary | SOP |
|---|---|---|---|---|---|
| RCRP | EPA 8260B | 1,2,4-Trichlorobenzene | NPW | MN | |
| RCRP | EPA 8260B | 1,2,4-Trichlorobenzene | SCM | MN | |
| RCRP | EPA 8260B | 1,2,4-Trimethylbenzene | NPW | MN | |
| RCRP | EPA 8260B | 1,2,4-Trimethylbenzene | SCM | MN | |
| RCRP | EPA 8260B | 1,2-Dibromo-3-chloropropane (DBCP) | NPW | MN | |
| RCRP | EPA 8260B | 1,2-Dibromo-3-chloropropane (DBCP) | SCM | MN | |
| RCRP | EPA 8260B | 1,2-Dibromoethane (EDB, Ethylene dibromide) | NPW | MN | |
| RCRP | EPA 8260B | 1,2-Dibromoethane (EDB, Ethylene dibromide) | SCM | MN | |
| RCRP | EPA 8260B | 1,2-Dichlorobenzene | SCM | MN | |
| RCRP | EPA 8260B | 1,2-Dichlorobenzene | NPW | MN | |
| RCRP | EPA 8260B | 1,2-Dichloroethane (Ethylene dichloride) | NPW | MN | |
| RCRP | EPA 8260B | 1,2-Dichloroethane (Ethylene dichloride) | SCM | MN | |
| RCRP | EPA 8260B | 1,2-Dichloropropane | NPW | MN | |
| RCRP | EPA 8260B | 1,2-Dichloropropane | SCM | MN | |
| RCRP | EPA 8260B | 1,3,5-Trimethylbenzene | NPW | MN | |
| RCRP | EPA 8260B | 1,3,5-Trimethylbenzene | SCM | MN | |
| RCRP | EPA 8260B | 1,3-Dichlorobenzene | SCM | MN | |
| RCRP | EPA 8260B | 1,3-Dichlorobenzene | NPW | MN | |
| RCRP | EPA 8260B | 1,3-Dichloropropane | NPW | MN | |
| RCRP | EPA 8260B | 1,3-Dichloropropane | SCM | MN | |
| RCRP | EPA 8260B | 1,4-Dichlorobenzene | NPW | MN | |
| RCRP | EPA 8260B | 1,4-Dichlorobenzene | SCM | MN | |
| RCRP | EPA 8260B | 1,4-Dioxane (1,4- Diethyleneoxide) | NPW | MN | |
| RCRP | EPA 8260B | 1,4-Dioxane (1,4- Diethyleneoxide) | SCM | MN | |
| RCRP | EPA 8260B | 2,2-Dichloropropane | NPW | MN | |
| RCRP | EPA 8260B | 2,2-Dichloropropane | SCM | MN | |
| RCRP | EPA 8260B | 2-Butanone (Methyl ethyl ketone, MEK) | NPW | MN | |
| RCRP | EPA 8260B | 2-Butanone (Methyl ethyl ketone, MEK) | SCM | MN | |
| RCRP | EPA 8260B | 2-Chloroethyl vinyl ether | NPW | MN | |
| RCRP | EPA 8260B | 2-Chloroethyl vinyl ether | SCM | MN | |
| RCRP | EPA 8260B | 2-Chlorotoluene | SCM | MN | |
| RCRP | EPA 8260B | 2-Chlorotoluene | NPW | MN | |
| RCRP | EPA 8260B | 2-Hexanone | SCM | MN | |
| RCRP | EPA 8260B | 2-Hexanone | NPW | MN | |
| RCRP | EPA 8260B | 2-Nitropropane | SCM | MN | |

| Program | Method | Analyte | Matrix | Primary | SOP |
|---|---|---|---|---|---|
| RCRP | EPA 8260B | 2-Nitropropane | NPW | MN | |
| RCRP | EPA 8260B | 4-Chlorotoluene | NPW | MN | |
| RCRP | EPA 8260B | 4-Chlorotoluene | SCM | MN | |
| RCRP | EPA 8260B | 4-Isopropyltoluene (p-Cymene) | NPW | MN | |
| RCRP | EPA 8260B | 4-Isopropyltoluene (p-Cymene) | SCM | MN | |
| RCRP | EPA 8260B | 4-Methyl-2-pentanone (MIBK) | SCM | MN | |
| RCRP | EPA 8260B | 4-Methyl-2-pentanone (MIBK) | NPW | MN | |
| RCRP | EPA 8260B | Acetone | SCM | MN | |
| RCRP | EPA 8260B | Acetone | NPW | MN | |
| RCRP | EPA 8260B | Acetonitrile | SCM | MN | |
| RCRP | EPA 8260B | Acetonitrile | NPW | MN | |
| RCRP | EPA 8260B | Acrolein (Propenal) | SCM | MN | |
| RCRP | EPA 8260B | Acrolein (Propenal) | NPW | MN | |
| RCRP | EPA 8260B | Acrylonitrile | SCM | MN | |
| RCRP | EPA 8260B | Acrylonitrile | NPW | MN | |
| RCRP | EPA 8260B | Allyl chloride (3-Chloropropene) | NPW | MN | |
| RCRP | EPA 8260B | Allyl chloride (3-Chloropropene) | SCM | MN | |
| RCRP | EPA 8260B | Benzene | SCM | MN | |
| RCRP | EPA 8260B | Benzene | NPW | MN | |
| RCRP | EPA 8260B | Bromobenzene | SCM | MN | |
| RCRP | EPA 8260B | Bromobenzene | NPW | MN | |
| RCRP | EPA 8260B | Bromochloromethane | SCM | MN | |
| RCRP | EPA 8260B | Bromochloromethane | NPW | MN | |
| RCRP | EPA 8260B | Bromodichloromethane | NPW | MN | |
| RCRP | EPA 8260B | Bromodichloromethane | SCM | MN | |
| RCRP | EPA 8260B | Bromoform | NPW | MN | |
| RCRP | EPA 8260B | Bromoform | SCM | MN | |
| RCRP | EPA 8260B | Carbon disulfide | NPW | MN | |
| RCRP | EPA 8260B | Carbon disulfide | SCM | MN | |
| RCRP | EPA 8260B | Carbon tetrachloride | SCM | MN | |
| RCRP | EPA 8260B | Carbon tetrachloride | NPW | MN | |
| RCRP | EPA 8260B | Chlorobenzene | NPW | MN | |
| RCRP | EPA 8260B | Chlorobenzene | SCM | MN | |
| RCRP | EPA 8260B | Chlorodibromomethane | SCM | MN | |
| RCRP | EPA 8260B | Chlorodibromomethane | NPW | MN | |
| RCRP | EPA 8260B | Chloroethane (Ethyl chloride) | NPW | MN | |

| Program | Method | Analyte | Matrix | Primary | SOP |
|---|---|---|---|---|---|
| RCRP | EPA 8260B | Chloroethane (Ethyl chloride) | SCM | MN | |
| RCRP | EPA 8260B | Chloroform | NPW | MN | |
| RCRP | EPA 8260B | Chloroform | SCM | MN | |
| RCRP | EPA 8260B | Chloroprene (2-Chloro-1,3-butadiene) | NPW | MN | |
| RCRP | EPA 8260B | Chloroprene (2-Chloro-1,3-butadiene) | SCM | MN | |
| RCRP | EPA 8260B | cis-1,2-Dichloroethylene | NPW | MN | |
| RCRP | EPA 8260B | cis-1,2-Dichloroethylene | SCM | MN | |
| RCRP | EPA 8260B | cis-1,3-Dichloropropene | SCM | MN | |
| RCRP | EPA 8260B | cis-1,3-Dichloropropene | NPW | MN | |
| RCRP | EPA 8260B | cis-1,4-Dichloro-2-butene | NPW | MN | |
| RCRP | EPA 8260B | cis-1,4-Dichloro-2-butene | SCM | MN | |
| RCRP | EPA 8260B | Dibromomethane (Methylene bromide) | SCM | MN | |
| RCRP | EPA 8260B | Dibromomethane (Methylene bromide) | NPW | MN | |
| RCRP | EPA 8260B | Dichlorodifluoromethane (Freon-12) | SCM | MN | |
| RCRP | EPA 8260B | Dichlorodifluoromethane (Freon-12) | NPW | MN | |
| RCRP | EPA 8260B | Diethyl ether | NPW | MN | |
| RCRP | EPA 8260B | Diethyl ether | SCM | MN | |
| RCRP | EPA 8260B | Ethanol | SCM | MN | |
| RCRP | EPA 8260B | Ethanol | NPW | MN | |
| RCRP | EPA 8260B | Ethyl acetate | NPW | MN | |
| RCRP | EPA 8260B | Ethyl acetate | SCM | MN | |
| RCRP | EPA 8260B | Ethyl methacrylate | SCM | MN | |
| RCRP | EPA 8260B | Ethyl methacrylate | NPW | MN | |
| RCRP | EPA 8260B | Ethylbenzene | SCM | MN | |
| RCRP | EPA 8260B | Ethylbenzene | NPW | MN | |
| RCRP | EPA 8260B | Hexachlorobutadiene | NPW | MN | |
| RCRP | EPA 8260B | Hexachlorobutadiene | SCM | MN | |
| RCRP | EPA 8260B | Iodomethane (Methyl iodide) | SCM | MN | |
| RCRP | EPA 8260B | Iodomethane (Methyl iodide) | NPW | MN | |
| RCRP | EPA 8260B | Isobutyl alcohol (2-Methyl-1-propanol) | SCM | MN | |
| RCRP | EPA 8260B | Isobutyl alcohol (2-Methyl-1-propanol) | NPW | MN | |
| RCRP | EPA 8260B | Isopropyl alcohol (2-Propanol, Isopropanol) | NPW | MN | |
| RCRP | EPA 8260B | Isopropyl alcohol (2-Propanol, Isopropanol) | SCM | MN | |
| RCRP | EPA 8260B | Isopropylbenzene | NPW | MN | |
| RCRP | EPA 8260B | Isopropylbenzene | SCM | MN | |

| Program | Method | Analyte | Matrix | Primary | SOP |
|---|---|---|---|---|---|
| RCRP | EPA 8260B | m+p-xylene | SCM | MN | |
| RCRP | EPA 8260B | m+p-xylene | NPW | MN | |
| RCRP | EPA 8260B | Methacrylonitrile | SCM | MN | |
| RCRP | EPA 8260B | Methacrylonitrile | NPW | MN | |
| RCRP | EPA 8260B | Methyl bromide (Bromomethane) | NPW | MN | |
| RCRP | EPA 8260B | Methyl bromide (Bromomethane) | SCM | MN | |
| RCRP | EPA 8260B | Methyl chloride (Chloromethane) | SCM | MN | |
| RCRP | EPA 8260B | Methyl chloride (Chloromethane) | NPW | MN | |
| RCRP | EPA 8260B | Methyl methacrylate | NPW | MN | |
| RCRP | EPA 8260B | Methyl methacrylate | SCM | MN | |
| RCRP | EPA 8260B | Methyl tert-butyl ether (MTBE) | NPW | MN | |
| RCRP | EPA 8260B | Methyl tert-butyl ether (MTBE) | SCM | MN | |
| RCRP | EPA 8260B | Methylene chloride (Dichloromethane) | NPW | MN | |
| RCRP | EPA 8260B | Methylene chloride (Dichloromethane) | SCM | MN | |
| RCRP | EPA 8260B | n-Butyl alcohol (1-Butanol, n-Butanol) | SCM | MN | |
| RCRP | EPA 8260B | n-Butyl alcohol (1-Butanol, n-Butanol) | NPW | MN | |
| RCRP | EPA 8260B | n-Butylbenzene | NPW | MN | |
| RCRP | EPA 8260B | n-Butylbenzene | SCM | MN | |
| RCRP | EPA 8260B | n-Propylbenzene | SCM | MN | |
| RCRP | EPA 8260B | n-Propylbenzene | NPW | MN | |
| RCRP | EPA 8260B | Naphthalene | NPW | MN | |
| RCRP | EPA 8260B | Naphthalene | SCM | MN | |
| RCRP | EPA 8260B | o-Xylene | NPW | MN | |
| RCRP | EPA 8260B | o-Xylene | SCM | MN | |
| RCRP | EPA 8260B | Propionitrile (Ethyl cyanide) | NPW | MN | |
| RCRP | EPA 8260B | sec-Butylbenzene | NPW | MN | |
| RCRP | EPA 8260B | sec-Butylbenzene | SCM | MN | |
| RCRP | EPA 8260B | Styrene | NPW | MN | |
| RCRP | EPA 8260B | Styrene | SCM | MN | |
| RCRP | EPA 8260B | tert-Butyl alcohol | SCM | MN | |
| RCRP | EPA 8260B | tert-Butyl alcohol | NPW | MN | |
| RCRP | EPA 8260B | tert-Butylbenzene | NPW | MN | |
| RCRP | EPA 8260B | tert-Butylbenzene | SCM | MN | |
| RCRP | EPA 8260B | Tetrachloroethylene (Perchloroethylene) | NPW | MN | |
| RCRP | EPA 8260B | Tetrachloroethylene (Perchloroethylene) | SCM | MN | |
| RCRP | EPA 8260B | Toluene | NPW | MN | |

| Program | Method | Analyte | Matrix | Primary | SOP |
|---|---|---|---|---|---|
| RCRP | EPA 8260B | Toluene | SCM | MN | |
| RCRP | EPA 8260B | trans-1,2-Dichloroethylene | NPW | MN | |
| RCRP | EPA 8260B | trans-1,2-Dichloroethylene | SCM | MN | |
| RCRP | EPA 8260B | trans-1,3-Dichloropropylene | NPW | MN | |
| RCRP | EPA 8260B | trans-1,3-Dichloropropylene | SCM | MN | |
| RCRP | EPA 8260B | trans-1,4-Dichloro-2-butene | SCM | MN | |
| RCRP | EPA 8260B | trans-1,4-Dichloro-2-butene | NPW | MN | |
| RCRP | EPA 8260B | Trichloroethene (Trichloroethylene) | SCM | MN | |
| RCRP | EPA 8260B | Trichloroethene (Trichloroethylene) | NPW | MN | |
| RCRP | EPA 8260B | Trichlorofluoromethane (Fluorotrichloromethane, Freon 11) | NPW | MN | |
| RCRP | EPA 8260B | Trichlorofluoromethane (Fluorotrichloromethane, Freon 11) | SCM | MN | |
| RCRP | EPA 8260B | Vinyl acetate | SCM | MN | |
| RCRP | EPA 8260B | Vinyl acetate | NPW | MN | |
| RCRP | EPA 8260B | Vinyl chloride | SCM | MN | |
| RCRP | EPA 8260B | Vinyl chloride | NPW | MN | |

**EPA 8270C**

Preparation Techniques: Extraction, EPA 1312 SPLP, non-volatiles; Extraction, EPA 1311 TCLP, non-volatiles; Extraction, ultrasonic; Extraction, separatory funnel liquid-liquid (LLE); Extraction, continuous liquid-liquid (LLE); Extraction, automated soxhlet;

| Program | Method | Analyte | Matrix | Primary | SOP |
|---|---|---|---|---|---|
| RCRP | EPA 8270C | 1,2,4-Trichlorobenzene | NPW | MN | |
| RCRP | EPA 8270C | 1,2,4-Trichlorobenzene | SCM | MN | |
| RCRP | EPA 8270C | 1,2-Dichlorobenzene | SCM | MN | |
| RCRP | EPA 8270C | 1,2-Dichlorobenzene | NPW | MN | |
| RCRP | EPA 8270C | 1,2-Dinitrobenzene | SCM | MN | |
| RCRP | EPA 8270C | 1,2-Diphenylhydrazine | SCM | MN | |
| RCRP | EPA 8270C | 1,2-Diphenylhydrazine | NPW | MN | |
| RCRP | EPA 8270C | 1,3-Dichlorobenzene | SCM | MN | |
| RCRP | EPA 8270C | 1,3-Dichlorobenzene | NPW | MN | |
| RCRP | EPA 8270C | 1,4-Dichlorobenzene | SCM | MN | |
| RCRP | EPA 8270C | 1,4-Dichlorobenzene | NPW | MN | |
| RCRP | EPA 8270C | 2,4,5-Trichlorophenol | NPW | MN | |
| RCRP | EPA 8270C | 2,4,5-Trichlorophenol | SCM | MN | |

| Program | Method | Analyte | Matrix | Primary | SOP |
|---|---|---|---|---|---|
| RCRP | EPA 8270C | 2,4,6-Trichlorophenol | NPW | MN | |
| RCRP | EPA 8270C | 2,4,6-Trichlorophenol | SCM | MN | |
| RCRP | EPA 8270C | 2,4-Dichlorophenol | SCM | MN | |
| RCRP | EPA 8270C | 2,4-Dichlorophenol | NPW | MN | |
| RCRP | EPA 8270C | 2,4-Dimethylphenol | NPW | MN | |
| RCRP | EPA 8270C | 2,4-Dimethylphenol | SCM | MN | |
| RCRP | EPA 8270C | 2,4-Dinitrophenol | NPW | MN | |
| RCRP | EPA 8270C | 2,4-Dinitrophenol | SCM | MN | |
| RCRP | EPA 8270C | 2,4-Dinitrotoluene (2,4-DNT) | NPW | MN | |
| RCRP | EPA 8270C | 2,4-Dinitrotoluene (2,4-DNT) | SCM | MN | |
| RCRP | EPA 8270C | 2,6-Dinitrotoluene (2,6-DNT) | NPW | MN | |
| RCRP | EPA 8270C | 2,6-Dinitrotoluene (2,6-DNT) | SCM | MN | |
| RCRP | EPA 8270C | 2-Chloronaphthalene | NPW | MN | |
| RCRP | EPA 8270C | 2-Chloronaphthalene | SCM | MN | |
| RCRP | EPA 8270C | 2-Chlorophenol | NPW | MN | |
| RCRP | EPA 8270C | 2-Chlorophenol | SCM | MN | |
| RCRP | EPA 8270C | 2-Methyl-4,6-dinitrophenol (4,6-Dinitro-2-methylphenol) | SCM | MN | |
| RCRP | EPA 8270C | 2-Methyl-4,6-dinitrophenol (4,6-Dinitro-2-methylphenol) | NPW | MN | |
| RCRP | EPA 8270C | 2-Methylnaphthalene | NPW | MN | |
| RCRP | EPA 8270C | 2-Methylnaphthalene | SCM | MN | |
| RCRP | EPA 8270C | 2-Methylphenol (o-Cresol) | NPW | MN | |
| RCRP | EPA 8270C | 2-Methylphenol (o-Cresol) | SCM | MN | |
| RCRP | EPA 8270C | 2-Nitroaniline | NPW | MN | |
| RCRP | EPA 8270C | 2-Nitroaniline | SCM | MN | |
| RCRP | EPA 8270C | 2-Nitrophenol | SCM | MN | |
| RCRP | EPA 8270C | 2-Nitrophenol | NPW | MN | |
| RCRP | EPA 8270C | 3,3'-Dichlorobenzidine | NPW | MN | |
| RCRP | EPA 8270C | 3,3'-Dichlorobenzidine | SCM | MN | |
| RCRP | EPA 8270C | 3-Methylphenol (m-Cresol) | SCM | MN | |
| RCRP | EPA 8270C | 3-Methylphenol (m-Cresol) | NPW | MN | |
| RCRP | EPA 8270C | 3-Nitroaniline | NPW | MN | |
| RCRP | EPA 8270C | 3-Nitroaniline | SCM | MN | |
| RCRP | EPA 8270C | 4-Bromophenyl phenyl ether | NPW | MN | |
| RCRP | EPA 8270C | 4-Bromophenyl phenyl ether | SCM | MN | |
| RCRP | EPA 8270C | 4-Chloro-3-methylphenol | SCM | MN | |

| Program | Method | Analyte | Matrix | Primary | SOP |
|---|---|---|---|---|---|
| RCRP | EPA 8270C | 4-Chloro-3-methylphenol | NPW | MN | |
| RCRP | EPA 8270C | 4-Chloroaniline | NPW | MN | |
| RCRP | EPA 8270C | 4-Chloroaniline | SCM | MN | |
| RCRP | EPA 8270C | 4-Chlorophenyl phenylether | SCM | MN | |
| RCRP | EPA 8270C | 4-Chlorophenyl phenylether | NPW | MN | |
| RCRP | EPA 8270C | 4-Methylphenol (p-Cresol) | SCM | MN | |
| RCRP | EPA 8270C | 4-Methylphenol (p-Cresol) | NPW | MN | |
| RCRP | EPA 8270C | 4-Nitroaniline | SCM | MN | |
| RCRP | EPA 8270C | 4-Nitroaniline | NPW | MN | |
| RCRP | EPA 8270C | 4-Nitrophenol | SCM | MN | |
| RCRP | EPA 8270C | 4-Nitrophenol | NPW | MN | |
| RCRP | EPA 8270C | Acenaphthene | NPW | MN | |
| RCRP | EPA 8270C | Acenaphthene | SCM | MN | |
| RCRP | EPA 8270C | Acenaphthylene | SCM | MN | |
| RCRP | EPA 8270C | Acenaphthylene | NPW | MN | |
| RCRP | EPA 8270C | Anthracene | NPW | MN | |
| RCRP | EPA 8270C | Anthracene | SCM | MN | |
| RCRP | EPA 8270C | Benzidine | NPW | MN | |
| RCRP | EPA 8270C | Benzidine | SCM | MN | |
| RCRP | EPA 8270C | Benzo(a)anthracene | SCM | MN | |
| RCRP | EPA 8270C | Benzo(a)anthracene | NPW | MN | |
| RCRP | EPA 8270C | Benzo(a)pyrene | SCM | MN | |
| RCRP | EPA 8270C | Benzo(a)pyrene | NPW | MN | |
| RCRP | EPA 8270C | Benzo(g,h,i)perylene | NPW | MN | |
| RCRP | EPA 8270C | Benzo(g,h,i)perylene | SCM | MN | |
| RCRP | EPA 8270C | Benzo(k)fluoranthene | NPW | MN | |
| RCRP | EPA 8270C | Benzo(k)fluoranthene | SCM | MN | |
| RCRP | EPA 8270C | Benzo[b]fluoranthene | SCM | MN | |
| RCRP | EPA 8270C | Benzo[b]fluoranthene | NPW | MN | |
| RCRP | EPA 8270C | Benzoic acid | SCM | MN | |
| RCRP | EPA 8270C | Benzoic acid | NPW | MN | |
| RCRP | EPA 8270C | Benzyl alcohol | NPW | MN | |
| RCRP | EPA 8270C | Benzyl alcohol | SCM | MN | |
| RCRP | EPA 8270C | bis(2-Chloroethoxy)methane | SCM | MN | |
| RCRP | EPA 8270C | bis(2-Chloroethoxy)methane | NPW | MN | |
| RCRP | EPA 8270C | bis(2-Chloroethyl) ether | NPW | MN | |

| Program | Method | Analyte | Matrix | Primary | SOP |
|---|---|---|---|---|---|
| RCRP | EPA 8270C | bis(2-Chloroethyl) ether | SCM | MN | |
| RCRP | EPA 8270C | bis(2-Chloroisopropyl) ether | NPW | MN | |
| RCRP | EPA 8270C | bis(2-Chloroisopropyl) ether | SCM | MN | |
| RCRP | EPA 8270C | Butyl benzyl phthalate | NPW | MN | |
| RCRP | EPA 8270C | Butyl benzyl phthalate | SCM | MN | |
| RCRP | EPA 8270C | Chrysene | SCM | MN | |
| RCRP | EPA 8270C | Chrysene | NPW | MN | |
| RCRP | EPA 8270C | Di(2-ethylhexyl) phthalate (bis(2-Ethylhexyl)phthalate, DEHP) | NPW | MN | |
| RCRP | EPA 8270C | Di(2-ethylhexyl) phthalate (bis(2-Ethylhexyl)phthalate, DEHP) | SCM | MN | |
| RCRP | EPA 8270C | Di-n-butyl phthalate | NPW | MN | |
| RCRP | EPA 8270C | Di-n-butyl phthalate | SCM | MN | |
| RCRP | EPA 8270C | Di-n-octyl phthalate | SCM | MN | |
| RCRP | EPA 8270C | Di-n-octyl phthalate | NPW | MN | |
| RCRP | EPA 8270C | Dibenz(a,h) anthracene | SCM | MN | |
| RCRP | EPA 8270C | Dibenz(a,h) anthracene | NPW | MN | |
| RCRP | EPA 8270C | Dibenzofuran | NPW | MN | |
| RCRP | EPA 8270C | Dibenzofuran | SCM | MN | |
| RCRP | EPA 8270C | Diethyl phthalate | NPW | MN | |
| RCRP | EPA 8270C | Diethyl phthalate | SCM | MN | |
| RCRP | EPA 8270C | Dimethyl phthalate | SCM | MN | |
| RCRP | EPA 8270C | Dimethyl phthalate | NPW | MN | |
| RCRP | EPA 8270C | Fluoranthene | NPW | MN | |
| RCRP | EPA 8270C | Fluoranthene | SCM | MN | |
| RCRP | EPA 8270C | Fluorene | NPW | MN | |
| RCRP | EPA 8270C | Fluorene | SCM | MN | |
| RCRP | EPA 8270C | Hexachlorobenzene | SCM | MN | |
| RCRP | EPA 8270C | Hexachlorobenzene | NPW | MN | |
| RCRP | EPA 8270C | Hexachlorobutadiene | SCM | MN | |
| RCRP | EPA 8270C | Hexachlorobutadiene | NPW | MN | |
| RCRP | EPA 8270C | Hexachlorocyclopentadiene | SCM | MN | |
| RCRP | EPA 8270C | Hexachlorocyclopentadiene | NPW | MN | |
| RCRP | EPA 8270C | Hexachloroethane | SCM | MN | |
| RCRP | EPA 8270C | Hexachloroethane | NPW | MN | |
| RCRP | EPA 8270C | Indeno(1,2,3-cd) pyrene | SCM | MN | |
| RCRP | EPA 8270C | Indeno(1,2,3-cd) pyrene | NPW | MN | |

| Program | Method | Analyte | Matrix | Primary | SOP |
|---|---|---|---|---|---|
| RCRP | EPA 8270C | Isophorone | SCM | MN | |
| RCRP | EPA 8270C | Isophorone | NPW | MN | |
| RCRP | EPA 8270C | n-Nitrosodi-n-propylamine | SCM | MN | |
| RCRP | EPA 8270C | n-Nitrosodi-n-propylamine | NPW | MN | |
| RCRP | EPA 8270C | n-Nitrosodimethylamine | SCM | MN | |
| RCRP | EPA 8270C | n-Nitrosodimethylamine | NPW | MN | |
| RCRP | EPA 8270C | n-Nitrosodiphenylamine | NPW | MN | |
| RCRP | EPA 8270C | n-Nitrosodiphenylamine | SCM | MN | |
| RCRP | EPA 8270C | Naphthalene | SCM | MN | |
| RCRP | EPA 8270C | Naphthalene | NPW | MN | |
| RCRP | EPA 8270C | Nitrobenzene | NPW | MN | |
| RCRP | EPA 8270C | Nitrobenzene | SCM | MN | |
| RCRP | EPA 8270C | Pentachlorophenol | NPW | MN | |
| RCRP | EPA 8270C | Pentachlorophenol | SCM | MN | |
| RCRP | EPA 8270C | Phenanthrene | SCM | MN | |
| RCRP | EPA 8270C | Phenanthrene | NPW | MN | |
| RCRP | EPA 8270C | Phenol | NPW | MN | |
| RCRP | EPA 8270C | Phenol | SCM | MN | |
| RCRP | EPA 8270C | Pyrene | SCM | MN | |
| RCRP | EPA 8270C | Pyrene | NPW | MN | |
| RCRP | EPA 8270C | Pyridine | SCM | MN | |
| RCRP | EPA 8270C | Pyridine | NPW | MN | |

**EPA 8270C SIM**

Preparation Techniques: Extraction, ultrasonic; Extraction, soxhlet; Extraction, separatory funnel liquid-liquid (LLE);

| Program | Method | Analyte | Matrix | Primary | SOP |
|---|---|---|---|---|---|
| RCRP | EPA 8270C SIM | Benzo(a)anthracene | SCM | MN | |
| RCRP | EPA 8270C SIM | Benzo(a)anthracene | NPW | MN | |
| RCRP | EPA 8270C SIM | Benzo(a)pyrene | NPW | MN | |
| RCRP | EPA 8270C SIM | Benzo(a)pyrene | SCM | MN | |
| RCRP | EPA 8270C SIM | Benzo(j)fluoranthene | NPW | MN | |
| RCRP | EPA 8270C SIM | Benzo(j)fluoranthene | SCM | MN | |
| RCRP | EPA 8270C SIM | Benzo(k)fluoranthene | NPW | MN | |
| RCRP | EPA 8270C SIM | Benzo(k)fluoranthene | SCM | MN | |

| Program | Method | Analyte | Matrix | Primary | SOP |
|---|---|---|---|---|---|
| RCRP | EPA 8270C SIM | Benzo[b]fluoranthene | SCM | MN | |
| RCRP | EPA 8270C SIM | Benzo[b]fluoranthene | NPW | MN | |
| RCRP | EPA 8270C SIM | Butyl benzyl phthalate | SCM | MN | |
| RCRP | EPA 8270C SIM | Butyl benzyl phthalate | NPW | MN | |
| RCRP | EPA 8270C SIM | Dibenz(a,h) anthracene | NPW | MN | |
| RCRP | EPA 8270C SIM | Dibenz(a,h) anthracene | SCM | MN | |
| RCRP | EPA 8270C SIM | Fluoranthene | NPW | MN | |
| RCRP | EPA 8270C SIM | Fluoranthene | SCM | MN | |
| RCRP | EPA 8270C SIM | Indeno(1,2,3-cd) pyrene | NPW | MN | |
| RCRP | EPA 8270C SIM | Indeno(1,2,3-cd) pyrene | SCM | MN | |
| RCRP | EPA 8270C SIM | Pyrene | NPW | MN | |
| RCRP | EPA 8270C SIM | Pyrene | SCM | MN | |

**EPA 8270D**

Preparation Techniques: Extraction, EPA 1312 SPLP, non-volatiles; Extraction, EPA 1311 TCLP, non-volatiles; Extraction, ultrasonic; Extraction, soxhlet; Extraction, separatory funnel liquid-liquid (LLE); Extraction, continuous liquid-liquid (LLE);

| Program | Method | Analyte | Matrix | Primary | SOP |
|---|---|---|---|---|---|
| RCRP | EPA 8270D | 1,2,4-Trichlorobenzene | SCM | MN | |
| RCRP | EPA 8270D | 1,2,4-Trichlorobenzene | NPW | MN | |
| RCRP | EPA 8270D | 1,2-Dichlorobenzene | NPW | MN | |
| RCRP | EPA 8270D | 1,2-Dichlorobenzene | SCM | MN | |
| RCRP | EPA 8270D | 1,2-Diphenylhydrazine | NPW | MN | |
| RCRP | EPA 8270D | 1,2-Diphenylhydrazine | SCM | MN | |
| RCRP | EPA 8270D | 1,3-Dichlorobenzene | NPW | MN | |
| RCRP | EPA 8270D | 1,4-Dichlorobenzene | SCM | MN | |
| RCRP | EPA 8270D | 1,4-Dichlorobenzene | NPW | MN | |
| RCRP | EPA 8270D | 2,4,5-Trichlorophenol | NPW | MN | |
| RCRP | EPA 8270D | 2,4,5-Trichlorophenol | SCM | MN | |
| RCRP | EPA 8270D | 2,4,6-Trichlorophenol | SCM | MN | |
| RCRP | EPA 8270D | 2,4,6-Trichlorophenol | NPW | MN | |
| RCRP | EPA 8270D | 2,4-Dichlorophenol | SCM | MN | |
| RCRP | EPA 8270D | 2,4-Dichlorophenol | NPW | MN | |
| RCRP | EPA 8270D | 2,4-Dimethylphenol | SCM | MN | |
| RCRP | EPA 8270D | 2,4-Dimethylphenol | NPW | MN | |

| Program | Method | Analyte | Matrix | Primary | SOP |
|---|---|---|---|---|---|
| RCRP | EPA 8270D | 2,4-Dinitrophenol | NPW | MN | |
| RCRP | EPA 8270D | 2,4-Dinitrophenol | SCM | MN | |
| RCRP | EPA 8270D | 2,4-Dinitrotoluene (2,4-DNT) | SCM | MN | |
| RCRP | EPA 8270D | 2,4-Dinitrotoluene (2,4-DNT) | NPW | MN | |
| RCRP | EPA 8270D | 2,6-Dinitrotoluene (2,6-DNT) | NPW | MN | |
| RCRP | EPA 8270D | 2,6-Dinitrotoluene (2,6-DNT) | SCM | MN | |
| RCRP | EPA 8270D | 2-Chloronaphthalene | SCM | MN | |
| RCRP | EPA 8270D | 2-Chlorophenol | NPW | MN | |
| RCRP | EPA 8270D | 2-Chlorophenol | SCM | MN | |
| RCRP | EPA 8270D | 2-Methylnaphthalene | SCM | MN | |
| RCRP | EPA 8270D | 2-Methylnaphthalene | NPW | MN | |
| RCRP | EPA 8270D | 2-Methylphenol (o-Cresol) | SCM | MN | |
| RCRP | EPA 8270D | 2-Methylphenol (o-Cresol) | NPW | MN | |
| RCRP | EPA 8270D | 2-Nitroaniline | NPW | MN | |
| RCRP | EPA 8270D | 2-Nitroaniline | SCM | MN | |
| RCRP | EPA 8270D | 2-Nitrophenol | NPW | MN | |
| RCRP | EPA 8270D | 2-Nitrophenol | SCM | MN | |
| RCRP | EPA 8270D | 3,3'-Dichlorobenzidine | NPW | MN | |
| RCRP | EPA 8270D | 3,3'-Dichlorobenzidine | SCM | MN | |
| RCRP | EPA 8270D | 3-Methylphenol (m-Cresol) | NPW | MN | |
| RCRP | EPA 8270D | 3-Methylphenol (m-Cresol) | SCM | MN | |
| RCRP | EPA 8270D | 3-Nitroaniline | NPW | MN | |
| RCRP | EPA 8270D | 3-Nitroaniline | SCM | MN | |
| RCRP | EPA 8270D | 4,6-Dinitro-2-methylphenol | SCM | MN | |
| RCRP | EPA 8270D | 4,6-Dinitro-2-methylphenol | NPW | MN | |
| RCRP | EPA 8270D | 4-Bromophenyl phenyl ether | NPW | MN | |
| RCRP | EPA 8270D | 4-Bromophenyl phenyl ether | SCM | MN | |
| RCRP | EPA 8270D | 4-Chloro-3-methylphenol | SCM | MN | |
| RCRP | EPA 8270D | 4-Chloro-3-methylphenol | NPW | MN | |
| RCRP | EPA 8270D | 4-Chloroaniline | SCM | MN | |
| RCRP | EPA 8270D | 4-Chloroaniline | NPW | MN | |
| RCRP | EPA 8270D | 4-Chlorophenyl phenylether | NPW | MN | |
| RCRP | EPA 8270D | 4-Chlorophenyl phenylether | SCM | MN | |
| RCRP | EPA 8270D | 4-Methylphenol (p-Cresol) | NPW | MN | |
| RCRP | EPA 8270D | 4-Methylphenol (p-Cresol) | SCM | MN | |
| RCRP | EPA 8270D | 4-Nitroaniline | SCM | MN | |

| Program | Method | Analyte | Matrix | Primary | SOP |
|---|---|---|---|---|---|
| RCRP | EPA 8270D | 4-Nitrophenol | SCM | MN | |
| RCRP | EPA 8270D | 4-Nitrophenol | NPW | MN | |
| RCRP | EPA 8270D | Acenaphthene | NPW | MN | |
| RCRP | EPA 8270D | Acenaphthene | SCM | MN | |
| RCRP | EPA 8270D | Acenaphthylene | SCM | MN | |
| RCRP | EPA 8270D | Acenaphthylene | NPW | MN | |
| RCRP | EPA 8270D | Anthracene | SCM | MN | |
| RCRP | EPA 8270D | Anthracene | NPW | MN | |
| RCRP | EPA 8270D | Benzidine | NPW | MN | |
| RCRP | EPA 8270D | Benzidine | SCM | MN | |
| RCRP | EPA 8270D | Benzo(a)anthracene | SCM | MN | |
| RCRP | EPA 8270D | Benzo(a)anthracene | NPW | MN | |
| RCRP | EPA 8270D | Benzo(a)pyrene | NPW | MN | |
| RCRP | EPA 8270D | Benzo(a)pyrene | SCM | MN | |
| RCRP | EPA 8270D | Benzo(g,h,i)perylene | SCM | MN | |
| RCRP | EPA 8270D | Benzo(g,h,i)perylene | NPW | MN | |
| RCRP | EPA 8270D | Benzo(k)fluoranthene | NPW | MN | |
| RCRP | EPA 8270D | Benzo(k)fluoranthene | SCM | MN | |
| RCRP | EPA 8270D | Benzo[b]fluoranthene | NPW | MN | |
| RCRP | EPA 8270D | Benzo[b]fluoranthene | SCM | MN | |
| RCRP | EPA 8270D | Benzoic acid | NPW | MN | |
| RCRP | EPA 8270D | Benzoic acid | SCM | MN | |
| RCRP | EPA 8270D | Benzyl alcohol | NPW | MN | |
| RCRP | EPA 8270D | Benzyl alcohol | SCM | MN | |
| RCRP | EPA 8270D | bis(2-Chloroethoxy)methane | NPW | MN | |
| RCRP | EPA 8270D | bis(2-Chloroethoxy)methane | SCM | MN | |
| RCRP | EPA 8270D | bis(2-Chloroethyl) ether | NPW | MN | |
| RCRP | EPA 8270D | bis(2-Chloroethyl) ether | SCM | MN | |
| RCRP | EPA 8270D | bis(2-Chloroisopropyl) ether | SCM | MN | |
| RCRP | EPA 8270D | Butyl benzyl phthalate | NPW | MN | |
| RCRP | EPA 8270D | Butyl benzyl phthalate | SCM | MN | |
| RCRP | EPA 8270D | Carbazole | SCM | MN | |
| RCRP | EPA 8270D | Carbazole | NPW | MN | |
| RCRP | EPA 8270D | Chrysene | NPW | MN | |
| RCRP | EPA 8270D | Di(2-ethylhexyl) phthalate (bis(2-Ethylhexyl)phthalate, DEHP) | NPW | MN | |

| Program | Method | Analyte | Matrix | Primary | SOP |
|---|---|---|---|---|---|
| RCRP | EPA 8270D | Di(2-ethylhexyl) phthalate (bis(2-Ethylhexyl)phthalate, DEHP) | SCM | MN | |
| RCRP | EPA 8270D | Di-n-butyl phthalate | SCM | MN | |
| RCRP | EPA 8270D | Di-n-octyl phthalate | NPW | MN | |
| RCRP | EPA 8270D | Di-n-octyl phthalate | SCM | MN | |
| RCRP | EPA 8270D | Dibenz(a,h) anthracene | SCM | MN | |
| RCRP | EPA 8270D | Dibenz(a,h) anthracene | NPW | MN | |
| RCRP | EPA 8270D | Dibenzofuran | SCM | MN | |
| RCRP | EPA 8270D | Dibenzofuran | NPW | MN | |
| RCRP | EPA 8270D | Diethyl phthalate | SCM | MN | |
| RCRP | EPA 8270D | Dimethyl phthalate | SCM | MN | |
| RCRP | EPA 8270D | Fluoranthene | SCM | MN | |
| RCRP | EPA 8270D | Fluoranthene | NPW | MN | |
| RCRP | EPA 8270D | Fluorene | NPW | MN | |
| RCRP | EPA 8270D | Fluorene | SCM | MN | |
| RCRP | EPA 8270D | Hexachlorobenzene | SCM | MN | |
| RCRP | EPA 8270D | Hexachlorobenzene | NPW | MN | |
| RCRP | EPA 8270D | Hexachlorobutadiene | SCM | MN | |
| RCRP | EPA 8270D | Hexachlorobutadiene | NPW | MN | |
| RCRP | EPA 8270D | Hexachlorocyclopentadiene | NPW | MN | |
| RCRP | EPA 8270D | Hexachlorocyclopentadiene | SCM | MN | |
| RCRP | EPA 8270D | Hexachloroethane | NPW | MN | |
| RCRP | EPA 8270D | Hexachloroethane | SCM | MN | |
| RCRP | EPA 8270D | Indeno(1,2,3-cd) pyrene | NPW | MN | |
| RCRP | EPA 8270D | Indeno(1,2,3-cd) pyrene | SCM | MN | |
| RCRP | EPA 8270D | Isophorone | NPW | MN | |
| RCRP | EPA 8270D | Isophorone | SCM | MN | |
| RCRP | EPA 8270D | n-Nitrosodi-n-propylamine | SCM | MN | |
| RCRP | EPA 8270D | n-Nitrosodi-n-propylamine | NPW | MN | |
| RCRP | EPA 8270D | n-Nitrosodimethylamine | NPW | MN | |
| RCRP | EPA 8270D | n-Nitrosodimethylamine | SCM | MN | |
| RCRP | EPA 8270D | n-Nitrosodiphenylamine | SCM | MN | |
| RCRP | EPA 8270D | n-Nitrosodiphenylamine | NPW | MN | |
| RCRP | EPA 8270D | Naphthalene | NPW | MN | |
| RCRP | EPA 8270D | Naphthalene | SCM | MN | |
| RCRP | EPA 8270D | Nitrobenzene | NPW | MN | |
| RCRP | EPA 8270D | Nitrobenzene | SCM | MN | |

| Program | Method | Analyte | Matrix | Primary | SOP |
|---|---|---|---|---|---|
| RCRP | EPA 8270D | Pentachlorophenol | SCM | MN | |
| RCRP | EPA 8270D | Phenanthrene | SCM | MN | |
| RCRP | EPA 8270D | Phenanthrene | NPW | MN | |
| RCRP | EPA 8270D | Phenol | SCM | MN | |
| RCRP | EPA 8270D | Phenol | NPW | MN | |
| RCRP | EPA 8270D | Pyrene | NPW | MN | |
| RCRP | EPA 8270D | Pyridine | SCM | MN | |
| RCRP | EPA 8270D | Pyridine | NPW | MN | |
| RCRP | EPA 8270D | Quinoline | SCM | MN | |
| RCRP | EPA 8270D | Quinoline | NPW | MN | |

**EPA 8270D SIM**

Preparation Techniques: Extraction, ultrasonic; Extraction, soxhlet; Extraction, separatory funnel liquid-liquid (LLE);

| Program | Method | Analyte | Matrix | Primary | SOP |
|---|---|---|---|---|---|
| RCRP | EPA 8270D SIM | Acenaphthene | NPW | MN | |
| RCRP | EPA 8270D SIM | Acenaphthene | SCM | MN | |
| RCRP | EPA 8270D SIM | Acenaphthylene | NPW | MN | |
| RCRP | EPA 8270D SIM | Acenaphthylene | SCM | MN | |
| RCRP | EPA 8270D SIM | Anthracene | SCM | MN | |
| RCRP | EPA 8270D SIM | Anthracene | NPW | MN | |
| RCRP | EPA 8270D SIM | Benzo(a)anthracene | SCM | MN | |
| RCRP | EPA 8270D SIM | Benzo(a)anthracene | NPW | MN | |
| RCRP | EPA 8270D SIM | Benzo(a)pyrene | NPW | MN | |
| RCRP | EPA 8270D SIM | Benzo(a)pyrene | SCM | MN | |
| RCRP | EPA 8270D SIM | Benzo(g,h,i)perylene | NPW | MN | |
| RCRP | EPA 8270D SIM | Benzo(g,h,i)perylene | SCM | MN | |
| RCRP | EPA 8270D SIM | Benzo(k)fluoranthene | NPW | MN | |
| RCRP | EPA 8270D SIM | Benzo(k)fluoranthene | SCM | MN | |
| RCRP | EPA 8270D SIM | Benzo[b]fluoranthene | SCM | MN | |
| RCRP | EPA 8270D SIM | Benzo[b]fluoranthene | NPW | MN | |
| RCRP | EPA 8270D SIM | Butyl benzyl phthalate | NPW | MN | |
| RCRP | EPA 8270D SIM | Chrysene | SCM | MN | |
| RCRP | EPA 8270D SIM | Chrysene | NPW | MN | |
| RCRP | EPA 8270D SIM | Di-n-butyl phthalate | NPW | MN | |

| Program | Method | Analyte | Matrix | Primary | SOP |
|---|---|---|---|---|---|
| RCRP | EPA 8270D SIM | Dibenz(a,h) anthracene | SCM | MN | |
| RCRP | EPA 8270D SIM | Dibenz(a,h) anthracene | NPW | MN | |
| RCRP | EPA 8270D SIM | Fluoranthene | SCM | MN | |
| RCRP | EPA 8270D SIM | Fluoranthene | NPW | MN | |
| RCRP | EPA 8270D SIM | Fluorene | NPW | MN | |
| RCRP | EPA 8270D SIM | Fluorene | SCM | MN | |
| RCRP | EPA 8270D SIM | Indeno(1,2,3-cd) pyrene | SCM | MN | |
| RCRP | EPA 8270D SIM | Indeno(1,2,3-cd) pyrene | NPW | MN | |
| RCRP | EPA 8270D SIM | Naphthalene | SCM | MN | |
| RCRP | EPA 8270D SIM | Naphthalene | NPW | MN | |
| RCRP | EPA 8270D SIM | Phenanthrene | SCM | MN | |
| RCRP | EPA 8270D SIM | Phenanthrene | NPW | MN | |
| RCRP | EPA 8270D SIM | Pyrene | SCM | MN | |
| RCRP | EPA 8270D SIM | Pyrene | NPW | MN | |
| RCRP | EPA 8270D SIM | Quinoline | SCM | MN | |
| RCRP | EPA 8270D SIM | Quinoline | NPW | MN | |

**EPA 8280B**

Preparation Techniques: Extraction, separatory funnel liquid-liquid (LLE);

| Program | Method | Analyte | Matrix | Primary | SOP |
|---|---|---|---|---|---|
| RCRP | EPA 8280B | 1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD) | SCM | MN | |
| RCRP | EPA 8280B | 1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD) | NPW | MN | |
| RCRP | EPA 8280B | 1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF) | SCM | MN | |
| RCRP | EPA 8280B | 1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF) | NPW | MN | |
| RCRP | EPA 8280B | 1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (1,2,3,4,6,7,8-hpcdd) | NPW | MN | |
| RCRP | EPA 8280B | 1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (1,2,3,4,6,7,8-hpcdd) | SCM | MN | |
| RCRP | EPA 8280B | 1,2,3,4,6,7,8-Heptachlorodibenzofuran (1,2,3,4,6,7,8-hpcdf) | NPW | MN | |
| RCRP | EPA 8280B | 1,2,3,4,6,7,8-Heptachlorodibenzofuran (1,2,3,4,6,7,8-hpcdf) | SCM | MN | |
| RCRP | EPA 8280B | 1,2,3,4,7,8,9-Heptachlorodibenzofuran (1,2,3,4,7,8,9-hpcdf) | NPW | MN | |
| RCRP | EPA 8280B | 1,2,3,4,7,8,9-Heptachlorodibenzofuran (1,2,3,4,7,8,9-hpcdf) | SCM | MN | |

| Program | Method | Analyte | Matrix | Primary | SOP |
|---|---|---|---|---|---|
| RCRP | EPA 8280B | 1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (1,2,3,4,7,8-Hxcdd) | NPW | MN | |
| RCRP | EPA 8280B | 1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (1,2,3,4,7,8-Hxcdd) | SCM | MN | |
| RCRP | EPA 8280B | 1,2,3,4,7,8-Hexachlorodibenzofuran (1,2,3,4,7,8-Hxcdf) | SCM | MN | |
| RCRP | EPA 8280B | 1,2,3,4,7,8-Hexachlorodibenzofuran (1,2,3,4,7,8-Hxcdf) | NPW | MN | |
| RCRP | EPA 8280B | 1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin(1,2,3,6,7,8-Hxcdd) | NPW | MN | |
| RCRP | EPA 8280B | 1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin(1,2,3,6,7,8-Hxcdd) | SCM | MN | |
| RCRP | EPA 8280B | 1,2,3,6,7,8-Hexachlorodibenzofuran (1,2,3,6,7,8-Hxcdf) | SCM | MN | |
| RCRP | EPA 8280B | 1,2,3,6,7,8-Hexachlorodibenzofuran (1,2,3,6,7,8-Hxcdf) | NPW | MN | |
| RCRP | EPA 8280B | 1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (1,2,3,7,8,9-Hxcdd) | NPW | MN | |
| RCRP | EPA 8280B | 1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (1,2,3,7,8,9-Hxcdd) | SCM | MN | |
| RCRP | EPA 8280B | 1,2,3,7,8,9-Hexachlorodibenzofuran (1,2,3,7,8,9-Hxcdf) | SCM | MN | |
| RCRP | EPA 8280B | 1,2,3,7,8,9-Hexachlorodibenzofuran (1,2,3,7,8,9-Hxcdf) | NPW | MN | |
| RCRP | EPA 8280B | 1,2,3,7,8-Pentachlorodibenzo-p-dioxin (1,2,3,7,8-Pecdd) | SCM | MN | |
| RCRP | EPA 8280B | 1,2,3,7,8-Pentachlorodibenzo-p-dioxin (1,2,3,7,8-Pecdd) | NPW | MN | |
| RCRP | EPA 8280B | 1,2,3,7,8-Pentachlorodibenzofuran (1,2,3,7,8-Pecdf) | NPW | MN | |
| RCRP | EPA 8280B | 1,2,3,7,8-Pentachlorodibenzofuran (1,2,3,7,8-Pecdf) | SCM | MN | |
| RCRP | EPA 8280B | 2,3,4,6,7,8-Hexachlorodibenzofuran | NPW | MN | |
| RCRP | EPA 8280B | 2,3,4,6,7,8-Hexachlorodibenzofuran | SCM | MN | |
| RCRP | EPA 8280B | 2,3,4,7,8-Pentachlorodibenzofuran | SCM | MN | |
| RCRP | EPA 8280B | 2,3,4,7,8-Pentachlorodibenzofuran | NPW | MN | |
| RCRP | EPA 8280B | 2,3,7,8-Tetrachlorodibenzo- p-dioxin (2,3,7,8-TCDD) | SCM | MN | |
| RCRP | EPA 8280B | 2,3,7,8-Tetrachlorodibenzo- p-dioxin (2,3,7,8-TCDD) | NPW | MN | |
| RCRP | EPA 8280B | 2,3,7,8-Tetrachlorodibenzofuran | NPW | MN | |
| RCRP | EPA 8280B | 2,3,7,8-Tetrachlorodibenzofuran | SCM | MN | |
| RCRP | EPA 8280B | Total HpCDD | NPW | MN | |
| RCRP | EPA 8280B | Total HpCDD | SCM | MN | |
| RCRP | EPA 8280B | Total HpCDF | SCM | MN | |
| RCRP | EPA 8280B | Total HpCDF | NPW | MN | |

| Program | Method | Analyte | Matrix | Primary | SOP |
|---|---|---|---|---|---|
| RCRP | EPA 8280B | Total HxCDD | SCM | MN | |
| RCRP | EPA 8280B | Total HxCDD | NPW | MN | |
| RCRP | EPA 8280B | Total HxCDF | SCM | MN | |
| RCRP | EPA 8280B | Total HxCDF | NPW | MN | |
| RCRP | EPA 8280B | Total PeCDD | SCM | MN | |
| RCRP | EPA 8280B | Total PeCDD | NPW | MN | |
| RCRP | EPA 8280B | Total PeCDF | SCM | MN | |
| RCRP | EPA 8280B | Total PeCDF | NPW | MN | |
| RCRP | EPA 8280B | Total TCDD | NPW | MN | |
| RCRP | EPA 8280B | Total TCDD | SCM | MN | |
| RCRP | EPA 8280B | Total TCDF | SCM | MN | |
| RCRP | EPA 8280B | Total TCDF | NPW | MN | |

**EPA 8290**

Preparation Techniques: Extraction, soxhlet; Extraction, separatory funnel liquid-liquid (LLE);

| Program | Method | Analyte | Matrix | Primary | SOP |
|---|---|---|---|---|---|
| RCRP | EPA 8290 | 1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD) | TISSUE | MN | |
| RCRP | EPA 8290 | 1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD) | NPW | MN | |
| RCRP | EPA 8290 | 1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD) | SCM | MN | |
| RCRP | EPA 8290 | 1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF) | NPW | MN | |
| RCRP | EPA 8290 | 1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF) | TISSUE | MN | |
| RCRP | EPA 8290 | 1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF) | SCM | MN | |
| RCRP | EPA 8290 | 1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (1,2,3,4,6,7,8-hpcdd) | SCM | MN | |
| RCRP | EPA 8290 | 1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (1,2,3,4,6,7,8-hpcdd) | TISSUE | MN | |
| RCRP | EPA 8290 | 1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (1,2,3,4,6,7,8-hpcdd) | NPW | MN | |
| RCRP | EPA 8290 | 1,2,3,4,6,7,8-Heptachlorodibenzofuran (1,2,3,4,6,7,8-hpcdf) | NPW | MN | |
| RCRP | EPA 8290 | 1,2,3,4,6,7,8-Heptachlorodibenzofuran (1,2,3,4,6,7,8-hpcdf) | SCM | MN | |
| RCRP | EPA 8290 | 1,2,3,4,6,7,8-Heptachlorodibenzofuran (1,2,3,4,6,7,8-hpcdf) | TISSUE | MN | |
| RCRP | EPA 8290 | 1,2,3,4,7,8,9-Heptachlorodibenzofuran (1,2,3,4,7,8,9-hpcdf) | SCM | MN | |

| Program | Method | Analyte | Matrix | Primary | SOP |
|---|---|---|---|---|---|
| RCRP | EPA 8290 | 1,2,3,4,7,8,9-Heptachlorodibenzofuran (1,2,3,4,7,8,9-hpcdf) | NPW | MN | |
| RCRP | EPA 8290 | 1,2,3,4,7,8,9-Heptachlorodibenzofuran (1,2,3,4,7,8,9-hpcdf) | TISSUE | MN | |
| RCRP | EPA 8290 | 1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (1,2,3,4,7,8-Hxcdd) | TISSUE | MN | |
| RCRP | EPA 8290 | 1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (1,2,3,4,7,8-Hxcdd) | SCM | MN | |
| RCRP | EPA 8290 | 1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (1,2,3,4,7,8-Hxcdd) | NPW | MN | |
| RCRP | EPA 8290 | 1,2,3,4,7,8-Hexachlorodibenzofuran (1,2,3,4,7,8-Hxcdf) | SCM | MN | |
| RCRP | EPA 8290 | 1,2,3,4,7,8-Hexachlorodibenzofuran (1,2,3,4,7,8-Hxcdf) | TISSUE | MN | |
| RCRP | EPA 8290 | 1,2,3,4,7,8-Hexachlorodibenzofuran (1,2,3,4,7,8-Hxcdf) | NPW | MN | |
| RCRP | EPA 8290 | 1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin(1,2,3,6,7,8-Hxcdd) | TISSUE | MN | |
| RCRP | EPA 8290 | 1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin(1,2,3,6,7,8-Hxcdd) | SCM | MN | |
| RCRP | EPA 8290 | 1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin(1,2,3,6,7,8-Hxcdd) | NPW | MN | |
| RCRP | EPA 8290 | 1,2,3,6,7,8-Hexachlorodibenzofuran (1,2,3,6,7,8-Hxcdf) | NPW | MN | |
| RCRP | EPA 8290 | 1,2,3,6,7,8-Hexachlorodibenzofuran (1,2,3,6,7,8-Hxcdf) | SCM | MN | |
| RCRP | EPA 8290 | 1,2,3,6,7,8-Hexachlorodibenzofuran (1,2,3,6,7,8-Hxcdf) | TISSUE | MN | |
| RCRP | EPA 8290 | 1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (1,2,3,7,8,9-Hxcdd) | NPW | MN | |
| RCRP | EPA 8290 | 1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (1,2,3,7,8,9-Hxcdd) | TISSUE | MN | |
| RCRP | EPA 8290 | 1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (1,2,3,7,8,9-Hxcdd) | SCM | MN | |
| RCRP | EPA 8290 | 1,2,3,7,8,9-Hexachlorodibenzofuran (1,2,3,7,8,9-Hxcdf) | NPW | MN | |
| RCRP | EPA 8290 | 1,2,3,7,8,9-Hexachlorodibenzofuran (1,2,3,7,8,9-Hxcdf) | SCM | MN | |
| RCRP | EPA 8290 | 1,2,3,7,8,9-Hexachlorodibenzofuran (1,2,3,7,8,9-Hxcdf) | TISSUE | MN | |
| RCRP | EPA 8290 | 1,2,3,7,8-Pentachlorodibenzo-p-dioxin (1,2,3,7,8-Pecdd) | SCM | MN | |
| RCRP | EPA 8290 | 1,2,3,7,8-Pentachlorodibenzo-p-dioxin (1,2,3,7,8-Pecdd) | NPW | MN | |
| RCRP | EPA 8290 | 1,2,3,7,8-Pentachlorodibenzo-p-dioxin (1,2,3,7,8-Pecdd) | TISSUE | MN | |
| RCRP | EPA 8290 | 1,2,3,7,8-Pentachlorodibenzofuran (1,2,3,7,8-Pecdf) | TISSUE | MN | |
| RCRP | EPA 8290 | 1,2,3,7,8-Pentachlorodibenzofuran (1,2,3,7,8-Pecdf) | SCM | MN | |

| Program | Method | Analyte | Matrix | Primary | SOP |
|---|---|---|---|---|---|
| RCRP | EPA 8290 | 1,2,3,7,8-Pentachlorodibenzofuran (1,2,3,7,8-Pecdf) | NPW | MN | |
| RCRP | EPA 8290 | 2,3,4,6,7,8-Hexachlorodibenzofuran | TISSUE | MN | |
| RCRP | EPA 8290 | 2,3,4,6,7,8-Hexachlorodibenzofuran | NPW | MN | |
| RCRP | EPA 8290 | 2,3,4,6,7,8-Hexachlorodibenzofuran | SCM | MN | |
| RCRP | EPA 8290 | 2,3,4,7,8-Pentachlorodibenzofuran | TISSUE | MN | |
| RCRP | EPA 8290 | 2,3,4,7,8-Pentachlorodibenzofuran | NPW | MN | |
| RCRP | EPA 8290 | 2,3,4,7,8-Pentachlorodibenzofuran | SCM | MN | |
| RCRP | EPA 8290 | 2,3,7,8-Tetrachlorodibenzo- p-dioxin (2,3,7,8-TCDD) | NPW | MN | |
| RCRP | EPA 8290 | 2,3,7,8-Tetrachlorodibenzo- p-dioxin (2,3,7,8-TCDD) | SCM | MN | |
| RCRP | EPA 8290 | 2,3,7,8-Tetrachlorodibenzo- p-dioxin (2,3,7,8-TCDD) | TISSUE | MN | |
| RCRP | EPA 8290 | 2,3,7,8-Tetrachlorodibenzofuran | SCM | MN | |
| RCRP | EPA 8290 | 2,3,7,8-Tetrachlorodibenzofuran | TISSUE | MN | |
| RCRP | EPA 8290 | 2,3,7,8-Tetrachlorodibenzofuran | NPW | MN | |
| RCRP | EPA 8290 | Total Heptachlorodibenzo-p-dioxin (HpCDD, Total) | TISSUE | MN | |
| RCRP | EPA 8290 | Total Heptachlorodibenzofuran (HpCDF, Total) | TISSUE | MN | |
| RCRP | EPA 8290 | Total Hexachlorodibenzo-p-dioxin (HxCDD, Total) | TISSUE | MN | |
| RCRP | EPA 8290 | Total Hexachlorodibenzofuran (HxCDF, Total) | TISSUE | MN | |
| RCRP | EPA 8290 | Total Hpcdd | NPW | MN | |
| RCRP | EPA 8290 | Total Hpcdd | SCM | MN | |
| RCRP | EPA 8290 | Total Hpcdf | SCM | MN | |
| RCRP | EPA 8290 | Total Hpcdf | NPW | MN | |
| RCRP | EPA 8290 | Total Hxcdd | NPW | MN | |
| RCRP | EPA 8290 | Total Hxcdd | SCM | MN | |
| RCRP | EPA 8290 | Total Hxcdf | NPW | MN | |
| RCRP | EPA 8290 | Total Hxcdf | SCM | MN | |
| RCRP | EPA 8290 | Total Pecdd | SCM | MN | |
| RCRP | EPA 8290 | Total Pecdd | NPW | MN | |
| RCRP | EPA 8290 | Total Pecdf | NPW | MN | |
| RCRP | EPA 8290 | Total Pecdf | SCM | MN | |
| RCRP | EPA 8290 | Total Pentachlorodibenzo-p-dioxin (PeCDD, Total) | TISSUE | MN | |
| RCRP | EPA 8290 | Total Pentachlorodibenzofuran (PeCDF, Total) | TISSUE | MN | |
| RCRP | EPA 8290 | Total TCDD | NPW | MN | |

| Program | Method | Analyte | Matrix | Primary | SOP |
|---|---|---|---|---|---|
| RCRP | EPA 8290 | Total TCDD | SCM | MN | |
| RCRP | EPA 8290 | Total TCDF | NPW | MN | |
| RCRP | EPA 8290 | Total TCDF | SCM | MN | |
| RCRP | EPA 8290 | Total Tetrachlorodibenzo-p-dioxin (TCDD, Total) | TISSUE | MN | |
| RCRP | EPA 8290 | Total Tetrachlorodibenzofuran (TCDF, Total) | TISSUE | MN | |

**EPA 8290A**

Preparation Techniques: Extraction, soxhlet; Extraction, separatory funnel liquid-liquid (LLE);

| Program | Method | Analyte | Matrix | Primary | SOP |
|---|---|---|---|---|---|
| RCRP | EPA 8290A | 1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD) | TISSUE | MN | |
| RCRP | EPA 8290A | 1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD) | NPW | MN | |
| RCRP | EPA 8290A | 1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD) | SCM | MN | |
| RCRP | EPA 8290A | 1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF) | SCM | MN | |
| RCRP | EPA 8290A | 1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF) | NPW | MN | |
| RCRP | EPA 8290A | 1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF) | TISSUE | MN | |
| RCRP | EPA 8290A | 1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (1,2,3,4,6,7,8-hpcdd) | NPW | MN | |
| RCRP | EPA 8290A | 1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (1,2,3,4,6,7,8-hpcdd) | TISSUE | MN | |
| RCRP | EPA 8290A | 1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (1,2,3,4,6,7,8-hpcdd) | SCM | MN | |
| RCRP | EPA 8290A | 1,2,3,4,6,7,8-Heptachlorodibenzofuran (1,2,3,4,6,7,8-hpcdf) | NPW | MN | |
| RCRP | EPA 8290A | 1,2,3,4,6,7,8-Heptachlorodibenzofuran (1,2,3,4,6,7,8-hpcdf) | SCM | MN | |
| RCRP | EPA 8290A | 1,2,3,4,6,7,8-Heptachlorodibenzofuran (1,2,3,4,6,7,8-hpcdf) | TISSUE | MN | |
| RCRP | EPA 8290A | 1,2,3,4,7,8,9-Heptachlorodibenzofuran (1,2,3,4,7,8,9-hpcdf) | NPW | MN | |
| RCRP | EPA 8290A | 1,2,3,4,7,8,9-Heptachlorodibenzofuran (1,2,3,4,7,8,9-hpcdf) | TISSUE | MN | |
| RCRP | EPA 8290A | 1,2,3,4,7,8,9-Heptachlorodibenzofuran (1,2,3,4,7,8,9-hpcdf) | SCM | MN | |
| RCRP | EPA 8290A | 1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (1,2,3,4,7,8-Hxcdd) | SCM | MN | |
| RCRP | EPA 8290A | 1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (1,2,3,4,7,8-Hxcdd) | TISSUE | MN | |

| Program | Method | Analyte | Matrix | Primary | SOP |
|---|---|---|---|---|---|
| RCRP | EPA 8290A | 1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (1,2,3,4,7,8-Hxcdd) | NPW | MN | |
| RCRP | EPA 8290A | 1,2,3,4,7,8-Hexachlorodibenzofuran (1,2,3,4,7,8-Hxcdf) | NPW | MN | |
| RCRP | EPA 8290A | 1,2,3,4,7,8-Hexachlorodibenzofuran (1,2,3,4,7,8-Hxcdf) | SCM | MN | |
| RCRP | EPA 8290A | 1,2,3,4,7,8-Hexachlorodibenzofuran (1,2,3,4,7,8-Hxcdf) | TISSUE | MN | |
| RCRP | EPA 8290A | 1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin(1,2,3,6,7,8-Hxcdd) | NPW | MN | |
| RCRP | EPA 8290A | 1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin(1,2,3,6,7,8-Hxcdd) | SCM | MN | |
| RCRP | EPA 8290A | 1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin(1,2,3,6,7,8-Hxcdd) | TISSUE | MN | |
| RCRP | EPA 8290A | 1,2,3,6,7,8-Hexachlorodibenzofuran (1,2,3,6,7,8-Hxcdf) | SCM | MN | |
| RCRP | EPA 8290A | 1,2,3,6,7,8-Hexachlorodibenzofuran (1,2,3,6,7,8-Hxcdf) | TISSUE | MN | |
| RCRP | EPA 8290A | 1,2,3,6,7,8-Hexachlorodibenzofuran (1,2,3,6,7,8-Hxcdf) | NPW | MN | |
| RCRP | EPA 8290A | 1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (1,2,3,7,8,9-Hxcdd) | TISSUE | MN | |
| RCRP | EPA 8290A | 1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (1,2,3,7,8,9-Hxcdd) | SCM | MN | |
| RCRP | EPA 8290A | 1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (1,2,3,7,8,9-Hxcdd) | NPW | MN | |
| RCRP | EPA 8290A | 1,2,3,7,8,9-Hexachlorodibenzofuran (1,2,3,7,8,9-Hxcdf) | TISSUE | MN | |
| RCRP | EPA 8290A | 1,2,3,7,8,9-Hexachlorodibenzofuran (1,2,3,7,8,9-Hxcdf) | SCM | MN | |
| RCRP | EPA 8290A | 1,2,3,7,8,9-Hexachlorodibenzofuran (1,2,3,7,8,9-Hxcdf) | NPW | MN | |
| RCRP | EPA 8290A | 1,2,3,7,8-Pentachlorodibenzo-p-dioxin (1,2,3,7,8-Pecdd) | SCM | MN | |
| RCRP | EPA 8290A | 1,2,3,7,8-Pentachlorodibenzo-p-dioxin (1,2,3,7,8-Pecdd) | NPW | MN | |
| RCRP | EPA 8290A | 1,2,3,7,8-Pentachlorodibenzo-p-dioxin (1,2,3,7,8-Pecdd) | TISSUE | MN | |
| RCRP | EPA 8290A | 1,2,3,7,8-Pentachlorodibenzofuran (1,2,3,7,8-Pecdf) | SCM | MN | |
| RCRP | EPA 8290A | 1,2,3,7,8-Pentachlorodibenzofuran (1,2,3,7,8-Pecdf) | TISSUE | MN | |
| RCRP | EPA 8290A | 1,2,3,7,8-Pentachlorodibenzofuran (1,2,3,7,8-Pecdf) | NPW | MN | |
| RCRP | EPA 8290A | 2,3,4,6,7,8-Hexachlorodibenzofuran | TISSUE | MN | |
| RCRP | EPA 8290A | 2,3,4,6,7,8-Hexachlorodibenzofuran | NPW | MN | |
| RCRP | EPA 8290A | 2,3,4,6,7,8-Hexachlorodibenzofuran | SCM | MN | |
| RCRP | EPA 8290A | 2,3,4,7,8-Pentachlorodibenzofuran | NPW | MN | |

| Program | Method | Analyte | Matrix | Primary | SOP |
|---|---|---|---|---|---|
| RCRP | EPA 8290A | 2,3,4,7,8-Pentachlorodibenzofuran | SCM | MN | |
| RCRP | EPA 8290A | 2,3,4,7,8-Pentachlorodibenzofuran | TISSUE | MN | |
| RCRP | EPA 8290A | 2,3,7,8-Tetrachlorodibenzo- p-dioxin (2,3,7,8-TCDD) | TISSUE | MN | |
| RCRP | EPA 8290A | 2,3,7,8-Tetrachlorodibenzo- p-dioxin (2,3,7,8-TCDD) | SCM | MN | |
| RCRP | EPA 8290A | 2,3,7,8-Tetrachlorodibenzo- p-dioxin (2,3,7,8-TCDD) | NPW | MN | |
| RCRP | EPA 8290A | 2,3,7,8-Tetrachlorodibenzofuran | TISSUE | MN | |
| RCRP | EPA 8290A | 2,3,7,8-Tetrachlorodibenzofuran | SCM | MN | |
| RCRP | EPA 8290A | 2,3,7,8-Tetrachlorodibenzofuran | NPW | MN | |
| RCRP | EPA 8290A | Total Heptachlorodibenzo-p-dioxin (HpCDD, Total) | NPW | MN | |
| RCRP | EPA 8290A | Total Heptachlorodibenzo-p-dioxin (HpCDD, Total) | SCM | MN | |
| RCRP | EPA 8290A | Total Heptachlorodibenzofuran (HpCDF, Total) | NPW | MN | |
| RCRP | EPA 8290A | Total Heptachlorodibenzofuran (HpCDF, Total) | SCM | MN | |
| RCRP | EPA 8290A | Total Hexachlorodibenzo-p-dioxin (HxCDD, Total) | NPW | MN | |
| RCRP | EPA 8290A | Total Hexachlorodibenzo-p-dioxin (HxCDD, Total) | SCM | MN | |
| RCRP | EPA 8290A | Total Hexachlorodibenzofuran (HxCDF, Total) | SCM | MN | |
| RCRP | EPA 8290A | Total Hexachlorodibenzofuran (HxCDF, Total) | NPW | MN | |
| RCRP | EPA 8290A | Total HpCDD | TISSUE | MN | |
| RCRP | EPA 8290A | Total HpCDF | TISSUE | MN | |
| RCRP | EPA 8290A | Total HxCDD | TISSUE | MN | |
| RCRP | EPA 8290A | Total HxCDF | TISSUE | MN | |
| RCRP | EPA 8290A | Total PeCDD | TISSUE | MN | |
| RCRP | EPA 8290A | Total PeCDF | TISSUE | MN | |
| RCRP | EPA 8290A | Total Pentachlorodibenzo-p-dioxin (PeCDD, Total) | NPW | MN | |
| RCRP | EPA 8290A | Total Pentachlorodibenzo-p-dioxin (PeCDD, Total) | SCM | MN | |
| RCRP | EPA 8290A | Total Pentachlorodibenzofuran (PeCDF, Total) | SCM | MN | |
| RCRP | EPA 8290A | Total Pentachlorodibenzofuran (PeCDF, Total) | NPW | MN | |
| RCRP | EPA 8290A | Total TCDD | TISSUE | MN | |
| RCRP | EPA 8290A | Total TCDF | TISSUE | MN | |
| RCRP | EPA 8290A | Total Tetrachlorodibenzo-p-dioxin (TCDD, Total) | NPW | MN | |

| Program | Method | Analyte | Matrix | Primary | SOP |
|---|---|---|---|---|---|
| RCRP | EPA 8290A | Total Tetrachlorodibenzo-p-dioxin (TCDD, Total) | SCM | MN | |
| RCRP | EPA 8290A | Total Tetrachlorodibenzofuran (TCDF, Total) | SCM | MN | |
| RCRP | EPA 8290A | Total Tetrachlorodibenzofuran (TCDF, Total) | NPW | MN | |

**EPA 9045D**

Preparation Techniques: N/A

| Program | Method | Analyte | Matrix | Primary | SOP |
|---|---|---|---|---|---|
| RCRP | EPA 9045D | pH | SCM | MN | |

**EPA 9071B**

Preparation Techniques: N/A

| Program | Method | Analyte | Matrix | Primary | SOP |
|---|---|---|---|---|---|
| RCRP | EPA 9071B | n-Hexane Extractable Material (O&G) | SCM | MN | |
| RCRP | EPA 9071B | Oil & Grease | SCM | MN | |

**EPA 9095B**

Preparation Techniques: N/A

| Program | Method | Analyte | Matrix | Primary | SOP |
|---|---|---|---|---|---|
| RCRP | EPA 9095B | Paint Filter Liquids Test | SCM | MN | |

**EPA RSK-175 (GC/FID)**

Preparation Techniques: N/A

| Program | Method | Analyte | Matrix | Primary | SOP |
|---|---|---|---|---|---|
| RCRP | EPA RSK-175 (GC/FID) | Ethane | NPW | MN | |
| RCRP | EPA RSK-175 (GC/FID) | Ethene | NPW | MN | |
| RCRP | EPA RSK-175 (GC/FID) | Methane | NPW | MN | |

**ASTM D516-90**

Preparation Techniques: N/A

| Program | Method | Analyte | Matrix | Primary | SOP |
|---|---|---|---|---|---|
| SDWP | ASTM D516-90 | Sulfate | DW | MN | |

**EPA 1613**

Preparation Techniques: Extraction, automated soxhlet; Extraction, solid phase (SPE); Extraction, separatory funnel liquid-liquid (LLE);

| Program | Method | Analyte | Matrix | Primary | SOP |
|---|---|---|---|---|---|
| SDWP | EPA 1613 | 2,3,7,8-Tetrachlorodibenzo- p-dioxin (2,3,7,8-TCDD) | DW | MN | |

**EPA 180.1**

Preparation Techniques: N/A

| Program | Method | Analyte | Matrix | Primary | SOP |
|---|---|---|---|---|---|
| SDWP | EPA 180.1 | Turbidity | DW | MN | |

**EPA 200.8**

Preparation Techniques: Digestion, hotplate or HotBlock;

| Program | Method | Analyte | Matrix | Primary | SOP |
|---|---|---|---|---|---|
| SDWP | EPA 200.8 | Aluminum | DW | MN | |
| SDWP | EPA 200.8 | Antimony | DW | MN | |
| SDWP | EPA 200.8 | Arsenic | DW | MN | |
| SDWP | EPA 200.8 | Barium | DW | MN | |
| SDWP | EPA 200.8 | Beryllium | DW | MN | |
| SDWP | EPA 200.8 | Cadmium | DW | MN | |
| SDWP | EPA 200.8 | Chromium | DW | MN | |
| SDWP | EPA 200.8 | Copper | DW | MN | |
| SDWP | EPA 200.8 | Lead | DW | MN | |
| SDWP | EPA 200.8 | Manganese | DW | MN | |

| Program | Method | Analyte | Matrix | Primary | SOP |
|---|---|---|---|---|---|
| SDWP | EPA 200.8 | Mercury | DW | MN | |
| SDWP | EPA 200.8 | Nickel | DW | MN | |
| SDWP | EPA 200.8 | Selenium | DW | MN | |
| SDWP | EPA 200.8 | Silver | DW | MN | |
| SDWP | EPA 200.8 | Thallium | DW | MN | |
| SDWP | EPA 200.8 | Zinc | DW | MN | |

**EPA 245.1**

Preparation Techniques: N/A

| Program | Method | Analyte | Matrix | Primary | SOP |
|---|---|---|---|---|---|
| SDWP | EPA 245.1 | Mercury | DW | MN | |

**EPA 353.2**

Preparation Techniques: N/A

| Program | Method | Analyte | Matrix | Primary | SOP |
|---|---|---|---|---|---|
| SDWP | EPA 353.2 | Nitrate | DW | MN | |
| SDWP | EPA 353.2 | Nitrite | DW | MN | |

**EPA 524.2**

Preparation Techniques: Purge and trap;

| Program | Method | Analyte | Matrix | Primary | SOP |
|---|---|---|---|---|---|
| SDWP | EPA 524.2 | 1,1,1,2-Tetrachloroethane | DW | MN | |
| SDWP | EPA 524.2 | 1,1,1-Trichloroethane | DW | MN | |
| SDWP | EPA 524.2 | 1,1,2,2-Tetrachloroethane | DW | MN | |
| SDWP | EPA 524.2 | 1,1,2-Trichloroethane | DW | MN | |
| SDWP | EPA 524.2 | 1,1-Dichloroethane | DW | MN | |
| SDWP | EPA 524.2 | 1,1-Dichloroethylene | DW | MN | |
| SDWP | EPA 524.2 | 1,1-Dichloropropene | DW | MN | |
| SDWP | EPA 524.2 | 1,2,3-Trichlorobenzene | DW | MN | |
| SDWP | EPA 524.2 | 1,2,3-Trichloropropane | DW | MN | |
| SDWP | EPA 524.2 | 1,2,4-Trichlorobenzene | DW | MN | |

| Program | Method | Analyte | Matrix | Primary | SOP |
|---|---|---|---|---|---|
| SDWP | EPA 524.2 | 1,2,4-Trimethylbenzene | DW | MN | |
| SDWP | EPA 524.2 | 1,2-Dichlorobenzene | DW | MN | |
| SDWP | EPA 524.2 | 1,2-Dichloroethane (Ethylene dichloride) | DW | MN | |
| SDWP | EPA 524.2 | 1,2-Dichloropropane | DW | MN | |
| SDWP | EPA 524.2 | 1,3,5-Trichlorobenzene | DW | MN | |
| SDWP | EPA 524.2 | 1,3-Dichlorobenzene | DW | MN | |
| SDWP | EPA 524.2 | 1,4-Dichlorobenzene | DW | MN | |
| SDWP | EPA 524.2 | 2,2-Dichloropropane | DW | MN | |
| SDWP | EPA 524.2 | 2-Chlorotoluene | DW | MN | |
| SDWP | EPA 524.2 | 4-Chlorotoluene | DW | MN | |
| SDWP | EPA 524.2 | Benzene | DW | MN | |
| SDWP | EPA 524.2 | Bromobenzene | DW | MN | |
| SDWP | EPA 524.2 | Bromochloromethane | DW | MN | |
| SDWP | EPA 524.2 | Bromodichloromethane | DW | MN | |
| SDWP | EPA 524.2 | Bromoform | DW | MN | |
| SDWP | EPA 524.2 | Bromomethane | DW | MN | |
| SDWP | EPA 524.2 | Carbon tetrachloride | DW | MN | |
| SDWP | EPA 524.2 | Chlorobenzene | DW | MN | |
| SDWP | EPA 524.2 | Chlorodibromomethane | DW | MN | |
| SDWP | EPA 524.2 | Chloroethane (Ethyl chloride) | DW | MN | |
| SDWP | EPA 524.2 | Chloroform | DW | MN | |
| SDWP | EPA 524.2 | cis-1,2-Dichloroethylene | DW | MN | |
| SDWP | EPA 524.2 | cis-1,3-Dichloropropene | DW | MN | |
| SDWP | EPA 524.2 | Dibromomethane (Methylene bromide) | DW | MN | |
| SDWP | EPA 524.2 | Dichlorodifluoromethane (Freon-12) | DW | MN | |
| SDWP | EPA 524.2 | Ethylbenzene | DW | MN | |
| SDWP | EPA 524.2 | Hexachlorobutadiene | DW | MN | |
| SDWP | EPA 524.2 | Isopropylbenzene | DW | MN | |
| SDWP | EPA 524.2 | Methyl chloride (Chloromethane) | DW | MN | |
| SDWP | EPA 524.2 | Methyl tert-butyl ether (MTBE) | DW | MN | |
| SDWP | EPA 524.2 | Methylene chloride (Dichloromethane) | DW | MN | |
| SDWP | EPA 524.2 | n-Butylbenzene | DW | MN | |
| SDWP | EPA 524.2 | n-Propylbenzene | DW | MN | |
| SDWP | EPA 524.2 | Naphthalene | DW | MN | |
| SDWP | EPA 524.2 | sec-Butylbenzene | DW | MN | |
| SDWP | EPA 524.2 | Styrene | DW | MN | |

| Program | Method | Analyte | Matrix | Primary | SOP |
|---|---|---|---|---|---|
| SDWP | EPA 524.2 | tert-Butylbenzene | DW | MN | |
| SDWP | EPA 524.2 | Tetrachloroethylene (Perchloroethylene) | DW | MN | |
| SDWP | EPA 524.2 | Toluene | DW | MN | |
| SDWP | EPA 524.2 | Total Trihalomethanes | DW | MN | |
| SDWP | EPA 524.2 | trans-1,2-Dichloroethylene | DW | MN | |
| SDWP | EPA 524.2 | trans-1,3-Dichloropropylene | DW | MN | |
| SDWP | EPA 524.2 | Trichloroethene (Trichloroethylene) | DW | MN | |
| SDWP | EPA 524.2 | Trichlorofluoromethane (Fluorotrichloromethane, Freon 11) | DW | MN | |
| SDWP | EPA 524.2 | Vinyl chloride | DW | MN | |
| SDWP | EPA 524.2 | Xylene (total) | DW | MN | |

**SM 2320 B-97**

Preparation Techniques: N/A

| Program | Method | Analyte | Matrix | Primary | SOP |
|---|---|---|---|---|---|
| SDWP | SM 2320 B-97 | Alkalinity as CaCO3 | DW | MN | |

**SM 2340 B-97**

Preparation Techniques: N/A

| Program | Method | Analyte | Matrix | Primary | SOP |
|---|---|---|---|---|---|
| SDWP | SM 2340 B-97 | Hardness | DW | MN | |

**SM 2540 C-97**

Preparation Techniques: N/A

| Program | Method | Analyte | Matrix | Primary | SOP |
|---|---|---|---|---|---|
| SDWP | SM 2540 C-97 | Residue-filterable (TDS) | DW | MN | |

**SM 4500-Cl G-93**

Preparation Techniques: N/A

| Program | Method | Analyte | Matrix | Primary | SOP |
|---|---|---|---|---|---|
| SDWP | SM 4500-Cl G-93 | Total chlorine | DW | MN | |

**SM 4500-CN$^-$ E-97**

Preparation Techniques: Distillation, MIDI; Distillation, macro; Distillation, micro;

| Program | Method | Analyte | Matrix | Primary | SOP |
|---|---|---|---|---|---|
| SDWP | SM 4500-CN$^-$ E-97 | Cyanide | DW | MN | |

**SM 4500-F$^-$ C-97**

Preparation Techniques: N/A;

| Program | Method | Analyte | Matrix | Primary | SOP |
|---|---|---|---|---|---|
| SDWP | SM 4500-F$^-$ C-97 | Fluoride | DW | MN | |

**SM 4500-H+ B-96**

Preparation Techniques: N/A

| Program | Method | Analyte | Matrix | Primary | SOP |
|---|---|---|---|---|---|
| SDWP | SM 4500-H+ B-96 | pH | DW | MN | |

**SM 4500-NO2$^-$ B-93**

Preparation Techniques: N/A

| Program | Method | Analyte | Matrix | Primary | SOP |
|---|---|---|---|---|---|
| SDWP | SM 4500-NO2$^-$ B-93 | Nitrite | DW | MN | |

**SM 4500-P E-97**

Preparation Techniques: N/A

| Program | Method | Analyte | Matrix | Primary | SOP |
|---|---|---|---|---|---|
| SDWP | SM 4500-P E-97 | Orthophosphate as P | DW | MN | |

**SM 9215 B (R2A)-94**

Preparation Techniques: N/A

| Program | Method | Analyte | Matrix | Primary | SOP |
|---|---|---|---|---|---|
| SDWP | SM 9215 B (R2A)-94 | Heterotrophic plate count | DW | MN | |

**SM 9223 B (Colilert®)-97**

Preparation Techniques: N/A

| Program | Method | Analyte | Matrix | Primary | SOP |
|---|---|---|---|---|---|
| SDWP | SM 9223 B (Colilert®)-97 | Escherichia coli | DW | MN | |
| SDWP | SM 9223 B (Colilert®)-97 | Total coliforms | DW | MN | |

## Underground Storage Tank Program

**EPA TO-15**

Preparation Techniques: N/A

| Program | Method | Analyte | Matrix | Primary | SOP |
|---|---|---|---|---|---|
| USTP | EPA TO-15 | 1,1,1-Trichloroethane | AIR | MN | |
| USTP | EPA TO-15 | 1,1,2,2-Tetrachloroethane | AIR | MN | |
| USTP | EPA TO-15 | 1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113) | AIR | MN | |
| USTP | EPA TO-15 | 1,1,2-Trichloroethane | AIR | MN | |
| USTP | EPA TO-15 | 1,1-Dichloroethane | AIR | MN | |
| USTP | EPA TO-15 | 1,1-Dichloroethylene | AIR | MN | |
| USTP | EPA TO-15 | 1,2,4-Trichlorobenzene | AIR | MN | |
| USTP | EPA TO-15 | 1,2,4-Trimethylbenzene | AIR | MN | |
| USTP | EPA TO-15 | 1,2-Dibromoethane (EDB, Ethylene dibromide) | AIR | MN | |
| USTP | EPA TO-15 | 1,2-Dichloro-1,1,2,2-tetrafluoroethane (Freon-114) | AIR | MN | |
| USTP | EPA TO-15 | 1,2-Dichlorobenzene | AIR | MN | |
| USTP | EPA TO-15 | 1,2-Dichloroethane (Ethylene dichloride) | AIR | MN | |
| USTP | EPA TO-15 | 1,2-Dichloropropane | AIR | MN | |
| USTP | EPA TO-15 | 1,3,5-Trimethylbenzene | AIR | MN | |
| USTP | EPA TO-15 | 1,3-Butadiene | AIR | MN | |
| USTP | EPA TO-15 | 1,3-Dichlorobenzene | AIR | MN | |

| Program | Method | Analyte | Matrix | Primary | SOP |
|---|---|---|---|---|---|
| USTP | EPA TO-15 | 1,4-Dichlorobenzene | AIR | MN | |
| USTP | EPA TO-15 | 1-Propene | AIR | MN | |
| USTP | EPA TO-15 | 2-Butanone (Methyl ethyl ketone, MEK) | AIR | MN | |
| USTP | EPA TO-15 | 2-Hexanone | AIR | MN | |
| USTP | EPA TO-15 | 4-Ethyltoluene | AIR | MN | |
| USTP | EPA TO-15 | 4-Methyl-2-pentanone (MIBK) | AIR | MN | |
| USTP | EPA TO-15 | Acetone | AIR | MN | |
| USTP | EPA TO-15 | Benzene | AIR | MN | |
| USTP | EPA TO-15 | Benzyl chloride | AIR | MN | |
| USTP | EPA TO-15 | Bromodichloromethane | AIR | MN | |
| USTP | EPA TO-15 | Bromoform | AIR | MN | |
| USTP | EPA TO-15 | Carbon disulfide | AIR | MN | |
| USTP | EPA TO-15 | Carbon tetrachloride | AIR | MN | |
| USTP | EPA TO-15 | Chlorobenzene | AIR | MN | |
| USTP | EPA TO-15 | Chlorodibromomethane | AIR | MN | |
| USTP | EPA TO-15 | Chloroethane (Ethyl chloride) | AIR | MN | |
| USTP | EPA TO-15 | Chloroform | AIR | MN | |
| USTP | EPA TO-15 | cis-1,2-Dichloroethylene | AIR | MN | |
| USTP | EPA TO-15 | cis-1,3-Dichloropropene | AIR | MN | |
| USTP | EPA TO-15 | Cyclohexane | AIR | MN | |
| USTP | EPA TO-15 | Dichlorodifluoromethane (Freon-12) | AIR | MN | |
| USTP | EPA TO-15 | Ethanol | AIR | MN | |
| USTP | EPA TO-15 | Ethyl acetate | AIR | MN | |
| USTP | EPA TO-15 | Ethylbenzene | AIR | MN | |
| USTP | EPA TO-15 | Hexachlorobutadiene | AIR | MN | |
| USTP | EPA TO-15 | Isopropyl alcohol (2-Propanol, Isopropanol) | AIR | MN | |
| USTP | EPA TO-15 | m+p-xylene | AIR | MN | |
| USTP | EPA TO-15 | Methyl bromide (Bromomethane) | AIR | MN | |
| USTP | EPA TO-15 | Methyl chloride (Chloromethane) | AIR | MN | |
| USTP | EPA TO-15 | Methyl tert-butyl ether (MTBE) | AIR | MN | |
| USTP | EPA TO-15 | Methylene chloride (Dichloromethane) | AIR | MN | |
| USTP | EPA TO-15 | n-Heptane | AIR | MN | |
| USTP | EPA TO-15 | n-Hexane | AIR | MN | |
| USTP | EPA TO-15 | Naphthalene | AIR | MN | |
| USTP | EPA TO-15 | o-Xylene | AIR | MN | |
| USTP | EPA TO-15 | Styrene | AIR | MN | |

| Program | Method | Analyte | Matrix | Primary | SOP |
|---|---|---|---|---|---|
| USTP | EPA TO-15 | Tetrachloroethylene (Perchloroethylene) | AIR | MN | |
| USTP | EPA TO-15 | Tetrahydrofuran (THF) | AIR | MN | |
| USTP | EPA TO-15 | Toluene | AIR | MN | |
| USTP | EPA TO-15 | trans-1,2-Dichloroethylene | AIR | MN | |
| USTP | EPA TO-15 | trans-1,3-Dichloropropylene | AIR | MN | |
| USTP | EPA TO-15 | Trichloroethene (Trichloroethylene) | AIR | MN | |
| USTP | EPA TO-15 | Trichlorofluoromethane (Fluorotrichloromethane, Freon 11) | AIR | MN | |
| USTP | EPA TO-15 | Vinyl acetate | AIR | MN | |
| USTP | EPA TO-15 | Vinyl chloride | AIR | MN | |

**WI(95) DRO**

Preparation Techniques: N/A

| Program | Method | Analyte | Matrix | Primary | SOP |
|---|---|---|---|---|---|
| USTP | WI(95) DRO | Diesel range organics (DRO) | NPW | MN | |
| USTP | WI(95) DRO | Diesel range organics (DRO) | SCM | MN | |

**WI(95) GRO**

Preparation Techniques: N/A

| Program | Method | Analyte | Matrix | Primary | SOP |
|---|---|---|---|---|---|
| USTP | WI(95) GRO | Gasoline range organics (GRO) | NPW | MN | |
| USTP | WI(95) GRO | Gasoline range organics (GRO) | SCM | MN | |

**WI(95) GRO**

Preparation Techniques: N/A

| Program | Method | Analyte | Matrix | Primary | SOP |
|---|---|---|---|---|---|
| USTP | WI(95) GRO | Petroleum Volatile Organic Compounds (PVOC) | SCM | MN | |
| USTP | WI(95) GRO | Petroleum Volatile Organic Compounds (PVOC) | NPW | MN | |

Note: Method beginning with "SM" refer to the approved editions of Standard methods for the Examination of Water and Wastes. Approved methods are listed in the applicable parts of Title 40 of the Code of Federal Regulations (including its subsequent Federal Register updates), MN Statutes and Rules, and state-issued permits.

# QUALITY ASSURANCE MANUAL

## Quality Assurance/Quality Control Policies and Procedures

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2/2/2012
Date

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# PACE ANALYTICAL SERVICES – MINNESOTA AND MONTANA
# LOCAL APPROVAL

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# 1.0. INTRODUCTION AND ORGANIZATIONAL STRUCTURE

**"Working together to protect our environment and improve our health"**
*Pace Analytical Services Inc. - Mission Statement*

## 1.1. Introduction to PASI

Pace Analytical Services, Inc. (PASI) is a privately held, full-service analytical testing firm operating a nationwide system of laboratories. PASI offers extensive services beyond standard analytical testing, including: bioassay for aquatic toxicity, air toxics, industrial hygiene testing, explosives, dioxins and coplanar PCB's by high resolution mass spectroscopy , radiochemical analyses, product testing, pharmaceutical testing, field services and mobile laboratory capabilities. PASI has implemented a consistent Quality System in each of its laboratories and service centers. In addition, the company utilizes an advanced data management system that is highly efficient and allows for flexible data reporting. Together, these systems ensure data reliability and superior on-time performance. This document defines the Quality System and QA/QC protocols.

Our goal is to combine our expertise in laboratory operations with customized solutions to meet the specific needs of our customers.

## 1.2. Statement of Purpose

To meet the business needs of our customers for high quality, cost-effective analytical measurements and services.

## 1.3. Quality Policy Statement and Goals of the Quality System

PASI management is committed to maintaining the highest possible standard of service for our customers by following a documented quality system. The overall objective of this quality system is to provide reliable data of known quality through adherence to rigorous quality assurance policies and quality control procedures as documented in this Quality Assurance Manual.

All personnel within the PASI network are required to be familiar with all facets of the quality system relevant to their position and implement these policies and procedures in their daily work. This daily focus on quality is applied with initial project planning, continued through all field and laboratory activities, and is ultimately included in the final report generation.

PASI management demonstrates its commitment to quality by providing the resources, including facilities, equipment, and personnel to ensure the adherence to these documented policies and procedures and to promote the continuous improvement of the quality system. All PASI personnel must comply with all current applicable state, federal, and industry standards, such as the NELAC, TNI, NVLAP, and ISO 17025 standards, and are required to perform all tests in accordance with stated methods and customer requirements.

## 1.4. Core Values

- **Integrity-** Pace personnel are required to abide by the PASI Code of Ethics and all Pace employees must go through Data Integrity/Ethics training upon initial orientation and as an annual refresher.
- **Value Employees-** Pace management views employees as our most important asset and communicates to them the relevance and importance of their activities within their job functions and how they contribute to the achievement of the objectives of the quality management system.
- **Know Our Customers-** Pace makes every effort to know our customers and address their sampling and analytical needs. More information on this item can be found in section 2.0.
- **Honor Commitments-** Pace labs focus on making solid commitments with regards to quality, capacity, and agreed upon turnaround time to our customers.
- **Flexible Response To Demand-** Pace labs are equipped with both the material and personnel resources to enable them to be responsive to the demands of customers when situations or projects need change.
- **Pursue Opportunities-** Pace is committed to pursuing opportunities for the growth of the company by constantly exploring markets and areas where we can expand.
- **Continuously Improve-** Pace has committed much time and effort into establishing a continuous improvement program where company personnel meet on a regular basis to share ideas in cost reduction, production improvement and standardization in order to develop best practices. This information, as well as company financial and production metrics, are tracked, evaluated, and shared with each Pace facility.

## 1.5. Code of Ethics

PASI's fundamental ethical principles are as follows:

- Each PASI employee is responsible for the propriety and consequences of his or her actions;
- Each PASI employee must conduct all aspects of Company business in an ethical and strictly legal manner, and must obey the laws of the United States and of all localities, states and nations where PASI does business or seeks to do business;
- Each PASI employee must reflect the highest standards of honesty, integrity and fairness on behalf of the Company with customers, suppliers, the public, and one another.
- Each PASI employee must recognize and understand that our daily activities in environmental laboratories affect public health as well as the environment and that environmental laboratory analysts are a critical part of the system society depends upon to improve and guard our natural resources:

Strict adherence by each PASI employee to this Code of Ethics and to the Standards of Conduct is essential to the continued vitality of PASI and to continue the pursuit of our common mission to protect our environment and improve our health.

Failure to comply with the Code of Ethics and Standards of Conduct will result in disciplinary action up to and including termination and referral for civil or criminal prosecution where appropriate. An employee will be notified of an infraction and given an opportunity to explain, as prescribed under current disciplinary procedures.

## 1.6. Standards of Conduct

### 1.6.1. Data Integrity

The accuracy and integrity of the analytical results and its supporting documentation produced at PASI are the cornerstones of the company. Lack of data integrity is an assault on our most basic values putting PASI and its employees at grave financial and legal risk and will not be tolerated. Therefore, employees are to accurately prepare and maintain all technical records, scientific notebooks, calculations, and databases. Employees are prohibited from making false entries or misrepresentations of data for any reason.

Managerial staff must make every effort to ensure that personnel are free from any undue pressures that may affect the quality or integrity of their work including commercial, financial, over-scheduling, and working condition pressures.

### 1.6.2. Confidentiality

PASI employees must not use or disclose confidential or proprietary information except when in connection with their duties at PASI. This is effective over the course of employment and for an additional period of two years thereafter.

Confidential or proprietary information, belonging to either PASI and/or its customers, includes but is not limited to test results, trade secrets, research and development matters, procedures, methods, processes and standards, company-specific techniques and equipment, marketing and customer information, inventions, materials composition, etc.

### 1.6.3. Conflict of Interest

PASI employees must avoid situations that might involve a conflict of interest or could appear questionable to others. The employee must be careful in two general areas:

- Participation in activities that conflict or appear to conflict with the employees' PASI responsibilities.
- Offering or accepting anything that might influence the recipient or cause another person to believe that the recipient may be influenced to behave or in a different manner than he would normally. This includes bribes, gifts, kickbacks, or illegal payments.

Employees are not to engage in outside business or economic activity relating to a sale or purchase by the Company. Other problematic activities include service on the Board of Directors of a competing or supplier company, significant ownership in a competing or supplier company, employment for a competing or supplier company, or participation in any outside business during the employee's work hours.

### 1.6.4. Compliance

All employees are required to read, understand, and comply with the various components of the standards listed in this document. As confirmation that they understand their responsibility, each employee is required to sign an acknowledgment form annually that then becomes part of the

employee's permanent record. Employees will be held accountable for complying with the Quality Systems as summarized in the Quality Assurance Manual.

## 1.7. Laboratory Organization

The PASI Corporate Office centralizes company-wide accounting, business development, financial management, human resources development, information systems, marketing, quality, safety, and training activities. PASI's Director of Quality is responsible for assisting the development, implementation and monitoring of quality programs for the company. See Attachment IIB for the Corporate Organizational structure.

Each laboratory within the system operates with local management, but all share common systems and receives support from the Corporate Office.

A General Manager (GM) supervises each regional laboratory. Some operations may have an Assistant General Manager (AGM) in situations where the General Manager is responsible for multiple laboratory facilities and is not necessarily in the facility on a regular basis. Quality Managers (QM) at each laboratory report directly to their General Manager or Assistant General Manager and will also receive guidance and direction from the Director of Quality.

The General Manager bears the responsibility for the laboratory operations and serves as the final, local authority in all matters. In the absence of the General Manager or Assistant General Manager, the Quality Manager serves as the next in command. He or she assumes the responsibilities of the GM until the GM is available to resume the duties of their position. In the absence of the GM and QM, management responsibility of the laboratory is passed to the Laboratory Operations Manager, however named, – provided such a position is identified – and then to the most senior department manager until the return of the GM or QM. The most senior department manager in charge may include the Client Services Manager or the Administrative Business Manager at the discretion of the General Manager.

A Laboratory Operations Manager or Technical Director who is absent for a period of time exceeding 15 consecutive calendar days shall designate another full-time staff member meeting the qualifications of the technical director to temporarily perform this function. The laboratory General Manager or Quality Manager has the authority to make this designation in the event the existing Laboratory Operations Manager or Technical Director is unable to do so. If this absence exceeds 35 consecutive calendar days, the primary accrediting authority shall be notified in writing.

The Quality Manager has the responsibility and authority to ensure the Quality System is implemented and followed at all times. In circumstances where a laboratory is not meeting the established level of quality or following the policies set forth in this Quality Assurance Manual, the Quality Manager has the authority to halt laboratory operations should he or she deem such an action necessary. The QM will immediately communicate the halting of operations to the GM and keep him or her posted on the progress of corrective actions. In the event the GM and QM are not in agreement as to the need for the suspension, the Chief Operating Officer and Director of Quality will be called in to mediate the situation.

Under the direction of the General Manager, the technical staff of the laboratory is generally organized into the following functional groups:

- Organic Sample Preparation
- Wet Chemistry Analysis
- Metals Analysis
- Volatiles Analysis
- Semi-volatiles Analysis
- Radiochemical Analysis
- Microbiology
- Air Analysis
- HRMS Analysis
- Process Testing

Appropriate support groups are present in each laboratory. The actual organizational structure for PASI – Minnesota and Montana is listed in Attachment IIA. In the event of a change in General Manager, Quality Manager, or any Laboratory Operations Manager/Technical Director, the laboratory will notify its accrediting authorities and revise the organizational chart in the Quality Assurance Manual (QAM) within 30 days. For changes in Department Managers or Supervisors or other laboratory personnel, no notifications will be sent to the laboratory's accrediting agencies; changes to the organizational chart will be updated during or prior to the annual review process. Changes or additions in these key personnel will also be noted by additional signatures on the Quality Manual, as applicable. In any case, the QAM will remain in effect until the next scheduled revision.

## 1.8. Laboratory Job Descriptions

### 1.8.1. Senior General Manager

- Oversees all functions of all the operations within their designated region;
- Oversees the development of local General Managers within their designated region;
- Oversees and authorizes personnel development including staffing, recruiting, training, workload scheduling, employee retention and motivation;
- Oversees the preparation of budgets and staffing plans for all operations within their designated region;
- Ensures compliance with all applicable state, federal and industry standards.

### 1.8.2. General Manager (local laboratory)

- Oversees all functions of the operations;
- Authorizes personnel development including staffing, recruiting, training, workload scheduling, employee retention and motivation;
- Prepares budgets and staffing plans;
- Monitors the Quality Systems of the laboratory and advises the Quality Manager accordingly;
- Ensures compliance with all applicable state, federal and industry standards.

### 1.8.3. Laboratory Operations Manager

- In the absence of the GM, performs all duties as listed above for the General Manager;
- Oversees the daily production and quality activities of all departments;
- Manages all departments and works with staff to ensure department objectives are met;
- Works with all departments to ensure capacity and customer expectations are accurately understood and met;

- Works with General Manager to prepare appropriate budget and staffing plans for all departments;
- Responsible for prioritizing personnel and production activities within all departments;
- Performs formal and informal performance reviews of departmental staff.

### 1.8.4 Quality Manager

- Oversees the laboratory Quality Systems while functioning independently from laboratory operations. Reports directly to the General Manager;
- Monitors Quality Assurance policies and Quality Control procedures to ensure that the laboratory achieves established standards of quality;
- Maintains records of quality control data and evaluates data quality;
- Conducts periodic internal audits and coordinates external audits performed by regulatory agencies or customer representatives;
- Operate as the designated data integrity officer, retain and investigate confidential reporting of instances of improper, unethical or illegal activities.
- Reviews and maintains records of proficiency testing results;
- Maintains the document control system;
- Assists in development and implementation of appropriate training programs;
- Provides technical support to laboratory operations regarding methodology and project QA/QC requirements;
- Maintains certifications from federal and state programs;
- Ensures compliance with all applicable state, federal and industry standards;
- Maintains the laboratory training records, including those in the Learning Management System (LMS);
- Monitors correctives actions;
- Maintains the currency of the Quality Manual.

### 1.8.5 Technical Director

- Monitors the standards of performance in quality assurance and quality control data;
- Monitors the validity of analyses performed and data generated;
- Reviews tenders, contracts and QAPPs to ensure the laboratory can meet the data quality objectives for any given project;
- Provides technical guidance in the review, development, and validation of new methodologies.

### 1.8.6 Administrative Business Manager

- Responsible for financial and administrative management for the entire facility;
- Provides input relative to tactical and strategic planning activities;
- Organizes financial information so that the facility is run as a fiscally responsible business;
- Works with staff to confirm that appropriate processes are put in place to track revenues and expenses;
- Provide ongoing financial information to the General Manager and the management team so they can better manage their business;

- Utilizes historical information and trends to accurately forecast future financial positions;
- Works with management to ensure that key measurements are put in place to be utilized for trend analysis—this will include personnel and supply expenses, and key revenue and expense ratios;
- Works with General Manager to develop accurate budget and track on an ongoing basis;
- Works with entire management team to submit complete and justified capital budget requests and to balance requests across departments;
- Works with project management team and administrative support staff to ensure timely and accurate invoicing.

### 1.8.7 Client Services Manager

- Oversees all the day to day activities of the Client Services Department which includes Project Management and, possibly, Sample Control;
- Responsible for staffing and all personnel management related issues for Client Services;
- Serves as the primary senior consultant to customers on all project related issues such as set up, initiation, execution and closure;
- Performs or is capable of performing all duties listed for that of Project Manager.

### 1.8.8 Project Manager

- Coordinates daily activities including taking orders, reporting data and analytical results;
- Serves as the primary technical and administrative liaison between customers and PASI;
- Communicates with operations staff to update and set project priorities;
- Provides results to customers in the requested format (verbal, hardcopy, electronic, etc.);
- Works with customers, laboratory staff, and other appropriate PASI staff to develop project statements of work or resolve problems of data quality;
- Responsible for solicitation of work requests, assisting with proposal preparation and project initiation with customers and maintain customer records;
- Mediation of project schedules and scope of work through communication with internal resources and management;
- Responsible for preparing routine and non-routine quotations, reports and technical papers;
- Interfaces between customers and management personnel to achieve customer satisfaction;
- Manages large-scale complex projects;
- Supervises less experienced project managers and provide guidance on management of complex projects;
- Arranges bottle orders and shipment of sample kits to customers;
- Verifies login information relative to project requirements and field sample Chains-of-Custody.

### 1.8.9 Project Coordinator

- Responsible for preparation of project specifications and provides technical/project support;
- Coordinates project needs with other department sections and assists with proposal preparation;
- Prepares routine proposals and invoicing;

- Responsible for scanning, copying, assembling and binding final reports;
- Other duties include filing, maintaining forms, process outgoing mail, maintaining training database and data entry.

### 1.8.10 Department Manager/Supervisor

- Oversees the day-to-day production and quality activities of their assigned department;
- Ensures that quality assurance and quality control criteria of analytical methods and projects are satisfied;
- Assesses data quality and takes corrective action when necessary;
- Approves and releases technical and data management reports;
- Ensures compliance with all applicable state, federal and industry standards.

### 1.8.11 Group Supervisor/Leader

- Trains analysts in laboratory operations and analytical procedures;
- Organizes and schedules analyses with consideration for sample holding times;
- Implements data verification procedures by assigning data verification duties to appropriate personnel;
- Evaluates instrument performance and supervises instrument calibration and preventive maintenance programs;
- Reports non-compliance situations to laboratory management including the Quality Manager.

### 1.8.12 Laboratory Analyst

- Performs detailed preparation and analysis of samples according to published methods and laboratory procedures;
- Processes and evaluates raw data obtained from preparation and analysis steps;
- Generates final results from raw data, performing primary review against method criteria;
- Monitors quality control data associated with analysis and preparation. This includes examination of raw data such as chromatograms as well as an inspection of reduced data, calibration curves, and laboratory notebooks;
- Reports data in LIMS, authorizing for release pending secondary approval;
- Conducts routine and non-routine maintenance of equipment as required;
- Performs or is capable of performing all duties associated with that of Laboratory Technician.

### 1.8.13 Laboratory Technician

- Prepares standards and reagents according to published methods or in house procedures;
- Performs preparation and analytical steps for basic laboratory methods;
- Works under the direction of a Laboratory Analyst on complex methodologies;
- Assists Laboratory Analysts on preparation, analytical or data reduction steps for complex methodologies;
- Monitors quality control data as required or directed. This includes examination of raw data such as chromatograms as well as an inspection of reduced data, calibration curves, and laboratory notebooks.

### 1.8.14 Sample Management Personnel

- Signs for incoming samples and verifies the data entered on the Chain of custody forms;
- Enters the sample information into the Laboratory Information Management System (LIMS) for tracking and reporting;
- Stages samples according to EPA requirements;
- Assists Project Managers and Coordinators in filling bottle orders and sample shipments.

### 1.8.15 Systems Administrator or Systems Manager

- Assists with the creation and maintenance of electronic data deliverables (EDDs);
- Coordinates the installation and use of all hardware, software and operating systems;
- Performs troubleshooting on all aforementioned systems;
- Trains new and existing users on systems and system upgrades;
- Maintains all system security passwords;
- Maintains the electronic backups of all computer systems.

### 1.8.16 Quality Assurance Analyst

- Assigned direct oversight, under supervision of the Quality Manager, of sections of the Laboratory Quality Systems for development, implementation and maintenance;
- Oversight of Laboratory Certifications, maintaining and acquiring new certification based on client and project needs and regulatory changes. Works with agencies and reports any regulatory or certification changes to Quality Manager;
- Oversight of Performance Testing (PT) Studies working with the laboratory to order and report results as needed;
- Oversight of controlled documents including numbering, tracking new documents and supplying logbooks as required;
- Maintains calibration of temperature monitoring support equipment

### 1.8.17 Safety/Chemical Hygiene Officer

- Maintains the laboratory Chemical Hygiene Plan;
- Plans and implements safety policies and procedures;
- Maintains safety records;
- Organizes and/or performs safety training;
- Performs safety inspections and provides corrective/preventative actions;
- Assists personnel with safety issues.

### 1.8.18 Program Director/Hazardous Waste Coordinator (or otherwise named)

- Evaluates waste streams and helps to select appropriate waste transportation and disposal companies;
- Maintains complete records of waste disposal including waste manifests and state reports;

- Assists in training personnel on waste-related issues such as waste handling and storage, waste container labeling, proper satellite accumulation, secondary containment, etc.;
- Conducts a weekly inspection of the waste storage areas of the laboratory.

## 1.9 Training and Orientation

Training for Pace employees is managed through a web-based Learning Management System. After a new employee has been instructed in matters of human resources, they are given instructional materials for the LMS and a password for access.

A new hire training checklist is provided to the new employee that lists training items for the employee to work through either independently on LMS or with their supervisor or trainer. The training items that can be completed independently include:

- Reading through applicable Standard Operating Procedures;
- Reviewing the Quality Manual and Chemical Hygiene Plan;
- Core training modules such as quality control indicators, basic laboratory skills, etc.;
- Quality Systems training including traceability of measurements, method calibration, calibration verification, accuracy, precision and uncertainty of measurements, corrective actions, documentation, and root cause analysis;
- Data Integrity/Ethics training.

The new employee's Department Supervisor provides the employee with a basic understanding of the role of the laboratory within the structure of PASI and the basic elements of that individual's position. Supervised training uses the following techniques:

- Hands-on training
- Training checklists/worksheets
- Lectures and training sessions
- Method-specific training
- Conferences and seminars
- Short courses
- Specialized training by instrument manufacturers
- Proficiency testing programs.
- On-line courses

Group Supervisors/Leaders are responsible for providing documentation of training and proficiency for each employee under their supervision. The employee’s training file indicates what procedures an analyst or a technician is capable of performing, either independently or with supervision. The files also include documentation of continuing capability, which are fully detailed in Section 3.4. Training documentation files for each person are maintained by the Quality Office either in hardcopy format or within the LMS.

All procedures and training records are maintained and available for review during laboratory audits. These procedures are reviewed/updated periodically by laboratory management. Additional information can be found in SOP S-ALL-Q-020 ***Training Procedures*** or its equivalent revision or replacement.

## 1.10 Data Integrity System

The data integrity system at PASI provides assurances to management that a highly ethical approach is being applied to all planning, training and implementation of methods. Data integrity is crucial to the success of our company and Pace Analytical is committed to creating and maintaining a culture of quality throughout the organization. To accomplish this goal, PASI has implemented a data integrity system that encompasses the following four requirements:

1. A data integrity training program: standardized training is given to each new employee and a yearly refresher is presented to all employees. Key topics addressed by this training include:
   a. Need for honesty and transparency in analytical reporting
   b. Process for reporting data integrity issues
   c. Specific examples of unethical behavior and improper practices
   d. Documentation of non-conforming data that is still useful to the data user
   e. Consequences and punishments for unethical behavior
   f. Examples of monitoring devices used by management to review data and systems
2. Signed data integrity documentation for all employees: this includes a written quiz following the Ethics training session and written agreement to abide by the Code of Ethics and Standards of Conduct explained in the employee manual.
3. In-depth, periodic monitoring of data integrity including peer data review and validation, internal raw data audits, proficiency testing studies, etc.
4. Documentation of any review or investigation into possible data integrity infractions. This documentation, including any disciplinary actions involved, corrective actions taken, and notifications to customers must be available for review for laboratory assessors and must be retained for a minimum of five years.

PASI management makes every effort to ensure that personnel are free from any undue pressures that affect the quality of their work including commercial, financial, over scheduling, and working condition pressures.

Corporate management also provides all PASI facilities a mechanism for confidential reporting of data integrity issues that ensures confidentiality and a receptive environment in which all employees are comfortable discussing items of ethical concern. The anonymous message line is monitored by the Corporate Director of Quality who will ensure that all concerns are evaluated and, where necessary, brought to the attention of executive management and investigated. **The message line voice mail box number is available in the Pace Employee Handbook.**

## 1.11 Laboratory Safety

It is the policy of PASI to make safety and health an integral part of daily operations and to ensure that all employees are provided with safe working conditions, personal protective equipment, and requisite training to do their work without injury. Each employee is responsible for his/her own safety as well as those working in the immediate area by complying with established company rules and procedures. These rules and procedures as well as a more detailed description of the employees' responsibilities are contained in the corporate Safety Manual and Chemical Hygiene Plan.

## 1.12 Security and Confidentiality

Security is maintained by controlled access to laboratory buildings. Exterior doors to laboratory buildings remain either locked or continuously monitored by PASI staff. Keyless door lock combinations and computer access codes/logins are changed periodically. Posted signs direct visitors to the reception office and mark all other areas as off limits to unauthorized personnel. All visitors, including PASI staff from other facilities, must sign the Visitor's Logbook maintained by the receptionist. A staff member will accompany them during the duration of their stay on the premises unless the GM, QM, LOM or TD specify otherwise. In this instance, the staff member will escort the visitor back to the reception area at the end of his/her visit where he/she signs out. The last staff member to leave their department for the day should ensure that all outside access points to that area are secure.

Additional security is provided where necessary, e.g., specific secure areas for sample, data, and customer report storage, as requested by customers or cases where national security is of concern. These areas are lockable within the facilities, or are securely offsite. Access is limited to specific individuals or their designees. Security of sample storage areas is the responsibility of the Sample Custodian. Security of samples and data during analysis and data reduction is the responsibility of Group Supervisors. Security of customer report archives is the responsibility of the Client Services Manager. These secure areas are locked whenever these individuals or their designees are not present in the facility.

Access to designated laboratory sample storage locations is limited to authorized personnel only. Provisions for lock and key access are provided. No samples are to be removed without proper authorization. If requested by customer or contract, samples are not to be removed from secure storage areas without filling out an associated internal chain of custody.

Standard business practices of confidentiality are applied to all documents and information regarding customer analyses. Specific protocols for handling confidential documents are described in PASI SOPs. Additional protocols for sample identification by internal laboratory identification numbers only are implemented as required under contract specific Quality Assurance Project Plans (QAPPs).

All information pertaining to a particular customer, including national security concerns will remain confidential. Data will be released to outside agencies only with written authorization from the customer or where federal or state law requires the company to do so.

# 2.0. SAMPLE CUSTODY

## 2.1. Sampling Support

Each individual PASI laboratory provides shipping containers, properly preserved sample containers, custody documents, and field quality control samples to support field-sampling events. Guidelines for sample container types, preservatives, and holding times for a variety of methods are listed in Attachment VIII. Note that all analyses listed are not necessarily performed at all PASI laboratories and there may be additional laboratory analyses performed that are not included in these tables. PASI – Minneapolis and Montana may provide pick-up and delivery services to their customers when needed.

## 2.2. Field Services

Pace Analytical has a large Field Services Division which is based in their Minneapolis facility as well as limited field service capabilities in some of our other facilities. Field Services provides comprehensive nationwide service offerings including:

- Stack Testing
- Ambient Air
- CEM Certification Testing
- Air Quality Monitoring
- Onsite Analytical Services- FTIR and GC
- Real-time Process Diagnostic/Optimization Testing
- Wastewater, Groundwater and Drinking Water Monitoring
- Storm Water and Surface Water Monitoring
- Soil and Waste Sampling
- Mobile Laboratory Services

Field Services operates under the PASI Corporate Quality System, with applicable and necessary provisions to address the activities, methods, and goals specific to Field Services. All procedures and methods used by Field Services are documented in Standard Operating Procedures and Procedure Manuals.

## 2.3. Project Initiation

Prior to accepting new work, the laboratory reviews its performance capability. The laboratory confirms that sufficient personnel, equipment capacity, analytical method capability, etc., are available to complete the required work. Customer needs, certification requirements, and data quality objectives are defined and the appropriate sampling and analysis plan is developed to meet the project requirements by project managers or sales representatives. Members of the management staff review current instrument capacity, personnel availability and training, analytical procedures capability, and projected sample load. Management then informs the sales and client services personnel whether or not the laboratory can accept the new project via written correspondence, email, and/or daily operations meetings.

The laboratory maintains records of all such reviews, including discussions with customers. Routine analytical project documentation of quotes, notes, dates, initials, and/or recordings is maintained in a

project folder by project management. Conditions for new and more complex contracts are determined by the General Managers and sales representatives. Quality Management is consulted on technical requirements and operations staff provides input on volume capacities. Evidence of these reviews is maintained in the form of awarded Request for Proposals (RFPs), signed quotes or contracts, and a Customer Relationship Management (CRM) database. If a review identifies a potential mismatch between customer requirements and laboratory capabilities and/or capacities, Pace will specify its level of commitment by listing these exceptions to the requirements within the RFP, quote or contract.

Additional information regarding specific procedures for reviewing new work requests can be found in SOP S-ALL-C-006 ***Review of Analytical Requests*** or its equivalent revision or replacement.

## 2.4. Chain of Custody

A chain of custody (COC) provides the legal documentation of samples from time of collection to completion of analysis. PASI has implemented Standard Operating Procedures to ensure that sample custody traceability and responsibility objectives are achieved for every project.

Field personnel or client representatives must complete a chain of custody for all samples that are received by the laboratory. The importance of completeness of COCs is stressed to the samplers and is critical to efficient sample receipt and to insure the requested methods are used to analyze the correct samples.

If sample shipments are not accompanied by the correct documentation, the Sample Receiving department notifies a Project Manager. The Project Manager then obtains the correct documentation/information from the customer in order for analysis of samples to proceed.

The sampler is responsible for providing the following information on the chain of custody form:

- Customer project name
- Project location or number
- Field sample number/identification
- Date and time sampled
- Sample matrix
- Preservative
- Requested analyses
- Sampler signature
- Relinquishing signature
- Date and time relinquished
- Sampler remarks as needed
- Custody Seal Number if present
- Regulatory Program Designation
- The state where the samples were collected to ensure all applicable state requirements are met
- Turnaround time requested
- Purchase order number

The COC is filled out completely and legibly with indelible ink. Errors are corrected by drawing a single line through the initial entry and initialing and dating the change. All transfers of samples are

recorded on the chain of custody in the "relinquished" and "received by" sections. All information except signatures is printed.

Additional information can be found in S-MN-C-001 ***Sample Management*** or its equivalent revision or replacement.

## 2.5. Sample Acceptance Policy

In accordance with regulatory guidelines, PASI complies with the following sample acceptance policy for all samples received.

If the samples do not meet the sample receipt acceptance criteria outlined below, the laboratory is required to document all non-compliances, contact the customer, and either reject the samples or fully document any decisions to proceed with analyses of samples which do not meet the criteria. Any results reported from samples not meeting these criteria are appropriately qualified on the final report.

All samples must:

- Have unique customer identification that is clearly marked on durable waterproof labels affixed to the sample containers that match the chain of custody.
- Have clear documentation on the chain of custody related to the location of the sampling site with the time and date of sample collection.
- Have the sampler's name and signature.
- Have all requested analyses clearly designated on the COC.
- Have clear documentation of any special analytical or data reporting requirements.
- Be in appropriate sample containers with clear documentation of the preservatives used.
- Be correctly preserved unless the method allows for laboratory preservation.
- Be received within holding time. Any samples with hold times that are exceeded will not be processed without prior customer approval.
- Have sufficient sample volume to proceed with the analytical testing. If insufficient sample volume is received, analysis will not proceed without customer approval.
- Be received within appropriate temperature ranges - not frozen but ≤6°C (See Note 1), unless program requirements or customer contractual obligations mandate otherwise (see Note 2). The cooler temperature is recorded directly on the COC and the SCUR. Samples that are delivered to the laboratory immediately after collection are considered acceptable if there is evidence that the chilling process has been started. For example, by the arrival of the samples on ice. If samples arrive that are not compliant with these temperature requirements, the customer will be notified. The analysis will NOT proceed unless otherwise directed by the customer. If less than 72 hours remain in the hold time for the analysis, the analysis may be started while the customer is contacted to avoid missing the hold time. Data associated with any deviations from the above sample acceptance policy requirements will be appropriately qualified.

**Note 1:** Temperature will be read and recorded based on the precision of the measuring device. For example, temperatures obtained from a thermometer graduated to 0.1°C will be read and recorded to ±0.1°C. Measurements obtained from a thermometer graduate to 0.5°C will be read to ±0.5°C. Measurements read at the specified precision are not to be rounded down to meet the ≤6°C limit

**Note 2:** Some microbiology methods allow sample receipt temperatures of up to 10°C. Consult the specific method for microbiology samples received above 6°C prior to initiating corrective action for out of temperature preservation conditions.

**Note 3**: Biological Tissue Samples must be received frozen at $\leq 0^{o}$C.

Upon sample receipt, the following items are also checked and recorded:

- Presence of custody seals or tapes on the shipping containers
- Sample condition: Intact, broken/leaking, bubbles in VOA samples
- Sample holding time
- Sample pH when required
- Appropriate containers

Samples for drinking water analysis that are improperly preserved, or are received past holding time, are rejected at the time of receipt, with the exception of VOA samples that are tested for pH at the time of analysis.

Additional information can be found in S-MN-C-001 ***Sample Management*** or its equivalent revision or replacement.

## 2.6. Sample Log-in

After sample inspection, all sample information on the chain of custody is entered into the Laboratory Information Management System.

This permanent record documents receipt of all sample containers including:

- Customer name and contact
- Customer number
- Pace Analytical project number
- Pace Analytical Project Manager
- Sample descriptions
- Due dates
- List of analyses requested
- Date and time of laboratory receipt
- Field ID code
- Date and time of collection
- Any comments resulting from inspection for sample rejection

All samples received are logged into the LIMS within one working day of receipt. Sample login may be delayed due to customer clarification of analysis needed, corrective actions for sample receipt non-conformance, or other unusual circumstances. If the time collected for any sample is unspecified and Pace is unable to obtain this information from the customer, the laboratory will use *00:00* as the time sampled. All hold times will be based on this sampling time and qualified accordingly if exceeded.

For DoD work, if the time of the sample collection is not provided, the laboratory must assume the most conservative time of day. This is defined as 12:01am.

The Laboratory Information Management System (EPIC Pro) automatically generates a unique identification number for each sample created in the system. The LIMS sample number follows the general convention of BB-XXXXXX-YYY. The BB represents the laboratory identification within Pace's laboratory network. The 5 digit "X" number represents the project number followed by a 3 digit sample number. The project number is a sequential number that is assigned as a new project is created. The sample number corresponds to the number of samples submitted by the client. In addition to the unique sample ID, there is a sample container ID that consists of the sample number, the container type (e.g. BP1U), and bottle 1 of Y, where Y represents the total number of containers of that particular type. Together the sample LIMs number and sample container ID number create a unique barcode encryption that can be linked to the sample analysis requested by the client. This unique identification number is placed on the sample container as a durable label and becomes the link between the laboratory's sample management system and the customer's field identification; it will be a permanent reference number for all future interactions.

Current region codes are noted below. More may be added without updating this document.

| | |
|---|---|
| 10 = Minnesota and Montana | 35 = Florida |
| 92 = Asheville and Charlotte | 20 = Gulf Coast |
| 60 = Kansas | 30 = Pittsburgh |
| 50 = Indianapolis | 40 = Green Bay |
| 3038 = Pittsburgh Radiological | 17 = Pace Life Sciences |
| 25 = Seattle | 65 = Schenectady (NEA) |
| 51 = Columbus | |

Sample labels are printed from the LIMS and affixed to each sample container.

Samples with hold times that are near expiration date/time may be sent directly to the laboratory for analysis at the discretion of the Project Manager and/or General Manager.

Additional information can be found in S-MN-C-001 ***Sample Management*** or its equivalent revision or replacement.

## 2.7. Sample Storage

### 2.7.1. Storage Conditions

Samples are stored away from all standards, reagents, or other potential sources of contamination. Samples are stored in a manner that prevents cross contamination. Volatile samples are stored separately from other samples. All sample fractions, extracts, leachates, and other sample preparation products are stored in the same manner as actual samples or as specified by the analytical method.

Storage blanks, consisting of two 40mL aliquots of reagent water, are stored with volatile samples and are used to measure cross-contamination acquired during storage. If applicable, laboratories

must have documented procedures and criteria for evaluating storage blanks, appropriate to the types of samples being stored.

### 2.7.2. Temperature Monitoring

Samples are taken to the appropriate storage location immediately after sample receipt and check-in procedures are completed. All sample storage areas are located in limited access areas and are monitored to ensure sample integrity.

The temperature of each refrigerated storage area is maintained at ≤6°C unless state or program requirements differ. The temperature of each freezer storage area is maintained at < - 10°C unless state or program requirements differ. The temperature of each storage area is checked and documented each day of use (each calendar day). If the temperature falls outside the acceptable limits, the following corrective actions are taken and appropriately documented:

- The temperature is rechecked after two hours to verify temperature exceedance. Corrective action is initiated if necessary.
- The Quality Manager and/or laboratory management are notified if the problem persists.
- The samples are relocated to a proper environment if the temperature cannot be maintained after corrective actions are implemented.
- The affected customers are notified.
- Documentation is provided on analytical report.

### 2.7.3. Hazardous Materials

Pure product or potentially heavily contaminated samples must be tagged as "hazardous" or "lab pack" and stored separately from other samples.

### 2.7.4. Foreign/Quarantined Soils

Depending on the soil disposal practices of the laboratory, foreign soils and soils from USDA regulated areas are segregated. The USDA requires these samples to be incinerated or sterilized by an approved treatment procedure. Additional information regarding USDA regulations and sample handling can be found in applicable local laboratory SOPs.

Additional information on sample storage can be found in S-MN-C-001 ***Sample Management***, in S-MN-Q-253 Procedure for Handling of USDA Regulated Soils, and in S-MN-S-003 ***Waste Handling and Management***, or equivalent replacement SOPs.

## 2.8. Sample Protection

PASI laboratory facilities are operated under controlled access protocols to ensure sample and data integrity. Visitors must register at the front desk and be properly escorted at all times.

Samples are removed from storage areas by designated personnel and returned to the storage areas, if necessary, immediately after the required sample quantity has been taken.

Upon customer request, additional and more rigorous chain of custody protocols for samples and data can be implemented. For example, some projects may require complete documentation of sample custody within the secure laboratory.

Additional information can be found in S-MN-C-001 ***Sample Management*** or its equivalent revision or replacement.

## 2.9. Subcontracting Analytical Services

Every effort is made to perform all analyses for PASI customers within the laboratory that receives the samples. When subcontracting to a laboratory other than the receiving laboratory, whether inside or outside the PASI network, becomes necessary, a preliminary verbal communication with that laboratory is undertaken. Customers are notified in writing of the subcontracting laboratory's intention to subcontract any portion of the testing to another laboratory. Work performed under specific protocols may involve special considerations.

Prior to subcontracting samples to a laboratory outside Pace Analytical, the potential sub-contract laboratory will be pre-qualified by verifying that the subcontractor meets the following criteria:

- All certifications required for the proposed subcontract are in effect,
- Sufficient professional liability and other required insurance coverage is in effect, and
- Is not involved in legal action by any federal, state, or local government agency for data integrity issues and has not been convicted in such investigation at any time during the past 5 years.

The contact and preliminary arrangements are made between the PASI Project Manager and the appropriate subcontract laboratory personnel. The specific terms of the subcontract laboratory agreement include:

- Method of analysis
- Number and type of samples expected
- Project specific QA/QC requirements
- Deliverables required
- Laboratory certification requirement
- Price per analysis
- Turn-around time requirements

Chain of custody forms are generated for samples requiring subcontracting to other laboratories. Sample receiving personnel re-package the samples for shipment, create a transfer chain of custody form and record the following information:

- Pace Analytical Laboratory Number
- Matrix
- Requested analysis
- Special instructions regarding turnaround, required detection or reporting limits, or any unusual information known about the samples or analytical procedure.
- Signature in "Relinquished By"

All subcontracted sample data reports are sent to the PASI Project Manager. Pace will provide a copy of the subcontractor's report to the client when requested.

Any Pace Analytical work sent to other labs within the PASI network is handled as subcontracted work and all final reports are labeled clearly with the name of the laboratory performing the work. Any non-NELAC work is clearly identified. PASI will not be responsible for analytical data if the subcontract laboratory was designated by the customer.

Additional information can be found in S-MN-C-004 ***Subcontracting Samples*** or its equivalent revision or replacement.

DoD laboratories must ensure that subcontracted labs meet the requirements of the DoD QSM. Subcontracted labs must be accredited by DoD or its designated representatives. Subcontracted labs must receive project specific approval from the DoD client before any samples are analyzed. These requirements also apply to the use of any laboratory under the same corporate umbrella, but at a different facility or location.

## 2.10. Sample Retention and Disposal

Samples, extracts, digestates, and leachates must be retained by the laboratory for the period of time necessary to protect the interests of the laboratory and the customer.

Unused portions of samples are retained by each laboratory based on program or customer requirements for sample retention and storage. The sample retention time is a minimum of 45 days from receipt of the samples. Samples requiring storage beyond this time due to special requests or contractual obligations will not be stored under temperature controlled conditions unless the laboratory has sufficient capacity and their presence does not compromise the integrity of other samples.

After this period expires, non-hazardous samples are properly disposed of as non-hazardous waste. The preferred method for disposition of hazardous samples is to return the excess sample to the customer. If it is not feasible to return samples, or the customer requires PASI to dispose of excess samples, proper arrangements will be made for disposal by an approved contractor.

Additional information can be found in S-MN-S-003 ***Waste Handling and Management*** and S-MN-C-001 ***Sample Management*** or their equivalent revisions or replacements.

# 3.0. ANALYTICAL CAPABILITIES

## 3.1. Analytical Method Sources

PASI laboratories are capable of analyzing a full range of environmental samples from a variety of matrices, including air, surface water, wastewater, groundwater, soil, sediment, biota, and other waste products. The latest valid editions of methodologies are applied from regulatory and professional sources including EPA, ASTM, USGS, NIOSH, A2LA, A-Class, NVLAP, Standard Methods, and State Agencies. Section 11 is a representative listing of general analytical protocol references. PASI discloses in writing to its customers and regulatory agencies any instances in which modified methods are being used in the analysis of samples.

In the event of a customer-specific need, instrumentation constraint or regulatory requirement, PASI laboratories reserve the right to use valid versions of methods that may not be the most recent edition available.

## 3.2. Analytical Method Documentation

The primary form of PASI laboratory documentation of analytical methods is the Standard Operating Procedure (SOP). SOPs contain pertinent information as to what steps are required by an analyst to successfully perform a procedure. The required contents for the SOPs are specified in the company-wide SOP for ***Preparation of SOPs***, S-ALL-Q-001, or equivalent replacement.

The SOPs may be supplemented by other training materials that further detail how methods are specifically performed. This training material will undergo periodic, documented review along with the other Quality System documentation.

## 3.3. Analytical Method Validation

In some situations, PASI develops and validates methodologies that may be more applicable to a specific problem or objective. When non-standard methods are required for specific projects or analytes of interest, or when the laboratory develops or modifies a method, the laboratory validates the method prior to applying it to customer samples. Method validity is established by meeting criteria for precision and accuracy as established by the data quality objectives specified by the end user of the data. The laboratory records the validation procedure, the results obtained and a statement as to the usability of the method. The minimum requirements for method validation include determination of the limit of detection and limit of quantitation, evaluation of precision and bias, and evaluation of selectivity of each analyte of interest.

Additional information can be found in SOP S-MN-Q-252 ***Methods Validation and Modification Studies***, or equivalent replacement.

## 3.4. Demonstration of Capability (DOC)

Analysts complete an initial demonstration of capability (IDOC) study prior to performing a method or when there is a change in instrument type, personnel, or test method, or at any time that a method has not been performed by the laboratory or analyst in a 12-month period. The mean recovery and

standard deviation of each analyte, taken from 4 replicates of a quality control standard is calculated and compared to method criteria (if available) or established laboratory criteria for evaluation of acceptance. Each laboratory maintains copies of all demonstrations of capability, including those that fail acceptance criteria and corresponding raw data for future reference and must document the acceptance criteria prior to the analysis of the DOC. Demonstrations of capability are verified on an annual basis.

For Continuing Demonstrations of Capability, the laboratories may use Performance Testing (PT) samples in lieu of the 4-replicate approach listed above. For methods or procedures that do not lend themselves to the "4-replicate" approach, the demonstration of capability requirements will be specified in Section 13 – Method Performance of the applicable SOP.

Alternative demonstrations of capability procedures may be used for methods that don't lend themselves to the "4 replicate" approach. For methods that only measure precision, the precision of four laboratory duplicate pairs will be assessed. The relative percent differences must be within the method acceptance limits. For procedures like TCLP or SPLP, the analyst will demonstrate making the buffer solution and performing the tumbling process. The trainer or supervisor will sign-off on demonstration of capability of the tumbling process.

Additional information can be found in SOP S-ALL-Q-020 ***Training Procedures*** or its equivalent revision or replacement.

## 3.5. Regulatory and Method Compliance

PASI understands that expectations of our customers commonly include the assumption that laboratory data will satisfy specific regulatory requirements. Therefore PASI attempts to ascertain, prior to beginning a project, what applicable regulatory jurisdiction, agency, or protocols apply to that project. This information is also required on the chain of custody submitted with samples.

PASI makes every effort to detect regulatory or project plan inconsistencies, based upon information from the customer, and communicate them immediately to the customer in order to aid in the decision making process. PASI will not be liable if the customer chooses not to follow PASI recommendations.

It is PASI policy to disclose in a forthright manner any detected noncompliance affecting the usability of data produced by our laboratories. The laboratory will notify customers within 30 days of fully characterizing the nature of the nonconformance, the scope of the nonconformance and the impact it may have on data usability.

# 4.0. QUALITY CONTROL PROCEDURES

Quality control data is analyzed and where they are found to be outside pre-defined criteria, planned action is taken to correct the problem in order to prevent incorrect results from being reported. Quality control samples are to be processed in the same manner as client samples.

## 4.1. Method Blank

A method blank is used to evaluate contamination in the preparation/analysis system and is processed through all preparation and analytical steps with its associated samples.

A method blank is processed at a minimum frequency of one per preparation batch. In the case of a method that has no separate preparation step, a method blank is processed with no more than 20 samples of a specific matrix performed by the same analyst, using the same method, standards, and reagents.

The method blank consists of a matrix similar to the associated samples that is known to be free of analytes of interest. Laboratories will characterize a representative matrix as “clean” if the matrix contains contaminants at less than ½ the laboratory’s reporting limit.

Method blanks are not applicable for certain analyses, such as pH, conductivity, flash point and temperature.

Each method blank is evaluated for contamination. The source of any contamination is investigated and documented corrective action is taken when the concentration of any target analyte is detected above the reporting limit and is greater then 1/10 of the amount of that analyte found in any associated sample. Corrective actions include the re-preparation and re-analysis of all the samples (where possible) along with the full set of required quality control samples. Data qualifiers must be applied to any result reported that is associated with a contaminated method blank.

For DoD samples, the method blank will be considered to be contaminated if: 1) The concentration of any target analyte in the method blank exceeds 1/2 the reporting limit and is greater than 1/10 the amount measured in any sample or 1/10 the regulatory limit whichever is greater; 2) The concentration of any common laboratory contaminant in the method blank exceeds the reporting limit and is greater than 1/10 the amount measured in any sample or 1/10 the regulatory limit whichever is greater or 3) The method blank result otherwise affects the sample results as per the test method requirements or the project-specific objectives. If the method blank is contaminated as described above, then the laboratory shall reprocess affected samples in a subsequent preparation batch, except when sample results are below the LOD. If insufficient sample volume remains for reprocessing, the results shall be reported with appropriate data qualifiers.

Deviations made from this policy must be approved by the Quality Manager prior to release of the data.

For Ohio VAP projects, the laboratory must minimize the use of qualified data. In the case of method blank having any reportable contamination, the laboratory is required to reanalyze the associated samples with an acceptable method blank if there is sufficient sample remaining. Acceptable method blanks are those that are free of contamination below the reporting limit. The

laboratory must make every effort to take the appropriate corrective actions and resolve any anomalies regarding method blanks for Ohio VAP projects.

## 4.2. Laboratory Control Sample

The Laboratory Control Sample (LCS) is used to evaluate the performance of the entire analytical system including preparation and analysis.

An LCS is processed at a minimum frequency of one per preparation batch. In the case of a method that has no separate preparation step, an LCS will be processed with no more than 20 samples of a specific matrix performed by the same analyst, using the same method, standards, and reagents.

The LCS consists of a matrix similar to the associated samples that is known to be free of the analytes of interest that is then spiked with known concentrations of target analytes.

The LCS contains **all** analytes specified by a specific method or by the customer or regulatory agency (which may include full list of target compounds, with certain exceptions. These exceptions may include analyzing only specific Aroclors when PCB analysis is requested or not spiking with all EPA Appendix IX compounds when a full Appendix IX list of compounds is requested). In the absence of specified components, the laboratory will spike with the following compounds:

- For multi-peak analytes (e.g. PCBs, technical chlordane, toxaphene), a representative standard will be processed.
- For methods with long lists of analytes, a representative number of target analytes may be chosen. The following criteria is used to determine the number of LCS compounds used:
    - For methods with 1-10 target compounds, the laboratory will spike with all compounds
    - For methods with 11-20 target compounds, the laboratory will spike with at least 10 compounds or 80%, whichever is greater
    - For methods with greater than 20 compounds, the laboratory will spike with at least 16 compounds.

The LCS is evaluated against the method default or laboratory-derived acceptance criteria. For those methods that require laboratory-derived limits, method default control limits may be used until the laboratory has a minimum of 20, but preferably greater than 30, data points from which to derive internal acceptance criteria. Any compound that is outside of these limits is considered to be ‘out of control’ and must be qualified appropriately. Any associated sample containing an ‘out-of-control’ compound must either be re-analyzed with a successful LCS or reported with the appropriate data qualifier. When the acceptance criteria for the LCS are exceeded high, and there are associated samples that are non-detects, then those non-detects can be reported with data qualifiers, or when the acceptance criteria are exceeded low, those associated sample results may be reported if they exceed the maximum regulatory limit/decision level with data qualifiers.

For LCSs containing a large number of analytes, it is statistically likely that a few recoveries will be outside of control limits. This does not necessarily mean that the system is out of control, and therefore no corrective action would be necessary (except for proper documentation). NELAC has allowed for a minimum number of marginal exceedances, defined as recoveries that are beyond the LCS control limits (3X the standard deviation) but less than the marginal exceedance limits (4X the standard deviation). The number of allowable exceedances depends on the number of compounds in

the LCS. If more analyte recoveries exceed the LCS control limits than is allowed (see below) or if any one analyte exceeds the marginal exceedance limits, then the LCS is considered non-compliant and corrective actions are necessary. The number of allowable exceedances is as follows:

- >90 analytes in the LCS- 5 analytes
- 71-90 analytes in the LCS- 4 analytes
- 51-70 analytes in the LCS- 3 analytes
- 31-50 analytes in the LCS- 2 analytes
- 11-30 analytes in the LCS- 1 analyte
- <11 analytes in the LCS- no analytes allowed out)

A matrix spike (MS) can be used in place of a non-compliant LCS in a batch as long as the MS passes the LCS acceptance criteria (this is a NELAC allowance). When this happens, full documentation must be made available to the data user. If this is not allowed by a customer or regulatory body, the associated samples must be rerun with a compliant LCS (if possible) or reported with appropriate data qualifiers.

Deviations made from this policy must be approved by the Quality Manager prior to release of the data.

For Ohio VAP and South Carolina projects, the laboratory must minimize the use of qualified data. In the case of LCS failures, the laboratory is required to reanalyze the associated samples with an acceptable LCS for all target compounds if there is sufficient sample remaining. The laboratory must make every effort to take the appropriate corrective actions and resolve any anomalies regarding LCSs for Ohio VAP projects.

For Department of Defense projects, the laboratory is not allowed to have any target analytes that exceed DoD LCS control limits. In the case of LCS failures, the laboratory is required to reanalyze the associated samples with an acceptable LCS for all target compounds if there is sufficient sample remaining. The laboratory must make every effort to take the appropriate corrective actions and resolve any anomalies regarding LCSs for Department of Defense projects. See applicable method SOPs for further corrective action.

## 4.3. Matrix Spike/Matrix Spike Duplicate (MS/MSD)

A matrix spike (MS) is used to determine the effect of the sample matrix on compound recovery for a particular method. The information from these spikes is sample or matrix specific and is not used to determine the acceptance of an entire batch unless the MS is actually used as the LCS.

A **Matrix Spike/Matrix Spike Duplicate** (MS/MSD) set is processed at a frequency specified in a particular method or as determined by a specific customer request. This frequency will be specified in the applicable method SOP or customer QAPP. In the absence of such requirements, an MS/MSD set is routinely analyzed once per every 20 samples per matrix per method.

The MS and MSD consist of the sample matrix that is then spiked with known concentrations of target analytes. Laboratory personnel spike customer samples that are specifically designated as MS/MSD samples or, when no designated samples are present in a batch, randomly select samples to

spike that have adequate sample volume or weight. Spiked samples are prepared and analyzed in the same manner as the original samples and are selected from different customers if possible.

The MS and MSD contain all analytes specified by a specific method or by the customer or regulatory agency. In the absence of specified components, the laboratory will spike with the same number of compounds as previously discussed in the LCS section.

The MS and MSD are evaluated against the method or laboratory derived criteria. Any compound that is outside of these limits is considered to be 'out of control' and must be qualified appropriately. Batch acceptance, however, is based on method blank and LCS performance, not on MS/MSD recoveries. The spike recoveries give the data user a better understanding of the final results based on their site specific information.

A matrix spike and sample duplicate will be performed instead of a matrix spike and matrix spike duplicate when specified by the customer or method.

Deviations made from this policy must be approved by the Quality Manager prior to release of the data.

For Ohio VAP projects, the laboratory must minimize the use of qualified data. In the case of MS/MSD failures, the laboratory is required to reanalyze the associated samples only when the associated LCS also fails acceptance criteria and if there is sufficient sample remaining. When an LCS is acceptable and the MS results are outside of criteria, and no system anomaly is detected, the samples will be reported with appropriate data qualifiers indicating matrix interference. The laboratory must make every effort to take the appropriate corrective actions and resolve any anomalies regarding LCSs for Ohio VAP projects.

For DoD work, each preparation batch of samples must contain an associated MS and MSD (or sample duplicate) using the same matrix collected for the specific DoD project. If adequate sample material is not available, then the lack of MS/MSDs shall be noted in the case narrative. Additional MS/MSDs may be required on a project-specific basis. The MS/MSD must be spiked with all target analytes with the exception of PCB analysis, which is spiked per the method. The concentration of the spiked compounds shall be at or below the midpoint of the calibration range or at the appropriate concentration of concern. Multiple spiked samples may need to be prepared to avoid interferences.

For DoD work, the results of all MS/MSD must be evaluated using the same acceptance criteria used for the LCS.

## 4.4. Surrogates

Surrogates are compounds that reflect the chemistry of target analytes and are typically added to samples for organic analyses to monitor the effect of the sample matrix on compound recovery.

Surrogates are added to each customer sample (for organics), method blank, LCS, and MS prior to extraction or analysis. The surrogates are evaluated against the method or laboratory derived acceptance criteria or against project-specific acceptance criteria specified by the client, if applicable. Any surrogate compound that is outside of these limits is considered to be 'out of control' and must be qualified appropriately. Samples with surrogate failures are typically re-

extracted and/or re-analyzed to confirm that the out-of-control value was caused by the matrix of the sample and not by some other systematic error. An exception to this would be samples that have high surrogate values but no reportable hits for target compounds. These samples would be reported, with a qualifier, because the implied high bias would not affect the final results. For methods with multiple surrogates, documentation regarding acceptance and associated compounds will be found in the individual method SOPs.

Deviations made from this policy must be approved by the Quality Manager prior to release of the data.

## 4.5. Sample Duplicate

A sample duplicate is a second portion of sample that is prepared and analyzed in the laboratory along with the first portion. It is used to measure the precision associated with preparation and analysis. A sample duplicate is processed at a frequency specified by the particular method or as determined by a specific customer.

The sample and duplicate are evaluated against the method or laboratory derived criteria for relative percent difference (RPD). Any duplicate that is outside of these limits is considered to be 'out of control' and must be qualified appropriately.

Deviations made from this policy must be approved by the Quality Manager prior to release of the data.

For Ohio VAP projects, the laboratory must minimize the use of qualified data. In the case of duplicate samples exceeding the RPD criteria found in applicable analytical SOPs, the laboratory is required to reanalyze the associated sample and duplicate as long as no sampling error was detected if there is sufficient sample remaining. If the sample and duplicate still do not agree, a comment would be made stating there may be sample non-homogeneity. The laboratory must make every effort to take the appropriate corrective actions and resolve any anomalies regarding sample duplicates for Ohio VAP projects.

## 4.6. Internal Standards

Internal Standards are method-specific analytes added to every standard, method blank, laboratory control sample, matrix spike, matrix spike duplicate, and sample at a known concentration, prior to analysis for the purpose of adjusting the response factor used in quantifying target analytes. At a minimum, the laboratory will follow method specific guidelines for the treatment of internal standard recoveries as they are related to the reporting of data.

Deviations made from this policy must be approved by the Quality Manager prior to release of the data.

For Ohio VAP projects, samples with internal standard that are outside of method criteria must be reanalyzed to confirm sample matrix effect. The laboratory must make every effort to take the appropriate corrective actions and resolve any anomalies regarding internal standards for Ohio VAP projects.

## 4.7. Field Blanks

Field blanks are blanks prepared at the sampling site in order to monitor for contamination that may be present in the environment where samples are collected. These field quality control samples are often referenced as field blanks, rinsate blanks, or equipment blanks. The laboratory analyzes these field blanks as normal samples and informs the customer if there are any target compounds detected above the reporting limits.

## 4.8. Trip Blanks

Trip blanks are blanks that originate from the laboratory as part of the sampling event and are used to monitor for contamination of samples during transport. These blanks accompany the empty sample containers to the field and then accompany the collected samples back to the laboratory. These blanks are routinely analyzed for volatile methods where ambient background contamination is likely to occur.

## 4.9. Limit of Detection (LOD)

PASI laboratories are required to use a documented procedure to determine a limit of detection for each analyte of concern in each matrix reported. All sample processing steps of the preparation and analytical methods are included in this determination including any clean ups. For any test that does not have a valid LOD, sample results below the limit of quantitation (LOQ) cannot be reported.

The LOD is initially established for the compounds of interest for each method in a clean matrix with no target analytes present and no interferences at a concentration that would impact the results. The LOD is then determined every time there is a change in the test method that affects how the test is performed or when there has been a change in the instrument that affects the sensitivity. If required by customer, method or accreditation body, the LOD will be re-established annually for all applicable methods.

Unless otherwise noted, the method used by PASI laboratories to determine LODs is based on the Method Detection Limit (MDL) procedure outlined in 40 CFR Part 136, Appendix B. Where required by regulatory program or customer, the above referenced procedure will be followed.

Where specifically stated in the published method, LODs or MDLs will be performed at the listed frequency.

The validity of the LOD must be shown by detection (a value above zero) of the analytes in a QC sample in each quality system matrix. The QC sample must contain the analyte at no more than 3X the LOD for a single analyte test and 4X the LOD for multiple analyte tests. This verification must be performed on each instrument used for sample analysis and reporting of data. The validity of the LOD must be verified as part of the LOD determination process. This verification must be done prior to the use of the LOD for sample analysis.

An LOD study is not required for any analyte for which spiking solutions or quality control samples are not available such as temperature.

The LOD, if required, shall be verified annually for each quality system matrix, technology and analyte. In lieu of performing full LOD (MDL) studies annually, the laboratory can verify the LOD (MDL) on an annual basis, providing this verification is fully documented and does not contradict other customer or program requirements that the laboratory must follow. The requirements of this verification are:

- The spike concentration of the verification must be no more than 3X times the LOD for single analyte tests and 4X the LOD for multiple analyte tests.
- The laboratory must verify the LOD on each instrument used for the reporting of sample data.
- The laboratory must be able to identify all target analytes in the verification standard (distinguishable from noise).

For Ohio VAP projects, a valid MDL must be in place prior to sample analysis. MDLs must be spiked at or below the reporting limit and will not be accepted if it was spike higher than the reporting limit.

Additional information can be found in SOP S-MN-Q-269 ***Method Detection Limit Studies*** or its equivalent revision or replacement.

## 4.10. Limit of Quantitation (LOQ)

A limit of quantitation (LOQ) for every analyte of concern must be determined. For PASI laboratories, this LOQ is referred to as the RL, or Reporting Limit. This RL is based on the lowest calibration standard concentration that is used in each initial calibration. Results below this level are not allowed to be reported without qualification since the results would not be substantiated by a calibration standard. For methods with a determined LOD, results can be reported out below the LOQ but above the LOD if they are properly qualified (e.g. J flag).

The LOQ must be higher than the LOD.

To verify the LOQ, the laboratory will prepare a sample in the same matrix used for the LCS. The sample will be spiked with target analytes at the concentration(s) equivalent to or less than the RL(s). This sample must undergo the routine sample preparation procedure including any routine sample cleanup steps. The sample is then analyzed and the recovery of each target analyte determined. The recovery for each target analyte must meet the laboratories current control limits for an LCS.

For DoD approved methods, the LOQ and LOD shall be verified quarterly and valid LOQ must be in place prior to sample analysis.

Additional information can be found in SOP S-MN-Q-269 ***Method Detection Limit Studies*** or its equivalent revision or replacement.

## 4.11. Estimate of Analytical Uncertainty

PASI laboratories can provide an estimation of uncertainty for results generated by the laboratory. The estimate quantifies the error associated with any given result at a 95% confidence interval. This

estimate does not include bias that may be associated with sampling. The laboratory has a procedure in place for making this estimation. In the absence of a regulatory or customer-specific procedure, PASI laboratories base this estimation on the recovery data obtained from the Laboratory Control Spikes. The uncertainty is a function of the standard deviation of the recoveries multiplied by the appropriate Student's t Factor at 95% confidence. Additional information pertaining to the estimation of uncertainty and the exact manner in which it is derived are contained in the SOP *S-MN-Q-255*, ***Estimation of Uncertainty*** or its equivalent revision or replacement.

The measurement of uncertainty is provided only on request by the customer, as required by specification or regulation and when the result is used to determine conformance within a specification limit.

## 4.12. Proficiency Testing (PT) Studies

PASI laboratories participate in the NELAC defined proficiency testing program. PT samples are obtained from NIST approved providers and analyzed and reported at a minimum of two times per year for the relevant fields of testing per matrix.

The laboratory initiates an investigation whenever PT results are deemed 'unacceptable' by the PT provider. All findings and corrective actions taken are reported to the Quality Manager. A corrective action plan is initiated and this report is sent to the appropriate state accreditation agencies for their review. Additional PTs will be analyzed and reported as needed for certification purposes.

PT samples are treated as typical customer samples, utilizing the same staff, methods, equipment, facilities, and frequency of analysis. PT samples are included in the laboratory's normal analytical processes and do not receive extraordinary attention due to their nature.

Comparison of analytical results with anyone participating in the same PT study is prohibited prior to the close of the study.

Additional information can be found in SOP S-MN-Q-258 ***PE/PT Program*** or its equivalent revision or replacement.

## 4.13. Rounding and Significant Figures

In general, the PASI laboratories report data to no more than three significant digits. Therefore, all measurements made in the analytical process must reflect this level of precision. In the event that a parameter that contributes to the final result has less than three significant figures of precision, the final result must be reported with no more significant figures than that of the parameter in question. The rounding rules listed below are descriptive of the LIMS and not necessarily of any supporting program such as Excel.

### 4.13.1. Rounding

PASI-Minnesota and Montana follows the odd / even guidelines for rounding numbers:

- If the figure following the one to be retained is less than five, that figure is dropped and the retained ones are not changed (with three significant figures, 2.544 is rounded to 2.54).

- If the figure following the ones to be retained is greater than five, that figure is dropped and the last retained one is rounded up (with three significant figures, 2.546 is rounded to 2.55).
- If the figure following the ones to be retained is five and if there are no figures other than zeros beyond that five, then the five is dropped and the last figure retained is unchanged if it is even and rounded up if it is odd (with three significant figures, 2.525 is rounded to 2.52 and 2.535 is rounded to 2.54).

### 4.13.2. Significant Digits

Unless specified by federal, state, or local requirements or on specific request by a customer, PASI-Minnesota and Montana reports all analytical results to 3 significant digits, regardless of the magnitude of the value reported.

PASI-Minnesota and Montana follows the following convention for reporting to a specified number of significant figures. Unless specified by federal, state, or local requirements or on specific request by a customer, the laboratory reports:

- Values > 10 – Reported to 3 significant digits
- Values ≤ 10 – Reported to 2 significant digits

# 5.0. DOCUMENT MANAGEMENT AND CHANGE CONTROL

## 5.1. Document Management

Additional information can be found in SOP S-ALL-Q-002 ***Document Management*** or its equivalent revision or replacement. Information on Pace's policy for electronic signatures can also be found in this SOP.

Pace Analytical Services, Inc. has an established procedure for managing documents that are part of the quality system. The list of managed documents includes, but is not limited to, Standard Operating Procedures (both technical and non-technical), Quality Assurance Manuals, quality policy statements, training documents, work-processing documents, charts, posters, memoranda, notices, forms, software, and any other procedures, tables, plans, etc. that have a direct bearing on the quality system (including applicable data records and non-technical documents).

A master list of all managed documents is maintained at each facility identifying the current revision status and distribution of the controlled documents. This establishes that there are no invalid or obsolete documents in use in the facility. All documents are reviewed periodically and revised if necessary. Obsolete documents are systematically discarded or archived for audit or knowledge preservation purposes.

Each managed document is uniquely identified to include the date of issue, the revision identification, page numbers, the total number of pages and the issuing authorities. For complete information on document numbering, refer to SOP S-ALL-Q-003 ***Document Numbering***.

SOPs, specifically, are available to all laboratory staff via the Learning Management System (LMS) which is a secure repository that is accessed through an internet portal. As a local alternative to the hard copy system of controlled documents, secured electronic copies of controlled documents may be maintained on the laboratory's local server. These document files must be read-only for all personnel except the Quality Department and system administrator. Other requirements for this system are as follows:

- Electronic documents must be readily accessible to all facility employees.
- All hardcopy SOPs must be obtained from the Quality Department.

### 5.1.1. Quality Assurance Manual (QAM)

The Quality Assurance Manual is the company-wide document that describes all aspects of the quality system for PASI. The base QAM template is distributed by the Corporate Quality Department to each of the regional Quality Managers. The regional management personnel modify the necessary and permissible sections of the base template and submit those modifications to the Corporate Director of Quality for review. Once approved and signed by both the CEO and the Director of Quality; the General Manager, Quality Manager, and any Technical Directors, however named, sign the Quality Assurance Manual. Each regional Quality Manager is then in charge of distribution to employees, external customers or regulatory agencies and maintaining a distribution list of controlled document copies. The Quality Assurance Manual template is reviewed on an annual basis by all of the PASI Quality Managers and revised accordingly by the Director of Quality.

### 5.1.2. Standard Operating Procedures (SOPs)

SOPs fall into two categories: company-wide documents and facility specific documents. Company-wide SOPs start with the prefix S-ALL- and local SOPs start with the individual facility prefix.

The purpose of the company-wide SOPs is to establish policies and procedure that are common and applicable to all PASI facilities. Company-wide SOPs are document-controlled by the corporate quality office and signed copies are distributed to all of the laboratory Quality Managers. The laboratory management personnel sign the company-wide SOPs. The laboratory Quality Manager is then in charge of distribution to employees, external customers, or regulatory agencies and maintaining a distribution list of controlled document copies.

PASI facilities are responsible for developing facility-specific SOPs applicable to their respective facility. The laboratory develops these facility-specific SOPs based on the corporate-wide SOP template. This template is written to incorporate a set of minimum method requirements and PASI best practice requirements. The laboratory facilities may add to or modify the corporate-wide SOP template provided there are no contradictions to the minimum method or best practice requirements. Facility-specific SOPs are controlled by the laboratory Quality Manager according to the corporate document management policies.

SOPs are reviewed every two years at a minimum although a more frequent review may be required by some state or federal agencies or customers. A review of the document does not necessarily constitute issuing a new revision. Documentation of this review and any applicable revisions are made in the last section of each SOP. This provides a historical record of all revisions.

All copies of superseded SOPs are removed from general use and the original copy of each SOP is archived for audit or knowledge preservation purposes. This ensures that all PASI employees use the most current version of each SOP and provides the Quality Manager with a historical record of each SOP.

Additional information can be found in SOP S-ALL-Q-001 ***Preparation of SOPs*** or its equivalent revision or replacement.

For Ohio VAP certification, it is required by the Ohio Administrative Code that the laboratory must seek Ohio VAP review and approval of all SOPs and Quality Manual subsequent modifications prior to implementation.

For DoD approval, all technical SOPs are reviewed for accuracy and adequacy annually and whenever method procedures change and updated as appropriate. All such reviews are documented and made available for assessment. Non-technical SOPs that are not required elements of the quality system are considered administrative SOPs and are not required to be reviewed annually.

### 5.1.3. Other Documentation

Additional documents such as Forms and Spreadsheets are controlled through the document management system.

## 5.2. Document Change Control

Changes to managed documents are reviewed and approved in the same manner as the original review. Any revision to a document requires the approval of the applicable signatories. After revisions are approved, a revision number is assigned and the previous version of the document is officially retired. Copies may be kept for audit or knowledge preservation purposes.

All controlled copies of the previous document are replaced with controlled copies of the revised document and the superseded copies are destroyed or archived. All affected personnel are advised that there has been a revision and any necessary training is scheduled.

## 5.3. Management of Change

The process for documenting necessary changes within the laboratory network are not typically handled using the corrective or preventive action system as outlined in section 9.0. Management of Change is a proactive approach to dealing with change to minimize the potential negative impact of systematic change in the laboratory and to ensure that each change has a positive desired outcome. This process will primarily be used for the implementation of large scale projects and information system changes as a means to apply consistent systems or procedures within the laboratory network. The request for change is submitted by the initiator and subsequently assigned to an individual or team for development and planning. The final completion of the process culminates in final approval and verification that the procedure was effectively implemented. Additional information can be found in SOP S-MN-Q-257 ***Management of Change*** or its equivalent revision or replacement.

# 6.0. EQUIPMENT AND MEASUREMENT TRACEABILITY

Each PASI facility is equipped with sufficient instrumentation and support equipment to perform the relevant analytical testing or field procedures performed by each facility. Support equipment includes chemical standards, thermometers, balances, disposable and mechanical pipettes, etc. This section details some of the procedures necessary to maintain traceability and to perform proper calibration of instrumentation and support equipment. See Attachment III for a list of equipment currently used at the Minnesota and Montana PASI facilities.

## 6.1. Standards and Traceability

Each PASI facility retains all pertinent information for standards, reagents, and chemicals to assure traceability to a national standard. This includes documentation of purchase, receipt, preparation, and use.

Upon receipt, all purchased standard reference materials are recorded into a standard logbook or database and assigned a unique identification number. The entries include the facility's unique identification number, the chemical name, manufacturer name, manufacturer's identification numbers, receipt date, and expiration date. Vendor's certificates of analysis for all standards, reagents, or chemicals are retained for future reference.

Subsequent preparations of intermediate or working solutions are also documented in a standard logbook or database. These entries include the stock standard name and lot number, the manufacturer name, the solvents used for preparation, the solvent lot number and manufacturer, the preparation steps, preparation date, expiration dates, preparer's initials, and a unique PASI identification number. This number is used in any applicable sample preparation or analysis logbook so the standard can be traced back to the standard preparation record. This process ensures traceability back to the national standard.

All prepared standard or reagent containers include the PASI identification number, the standard or chemical name, the date of preparation, the date of expiration, the concentration with units, and the preparer's initials. This ensures traceability back to the standard preparation logbook.

For containers that are too small to accommodate labels that list all of the above information associated with a standard, the minimum required information will be PASI standard ID, concentration, and expiration date. This assures that no standard will be used past its assigned expiration date.

If a second source standard is required to verify an existing calibration or spiking standard, this standard should be obtained from a different manufacturer or from a different lot unless client specific QAPP requirements state otherwise.

Additional information concerning standards and reagent traceability can be found in the SOP S-ALL-Q-025 ***Standard and Reagent Preparation and Traceability*** or its equivalent revision or replacement.

## 6.2. General Analytical Instrument Calibration Procedures

All support equipment and instrumentation are calibrated or checked before use to ensure proper functioning and verify that the laboratory's requirements are met. All calibrations are performed by, or under the supervision of, an experienced analyst at scheduled intervals against either certified standards traceable to recognized national standards or reference standards whose values have been statistically validated.

Calibration standards for each parameter are chosen to establish the linear range of the instrument and must bracket the concentrations of those parameters measured in the samples. The lowest calibration standard is the lowest concentration for which quantitative data may be reported. Data reported below this level is considered to have less certainty and must be reported using appropriate data qualifiers or explained in a narrative. The highest calibration standard is the highest concentration for which quantitative data may be reported. Data reported above this level is considered to have less certainty and must be reported using appropriate data qualifiers or explained in the narrative. Any specific method requirement for number and type of calibration standards supersedes the general requirement. Instrument and method specific calibration criteria are explained within the specific analytical standard operating procedures for each facility.

Instrumentation or support equipment that cannot be calibrated to specification or is otherwise defective is clearly labeled as out-of-service until it has been repaired and tested to demonstrate it meets the laboratory's specifications. All repair and maintenance activities including service calls are documented in the maintenance log. Equipment sent off-site for calibration testing is packed and transported to prevent breakage and is in accordance with the calibration laboratory's recommendations.

In the event that recalibration of a piece of test equipment indicates the equipment may have been malfunctioning during the course of sample analysis, an investigation is performed. The results of the investigation along with a summary of the information reviewed are documented and maintained by the quality manager. If the investigation indicates sample results have been impacted, the customer is notified within 30 days. This allows for sufficient investigation and review of documentation to determine the impact on the analytical results. Instrumentation found to be consistently out of calibration is either repaired and positively verified or taken out of service and replaced.

Raw data records are retained to document equipment performance. Sufficient raw data is retained to reconstruct the instrument calibration and explicitly connect the continuing calibration verification to the initial calibration.

### 6.2.1. General Organic Calibration Procedures

Calibration standards are prepared at a minimum of five concentrations for organic analyses. Results from all calibration standards analyzed must be included in constructing the calibration curve with the following exceptions:

- The lowest level calibration standard may be removed from the calibration as long as the remaining number of concentration levels meets the minimum established by the method and standard operating procedure. For multi-parameter methods, this may be done on an individual analyte basis. The reporting limit must be adjusted to the lowest concentration included in the calibration curve.

- The highest level calibration standard may be removed from the calibration as long as the remaining number of concentration levels meets the minimum established by the method and standard operating procedure. For multi-parameter methods, this may be done an individual analyte basis. The upper limit of quantitation must be adjusted to the highest concentration included in the calibration curve.
- Multiple points from either the high end or the low end of the calibration curve may be excluded as long as the remaining points are contiguous in nature and the minimum number of levels remains as established by method or standard operating procedure. The reporting limit or quantitation range, which is appropriate, must be adjusted accordingly.
- Results from a concentration level between the lowest and highest calibration levels can be excluded from the calibration curve for an acceptable cause with approval from the responsible department supervisor if the results for all analytes are excluded and the point is replaced by re-analysis. Re-analysis must occur within the same 12 hour tune time period for GC/MS methodologies and within 8 hours of the initial analysis for non-GC/MS methodologies, unless otherwise specified in the reference method. All samples analyzed prior to the re-analyzed calibration curve point must be re-analyzed after the calibration curve is completed.

Initial calibration curves are evaluated against appropriate statistical models as required by the analytical methods. Curves that do not meet the appropriate criteria require corrective action that may include re-running the initial calibration curve. All initial calibrations are verified with an initial calibration verification standard (ICV) obtained from a second manufacturer or second lot from the same manufacturer if that lot can be demonstrated as prepared independently from other lots prior to the analysis of samples. Sample results are quantitated from the initial calibration unless otherwise required by regulation, method, or program.

The calibration curve is periodically verified by the analysis of a mid-level continuing calibration verification (CCV) standard during the course of sample analysis. Continuing calibration verification is performed at the beginning and end of each analytical batch except if an internal standard is used, then only one verification at the beginning of the batch is needed, whenever it is expected that the analytical system may be out of calibration, if the time period for calibration has expired, or for analytical systems that have specific calibration verification requirements. This verification standard must meet acceptance criteria in order for sample analysis to proceed.

In the event that the CCV does not meet the acceptance criteria, a second CCV may be injected as part of the diagnostic evaluation and corrective action investigation. If the second CCV is acceptable, the analytical sequence may be continued. If both CCVs fail, the analytical sequence is terminated and corrective action is initiated. Sample analysis cannot begin until after documented corrective action has been completed and two consecutive passing CCVs have been analyzed. If required by specific state, program, or customer specification, the instrument is re-calibrated after two consecutive CCV failures. All samples analyzed since the last compliant CCV are re-analyzed for methodologies utilizing external calibration.

When instruments are operating unattended, autosamplers may be programmed to inject consecutive CCVs as a preventative measure against CCV failure with no corrective action. In this case, both CCVs must be evaluated to determine potential impact to the results. A summary of the decision tree and necessary documentation are listed below:

- If both CCVs meet the acceptance criteria, the analytical sequence is allowed to continue without corrective action. The 12 hour clock begins with the injection of the second CCV.
- If the first CCV does not meet the acceptance criteria and the second CCV is acceptable, the analytical sequence is continued and the results are reported.
- If the first CCV meets the acceptance criteria and the second CCV is out of control, the samples preceded by the out of control CCV must be re-analyzed in a compliant analytical sequence.
- If both CCVs are out of control, all samples since the last acceptable CCV must be re-analyzed in a compliant analytical sequence.

For DoD projects per Gray Box 37, if the laboratory analyzes two CCVs in a row as defined above, both CCVs must be evaluated. If either CCV fails, all samples and QC preceding and following the CCV pair have to be reanalyzed.

Some analytical methods require that samples be bracketed by passing CCVs analyzed both before and after the samples. This is specific to each method but, as a general rule, all external calibration methods require bracketing CCVs. Most internal standard calibrations do not require bracketing CCVs.

Some analytical methods require verification based on a time interval; some methods require a frequency based on an injection interval. The type and frequency of the calibration verifications is dependent on both the analytical method and possibly on the quality program associated with the samples. The type and frequency of calibration verification will be documented in the method specific SOP employed by each laboratory.

For Ohio VAP projects, the laboratory must minimize the use of qualified data. In the case of calibration verification standard failures, the laboratory is required to reanalyze the CCV and the associated samples so as not to report qualified data. Sample results may be reported if the CCV failure produces a high bias and the samples are non-detect. Where possible, the second attempt should be made using the original aliquot of the standard unless there is reason to suspect that the standard is the cause of failure. The laboratory must make every effort to take the appropriate corrective actions and resolve any anomalies regarding calibration verification standard failures for Ohio VAP projects.

### 6.2.2. General Inorganic Calibration Procedures

The instrument is initially calibrated with standards at multiple concentrations to establish the linearity of the instrument's response. A calibration blank is also included. Initial calibration curves are evaluated against appropriate statistical models as required by the analytical methods. The number of calibration standards used depends on the specific method criteria or customer project requirements, although normally a minimum of three standards is used.

The ICP and ICP/MS can be standardized with a zero point and a single point calibration if:

- Prior to analysis, the zero point and the single point calibration are analyzed and a linear range has been established,
- Zero point and single point calibration standards are analyzed with each batch

- A standard corresponding to the LOQ is analyzed with the batch and meets the established acceptance criteria
- The linearity is verified at the frequency established by the method or manufacturer.

All initial calibrations are verified with an initial calibration verification standard (ICV) obtained from a second manufacturer or second lot from the same manufacturer if the lot can be demonstrated as prepared independently from other lots prior to the analysis of samples. Sample results are quantitated from the initial calibration unless otherwise required by regulation, method, or program.

During the course of analysis, the calibration curve is periodically verified by the analysis of calibration verification standards (CCV). A calibration verification standard is analyzed within each analytical batch at method/program specific intervals to verify that the initial calibration is still valid. The CCV is also analyzed at the end of the analytical batch.

A calibration blank is also run with each calibration verification standard to verify the cleanliness of the system. All reported results must be bracketed by acceptable CCVs. Instrument and method specific calibration acceptance criteria are explained within the specific analytical standard operating procedures for each facility.

Interference check standards are also analyzed per method requirements and must meet acceptance criteria for metals analyses.

## 6.3. Support Equipment Calibration Procedures

All support equipment is calibrated or verified at least annually using NIST traceable references over the entire range of use. The results of calibrations or verifications must be within the specifications required or the equipment will be removed from service until repaired. The laboratory maintains records to demonstrate the correction factors applied to working thermometers.

On each day the equipment is used, balances, ovens, refrigerators (those used to keep samples and standards at required temperatures), freezers, and water baths are checked in the expected use range with NIST traceable references in order to ensure the equipment meets laboratory specifications and these checks are documented appropriately.

### 6.3.1. Analytical Balances

Each analytical balance is calibrated or verified at least annually by a qualified service technician. The calibration of each balance is verified each day of use prior to use with weights traceable to NIST bracketing the range of use. Calibration weights are ASTM Class 1 or other class weights that have been calibrated against a NIST standard weight and are re-certified annually against a NIST traceable reference. Some accrediting agencies may require more frequent checks. If balances are calibrated by an external agency, verification of their weights must be provided. All information pertaining to balance maintenance and calibration is recorded in the individual balance logbook and/or is maintained on file in the Quality department.

### 6.3.2. Thermometers

Certified, or reference, thermometers are maintained for checking calibration of working thermometers. Reference thermometers are provided with NIST traceability for initial calibration and are re-certified, at a minimum, every 3 years with equipment directly traceable to NIST.

Working thermometers are compared with the reference thermometers annually according to corporate metrology procedures. Each thermometer is individually numbered and assigned a correction factor based on the NIST reference source. In addition, working thermometers are visually inspected by laboratory personnel prior to use and temperatures are documented.

Laboratory thermometer inventory and calibration data are maintained in the Quality department.

### 6.3.3. pH/Electrometers

The meter is calibrated before use each day, using fresh buffer solutions. See method SOP S-MN-I-526 – pH, for more information.

### 6.3.4. Spectrophotometers

During use, spectrophotometer performance is checked at established frequencies in analysis sequences against initial calibration verification (ICV) and continuing calibration verification (CCV) standards.

### 6.3.5. Mechanical Volumetric Dispensing Devices

Mechanical volumetric dispensing devices including bottle top dispensers, pipettes, and burettes, excluding Class A volumetric glassware, are checked for accuracy on a quarterly basis. The accuracy of glass microliter syringes is verified and documented prior to initial use.

Additional information regarding calibration and maintenance of laboratory support equipment can be found in SOP S-MN-Q-264 ***Support Equipment*** or its equivalent revision or replacement.

## 6.4. Instrument/ Equipment Maintenance

The objectives of the Pace Analytical maintenance program are twofold: to establish a system of instrument care that maintains instrumentation and equipment at required levels of calibration and sensitivity, and to minimize loss of productivity due to repairs.

The Laboratory Operations Manager and department manager/supervisors are responsible for providing technical leadership to evaluate new equipment, solve equipment problems, and coordinate instrument repair and maintenance. Analysts have the primary responsibility to perform routine maintenance.

To minimize downtime and interruption of analytical work, preventative maintenance is routinely performed on each analytical instrument. Up-to-date instructions on the use and maintenance of equipment are available to staff in the department where the equipment is used.

Department manager/supervisors are responsible for maintaining an adequate inventory of spare parts required to minimize equipment downtime. This inventory includes parts and supplies that are subject to frequent failure, have limited lifetimes, or cannot be obtained in a timely manner should a failure occur.

All major equipment and instrumentation items are uniquely identified to allow for traceability. Equipment/instrumentation is, unless otherwise stated, identified as a system and not as individual pieces. The laboratory maintains equipment records that include the following:

- The name of the equipment and its software
- The manufacturer's name, type, and serial number
- Approximate date received and date placed into service
- Current location in the laboratory
- Condition when received (new, used, etc.)
- Copy of any manufacturer's manuals or instructions
- Dates and results of calibrations and next scheduled calibration (if known)
- Details of past maintenance activities, both routine and non-routine
- Details of any damage, modification or major repairs

All instrument maintenance is documented in maintenance logbooks or databases that are assigned to each particular instrument or system. A copy of the equipment list can be found in Attachment III.

When maintenance is performed to repair an instrument problem, depending on the initial problem, demonstration of return to control may be satisfied by the successful analysis of a tune, reagent blank, or continuing calibration standard depending on the instrument problem. The maintenance log entry must include a summary of the results of that analysis and verification by the analyst that the instrument has been returned to an in-control status. In addition, each entry must include the initials of the analyst making the entry, the dates the maintenance actions were performed, and the date the entry was made in the maintenance logbook, if different from the date(s) of the maintenance.

Any equipment that has been subjected to overloading or mishandling, or that gives suspect results, or has been shown to be defective, is taken out of service and clearly identified. The equipment shall not be used to analyze customer samples until it has been repaired and shown to perform satisfactorily.

# 7.0. CONTROL OF DATA

Analytical results processing, verification, and reporting are procedures employed that result in the delivery of defensible data. These processes include, but are not limited to, calculation of raw data into final concentration values, review of results for accuracy, evaluation of quality control criteria and assembly of technical reports for delivery to the data user.

All analytical data undergo a well-defined, well-documented multi-tier review process prior to being reported to the customer. This section describes procedures used by PASI for translating raw analytical data into accurate final sample reports as well as PASI data storage policies.

## 7.1. Analytical Results Processing

When analytical, field, or product testing data is generated, it is either recorded in a bound laboratory logbook (e.g. Run log or Instrument log) or copies of computer-generated printouts that are appropriately labeled and filed. These logbooks and other laboratory records are kept in accordance with each facility's Standard Operating Procedure for documentation storage and archival. If the laboratory chooses to minimize or eliminate its paper usage, these records can be kept on electronic media. In this case, the laboratory must ensure that there are sufficient redundant electronic copies so no data is lost due to unforeseen computer issues.

The primary analyst is responsible for initial data reduction and review. This includes confirming compliance with required methodology, verifying calculations, evaluating quality control data, noting non-conformances in logbooks or as footnotes or narratives, and uploading analytical results into the LIMS.

The primary analyst then compiles the initial data package for verification. This compilation must include sufficient documentation for data review. It may include standard calibrations, chromatograms, manual integration documentation, electronic printouts, chain of custody forms, and logbook copies.

Some agencies or customers require different levels of data reporting. For these special levels, the primary analyst may need to compile additional project information, such as initial calibration data or extensive spectral data, before the data package proceeds to the verification step.

## 7.2. Data Verification

Data verification is the process of examining data and accepting or rejecting it based on pre-defined criteria. This review step is designed to ensure that reported data are free from calculation and transcription errors, that quality control parameters are evaluated, and that any non-conformances are properly documented.

Analysts performing the analysis and subsequent data reduction have primary responsibility for quality of the data produced. The primary analyst initiates the data verification process by reviewing and accepting the data, provided QC criteria have been met for the samples being reported. Data review checklists, either hardcopy or electronic, are used to document the data review process. The primary analyst is responsible for the initial input of the data into the LIMS.

The completed data package is then sent to a designated qualified reviewer (this cannot be the primary analyst). The following criteria have been established to qualify someone as a data reviewer. To perform secondary data reviewer, the reviewer must:

1. Have a current Demonstration of Capability (DOC) study on file and have an SOP acknowledgement form on file for the method/procedure being reviewed; or, See Note

2. Have a DOC on file for a similar method/technology (i.e. GC/MS) and have an SOP acknowledgment form on file for the method/procedure being reviewed; or, See Note

3. Supervise or manage a Department and have an SOP acknowledgment form on file for the method/procedure being reviewed; or,

4. Have significant background in the department/methods being reviewed through education or experience and have an SOP acknowledgment form on file for the method/procedure being reviewed.

**Note:** Secondary reviewer status must be approved personally by the Quality Manager or General Manager in the event that this person has no prior experience on the specific method or general technology.

This reviewer provides an independent technical assessment of the data package and technical review for accuracy according to methods employed and laboratory protocols. This assessment involves a quality control review for use of the proper methodology and detection limits, compliance to quality control protocol and criteria, presence and completeness of required deliverables, and accuracy of calculations and data quantitation. The reviewer also validates the data entered into the LIMS.

Once the data have been technically reviewed and approved, authorization for release of the data from the analytical section is indicated by initialing and dating the data review checklist or otherwise initialing and dating the data (or designating the review of data electronically). The Operations or Project Manager examines the report for method appropriateness, detection limits and QC acceptability. Any deviations from the referenced methods are checked for documentation and validity, and QC corrective actions are reviewed for successful resolution.

Additional information regarding data review procedures can be found in SOP S-MN-L-132 ***Data Reduction, Validation, and Reporting in the Environmental Laboratory*** or its equivalent revision or replacement.

## 7.3. Data Reporting

Data for each analytical fraction pertaining to a particular PASI project number are delivered to the Project Manager for assembly into the final report. All points mentioned during technical and QC reviews are included in a case narrative if there is potential for data to be impacted.

Final reports are prepared according to the level of reporting required by the customer and can be transmitted to the customer via hardcopy or electronic deliverable. A standard PASI final report consists of the following components:

1. A title which designates the report as “Final Report”, “Laboratory Results”, “Certificate of Results”, etc.
2. Name and address of laboratory (or subcontracted laboratories, if used).
3. Phone number and name of laboratory contact to where questions can be referred.

4. A unique identification number for the report. The pages of the report shall be numbered and a total number of pages shall be indicated.
5. Name and address of customer and name of project
6. Unique identification of samples analyzed as well as customer sample IDs.
7. Identification of any sample that did not meet acceptable sampling requirements of the relevant governing agency, such as improper sample containers, holding times missed, sample temperature, etc.
8. Date and time of collection of samples, date of sample receipt by the laboratory, dates of sample preparation and analysis, and times of sample preparation and analysis when the holding time for either is 72 hours or less.
9. Identification of the test methods used.
10. Identification of sampling procedures if sampling was conducted by the laboratory.
11. Deviations from, additions to, or exclusions from the test methods. These can include failed quality control parameters, deviations caused by the matrix of the sample, etc., and can be shown as a case narrative or as defined footnotes to the analytical data.
12. Identification of whether calculations were performed on a dry or wet-weight basis.
13. Reporting limits used.
14. Final results or measurements, supported by appropriate chromatograms, charts, tables, spectra, etc.
15. A signature and title, electronic or otherwise, of person accepting responsibility for the content of the report.
16. Date report was issued.
17. A statement clarifying that the results of the report relate only to the samples tested or to the samples as they were received by the laboratory.
18. If necessary, a statement indicating that the report must not be reproduced except in full, without the written approval of the laboratory.
19. Identification of all test results provided by a subcontracted laboratory or other outside source.
20. Identification of results obtained outside of quantitation levels.

In addition to the requirements listed above, final reports shall also contain the following items when necessary for the interpretation of results:

21. Deviations from, additions to, or exclusions from the test method, and information on specific test conditions, such as environmental conditions.
22. Where relevant, a statement of compliance/non-compliance with requirements and/or specifications (e.g., the TNI standard).
23. Where applicable, a statement on the estimated uncertainty of measurement; information on uncertainty is needed in test reports when it is relevant to the validity or application of the test results, when a customer's instruction so requires, or when the uncertainty affects compliance to a specification limit.
24. Where appropriate and needed, opinions and interpretations, which may include opinions on the compliance/non-compliance of the results with requirements, fulfillment of contractual requirements, recommendations on how to use the results, and guidance to be used for improvement.
25. Additional information which may be required by specific methods, regulatory agencies, or customers.

Additional items may be required per Client QAPPs or different state regulations, i.e. Affidavit for Ohio VAP reports.

For DoD labs, in reference to item 8 listed above, both date and time of preparation and analysis are considered essential information, regardless of the length of the holding time, and shall be included as part of the laboratory report.

Any changes made to a final report shall be designated as "Revised" or equivalent wording. The laboratory must keep sufficient archived records of all laboratory reports and revisions. For higher levels of data deliverables, a copy of all supporting raw data is sent to the customer along with a final report of results. When possible, the PASI facility will provide electronic data deliverables (EDD) as required by contracts or upon customer request.

Customer data that requires transmission by telephone, telex, facsimile or other electronic means undergoes appropriate steps to preserve confidentiality.

The following positions are the only approved signatories for PASI final reports:

- Senior General Manager
- General Manager
- Quality Manager
- Client Services Manager
- Project Manager
- Project Coordinator

## 7.4. Data Security

All data including electronic files, logbooks, extraction/digestion/distillation worksheets, calculations, project files and reports, and any other information used to produce the technical report are maintained secured and retrievable by the PASI facility.

## 7.5. Data Archiving

All records compiled by PASI are maintained legible and retrievable and stored secured in a suitable environment to prevent loss, damage, or deterioration by fire, flood, vermin, theft, and/or environmental deterioration. Records are retained for a minimum of five years unless superseded by federal, state, contractual, and/or accreditation requirements. These records may include, but are not limited to, customer data reports, calibration and maintenance of equipment, raw data from instrumentation, quality control documents, observations, calculations, and logbooks. These records are retained in order to provide for possible historical reconstruction including sampling, receipt, preparation, analysis, and personnel involved. NELAP-related records will be made readily available to accrediting authorities. Access to archived data is documented and controlled by the Quality Manager or a designated Data Archivist.

Records that are computer generated have either a hard copy or electronic write protected backup copy. Hardware and software necessary for the retrieval of electronic data is maintained with the applicable records. Archived electronic records are stored protected against electronic and/or magnetic sources.

In the event of a change in ownership, accountability or liability, reports of analyses performed pertaining to accreditation will be maintained by the acquiring entity for a minimum of five years. In

the event of bankruptcy, laboratory reports and/or records will be transferred to the customer and/or the appropriate regulatory entity upon request.

For Ohio VAP labs, all records must be maintained for 10 years.

## 7.6. Data Disposal

Data that has been archived for the facility's required storage time may be disposed of in a secure manner by shredding, returning to customer, or utilizing some other means that does not jeopardize data confidentiality. Records of data disposal will be archived for a minimum of five years unless superseded by federal, contractual, and/or accreditation requirements.

For Ohio VAP labs, all records must be maintained for 10 years.

# 8.0. QUALITY SYSTEM AUDITS AND REVIEWS

## 8.1. Internal Audits

### 8.1.1. Responsibilities

The Quality Manager is responsible for designing and/or conducting internal audits in accordance with a predetermined schedule and procedure. Since internal audits represent an independent assessment of laboratory functions, the auditor must be functionally independent from laboratory operations to ensure objectivity. The auditor must be trained, qualified, and familiar enough with the objectives, principles, and procedures of laboratory operations to be able to perform a thorough and effective evaluation. The Quality Manger evaluates audit observations and verifies the completion of corrective actions. In addition, a periodic corporate audit will be conducted. The corporate audits will focus on the effectiveness of the Quality System as outlined in this manual but may also include other quality programs applicable to an individual laboratory.

### 8.1.2. Scope and Frequency of Internal Audits

The complete internal audit process consists of the following four sections:

- Raw Data Review audits- conducted according to a schedule per local Quality Manager. A certain number of these data review audits are conducted per quarter to accomplish this yearly schedule.
- Quality System audits- considered the traditional internal audit function and include analyst interviews to help determine whether practice matches method requirements and SOP language.
- Final Report reviews
- Corrective Action Effectiveness Follow-up

Internal systems audits are conducted yearly at a minimum. The scope of these audits includes evaluation of specific analytical departments or a specific quality related system as applied throughout the laboratory.

Examples of system-wide elements that can be audited include:

- Quality Systems documents, such as Standard Operating Procedures, training documents, Quality Assurance Manual, and all applicable addenda
- Data records and non-technical documents
- Personnel and training files.
- General laboratory safety protocols.
- Chemical handling practices, such as labeling of reagents, solutions, and standards as well as all associated documentation.
- Documentation concerning equipment and instrumentation, calibration/maintenance records, operating manuals.
- Sample receipt and management practices.
- Analytical documentation, including any discrepancies and corrective actions.
- General procedures for data security, review, documentation, reporting, and archiving.

- Data integrity issues such as proper manual integrations.

When the operations of a specific department are evaluated, a number of additional functions are reviewed including:

- Detection limit studies
- Internal chain of custody documentation
- Documentation of standard preparations
- Quality Control limits and Control charts

Certain projects may require an internal audit to ensure laboratory conformance to site work plans, sampling and analysis plans, QAPPs, etc.

A representative number of data audits are completed annually. The report format of any non-conformance is similar to that of other internal audits.

The laboratory, as part of their overall internal audit program, ensures that a review is conducted with respect to any evidence of inappropriate actions or vulnerabilities related to data integrity. Discovery and reporting of potential data integrity issues are handled in a confidential manner. All investigations that result in findings of inappropriate activity are fully documented, including the source of the problem, the samples and customers affected the impact on the data, the corrective actions taken by the laboratory, and which final reports had to be re-issued. Customers must be notified within 30 days after the data investigation is completed and the impact to final results is assessed.

### 8.1.3. Internal Audit Reports and Corrective Action Plans

Additional information can be found in SOP S-ALL-Q-011 ***Audits and Inspections*** or its equivalent revision or replacement.

A full description of the audit, including the identification of the operation audited, the date(s) on which the audit was conducted, the specific systems examined, and the observations noted are summarized in an internal audit report. Although other personnel may assist with the performance of the audit, the Quality Manager writes and issues the internal audit report identifying which audit observations are deficiencies that require corrective action.

When audit findings cast doubt on the effectiveness of the operations or on the correctness of validity of the laboratory's environmental test results, the laboratory will take timely corrective action and notify the customer in writing within three business days, if investigations show that the laboratory results may have been affected.

Once completed, the internal audit report is issued jointly to the Laboratory General Manager and the manager(s)/supervisor(s) of the audited operation at a minimum. The responsible manager(s)/supervisor(s) responds within 14 days with a proposed plan to correct all of the deficiencies cited in the audit report. The Quality Manager may grant additional time for responses to large or complex deficiencies (not to exceed 30 days). Each response must include timetables for completion of all proposed corrective actions.

The Quality Manager reviews the audit responses. If the response is accepted, the Quality Manager uses the action plan and timetable as a guideline for verifying completion of the corrective action(s). If the Quality Manager determines that the audit response does not adequately address the correction of cited deficiencies, the response will be returned for modification.

To complete the audit process, the Quality Manager performs a re-examination of the areas where deficiencies were found to verify that all proposed corrective actions have been implemented. An audit deficiency is considered closed once implementation of the necessary corrective action has been audited and verified. This is usually within 60-90 days after implementation. If corrective action cannot be verified, the associated deficiency remains open until that action is completed.

## 8.2. External Audits

PASI laboratories are audited regularly by regulatory agencies to maintain laboratory certifications and by customers to maintain appropriate specific protocols.

Audit teams external to the company review the laboratory to assess the effectiveness of systems and degree of technical expertise. The Quality Manager and other QA staff host the audit team and assist in facilitation of the audit process. Generally, the auditors will prepare a formalized audit report listing deficiencies observed and follow-up requirements for the laboratory. In some cases, items of concern are discussed during a debriefing convened at the end of the on-site review process.

The laboratory staff and supervisors develop corrective action plans to address any deficiencies with the guidance of the Quality Manager. The Laboratory General Manager provides the necessary resources for staff to develop and implement the corrective action plans. The Quality Manager collates this information and provides a written response to the audit team. The response contains the corrective action plan and expected completion dates for each element of the plan. The Quality Manager follows-up with the laboratory staff to ensure corrective actions are implemented and that the corrective action was effective.

## 8.3. Quarterly Quality Reports

The Quality Manager is responsible for preparing a quarterly report to management summarizing the effectiveness of the laboratory Quality Systems. This status report will include:

- Overview of quality activities for the quarter
- Certification status
- Proficiency Testing study results
- SOP revision activities
- Company-wide 3P Document implementation (internal program)
- External audit findings
- Internal audit (method/system) findings
- Manual integration audit findings (Mintminer)
- Raw Data and Final Report review findings
- MDL activities
- Corrective action activities
- Training activity status

- Other significant Quality System items

The Corporate Director of Quality utilizes the information from each laboratory to make decisions impacting the Quality Systems of the company as a whole. Each General Manager utilizes the quarterly report information to make decisions impacting Quality Systems and operational systems at a local level.

Additional information can be found in SOP S-ALL-Q-014 ***Quality System Review*** or its equivalent revision or replacement.

## 8.4. Annual Managerial Review

A managerial review of Quality Systems is performed on an annual basis at a minimum. This allows for assessing program effectiveness and introducing changes and/or improvements.

The managerial review must include the following topics of discussion:

- Suitability of quality management policies and procedures
- Manager/Supervisor reports
- Internal audit results
- Corrective and preventative actions
- External assessment results
- Proficiency testing studies
- Sample capacity and scope of work changes
- Customer feedback, including complaints
- Recommendations for improvement,
- Other relevant factors, such as quality control activities, resources, and staffing.

This managerial review must be documented for future reference by the Quality Manager and copies of the report are distributed to laboratory staff. Results should feed into the laboratory planning system and should include goals, objectives, and action plans for the coming year. The laboratory shall ensure that any actions identified during the review are carried out within an appropriate and agreed upon timescale.

## 8.5. Customer Service Reviews

As part of the annual managerial review listed previously, the sales staff is responsible for reporting on customer feedback, including complaints. The acquisition of this information is completed by performing surveys.

The sales staff continually receives customer feedback, both positive and negative, and reports this feedback to the laboratory management in order for them to evaluate and improve their management system, testing activities and customer service.

In addition, the labs must be willing to cooperate with customers or their representatives to clarify customer requests and to monitor the laboratory’s performance in relation to the work being performed for the customers.

# 9.0. CORRECTIVE ACTION

Additional information can be found in SOP S-MN-Q-262 ***Corrective Action/Preventive Action Process*** or its equivalent revision or replacement.

During the process of sample handling, preparation, and analysis, or during review of quality control records, or during reviews of non-technical portions of the lab, certain occurrences may warrant the necessity of corrective actions. These occurrences may take the form of analyst errors, deficiencies in quality control, method deviations, or other unusual circumstances. The Quality System of PASI provides systematic procedures for the documentation, monitoring, completion of corrective actions, and follow-up verification of the effectiveness of these corrective actions. This can be done using PASI's LabTrack system or other system that lists among at a minimum, the deficiency by issue number, the deficiency source, responsible party, root cause, resolution, due date, and date resolved.

## 9.1. Corrective Action Documentation

The following items are examples of sources of laboratory deviations or non-conformances that warrant some form of documented corrective action:

- Internal Laboratory Non-Conformance Trends
- PE/PT Sample Results
- Internal and External Audits
- Data or Records Review (including non-technical records)
- Client Complaints
- Client Inquiries
- Holding Time violations

Documentation of corrective actions may be in the form of a comment or footnote on the final report that explains the deficiency (e.g. matrix spike recoveries outside of acceptance criteria) or it may be a more formal documentation (either paper system or computerized spreadsheet). This depends on the extent of the deficiency, the impact on the data, and the method or customer requirements for documentation.

The person who discovers the deficiency or non-conformance initiates the corrective action documentation on the Non-Conformance Corrective/ Preventative Action report and/or LabTrack. The documentation must include the affected projects and sample numbers, the name of the applicable Project Manager, the customer name, and the sample matrix involved. The person initiating the corrective action documentation must also list the known causes of the deficiency or non-conformance as well as any corrective/preventative actions that they have taken. Preventive actions must be taken in order to prevent or minimize the occurrence of the situation.

In the event that the laboratory is unable to determine the cause, laboratory personnel and management staff will start a root cause analysis by going through an investigative process. During this process, the following general steps must be taken into account: defining the non-conformance, assigning responsibilities, determining if the condition is significant, and investigating the root cause of the nonconformance. General non-conformance investigative techniques follow the path of the sample through the process looking at each individual step in detail. The root cause must be documented within Lab Track or on the Corrective/Preventative Action Report.

After all the documentation is completed, the routing of the Corrective/Preventative Action Report and /or Lab Track will continue from the person initiating the corrective action, to their immediate supervisor or the Project Manager and finally to the Quality Manager, who is responsible for final review and signoff of all formal corrective/preventative actions.

In the event that analytical testing or results do not conform to laboratory procedures or customer requirements, the laboratory shall investigate the significance of the non-conformance and take appropriate corrective actions. Where necessary, the customer is notified and work is recalled. The procedures for handling non-conforming work are detailed in SOP S-MN-Q-262 ***Corrective Action/Preventive Action Process*** or its equivalent revision or replacement.

## 9.2. Corrective Action Completion

### 9.2.1. Internal Laboratory Non-Conformance Trends

There are several types of non-conformance trends that may occur in the laboratory that would require the initiation of a corrective action report. Laboratories may choose to initiate a corrective action for all instances of one or more of these categories if they so choose, however the intent is that each of these would be handled according to its severity; one time instances could be handled with a footnote or qualifier whereas a systemic problem with any of these categories may require an official corrective action process. These categories, as defined in the Corrective Action SOP are as follows:

- Login error
- Preparation Error
- Contamination
- Calibration Failure
- Internal Standard Failure
- LCS Failure
- Laboratory accident
- Spike Failure
- Instrument Failure
- Final Reporting error

### 9.2.2. PE/PT Sample Results

Any PT result assessed as “not acceptable” requires an investigation and applicable corrective actions. The operational staff is made aware of the PT failures and they are responsible for reviewing the applicable raw data and calibrations and list possible causes for error. The Quality Manager reviews their findings and initiates another external PT sample or an internal PT sample to try and correct the previous failure. Replacement PT results must be monitored by the Quality Manager and reported to the applicable regulatory authorities.

### 9.2.3. Internal and External Audits

The Quality Manager is responsible for documenting all audit findings and their corrective actions. This documentation must include the initial finding, the persons responsible for the corrective

action, the due date for responding to the auditing body, the root cause of the finding, and the corrective actions needed for resolution. The Quality Manager is also responsible for providing any back-up documentation used to demonstrate that a corrective action has been completed.

### 9.2.4. Data Review

In the course of performing primary and secondary review of data or in the case of raw data reviews (e.g. by the Quality Manager), errors may be found which require corrective actions. Any finding that affects the quality of the data requires some form of corrective action, which may include revising and re-issuing of final reports.

### 9.2.5. Client Complaints

Project Managers and Sales staff are responsible for issuing corrective action forms, when warranted, for customer complaints. As with other corrective actions, the possible causes of the problem are listed and the form is passed to the appropriate analyst or supervisor for investigation. After potential corrective actions have been determined, the Project Manager reviews the corrective action form to ensure all customer needs or concerns are being adequately addressed.

### 9.2.6. Client Inquiries

When an error on the customer report is discovered, the Project Manager is responsible for initiating a formal corrective action form that describes the failure (e.g. incorrect analysis reported, reporting units are incorrect, reporting limits do not meet objectives). The Project Manager is also responsible for revising the final report if necessary and submitting it to the customer.

### 9.2.7. Holding Time Violations

In the event that a holding time has been missed, the analyst or supervisor must complete a formal corrective action form or generate a Labtrack ticket. The Project Manager and the Quality Manager must be made aware of all holding time violations.

The Project Manager must contact the customer in order that appropriate decisions are made regarding the hold time excursion and the ultimate resolution is then documented and included in the customer project file. The Quality Manager includes a list of all missed holding times in their Quarterly Report to the corporate QA office.

## 9.3. Preventive Action Documentation

Pace laboratories can take advantage of several available information sources in order to identify needed improvements in all of their systems including technical, managerial, and quality. These sources may include:

- Management Continuous Improvement Plan (CIP) metrics which are used by all production departments within Pace. When groups compare performance across the company, ways to improve systems may be discovered. These improvements can be made within a department or laboratory-wide.

- Annual managerial reviews- part of this NELAC required and NVLAP required review is to look at all processes and procedures used by the laboratory over the past year and to determine ways to improve these processes in the future.
- Quality systems reviews- any frequent checks of quality systems (monthly logbook reviews, etc.) can uncover issues that can be corrected or adjusted before they become a larger issue.

When improvement opportunities are identified or if preventive action is required, the laboratory can develop, implement, and monitor preventive action plans.

# 10.0. GLOSSARY

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| 3P Program | The Pace Analytical continuous improvement program that focuses on Process, Productivity, and Performance. Best Practices are identified that can be used by all PASI labs. |
| Acceptance Criteria | Specified limits placed on characteristics of an item, process, or service defined in requirement documents. |
| Accreditation | The process by which an agency or organization evaluates and recognizes a laboratory as meeting certain predetermined qualifications or standards, thereby accrediting the laboratory. In the context of NELAP, this process is voluntary. |
| Accrediting Authority | The Territorial, State or Federal agency having responsibility and accountability for environmental laboratory accreditation and which grants accreditation. |
| Accrediting (or Accreditation) Body | Authoritative body that performs accreditation. |
| Accuracy | 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. |
| Aliquot | A discrete, measured, representative portion of a sample taken for analysis. |
| Analysis Code (Acode) | All the set parameters of a test, such as Analytes, Method, Detection Limits and Price. |
| Analyst | The designated individual who performs the “hands-on” analytical methods and associated techniques and who is responsible for applying required laboratory practices and other pertinent quality controls to meet the required level of quality. |
| Analyte | The specific chemicals or components for which a sample is analyzed; it may be a group of chemicals that belong to the same chemical family, and which are analyzed together. |
| Analytical Uncertainty | A subset of Measurement Uncertainty that includes all laboratory activities performed as part of the analysis. |
| Assessment | The evaluation process used to measure the performance or effectiveness of a system and its elements against specific criteria (this is an all-inclusive term used to denote any of the following: audit, performance evaluation, peer review, inspection or surveillance). |
| Atomic Absorption Spectrometer | Instrument used to measure concentration in metals samples. |
| Atomization | A process in which a sample is converted to free atoms. |
| Audit | A systematic and independent examination of facilities, equipment, personnel, training, procedures, record-keeping, data validation, data management, and reporting aspects of a system to determine whether QA/QC and technical activities are being conducted as planned and whether these activities will effectively achieve quality objectives. |

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| Batch | Environmental samples that are prepared and/or analyzed together with the same process and personnel, using the same lot(s) of reagents. A preparation batch is composed of one to 20 environmental samples of the same quality systems matrix, meeting the above-mentioned criteria and with a maximum time between the start of processing of 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) that are analyzed together as a group. An analytical batch can include prepared samples originating from various environmental matrices and can exceed 20 samples. |
| Bias | The systematic or persistent distortion of a measurement process, which causes errors in one direction (i.e., the expected sample measurement is different from the sample's true value). |
| Blank | 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 and is sometimes used to adjust or correct routine analytical results. |
| Blind Sample | A sample submitted for analysis with a composition known to the submitter. The analyst/laboratory may know the identity of the sample but not its composition. It is used to test analyst or laboratory proficiency in the execution of the measurement process. |
| BNA (Base Neutral Acid compounds) | A list of semi-volatile compounds typically analyzed by mass spectrometry methods. Named for the way they can be extracted out of environmental samples in an acidic, basic or neutral environment. |
| BOD (Biochemical Oxygen Demand) | Chemical procedure for determining how fast biological organisms use up oxygen in a body of water. |
| Calibration | Set of operations that establish, under specified conditions, the relationship between values of quantities indicated by a measuring instrument or measuring system, or values represented by a material measure or a reference material, and the corresponding values realized by standards. 1) In calibration of support equipment, the values realized by standards are established through the use of Reference Standards that are traceable to the International System of Units (SI); 2) In calibration according to test methods, the values realized by standards are typically established through the use of Reference Materials that are either purchased by the laboratory with a certificate of analysis or purity, or prepared by the laboratory using support equipment that has been calibrated or verified to meet specifications. |
| Calibration Curve | The graphical relationship between the known values, such as concentrations, of a series of calibration standards and their instrument response. |
| Calibration Method | A defined technical procedure for performing a calibration. |
| Calibration Range | The range of values (concentrations) between the lowest and highest calibration standards of a multi-level calibration curve. For metals analysis with a single-point calibration, the low-level calibration check standard and the high standard establish the linear calibration range, which lies within the linear dynamic range. |
| Calibration Standard | A substance or reference material used to calibrate an instrument. |

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| Certified Reference Material (CRM) | A 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. |
| Chain of Custody | An unbroken trail of accountability that verifies the physical security of samples, data, and records. |
| Chain of custody Form (COC) | A record that documents the possession of samples from the time of collection to receipt in the laboratory. This record generally includes the number and type of containers, mode of collection, collector, time of collection, preservation, and requested analyses. |
| Chemical Oxygen Demand (COD) | A test commonly used to indirectly measure the amount of organic compounds in water. |
| Client (referred to by ISO as Customer) | Any individual or organization for whom items or services are furnished or work performed in response to defined requirements and expectations. |
| Code of Federal Regulations (CFR) | A codification of the general and permanent rules published in the Federal Register by agencies of the federal government. |
| Comparability | An assessment of the confidence with which one data set can be compared to another. Comparable data are produced through the use of standardized procedures and techniques. |
| Completeness | The percent of valid data obtained from a measurement system compared to the amount of valid data expected under normal conditions. The equation for completeness is:<br><br>% Completeness = (Valid Data Points/Expected Data Points)*100 |
| Confirmation | Verification of the identity of a component through the use of an approach with a different scientific principle from the original method. These may include, but are not limited to:<br>• second-column confirmation;<br>• alternate wavelength;<br>• derivatization;<br>• mass spectral interpretation;<br>• alternative detectors; or<br>• additional cleanup procedures. |
| Conformance | An affirmative indication or judgment that a product or service has met the requirements of the relevant specifications, contract, or regulation; also the state of meeting the requirements. |
| Congener | A member of a class of related chemical compounds (e.g. PCBs, PCDDs). |
| Consensus Standard | A standard established by a group representing a cross-section of a particular industry or trade, or a part thereof. |
| Continuing Calibration Blank (CCB) | A blank sample used to monitor the cleanliness of an analytical system at a frequency determined by the analytical method. |
| Continuing Calibration Check Compounds (CCC) | Compounds listed in mass spectrometry methods that are used to evaluate an instrument calibration from the standpoint of the integrity of the system. High variability would suggest leaks or active sites on the instrument column. |

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| Continuing Calibration Verification | The verification of the initial calibration that is required during the course of analysis at periodic intervals. Continuing calibration verification applies to both external and internal standard calibration techniques, as well as to linear and non-linear calibration models. |
| Continuing Calibration Verification (CCV) Standard | Also referred to as a CVS in some methods, it is a standard used to verify the initial calibration of compounds in an analytical method. CCVs are analyzed at a frequency determined by the analytical method. |
| Continuous Emission Monitor (CEM) | A flue gas analyzer designed for fixed use in checking for environmental pollutants. |
| Contract Laboratory Program (CLP) | A national network of EPA personnel, commercial labs, and support contractors whose fundamental mission is to provide data of known and documented quality. |
| Contract Required Detection Limit (CRDL) | Detection limit that is required for EPA Contract Laboratory Program (CLP) contracts. |
| Contract Required Quantitation Limit (CRQL) | Quantitation limit (reporting limit) that is required for EPA Contract Laboratory Program (CLP) contracts. |
| Control Chart | A graphic representation of a series of test results, together with limits within which results are expected when the system is in a state of statistical control (see definition for Control Limit) |
| Control Limit | A range within which specified measurement results must fall to verify that the analytical system is in control. Control limit exceedances may require corrective action or require investigation and flagging of non-conforming data. |
| Corrective Action | The action taken to eliminate the causes of an existing non-conformity, defect, or other undesirable situation in order to prevent recurrence. |
| Corrective and Preventative Action (CAPA) | The primary management tools for bringing improvements to the quality system, to the management of the quality system's collective processes, and to the products or services delivered which are an output of established systems and processes. |
| Data Audit | A qualitative and quantitative evaluation of the documentation and procedures associated with environmental measurements to verify that the resulting data are of acceptable quality (i.e. that they meet specified acceptance criteria). |
| Data Quality Objective (DQO) | Systematic strategic planning tool based on the scientific method that identifies and defines the type, quality, and quantity of data needed to satisfy a specified use or end user. |
| Data Reduction | The process of transforming raw data by arithmetic or statistical calculations, standard curves, concentration factors, etc., and collation into a more usable form. |
| Definitive Data | Analytical data of known quality, concentration and level of uncertainty. The levels of quality and uncertainty of the analytical data are consistent with the requirements for the decision to be made. Suitable for final decision-making. |
| Demonstration of Capability | A procedure to establish the ability of the analyst to generate analytical results of acceptable accuracy and precision. |
| Detection Limit (DL) | The smallest analyte concentration that can be demonstrated to be different than zero or a blank concentration at the 99% level of confidence. At the DL, the false positive rate is 1%. |

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| Diesel Range Organics (DRO) | A range of compounds that denote all the characteristic compounds that make up diesel fuel (range can be state or program specific). |
| Digestion | A process in which a sample is treated (usually in conjunction with heat) to convert the sample to a more easily measured form. |
| Document Control (Management) | The act of ensuring that documents (and revisions thereto) are proposed, reviewed for accuracy, approved for release by authorized personnel, distributed properly and controlled (managed) to ensure use of the correct version at the location where the prescribed activity is performed. |
| Dry Weight | The weight after drying in an oven at a specified temperature. |
| Duplicate (or Replicate) | The analyses or measurements of the variable of interest performed identically on two subsamples of the same sample. The results of duplicate analyses are used to evaluate analytical or measurement precision but not the precision of sampling, preservation or storage internal to the laboratory. |
| Electron Capture Detector (ECD) | Device used in GC methods to detect compounds that absorb electrons (e.g. PCB compounds). |
| Electronic Data Deliverable (EDD) | A summary of environmental data (usually in spreadsheet form) which clients request for ease of data review and comparison to historical results. |
| Eluent | A solvent used to carry the components of a mixture through a stationary phase. |
| Elute | To extract, specifically, to remove (absorbed material) from an absorbent by means of a solvent. |
| Elution | A process in which solutes are washed through a stationary phase by movement of a mobile phase. |
| Environmental Data | Any measurements or information that describe environmental processes, locations, or conditions; ecological or health effects and consequences; or the performance of environmental technology. |
| Environmental Monitoring | The process of measuring or collecting environmental data. |
| Environmental Sample | A representative sample of any material (aqueous, non-aqueous, or multimedia) collected from any source for which determination of composition or contamination is requested or required. Environmental samples can generally be classified as follows:<br>• Non Potable Water ( Includes surface water, ground water, effluents, water treatment chemicals, and TCLP leachates or other extracts)<br>• Drinking Water - Delivered (treated or untreated) water designated as potable water<br>• Water/Wastewater - Raw source waters for public drinking water supplies, ground waters, municipal influents/effluents, and industrial influents/effluents<br>• Sludge - Municipal sludges and industrial sludges.<br>• Soil - Predominately inorganic matter ranging in classification from sands to clays.<br>• Waste - Aqueous and non-aqueous liquid wastes, chemical solids, and industrial liquid and solid wastes |
| Equipment Blank | A sample of analyte-free media used to rinse common sampling equipment to check effectiveness of decontamination procedures. |

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| False Negative | An analyte incorrectly reported as absent from the sample, resulting in potential risks from their presence. |
| False Positive | An item incorrectly identified as present in the sample, resulting in a high reporting value for the analyte of concern. |
| Field Blank | A blank sample prepared in the field by filling a clean container with reagent water and appropriate preservative, if any, for the specific sampling activity being undertaken. |
| Field Measurement | Determination of physical, biological, or radiological properties, or chemical constituents that are measured on-site, close in time and space to the matrices being sampled/measured, following accepted test methods. This testing is performed in the field outside of a fixed-laboratory or outside of an enclosed structure that meets the requirements of a mobile laboratory. |
| Field of Accreditation | Those matrix, technology/method, and analyte combinations for which the accreditation body offers accreditation. |
| Finding | An assessment conclusion that identifies a condition having a significant effect on an item or activity. An assessment finding may be positive or negative and is normally accompanied by specific examples of the observed condition. (For DoD, the finding must be linked to a specific requirement). |
| Flame Atomic Absorption Spectrometer (FAA) | Instrumentation used to measure the concentration of metals in an environmental sample based on the fact that ground state metals absorb light at different wavelengths. Metals in a solution are converted to the atomic state by use of a flame. |
| Flame Ionization Detector (FID) | A type of gas detector used in GC analysis where samples are passed through a flame which ionizes the sample so that various ions can be measured. |
| Gas Chromatography (GC) | Instrumentation which utilizes a mobile carrier gas to deliver an environmental sample across a stationary phase with the intent to separate compounds out and measure their retention times. |
| Gas Chromatograph/ Mass Spectrometry (GC/MS) | In conjunction with a GC, this instrumentation utilizes a mass spectrometer which measures fragments of compounds and determines their identity by their fragmentation patterns (mass spectra). |
| Gasoline Range Organics (GRO) | A range of compounds that denote all the characteristic compounds that make up gasoline (range can be state or program specific). |
| Graphite Furnace Atomic Absorption Spectrometry (GFAA) | Instrumentation used to measure the concentration of metals in an environmental sample based on the absorption of light at different wavelengths that are characteristic of different analytes. |
| High Pressure Liquid Chromatography (HPLC) | Instrumentation used to separate, identify and quantitate compounds based on retention times which are dependent on interactions between a mobile phase and a stationary phase. |
| Holding Time | The maximum time that samples may be held prior to preparation and/or analysis as defined by the method and still be considered valid or not compromised (40 CFR Part 136).<br>(DoD) The time elapsed from the time of sampling to the time of extraction or analysis, or from extraction to analysis, as appropriate. |
| Homogeneity | The degree to which a property or substance is uniformly distributed throughout a sample. |
| Homologue | One in a series of organic compounds in which each successive member has one more chemical group in its molecule than the next preceding member. |

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| Inductively Coupled Plasma Atomic Emission Spectrometry (ICP-AES) | Analytical technique used for the detection of trace metals which uses plasma to produce excited atoms that emit radiation of characteristic wavelengths. |
| Inductively Coupled Plasma- Mass Spectrometry (ICP/MS) | An ICP-AES that is used in conjunction with a mass spectrometer so that the instrument is not only capable of detecting trace amounts of metals and non-metals but is also capable of monitoring isotopic speciation for the ions of choice. |
| Infrared Spectrometer (IR) | An instrument that uses infrared light to identify compounds of interest. |
| Initial Calibration (ICAL) | The process of analyzing standards, prepared at specified concentrations, to define the quantitative response relationship of the instrument to the analytes of interest. Initial calibration is performed whenever the results of a calibration verification standard do not conform to the requirements of the method in use or at a frequency specified in the method. |
| Initial Calibration Verification (ICV) | A standard obtained or prepared from a source independent of the source of the standards for the initial calibration. Its concentration should be at or near the middle of the calibration range. It is done after the initial calibration. |
| Inspection | An activity such as measuring, examining, testing, or gauging one or more characteristics of an entity and comparing the results with specified requirements in order to establish whether conformance is achieved for each characteristic. |
| Instrument Blank | A clean sample (e.g., distilled water) processed through the instrumental steps of the measurement process; used to determine instrument contamination. |
| Interference, spectral | Occurs when particulate matter from the atomization scatters incident radiation from the source or when the absorption or emission from an interfering species either overlaps or is so close to the analyte wavelength that resolution becomes impossible. |
| Interference, chemical | Results from the various chemical processes that occur during atomization and later the absorption characteristics of the analyte. |
| Internal Standards | A known amount of standard added to a test portion of a sample as a reference for evaluating and controlling the precision and bias of the applied analytical method. |
| Intermediate Standard Solution | Reference solutions prepared by dilution of the stock solutions with an appropriate solvent. |
| International System of Units (SI) | The coherent system of units adopted and recommended by the General Conference on Weights and Measures. |
| Ion Chromatography (IC) | Instrumentation or process that allows the separation of ions and molecules based on the charge properties of the molecules. |
| Isomer | One of two or more compounds, radicals, or ions that contain the same number of atoms of the same element but differ in structural arrangement and properties. |

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| Laboratory Control Sample (LCS) | (however named, such as laboratory fortified blank, spiked blank, or QC check sample): A sample matrix, free from the analytes of interest, spiked with verified known amounts of analytes or a material containing known and verified amounts of analytes and taken through all sample preparation and analytical steps of the procedure unless otherwise noted in a reference method. It is generally used to establish intra-laboratory or analyst-specific precision and bias or to evaluate the performance of the total analytical system, including all preparation and analysis steps. |
| Laboratory Duplicate | Aliquots of a sample taken from the same container under laboratory conditions and processed and analyzed independently. |
| Laboratory Information Management System (LIMS) | A computer system that is used to maintain all sample information from sample receipt, through preparation and analysis and including sample report generation. |
| LabTrack | Database used by Pace Analytical to store and track corrective actions and other laboratory issues. |
| Learning Management System (LMS) | A training database used by Pace Analytical to train their employees. This system is a self-paced system which is capable of tracking all employee training requirements and documentation. |
| Legal Chain of custody | Procedures employed to record the possession of samples from the time of sampling through the retention time specified by the client or program. These procedures are performed at the special request of the client and include the use of a Chain of custody Form that documents the collection, transport, and receipt of compliance samples by the laboratory. In addition, these protocols document all handling of the samples within the laboratory. |
| Limit of Detection (LOD) | (TNI) An estimate of the minimum amount of an analyte in a given matrix that an analytical process can reliably detect.<br>(DoD) 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 is 1%. |
| Limit of Quantitation (LOQ) | (TNI) The minimum levels, concentrations or quantities of a target variable (e.g. target analyte) that can be reported with a specified degree of confidence.<br>(DoD) The lowest concentration that produces a quantitative result within specified limits of precision and bias. For DoD projects, the LOQ shall be set at or above the concentration of the lowest initial calibration standard. |
| Laboratory Information Management System (LIMS) | A computer system that is used to maintain all sample information from sample receipt, through preparation and analysis and including sample report generation. |
| Learning Management System (LMS) | A web-based database used by the laboratories to track and document training activities. The system is administered by the corporate training department and each laboratory's learn centers are maintained by a local administrator. |
| Lot | A quantity of bulk material of similar composition processed or manufactured at the same time. |
| Management | Those individuals directly responsible and accountable for planning, implementing, and assessing work. |
| Management System | System to establish policy and objectives and to achieve those objectives. |

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| Manager (however named) | The individual designated as being responsible for the overall operation, all personnel, and the physical plant of the environmental laboratory. A supervisor may report to the manager. In some cases, the supervisor and the manager may be the same individual. |
| Matrix | The substrate of a test sample. |
| Matrix Duplicate | A replicate matrix prepared in the laboratory and analyzed to obtain a measure of precision. |
| Matrix Spike (MS) (spiked sample or fortified sample) | A sample prepared, taken through all sample preparation and analytical steps of the procedure unless otherwise noted in a referenced method, by adding a known amount of target analyte to a specified amount of sample for which an independent test result of target analyte concentration is available. Matrix spikes are used, for example, to determine the effect of the matrix on a method's recovery efficiency. |
| Matrix Spike Duplicate (MSD) (spiked sample or fortified sample duplicate) | A second replicate matrix spike prepared in the laboratory and analyzed to obtain a measure of precision of the recovery of each analyte. |
| Method | A body of procedures and techniques for performing an activity (e.g., sampling, chemical analysis) systematically presented in the order in which they are to be executed. |
| Method Blank | A sample of a matrix similar to the batch of associated samples (when available) that is free from the analytes of interest and is processed simultaneously with and under the same conditions as samples through all steps of the analytical procedures: and in which no target analytes or interferences are present at concentrations that impact the analytical results for sample analyses. |
| Method Detection Limit (MDL) | One way to establish a Detection Limit; defined as the minimum concentration of a substance that can be measured and reported with 99% confidence that the analyte concentration is greater than zero and is determined from analysis of a sample in a given matrix containing the analyte. |
| Method of Standard Additions | A set of procedures adding one or more increments of a standard solution to sample aliquots of the same size in order to overcome inherent matrix effects. The procedures encompass the extrapolation back to obtain the sample concentration. |
| MintMiner | Program used by Pace Analytical to review large amounts of chromatographic data to monitor for errors or data integrity issues. |
| National Institute of Standards and Technology (NIST) | A federal agency of the US Department of Commerce's Technology Administration that is designed as the United States national metrology institute (or NMI). |
| National Pollutant Discharge Elimination System (NPDES) | A permit program that controls water pollution by regulating point sources that discharge pollutants into U.S. waters. |
| Negative Control | Measures taken to ensure that a test, its components, or the environment do not cause undesired effects, or produce incorrect test results. |
| Nitrogen Phosphorus Detector (NPD) | A detector used in GC analyses that utilizes thermal energy to ionize an analyte. With this detector, nitrogen and phosphorus can be selectively detected with a higher sensitivity than carbon. |

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| Nonconformance | An indication or judgment that a product or service has not met the requirement of the relevant specifications, contract, or regulation; also the state of failing to meet the requirements. |
| Not Detected (ND) | The result reported for a compound when the detected amount of that compound is less than the method reporting limit. |
| Performance Audit | The routine comparison of independently obtained qualitative and quantitative measurement system data with routinely obtained data in order to evaluate the proficiency of an analyst or laboratory. |
| Performance Based Measurement System (PBMS) | An analytical system wherein the data quality needs, mandates or limitations of a program or project are specified and serve as criteria for selecting appropriate test methods to meet those needs in a cost-effective manner. |
| Photo-ionization Detector (PID) | An ion detector which uses high-energy photons, typically in the ultraviolet range, to break molecules into positively charged ions. |
| Polychlorinated Biphenyls (PCB) | A class of organic compounds that were used as coolants and insulating fluids for transformers and capacitors. The production of these compounds was banned in the 1970's due to their high toxicity. |
| Positive Control | Measures taken to ensure that a test and/or its components are working properly and producing correct or expected results from positive test subjects. |
| Power of Hydrogen (pH) | The measure of acidity or alkalinity of a solution. |
| Practical Quantitation Limit (PQL) | Another term for a method reporting limit. The lowest reportable concentration of a compound based on parameters set up in an analytical method and the laboratory's ability to reproduce those conditions. |
| Precision | 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. |
| Preservation | Any conditions under which a sample must be kept in order to maintain the chemical and/or biological integrity of the sample. |
| Proficiency Testing | A means of evaluating a laboratory's performance under controlled conditions relative to a given set of criteria through analysis of unknown samples provided by an external source. |
| Proficiency Testing Sample | A sample, the composition of which is unknown to the analyst and is provided to test whether the analyst/laboratory can produce analytical results within the specified acceptance criteria. |
| Protocol | A detailed written procedure for field and/or laboratory operation that must be strictly followed. |
| Quality Assurance (QA) | (TNI) 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.<br>(DoD) An integrated system of activities involving planning, quality control, quality assessment, reporting, and quality improvement to ensure that a product or service meets defined standards of quality with a stated level of confidence. |

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| Quality Assurance Manual (QAM) | A document stating the management policies, objectives, principles, organizational structure and authority, responsibilities, accountability, and implementation of an agency, organization, or laboratory, to ensure the quality of its product and the utility of its product to its users. |
| Quality Assurance Project Plan (QAPP) | A formal document describing the detailed quality control procedures by which the quality requirements defined for the data and decisions pertaining to a specific project are to be achieved. |
| Quality Control (QC) | 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. |
| Quality Control Sample (QCS) | A sample used to assess the performance of all or a portion of the measurement system. One of any number of samples, such as Certified Reference Materials, a quality system matrix fortified by spiking, or actual samples fortified by spiking, intended to demonstrate that a measurement system or activity is in control. |
| Quality Manual | A document stating the management policies, objectives, principles, organizational structure and authority, responsibilities, accountability, and implementation of an agency, organization, or laboratory, to ensure the quality of its product and the utility of its product to its users. |
| 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, implementing, and assessing work performed by the organization and for carrying out required QA and QC. |

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| Quality System Matrix | These matrix definitions are to be used for purposes of batch and quality control requirements:<br>• **Air and Emissions**: Whole gas or vapor samples including those contained in flexible or rigid wall containers and the extracted concentrated analytes of interest from a gas or vapor that are collected with a sorbant tube, impinger solution, filter, or other device<br>• **Aqueous**: Any aqueous sample excluded from the definition of Drinking Water or Saline/Estuarine. Includes surface water, groundwater effluents, and TCLP or other extracts.<br>• **Biological Tissue**: Any sample of a biological origin such as fish tissue, shellfish or plant material. Such samples shall be grouped according to origin<br>• **Chemical Waste**: A product or by-product or an industrial process that results in a matrix not previously defined.<br>• **Drinking Water**: Any aqueous sample that has been designated a potable or potentially potable water source.<br>• **Non-aqueous liquid**: Any organic liquid with <15% settleable solids<br>• **Saline/Estuarine**: Any aqueous sample from an ocean or estuary, or other saltwater source such as the Great Salt Lake.<br>• **Solids**: Includes soils, sediments, sludges, and other matrices with >15% settleable solids. |
| Quantitation Range | The range of values in a calibration curve between the LOQ and the highest successively analyzed initial calibration standard. The quantitation range lies within the calibration range. |
| Random Error | The EPA has established that there is a 5% probability that the results obtained for any one analyte will exceed the control limits established for the test due to random error. As the number of compounds measured increases in a given sample, the probability for statistical error also increases. |
| Raw Data | Any original factual information from a measurement activity or study recorded in a laboratory notebook, 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 microfiche copies, computer printouts, magnetic media, including dictated observations, and recorded data from automated instruments. If exact copies of raw data have been prepared (e.g., tapes which have been transcribed verbatim, data and verified accurate by signature), the exact copy or exact transcript may be submitted. |
| Reagent Blank (method reagent blank) | A sample consisting of reagent(s), without the target analyte or sample matrix, introduced into the analytical procedure at the appropriate point and carried through all subsequent steps to determine the contribution of the reagents and of the involved analytical steps. |
| Reagent Grade | Analytical reagent (AR) grade, ACS reagent grade, and reagent grade are synonymous terms for reagents that conform to the current specifications of the Committee on Analytical Reagents of the American Chemical Society. |
| Reference Material | A material or substance one or more properties of which are sufficiently well established to be used for the calibration of an apparatus, the assessment of a measurement method, or for assigning values to materials. |

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| Reference Standard | (TNI) Standard used for the calibration of working measurement standards in a given organization or at a given location.<br>(DoD) A standard, generally of the highest metrological quality available at a given location, from which measurements made at that location are derived. |
| Relative Percent Difference (RPD) | A measure of precision defined as the difference between two measurements divided by the average concentration of the two measurements. |
| Reporting Limit (RL) | The level at which method, permit, regulatory and customer-specific objectives are met. The reporting limit may never be lower than the Limit of Detection (i.e. statistically determined MDL). Reporting limits are corrected for sample amounts, including the dry weight of solids, unless otherwise specified. There must be a sufficient buffer between the Reporting Limit and the MDL.<br>(DoD) A client-specified lowest concentration value that meets project requirements for quantitative data with known precision and bias for a specific analyte in a specific matrix. |
| Reporting Limit Verification Standard (or otherwise named) | A standard analyzed at the reporting limit for an analysis to verify the laboratory's ability to report to that level. |
| Representativeness | A quality element related to the ability to collect a sample reflecting the characteristics of the part of the environment to be assessed. Sample representativeness is dependent on the sampling techniques specified in the project work plan. |
| Requirement | Denotes a mandatory specification; often designated by the term "shall". |
| Retention Time | The time between sample injection and the appearance of a solute peak at the detector. |
| Sample | Portion of material collected for analysis, identified by a single, unique alphanumeric code. A sample may consist of portions in multiple containers, if a single sample is submitted for multiple or repetitive analysis. |
| Sample Condition Upon Receipt Form (SCURF) | Form used by Pace Analytical sample receiving personnel to document the condition of sample containers upon receipt to the laboratory (used in conjunction with a COC). |
| Sample Delivery Group (SDG) | A unit within a single project that is used to identify a group of samples for delivery. An SDG is a group of 20 or fewer field samples within a project, received over a period of up to 14 calendar days. Data from all samples in an SDG are reported concurrently. |
| Sample Receipt Form (SRF) | Letter sent to the client upon login to show the tests requested and pricing. |
| Sample Tracking | Procedures employed to record the possession of the samples from the time of sampling until analysis, reporting and archiving. These procedures include the use of a Chain of custody Form that documents the collection, transport, and receipt of compliance samples to the laboratory. In addition, access to the laboratory is limited and controlled to protect the integrity of the samples. |
| Sampling | Activity related to obtaining a representative sample of the object of conformity assessment, according to a procedure. |
| Selective Ion Monitoring (SIM) | A mode of analysis in mass spectrometry where the detector is set to scan over a very small mass range, typically one mass unit. The narrower the range, the more sensitive the detector. |

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| Selectivity | The ability to analyze, distinguish, and determine a specific analyte or parameter from another component that may be a potential interferent or that may behave similarly to the target analyte or parameter within the measurement system. |
| Sensitivity | The capability of a method or instrument to discriminate between measurement responses representing different levels (e.g., concentrations) of a variable of interest. |
| 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 as long as the requirement is fulfilled. |
| Should | Denotes a guideline or recommendation whenever noncompliance with the specification is permissible. |
| Signal-to-Noise Ratio | The signal carries information about the analyte, while noise is made up of extraneous information that is unwanted because it degrades the accuracy and precision of an analysis and also places a lower limit on the amount of analyte that can be detected. In most measurements, the average strength of the noise is constant and independent of the magnitude of the signal. Thus, the effect of noise on the relative error of a measurement becomes greater and greater as the quantity being measured (producing the signal) decreases in magnitude. |
| 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 (Document) | The document describing the elements of a laboratory accreditation that has been developed and established within the consensus principles of standard setting and meets the approval requirements of standard adoption organizations procedures and policies. |
| Standard (Chemical) | Standard samples are comprised of a known amount of standard reference material in the matrix undergoing analysis. A standard reference material is a certified reference material produced by US NIST and characterized for absolute content, independent of analytical test method. |
| Standard Blank (or Reagent Blank) | A calibration standard consisting of the same solvent/reagent matrix used to prepare the calibration standards without the analytes. It is used to construct the calibration curve by establishing instrument background. |
| Standard Method | A test method issued by an organization generally recognized as competent to do so. |
| Standard Operating Procedure (SOP) | A written document that details the method for an operation, analysis, or action with thoroughly prescribed techniques and steps. SOPs are officially approved as the methods for performing certain routine or repetitive tasks |
| Standard Reference Material (SRM) | A certified reference material produced by the US NIST or other equivalent organization and characterized for absolute content, independent of analytical method. |
| Statement of Qualifications (SOQ) | A document that lists information about a company, typically the qualifications of that company to compete on a bid for services. |
| Stock Standard | A concentrated reference solution containing one or more analytes prepared in the laboratory using an assayed reference compound or purchased from a reputable commercial source. |

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| Supervisor | The individual(s) designated as being responsible for a particular area or category of scientific analysis. This responsibility includes direct day-to-day supervision of technical employees, supply and instrument adequacy and upkeep, quality assurance/quality control duties and ascertaining that technical employees have the required balance of education, training and experience to perform the required analyses. |
| Surrogate | A substance with properties that mimic the analyte of interest. It is unlikely to be found in environmental samples and is added to them for quality control purposes. |
| Systems Audit | An on-site inspection or assessment of a laboratory's quality system. |
| Target Analytes | Analytes specifically named by a client (also called project-specific analytes). |
| Technical Director | Individual(s) who has overall responsibility for the technical operation of the environmental testing laboratory. |
| Test | A technical operation that consists of the determination of one or more characteristics or performance of a given product, material, equipment, organism, physical phenomenon, process or service according to a specified procedure. The result of a test is normally recorded in a document sometimes called a test report or a test certificate. |
| Test Method | An adoption of a scientific technique for performing a specific measurement as documented in a laboratory SOP or as published by a recognized authority. |
| Test Methods for Evaluating Solid Waste, Physical/ Chemical (SW-846) | EPA Waste's official compendium of analytical and sampling methods that have been evaluated and approved for use in complying with RCRA regulations. |
| Total Petroleum Hydrocarbons (TPH) | A term used to denote a large family of several hundred chemical compounds that originate from crude oil. Compounds may include gasoline components, jet fuel, volatile organics, etc. |
| Toxicity Characteristic Leaching Procedure (TCLP) | A solid sample extraction method for chemical analysis employed as an analytical method to simulate leaching of compounds through a landfill. |
| Traceability | The ability to trace the history, application, or location of an entity by means of recorded identifications. In a calibration sense, traceability relates measuring equipment to national or international standards, primary standards, basic physical conditions or properties, or reference materials. In a data collection sense, it relates calculations and data generated throughout the project back to the requirements for the quality of the project.<br>(DoD) The property of a result of a measurement whereby it can be related to appropriate standards, generally international or national standards, through an unbroken chain of comparisons. |
| Training Document | A training resource that provides detailed instructions to execute a specific method or job function. |
| Trip Blank | This blank sample is used to detect sample contamination from the container and preservative during transport and storage of the sample. A cleaned sample container is filled with laboratory reagent water and the blank is stored, shipped, and analyzed with its associated samples. |
| Tuning | A check and/or adjustment of instrument performance for mass spectrometry as required by the method. |

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| Ultraviolet Spectrophotometer (UV) | Instrument routinely used in quantitative determination of solutions of transition metal ions and highly conjugated organic compounds. |
| Uncertainty Measurement | The parameter associated with the result of a measurement that characterized the dispersion of the values that could be reasonably attributed to the measurand (i.e. the concentration of an analyte). |
| Validation | The confirmation by examination and provision of objective evidence that the particular requirements for a specific intended use are fulfilled. |
| Verification | Confirmation by examination and objective evidence that specified requirements have been met.<br>(DoD) Note: In connection with the management of measuring equipment, verification provides a means for checking that the deviations between values indicated by a measuring instrument and corresponding known values of a measured quantity are consistently smaller than the maximum allowable error defined in a standard, regulation or specification peculiar to the management of the measuring equipment. The result of verification leads to a decision either to restore in service, to perform adjustment, to repair, to downgrade, or to declare obsolete. In all cases, it is required that a written trace of the verification performed shall be kept on the measuring instrument's individual record. |
| Whole Effluent Toxicity (WET) | The aggregate toxic effect to aquatic organisms from all pollutants contained in a facility's wastewater (effluent). |

# 11.0. REFERENCES


- "Guidelines Establishing Test Procedures for the Analysis of Pollutants Under the Clean Water Act." Federal Register, 40 CFR Part 136.
- "Test Methods for Evaluating Solid Wastes: Physical/Chemical Methods." SW-846.
- "Methods for Chemical Analysis of Water and Wastes", EPA 600-4-79-020, 1979 Revised 1983, U.S. EPA.
- U.S. EPA Contract Laboratory Program Statement of Work for Organic Analysis
- U.S. EPA Contract Laboratory Program Statement of Work for Inorganic Analysis
- "Standard Methods for the Examination of Water and Wastewater." Current Edition APHA-AWWA-WPCF
- "Annual Book of ASTM Standards", Section 4: Construction, Volume 04.04: Soil and Rock; Building Stones, American Society of Testing and Materials.
- "Annual Book of ASTM Standards", Section 11: Water and Environmental Technology, American Society of Testing and Materials.
- "NIOSH Manual of Analytical Methods", Third Edition, 1984, U.S. Department of Health and Human Services, National Institute for Occupational Safety and Health.
- "Methods for the Determination of Organic Compounds in Finished Drinking Water and Raw Source Water", U.S. EPA, Environmental Monitoring and Support Laboratory – Cincinnati (September 1986).
- Quality Assurance of Chemical Measurements, Taylor, John K.; Lewis Publishers, Inc. 1987
- Methods for Non-conventional Pesticides Chemicals Analysis of Industrial and Municipal Wastewater, Test Methods, EPA-440/1-83/079C
- Environmental Measurements Laboratory (EML) Procedures Manual, HASL-300, US DOE, February, 1992.
- Requirements for Quality Control of Analytical Data, HAZWRAP, DOE/HWP-65/R1, July, 1990.
- Requirements for Quality Control of Analytical Data for the Environmental Restoration Program, Martin Marietta, ES/ER/TM-16, December, 1992.
- Quality Assurance Manual for Industrial Hygiene Chemistry, AIHA, 1988
- National Environmental Laboratory Accreditation Conference, Constitution, Bylaws, and Standards. Most recent

- ISO/IEC 17025:2005, General requirements for the competence of testing and calibration laboratories.

- Department of Defense Quality Systems Manual (QSM), version 4.2, October 25, 2010.

# 12.0. REVISIONS

The PASI Corporate Quality Office files both a paper copy and electronic version of a Microsoft Word document with tracked changes detailing all revisions made to the previous version of the Quality Assurance Manual. This document is available upon request. All revisions are summarized in the table below.

| Document Number | Reason for Change | Date |
|---|---|---|
| Quality Assurance Manual revision 13.0 | Increased font size of entire document.<br>Section 1.7, fifth paragraph: changed length of time Technical Director can be gone before contacting primary authority (from 65 down to 35 days per TNI standard).<br>Section 1.8.2: Reworded definition for Assistant GM to say “all departments”.<br>Fixed numbering issue with sub-sections for section 1.8 and used bullet points instead of numbers.<br>Section 1.8.19: revised position title to capture requirement of some labs.<br>Section 1.9: added language to second bullet point regarding LMS.<br>Section 1.9: added bullet point for on-line courses.<br>Section 2.5: added third note per request from GB (in red text).<br>Section 2.6: Added chart of 2-digit codes (laboratory designations) per audit finding from GB laboratory (matches corporate SOPs).<br>Section 2.7.4: added reference for Waste Handling and Management SOT.<br>Section 3.1: added more method agency references.<br>Section 3.4: added reference to Training SOP at end of section.<br>Section 4.1: fixed numbering issue. Removed anonymous phone number and added reference to the Employee Handbook.<br>Section 4.2: added paragraph of Ohio VAP required language (red text).<br>Section 4.3, fifth paragraph: reworded second sentence for clarity.<br>Section 4.3: added paragraphs of Ohio VAP and DoD required language (red text).<br>Section 4.4, first paragraph: added qualifier to end of paragraph that MS limits are used to assess the batch if the MS is used in place of the LCS.<br>Section 4.4: added paragraph of Ohio VAP required language (red text).<br>Section 4.6: added paragraph of Ohio VAP required language (red text).<br>Section 4.7: added paragraph of Ohio VAP required language (red text).<br>Section 4.10: added paragraph of Ohio VAP required language (red text).<br>Section 4.11: added paragraph of DoD required language (red text).<br>Section 5.1, fifth paragraph: changed wording from LAN/WAN to local server (as opposed to hardcopies) and added language about LMS access.<br>Section 5.1.2: added paragraphs of Ohio VAP and DoD required language (red text).<br>Added new section 5.3- Management of Change.<br>Section 6.2.1: added paragraph of Ohio VAP required language (red text).<br>Section 6.3.2: changed NIST thermometer calibration frequency to every 3 years to match current practice.<br>Section 7.3: added comment about Ohio VAP reporting (red text).<br>Section 8.1.2, last sentence: reworded to match current practice.<br>Section 8.1.3, last paragraph: reworded sentences regarding verification of corrective actions.<br>Section 8.3: revised list of Quarterly Quality report items to match the revised SOP.<br>Section 8.4: added last two bullet points and added second line of last paragraph to match ISO language.<br>Section 9.1: changed bullet point items to match CAR SOP.<br>Section 9.2.1: revised language to match SOP.<br>Section 9.2.2: moved language from old 9.2.8 to 9.2.2.<br>Section 9.2.4: added language to data review section. | 30Apr2010 |

| Document Number | Reason for Change | Date |
|---|---|---|
| | Glossary: Added definitions for analytical uncertainty, audit, bias, field of accreditation, finding, legal COC, matrix duplicate, method, PT sample, sampling, verification (per TNI standard).<br>Glossary: Added definitions for reporting limit verification standard and initial calibration verification per request.<br>Glossary: revised the following definitions to match new TNI language: DOC, LCS, LOD, MS, MSD, preservation, QA, QC, QC sample, raw data, reference standard, SOPs, and traceability. Also revised language within the definition for Quality System Matrix (previously just called Matrix).<br>Glossary: deleted definition for 'detection limit'.<br>Glossary: added definitions from company Acronym form from IT.<br>Glossary: added definitions for LabTrack and MintMiner.<br>Attachment VIII: added more tests to the chart per QM input including a line item for concentrated waste matrix for VOA 8260.<br>General: changed all references to "Director of Quality, Safety, and Training" to "Director of Quality".<br>General: revised document references to SOTs for Waste Handling and Management and Sample Management.<br>Removed corporate org chart from Attachment IIB and will provide this as a separate document to the QMs. In this way, revisions to the corporate org chart will not necessitate a new QAM revision. | |
| Quality Assurance Manual 14.0 | Cover page: moved signatures to cover page; added new form identification box in header. Added names of signatories<br>Section 1.1 edited for clarity<br>Section 1.3: added language to 3rd paragraph regarding compliance with method and client requirements (TNI V1M2, section 4.2). edited for clarity<br>Section 1.4: Added language describing each of the Core Values, including wording from TNI V1M2, section 4.1 into the "Value Employees" line item.<br>Section 1.5 added fourth bullet point<br>Sections 1.6.2, 1.6.2, 1.6.3, 1.6.4 edited for clarity<br>Section 1.7 edited for clarity<br>Section 1.8.4: added bullet point to QM responsibilities pertaining to corrective actions (TNI V1M2, section 4.1.7.1).<br>Section 1.8.4: added bullet point to QM responsibilities pertaining to the QAM (TNI V1M2, section 4.2.8.2).<br>Section 1.9: reworded and reorganized parts of this section to match current practices using the LMS and for clarity.<br>Section 1.10: moved Data Integrity section from Chapter 4 to Chapter 1.edited for clarity.<br>Section 1.11 edited for clarity<br>Sections 2.1, 2.3, 2.4, 2.5, 2.8, 2.9, 2.10 edited for clarity<br>Section 2.5: added additional bullet point regarding qualified data (TNI V1M2, section 5.8.6.g).<br>Section 2.6: added DoD red letter paragraph regarding time of collection (DoD gray box 14).<br>Section 2.7.1: added new second paragraph to discuss storage blanks (DoD gray box 19).<br>Section 2.7.2: reworded 2nd paragraph- temperatures are checked and documented each day of use (TNI V1M2, section 5.5.13.1.d).<br>Section 2.9: added red letter section to the end of this section regarding DoD subcontract labs (DoD gray box 10).<br>Section 2.9: added wording to the end of the fifth paragraph in this section regarding providing copies of subcontract reports to the client (TNI V1M2, section 4.5.5).<br>3.1 removed A2LA nad NVLAP and added Standard methods<br>Section 3.2, 3.3 edited for clarity<br>Section 3.4: added phrase to first paragraph (TNI V1M4, section 1.6.1).<br>Section 3.4: added language about running DOC if a method had not been | 17Feb2011 |

| Document Number | Reason for Change | Date |
|---|---|---|
| | run for 12 months (TNI V1M4, section 1.6.2). Also removed language regarding 'work cells' (removed from TNI standard).<br>Section 4.0; new general paragraph added to explain specifics regarding QC samples (TNI V1M2, section 5.9 and DoD gray box 45).<br>Section 4.1, 4.2, 4.3, 4.4, 4.5, 4.6, 4.9, 4.10, 4.12 edited for clarity<br>Section 4.1: added DoD red letter paragraph regarding method blank contamination (DoD gray box D-1).<br>Section 4.1: added new 4th paragraph regarding method blanks (TNI V1M4, section 1.7.3.1.d).<br>Section 4.2: added wording to 5th paragraph regarding exceedance of LCS limits and data qualifiers (TNI V1M4, section 1.7.4.2.a.i and ii).<br>Section 4.3: added red-letter paragraph regarding MS/MSD requirements for DoD (DoD gray boxes D-7 and D-8).<br>Section 4.4: added wording to 2nd paragraph regarding client-specific surrogate criteria (DoD gray box D-12).<br>Section 4.10: removed sentence from 2nd paragraph ('sufficient buffer' was too vague).<br>Section 4.11: adjusted title of section.<br>Section 5.1: added reference to electronic signature policy in Document Mgmt SOP (TNI V1M2, section 4.2.8.4.r).<br>Section 5.1.2: added language to DoD red letter paragraph (DoD gray box 20).edited for clarity<br>Section 6.1: reworded 5th paragraph to compensate for change in TNI language regarding second source standards (TNI V1M4, section 1.7.1.1.d). Added small vial labeling requirement. Added paragraph about minimum requirements for labeling.<br>Section 6.2, 6.2.1, 6.2.2, 6.3, 6.3.5, 6.4, 7.3, 8.1.1, 8.4 edited for clarity<br>Section 6.3: reworded 2nd paragraph- that all measurements are performed on each day if use and documented (TNI V1M2, section 5.5.13.1.d).<br>Section 6.3.1 added "bracketing the range of use" also edited for clarity<br>Section 7.2: added additional red-letter section for DoD data review steps to be added (DoD gray box 44) and added reference to Data Review SOP.<br>Section 7.3: added DoD red letter paragraph regarding the recording of sample prep and analysis time on final reports (DoD gray box 14).<br>Section 7.3: Added extra requirements for final reports when needed for interpretation of results (TNI V1M2, section 5.10).<br>Section 8.4: edited for clarity<br>Section 9.1: added paragraph regarding non-conforming work (TNI V1M2, section 4.9).<br>Section 9.2.1 added login error<br>Section 9.3 edited for clarity<br>Section 11: added DoD QSM version 4.2 as a reference.<br>Glossary: **added definitions** for NIST, reference material, standard (document), selectivity, acceptance criteria, accreditation, accrediting authority, accrediting body, analyst, assessment, atomization, calibration method, calibration range, calibration standard, certified reference material, chain of custody (as opposed to COC form), client (customer), congener, conformance, consensus standard, continuing calibration verification (as opposed to CCV standard), data audit, definitive data, detection limit, digestion, eluent, elute, elution, environmental data, environmental monitoring, homologue, inspection, interference (spectral and chemical), SI, instrument blank, isomer, laboratory duplicate, LOQ (added DoD version), manager, management, management system, matrix, method of standard additions, negative control, nonconformance, performance audit, positive control, quality manual, quantitation range, reagent blank, reference standard (DoD version), reporting limit (DoD version), requirement, retention time, sample, shall, should, signal-to-noise ratio, spike, standard method, standard reference material, supervisor, target analytes, technical | |

| Document Number | Reason for Change | Date |
|---|---|---|
| | director, test, test method, traceability (DoD version), tuning, validation.<br>Glossary: **revised definitions** for standard (chemical), accuracy, aliquot, analyte, batch, calibration, calibration curve, confirmation, corrective action, document control, duplicate, finding, holding time (added DoD version too), LCS, LOD (added DoD version too), MDL (adopted DoD clarification since TNI dropped MDL), precision, PT sample, quality assurance (added DoD version), QAPP, raw data, ICV, verification (added DoD note).<br>Glossary: **removed definition** for calibration verification. | |
| Quality Manual Revision 14.1 | Corrected Table of Content Errors and added QAA job description | 25May2011 |
| Quality Manual Revision 14.2 | Added DoD Gray Box 37 criteria to the organic CCV in Section 6.2.1<br>Added DoD Gray Box 18 Data Integrity Officer duties to Quality Manager responsibilities | 14Oct2011 |
| Quality Manual Revision 14.3 | 1.8.4 – added "operate as the designated…"<br>4.1 – added "method" in front of the word "blank" where appropriate, added "acceptable method blanks…"<br>6.3.1 – added "prior to use" before "with weights"<br>7.5 – added "for Ohio VAP labs…"<br>7.6 – added "for Ohio VAP labs…"<br>Attachment V - updated<br>Added The scope and application certificates are maintained in the filing cabinets in the QA Department.<br>To Attachment VI | 26Jan2012 |

## ATTACHMENT I- QUALITY CONTROL CALCULATIONS

**PERCENT RECOVERY (%REC)**

$$\%REC = \frac{(MSConc - SampleConc)}{TrueValue} * 100$$

NOTE: The SampleConc is zero (0) for theLCS and Surrogate Calculations

**PERCENT DIFFERENCE (%D)**

$$\%D = \frac{MeasuredValue - TrueValue}{TrueValue} * 100$$

where:
TrueValue = Amount spiked (can also be the $\overline{CF}$ or $\overline{RF}$ of the ICAL Standards)
Measured Value = Amount measured (can also be the CF or RF of the CCV)

**PERCENT DRIFT**

$$\%Drift = \frac{CalculatedConcentration - TheoreticalConcentration}{TheoreticalConcentrtion} * 100$$

**RELATIVE PERCENT DIFFERENCE (RPD)**

$$RPD = \frac{|(R1 - R2)|}{(R1 + R2)/2} * 100$$

where:
R1 = Result Sample 1
R2 = Result Sample 2

**CORRELATION COEFFICIENT (R)**

$$\frac{\sum_{i=1}^{N} W_i * (X_i - \overline{X}) * (Y_i - \overline{Y})}{\sqrt{\left(\sum_{i=1}^{N} W_i * (X_i - \overline{X})^2\right) * \left(\sum_{i=1}^{N} W_i * (Y_i - \overline{Y})^2\right)}}$$

*CorrCoeff =*

| | | |
|---|---|---|
| With: | N | Number of standard samples involved in the calibration |
| | i | Index for standard samples |
| | Wi | Weight factor of the standard sample no. i |
| | Xi | X-value of the standard sample no. i |
| | X(bar) | Average value of all x-values |
| | Yi | Y-value of the standard sample no. i |
| | Y(bar) | Average value of all y-values |

## ATTACHMENT I- QUALITY CONTROL CALCULATIONS (CONTINUED)

**STANDARD DEVIATION (S)**

$$S = \sqrt{\sum_{i=1}^{n} \frac{(X_i - \overline{X})^2}{(n-1)}}$$

where:
n = number of data points
$X_i$ = individual data point
$\overline{X}$ = average of all data points

**AVERAGE ($\overline{X}$)**

$$\overline{X} = \frac{\sum_{n=1}^{i} X_i}{n}$$

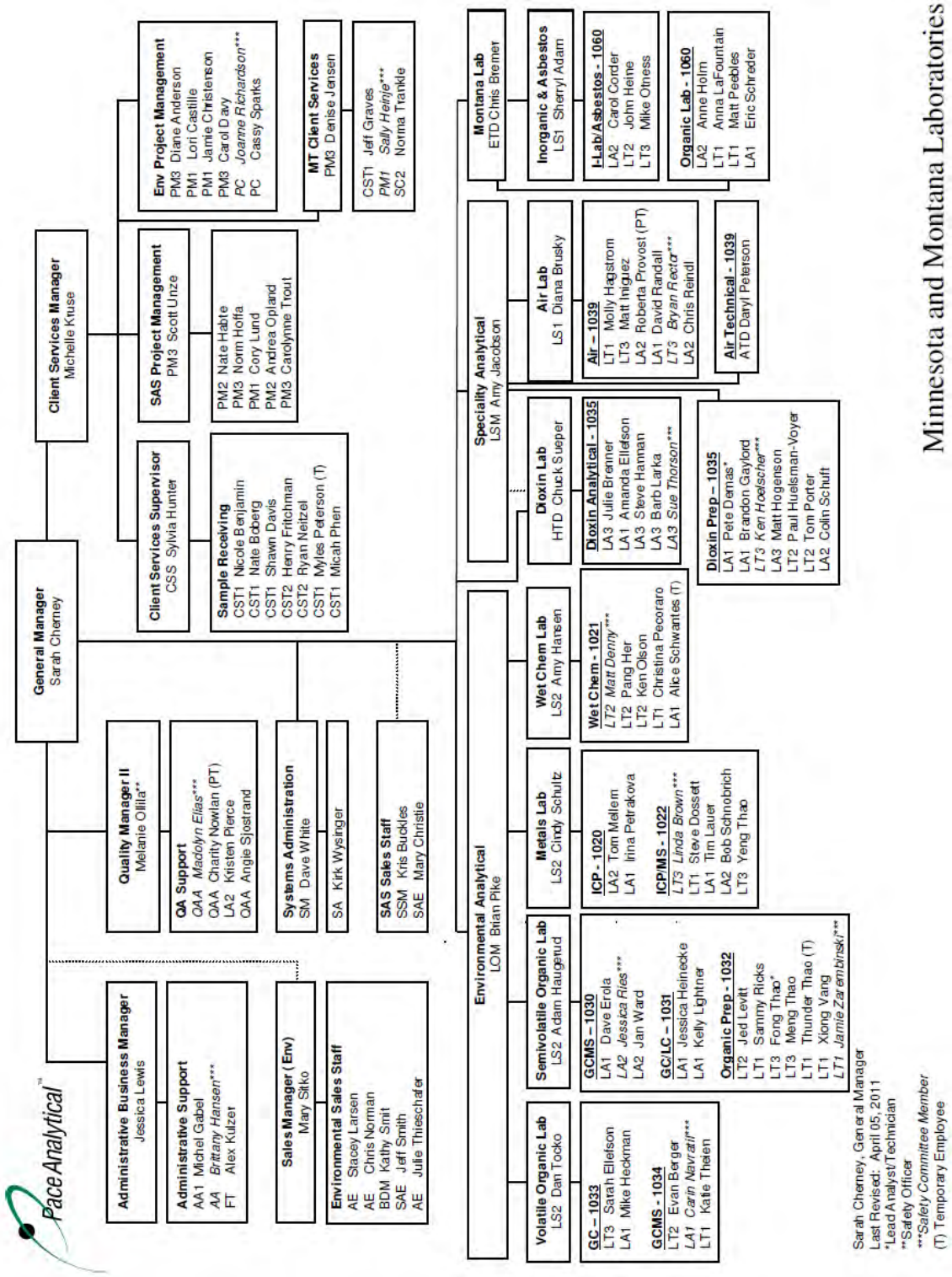
where:
n = number of data points
$X_i$ = individual data point

**RELATIVE STANDARD DEVIATION (RSD)**

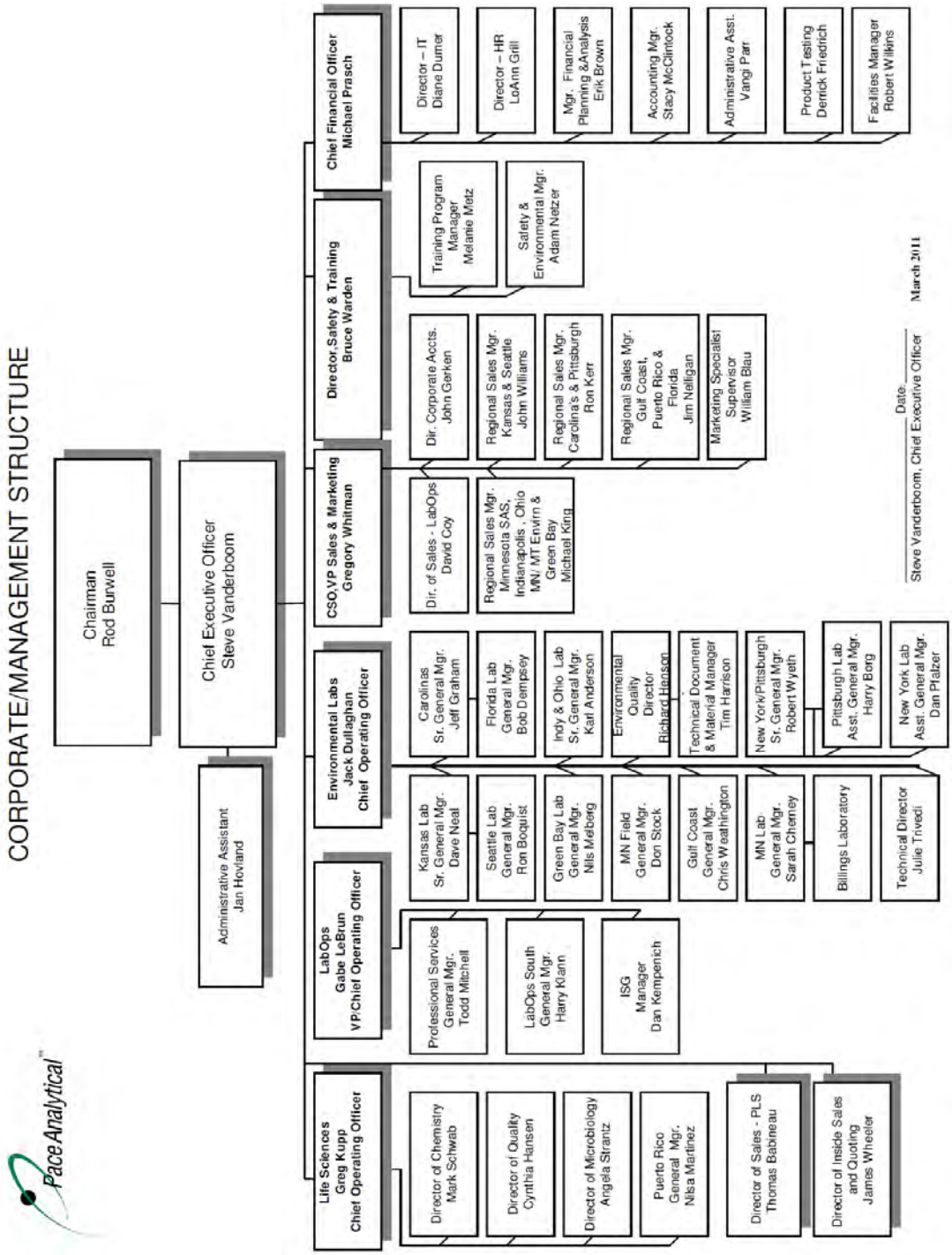
$$RSD = \frac{S}{\overline{X}} * 100$$

where:
S = Standard Deviation of the data points
$\overline{X}$ = average of all data points

# ATTACHMENT IIA- LABORATORY ORGANIZATIONAL CHART (CURRENT AS OF ISSUE DATE)



## ATTACHMENT IIB- CORPORATE ORGANIZATIONAL CHART (CURRENT AS OF ISSUE DATE)



# ATTACHMENT III- EQUIPMENT LIST (CURRENT AS OF ISSUE DATE)

| DEPT | INSTRUMENT | ID | MANUFACTURER | MODEL NUMBER | DETECTOR(S) | ANALYSIS |
|---|---|---|---|---|---|---|
| Air | GC | 10AIR0 | Agilent Technologies | 6890N | GC/MS | TO-15 |
| Air | MS | 10AIR0 | Agilent Technologies | 5973 Network | GC/MS | TO-15 |
| Air | Concentrator | 10AIR0 | Entech Instruments, Inc. | 7100A | GC/MS | TO-15 |
| Air | GC | 10AIR5 | HP | 5890 | TCD | 3C |
| Air | GC | 10AIR7 | Agilent Technologies | | GC/MS | TO-15 |
| Air | MS | 10AIR7 | Agilent Technologies | | GC/MS | TO-15 |
| Air | Concentrator | 10AIR7 | Entech Instruments, Inc. | 7100A | GC/MS | TO-15 |
| Air | GC | 10AIR9 | Agilent Technologies | G1530A | GC/FID/TCD | RSK 175 |
| Air | Headspace Sampler | 10AIR9 | Agilent Technologies | G1888 | GC/FID/TCD | RSK 175 |
| Air | GCMS | 10AIRA | ALS Ready | 6890A | GC | TO3 BTEX |
| Air | Concentrator | 10AIRA | Entech Instruments, Inc. | 7100A | GC | TO3 BTEX |
| Air | MS | 10AIRB | Agilent Technologies | 5973 inert | GC/MS | TO-15 |
| Air | GC | 10AIRB | Agilent Technologies | 6890 | GC/MS | TO-15 |
| Air | Concentrator | 10AIRB | Entech Concentrator | 7100A | GC/MS | TO-15 |
| Air | GC | 10AIRD | Agilent Technologies | 7890A | GC/MS | TO14/15 |
| Air | MS | 10AIRD | Agilent Technologies | 5975C | GC/MS | TO14/15 |
| Air | Concentrator | 10AIRD | Agilent Technologies | | GC/MS | TO14/15 |
| Air | Autosampler | 10AIRE | Agilent Technologies | 7693 | GC/MS | TO17 |
| Air | MS | 10AIRE | Agilent Technologies | 5975C | GC/MS | TO17 |
| Air | GC | 10AIRE | Agilent Technologies | 7890A | GC/MS | TO17 |
| Air | Thermal Desorber | 10AIRE | Perkin Elmer | Turbomatrix 650 | GC/MS | TO17 |
| Air | Canister Autosampler | AIR7T1 | Entech Instruments, Inc. | 7016 CA | NA | TO-15 |
| Air | Canister Autosampler | AIR7T2 | Entech Instruments, Inc. | 7017 CA | NA | TO-15 |
| Air | Canister Autosampler | AIRBT1 | Entech Instruments, Inc. | 7018 CA | NA | TO-15 |
| Air | Canister Autosampler | AIRBT2 | Entech Instruments, Inc. | 7019 CA | NA | TO-15 |
| Air | Canister Autosampler | AIR0T1 | Entech Instruments, Inc. | 7020 CA | NA | TO-15 |
| Air | Canister Autosampler | AIR0T3 | Entech Instruments, Inc. | 7021 CA | NA | TO-15 |
| Air | Oven | 10AIR10 | Despatch | LDB Series | NA | General - AIR |
| HRMS PREP | Balance | P1885308 | A&D | EK4100i | NA | General - DRMS Prep |
| HRMS PREP | Micro 100 Turbidimeter | 10HR10 | Scientific Inc. | Micro 100 Turbidimeter | NA | Turbidity |
| HRMS PREP | Microwave | NA | CEM | MarsXpress | NA | 8290/1613 Solid & Wipe, 1668A short list & 209 solid |
| HRMS PREP | Oven | 10HRMS11 | Scientific Prod. | DK63 | NA | General - HRMS Prep |
| HRMS PREP | N-EVAP | N-EVAP 1 | Organomation | 112 | NA | General - HRMS Prep |
| HRMS PREP | N-EVAP | N-EVAP 2 | Organomation | 112 | NA | General - HRMS Prep |
| HRMS PREP | N-EVAP | N-EVAP 3 | Organomation | 112 | NA | General - HRMS Prep |
| HRMS | GC/MS | 10MSHR09 | CTC Analytics | 6890N | GC/MS | 1613/8290/Mthd 23,29/TO9/DW |
| HRMS | GC/MS | 10MSHR09 | Micromass | Autospec Premier | GC/MS | 1613/8290/Mthd 23,29/PCB |
| HRMS | GC/MS | 10MSHR06 | HP | 6890A | GC/MS | 1613/8290/Mthd 23,29/1614 |
| HRMS | GC/MS | 10MSHR06 | Micromass | Autospec Ultima | GC/MS | 1613/8290/Mthd 23,29 |
| HRMS | GC/MS | 10MSHR10 | Thermo Scientific | Trace GC Ultra | GC/MS | 1613/8290/Mthd 23,29/DW |
| HRMS | GC/MS | 10MSHR10 | Thermo Scientific | Trace GC Ultra | GC/MS | 1613/8290/Mthd 23,29/DW |
| HRMS | GC/MS | 10MSHR10 | DFS | High Res Magnetic Sector MS | GC/MS | 1613/8290/Mthd 23,29/DW |
| HRMS | GC/MS | 10MSHR11 | Thermo Scientific | Trace GC Ultra | GC/MS | 1613/8290/Mthd 23,29/DW |
| HRMS | GC/MS | 10MSHR11 | Thermo Scientific | Trace GC Ultra | GC/MS | 1613/8290/Mthd 23,29/DW |
| HRMS | GC/MS | 10MSHR11 | DFS | High Res Magnetic Sector MS | GC/MS | 1613/8290/Mthd 23,29/DW |
| HRMS | GC/MS | 10MSHR05 | Agilent | 6890 | GC/MS | 1613/8290/Mthd 23,29/DW/PCB |
| HRMS | GC/MS | 10MSHR05 | Micromass | Autospec Ultima | GC/MS | 1613/8290/Mthd 23,29 |
| Metals | Balance | 50206779 | Sartorius | BP 110 S | NA | General - Metals |
| Metals | Balance | 5306049 | AND | FX 3200 | NA | General - Metals |
| Metals | Balance | 467 | Ohaus | 1500 D | NA | General - Metals |
| Metals | Ion Analyzer | 10WET15 | Orion | EA 940 | NA | pH |
| Metals | Turbidimeter | 10WET10 | Scienific Inc | Micro 100 Turbidimeter | NA | Turbidity |
| Metals | ICPMS | 10ICM03 | Thermo Scientific | Xseries 2 | MS | Metals |
| Metals | ICPMS | 10ICM02 | Perkin Elmer Sciex | Elan 9000 | MS | Metals |
| Metals | ICPMS | 10ICM4 | Thermo Scientific | XII | MS | Metals |
| Metals | ICP | 10ICP03 | Perkin Elmer Instruments | Optima 4300 DV | SCCD | Metals |
| Metals | ICP | 10ICP02 | Perkin Elmer Instruments | Optima 4300 DV | SCCD | Metals |
| Metals | Tumbler | 10MET06 | Associated Design & Mfg. Co. | 3740-24BRE | NA | TCLP Prep |
| Metals | Hot Block | 10MET01 | Environmental Express | NA | NA | 6010/Mercury/6020/200.8/Mthd 29 |
| Metals | Hot Block | 10MET02 | Environmental Express | NA | NA | 6010/Mercury/6020/200.8/Mthd 29 |
| Metals | Hot Block | 10MET03 | Environmental Express | NA | NA | 6010/Mercury/6020/200.8/Mthd 29 |
| Metals | Hot Block | 10MET04 | Environmental Express | NA | NA | 6010/Mercury/6020/200.8/Mthd 29 |
| Metals | Hot Block | 10MET05 | Thomas Cain Inc. | Deena 60 | NA | Metals Prep |
| Metals | Sonicator | 10MET07 | Fisher Scientific | FS20D | NA | Cleaning glassware |
| Metals | Stir Plate | 10MET19 | Barnstead/Thermolyne | Super-Nuova | NA | General - Metals |
| Metals | Hot Plate | 10MET18 | Thermolyne | Cimarec 3 | NA | General - Metals |
| Metals | Mercury Analyzer | 10HG3 | Cetac Quick Trace | M-7500 | NA | Mercury |
| Metals | Mercury Autosampler | 10HG3 | ASX-520 | MAS Ver w/Diluter | NA | Mercury |
| O-Prep | Balance | 8200351 | AND | FX-2000 | NA | General - O-prep |
| O-Prep | Balance | 25455076 | Denver Inst | MXX-612 | NA | General - O-prep |
| O-Prep | Muffle Furnace | 10WET21 | Fischer Scientific | Isotemp Muffle Furnace | NA | General - O-prep |
| O-Prep | UltraSonicator | 10OP12 | Branson | 8510 | NA | General - O-prep |
| O-Prep | Sonicator | 10OP01 | Masonix | XL 2020 | NA | 3550 |
| O-Prep | Sonicator | 10OP02 | Masonix | XL 2015 | NA | 3550 |

# ATTACHMENT III- EQUIPMENT LIST (CONTINUED)

| DEPT | INSTRUMENT | ID | MANUFACTURER | MODEL NUMBER | DETECTOR(S) | ANALYSIS |
|---|---|---|---|---|---|---|
| O-Prep | Sonicator | 10OP03 | Masonix | Sonicator 3000 | NA | 3550 |
| O-Prep | Sonicator | 10OP04 | Masonix | Sonicator 3000 | NA | 3550 |
| O-Prep | Soxtherm | 10OP06 | Gerhardt | NA | NA | 8082 |
| O-Prep | Soxtherm | 10OP07 | Gerhardt | NA | NA | 8082 |
| O-Prep | Soxtherm | 10OP08 | Gerhardt | NA | NA | 8082 |
| O-Prep | Soxtherm | 10OP09 | Gerhardt | NA | NA | 8082 |
| O-Prep | N-EVAP | 10OP10 | Organomation | 112 | NA | General - O-prep |
| O-Prep | N-EVAP | 10OP11 | Organomation | 112 | NA | General - O-prep |
| O-Prep | Centrifuge | 10OP13 | IEC | Centra GP8 | NA | General - O-prep |
| O-Prep | Centrifuge | 10OP14 | Damon/IEC Division | NA | NA | General - O-prep |
| O-Prep | Centrifuge | 10OP15 | International Clinical Centrifuge | CL28899M | NA | General - O-prep |
| SVOA | Balance | H47315 | Mettler | AE 200 | NA | General - SVOA |
| SVOA | GCMS | 10MSSA | Agilent | 7890A | MS | TO13, CPAH |
| SVOA | GCMS | 10MSSA | High Volume Injector | | MS | TO13, CPAH |
| SVOA | Mass Spec | 10MSS03 | HP | 5973 | MS | CPAH, PCP |
| SVOA | GC | 10MSS03 | HP | 6890 | MS | CPAH, PCP |
| SVOA | Agilent Tray | 10MSS03 | Agilent | N 10149 | MS | CPAH, PCP |
| SVOA | Injector Tower | 10MSS03 | Agilent | 7683 | MS | CPAH, PCP |
| SVOA | MS Detector | 10MSS06 | Agilent | 6890N | MS | SIM, PCP |
| SVOA | MS Detector | 10MSS07 | Agilent | 6890 | MS | 8280 |
| SVOA | AutoSampler Tower | 10MSS08 | Agilent | 7683 | MS | Sulfolane, 8270, 625 |
| SVOA | GC/Oven | 10MSS08 | Agilent | 6890N | MS | Sulfolane, 8270, 625 |
| SVOA | MS Detector | 10MSS08 | Agilent | 5973N | MS | Sulfolane, 8270, 625 |
| SVOA | AutoSampler Tray | 10MSS08 | Agilent | 7683 | MS | Sulfolane, 8270, 625 |
| SVOA | GC/Oven | 10MSS09 | Agilent | 6890A | MS | 8270, 625 |
| SVOA | AutoSampler Tower | 10MSS09 | Agilent | 18593B | MS | 8270, 625 |
| SVOA | MS Detector | 10MSS09 | Agilent | 5973N | MS | 8270, 625 |
| SVOA | AutoSampler Tray | 10MSS09 | Agilent | 18596C | MS | 8270, 625 |
| SVOA | GC Oven | 10GCS04 | HP | 5890 | Dual FID | AK, NWTPH |
| SVOA | AutoSampler /Tower | 10GCS04 | HP | 7673A | Dual FID | AK, NWTPH |
| SVOA | GC Oven | 10GCS05 | HP | 5890 SII | Dual FID | CALDRO, WIDRO |
| SVOA | AutoSampler Tray | 10GCS05 | HP | 18596B | Dual FID | CALDRO, WIDRO |
| SVOA | AutoSampler Tower | 10GCS05 | HP | 7673 | Dual FID | CALDRO, WIDRO |
| SVOA | GC | 10GCS07 | Agilent | 6890N | Dual ECD | PCB, TO4 |
| SVOA | AutoSampler Tray | 10GCS07 | Agilent | G2614A | Dual ECD | PCB, TO4 |
| SVOA | Tower | 10GCS07 | HP | N279 | Dual ECD | PCB, TO4 |
| SVOA | GC Oven | 10GCS08 | Agilent | 6890N | Dual FID | CALDRO, WIDRO |
| SVOA | AutoSampler | 10GCS08 | Agilent | 7683 | Dual FID | CALDRO, WIDRO |
| SVOA | Tower | 10GCS08 | Agilent | 7683 | Dual FID | CALDRO, WIDRO |
| SVOA | GC | 10GCS09 | Agilent | | Dual FID | DRO |
| SVOA | GCMS | 10MSSB | Agilent | 7863B | MS | SIM, TO13, High Volume Injection |
| SVOA | GCMS | 10MSSB | Agilent | 7890 | MS | SIM, TO13, High Volume Injection |
| SVOA | GCMS | 10MSSB | Agilent | 5975C | MS | SIM, TO13, High Volume Injection |
| SVOA | GCMS | 10MSSB | Agilent | 7863 | MS | SIM, TO13, High Volume Injection |
| SVOA | Oven | 10WET49 | Fisher Scientific | NA | NA | % Moisture |
| SVOA | Oven | 10WET50 | Baxter DS-64 | DS-64 | NA | % Moisture |
| VOA | Balance | 21353507 | Denver Inst | MXX-212 | NA | General - VOA |
| VOA | Balance | 5304905 | AND | FX-3200 | NA | General - VOA |
| VOA | AutoSampler | 10MSV1 | Environmental Sample Tech, Inc. | NA | NA | UST, BTEX |
| VOA | Concentrator | 10MSV1 | Tekmar | 3000 | MS | UST, BTEX |
| VOA | GC System | 10MSV1 | HP | 6890 | GC | UST, BTEX |
| VOA | MS Detector | 10MSV1 | HP | 5973 | MS | UST, BTEX |
| VOA | AutoSampler | 10MSV3 | O-I-Analytical | 4552 | NA | 8260 Med. Lvl Soil |
| VOA | Concentrator | 10MSV3 | Tekmar | 3100 | MS | 8260 Med. Lvl Soil |
| VOA | GC System | 10MSV3 | Agilent | 6890 | GC | 8260 Med. Lvl Soil |
| VOA | MS Detector | 10MSV3 | Agilent | 5973 | MS | 8260 Med. Lvl Soil |
| VOA | AutoSampler | 10MSV5 | Varian Archon | NA | NA | 8260/624/TCLP/UST |
| VOA | Concentrator | 10MSV5 | Tekmar Dohrmann | 3100 | MS | 8260/624/TCLP/UST |
| VOA | GC System | 10MSV5 | HP | 6890 | GC | 8260/624/TCLP/UST |
| VOA | MS Detector | 10MSV5 | HP MS | 5973 | MS | 8260/624/TCLP/UST |
| VOA | AutoSampler | 10MSV6 | Varian Archon | NA | NA | 524/8260/624 |
| VOA | Concentrator | 10MSV6 | Tekmar | 3000 | MS | 524/8260/624 |
| VOA | GC System | 10MSV6 | Agilent | 6890A | GC | 524/8260/624 |
| VOA | MS Detector | 10MSV6 | Agilent | 5973 | MS | 524/8260/624 |
| VOA | AutoSampler | 10MSV7 | Environmental Sample Tech, Inc. | NA | NA | SIM/8260/624/Low & Med Lvl Soil/TCLP/UST |
| VOA | GC System | 10MSV7 | Agilent Technologies | 6850 | MS | SIM/8260/624/Low & Med Lvl Soil/TCLP/UST |
| VOA | Concentrator | 10MSV7 | Tekmar | 3000 | GC | SIM/8260/624/Low & Med Lvl Soil/TCLP/UST |
| VOA | MS Detector | 10MSV7 | Agilent Technologies | 5975C | MS | SIM/8260/624/Low & Med Lvl Soil/TCLP/UST |
| VOA | GC/MS | 10MSV8 | Agilent Technologies | 5975C | GC/MS | 8260/624/TCLP/UST |
| VOA | AutoSampler | 10MSV8 | Environmental Sample Tech, Inc. | Centurion | NA | 8260/624/TCLP/UST |
| VOA | Concentrator | 10MSV8 | Encon Ev | NA | NA | 8260/624/TCLP/UST |
| VOA | AutoSampler | 10GCV1 | Varian Archon | NA | NA | 8021/8015/GRO |
| VOA | Concentrator | 10GCV1 | Tekmar Dohrmann | 3100 | NA | 8021/8015/GRO |
| VOA | GC System | 10GCV1 | HP | 5890 | PID/FID | 8021/8015/GRO |

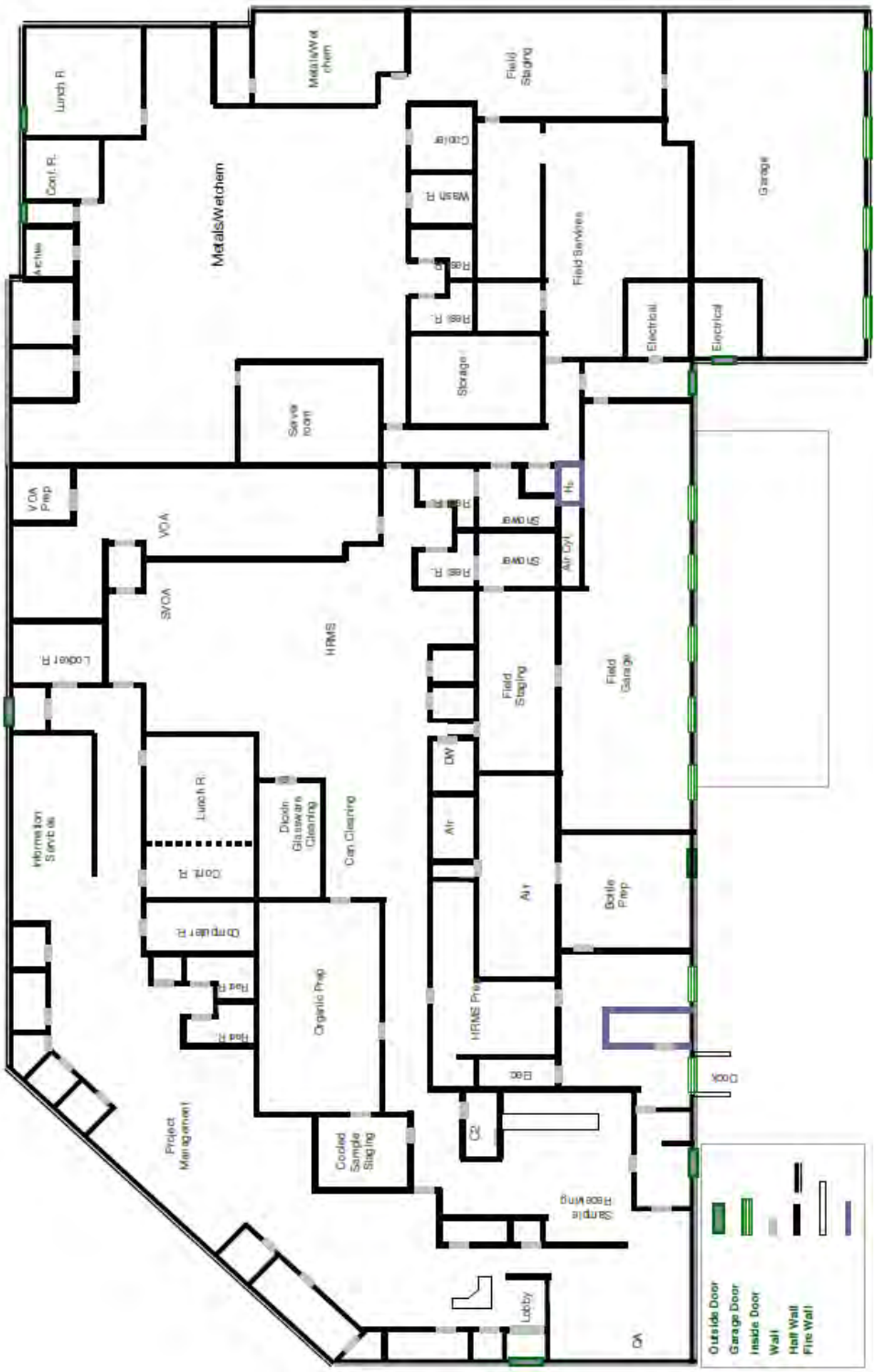
# ATTACHMENT III- EQUIPMENT LIST (CONTINUED)

| DEPT | INSTRUMENT | ID | MANUFACTURER | MODEL NUMBER | DETECTOR(S) | ANALYSIS |
|---|---|---|---|---|---|---|
| VOA | AutoSampler | 10GCV3 | Environmental Sample Tech, Inc. | NA | NA | 8021/8015/GRO |
| VOA | Concentrator | 10GCV3 | Tekmar Dohrmann | 3100 | NA | 8021/8015/GRO |
| VOA | GC system | 10GCV3 | HP | 5890 Series II | PID/FID | 8021/8015/GRO |
| VOA | AutoSampler | 10GCV5 | Varian Archon | | NA | 8021/8015/GRO |
| VOA | Concentrator | 10GCV5 | Tekmar | 3000 | NA | 8021/8015/GRO |
| VOA | GC system | 10GCV5 | HP | G1530A | PID/FID | 8021/8015/GRO |
| VOA | Oven | 10VOA03 | Thermo Scientific | NA | NA | General - VOA |
| VOA | Sonicator | 10VOA04 | Fisher Scientific | FS220 | NA | 8260/8021/8015/GRO |
| Wet Chem | Balance | 10406293 | Sartorius | AC 210 S | NA | General - Wet Chem |
| Wet Chem | Balance | 7123180939 | Ohaus | Scout Pro | NA | General - Wet Chem |
| Wet Chem | Balance | 30208225 | Sartorius | AC 210 S | NA | General - Wet Chem |
| Wet Chem | Balance | 1125521193 | Mettler-Toledo | AB135-S | NA | General - Wet Chem |
| Wet Chem | Incubator | 10WET16 | Fisher Scientific | Isotemp Incubator | NA | BOD |
| Wet Chem | Incubator | 10WET22 | Fisher Scientific | 307 | NA | BOD |
| Wet Chem | Incubator | 10WET35 | Fisher Scientific | 307C | NA | BOD |
| Wet Chem | Autotitrator | 10WET6 | Metrohm | 888 Titrando Titrator | | Alkalinity |
| Wet Chem | Autosampler | 10WET6 | Metrohm | 778 Sample Processor | NA | Alkalinity |
| Wet Chem | Diss. Oxy Meter | 10WET51 | YSI | 5000 | NA | BOD |
| Wet Chem | Oven | 10WET17 | Precision Scientific | 130 DM | NA | General - Wet Chem |
| Wet Chem | Oven | 10WET20 | Fisher Scientific | Isotemp Oven | NA | General - Wet Chem |
| Wet Chem | Oven | 10WET19 | VWR Scientific | 1370F | NA | General - Wet Chem |
| Wet Chem | AutoClave | 10WET29 | Harvey | NA | NA | General - Wet Chem |
| Wet Chem | pH Meter | 10WET7 | Orion | NA | NA | pH |
| Wet Chem | pH Meter | 10WET31 | IQ Scientific Instruments | NA | NA | pH |
| Wet Chem | Explandable Ion Analyzer | 10WET8 | Orion | EA 940 | Ions | Chlorides |
| Wet Chem | Thermoreactor | 10WET26 | Neutec Group Inc. | ECO 25 | NA | COD |
| Wet Chem | COD Reactor | 10WET11 | Bioscience, Inc. | NA | NA | COD |
| Wet Chem | Microwave | 10WET28 | GE | JES1142WD04 | NA | HPC Auger |
| Wet Chem | KoneLab | 10WET3 | Thermo Fisher Scientific | Konelab 20 | NA | Colormetric |
| Wet Chem | Conductivity meter | 10WET9 | Oaktom | Con 110 Series | NA | Specific Conductivity |
| Wet Chem | Colony Counter | 10WET30 | Gallenkamp | Colony Counter | NA | HPC |
| Wet Chem | Colony Counter | 10WET38 | Darkfield Quebec | Colony Counter | NA | HPC |
| Wet Chem | Water Bath | 10WET27 | Fisher Scientific | Isotemp 210 | NA | General - Wet Chem |
| Wet Chem | Digestion Block | 10WET12 | Environmental Express | NA | NA | |
| Wet Chem | Digestion Block | 10WET13 | MIDI-STIL | NA | NA | |
| Wet Chem | Spectrometer | 10WET32 | Hach | DR 2700 | NA | COD |
| Wet Chem | Hot Plate | 10WET33 | Presto | | NA | General - Wet Chem |
| Wet Chem | Hot Plate | 10WET34 | Presto | Tilt'n Drain Big Griddle | NA | General - Wet Chem |
| Wet Chem | Smart Chem | 10WT36 | West Co Scientific Instruments | Smart Chem 200 | NA | Colormetric |
| Wet Chem | Stir Plate | 10WET39 | Corning Stirrer | NA | NA | General - Wet Chem |
| Wet Chem | Hot Plate | 10WET40 | Corning | NA | NA | General - Wet Chem |
| Wet Chem | Stir Plate | 10WET41 | Fisher Scientific | NA | NA | General - Wet Chem |
| Wet Chem | Stir Plate | 10WET42 | Thermolyne | Cimarec 2 | NA | General - Wet Chem |
| Wet Chem | Stir Plate | 10WET43 | Fisher Scientific | NA | NA | General - Wet Chem |
| Wet Chem | Vortex Mixer | 10WET44 | American Scientific Prod. | S8223-1 | NA | General - Wet Chem |
| Wet Chem | Extractor | 10WET45 | Horizon Technology | Spe-dex 4790 | NA | Oil & Grease |
| Wet Chem | Extractor | 10WET46 | Horizon Technology | Spe-dex 4791 | NA | Oil & Grease |
| Wet Chem | Extractor | 10WET47 | Horizon Technology | Spe-dex 4792 | NA | Oil & Grease |
| Wet Chem | Extractor | 10WET48 | Horizon Technology | Spe-dex 4793 | NA | Oil & Grease |
| Wet Chem | Closed Cup - Penske | 10WT49 | Precision Scientific | NA | NA | Flashpoint |
| Wet Chem | Hot Plate | 10MET18 | Thermolyne | Cimarec 3 | NA | General - Wet Chem |
| Wet Chem | IC - autosampler | 10WT52 | Dionex | AS50 | Conductivity | Fl, Cl, Nitrite, Nitrate, Sulfate EPA Method 300.0 |
| Wet Chem | IC - oven | 10WT52 | Dionex | LC25 | Conductivity | Fl, Cl, Nitrite, Nitrate, Sulfate EPA Method 300.0 |
| Wet Chem | IC - conductivity detector | 10WT52 | Dionex | CD20 | Conductivity | Fl, Cl, Nitrite, Nitrate, Sulfate EPA Method 300.0 |
| Wet Chem | IC - gradient pump | 10WT52 | Dionex | GP50 | Conductivity | Fl, Cl, Nitrite, Nitrate, Sulfate EPA Method 300.0 |
| | | | | | | |
| Montana | Balance | 14138 | Fischer | 7227DA | NA | General - Montana |
| Montana | Balance | E86392 | Mettler | AE100 | NA | General - Montana |
| Montana | Balance | 24353410 | Denver | MXX-212 | NA | General - Montana |
| Montana | Balance | B027060 | Fischer | A200DS | NA | General - Montana |
| Montana | Balance | G325/202300491 | Ohaus | Adventuer | NA | General - Montana |
| Montana | SVOA GC | 11MT03 | Hewlett-Packard | 5890A | FID/PID | EPH |
| Montana | Autosampler | 11MT03 | Hewlett-Packard | 7673 | NA | EPH |
| Montana | Autosampler | 11MT03 | Hewlett-Packard | 7673 | NA | EPH |
| Montana | SVOA GC | 11MT04 | Hewlett-Packard | 5890 | FID/PID | EPH |
| Montana | Autosampler | 11MT04 | Hewlett-Packard | 7673 | NA | EPH |
| Montana | Autosampler | 11MT04 | Hewlett-Packard | 7673 | NA | EPH |
| Montana | Ion Chromatograph | 11MT05 | Dionex | ICS1000 | NA | EPA Method 300.0 |
| Montana | IC Autosampler | 11MT05 | Dionex | AS40-1 | NA | EPA Method 300.0 |
| Montana | Autoanalyzer Detector | 11MT06 | Astoria Pacific | 305A | Wavelength | N+N, NH3, TKN |
| Montana | Autoanalyzer Photometer | 11MT06 | Astoria Pacific | 350 | NA | N+N, NH3, TKN |
| Montana | Autoanalyzer Power Supply | 11MT06 | Astoria Pacific | 304A | NA | N+N, NH3, TKN |
| Montana | Autoanalyzer Heater Unit | 11MT06 | Astoria Pacific | 303A | NA | N+N, NH3, TKN |
| Montana | Autoanalyzer Autosampler | 11MT06 | Astoria Pacific | 311 | NA | N+N, NH3, TKN |

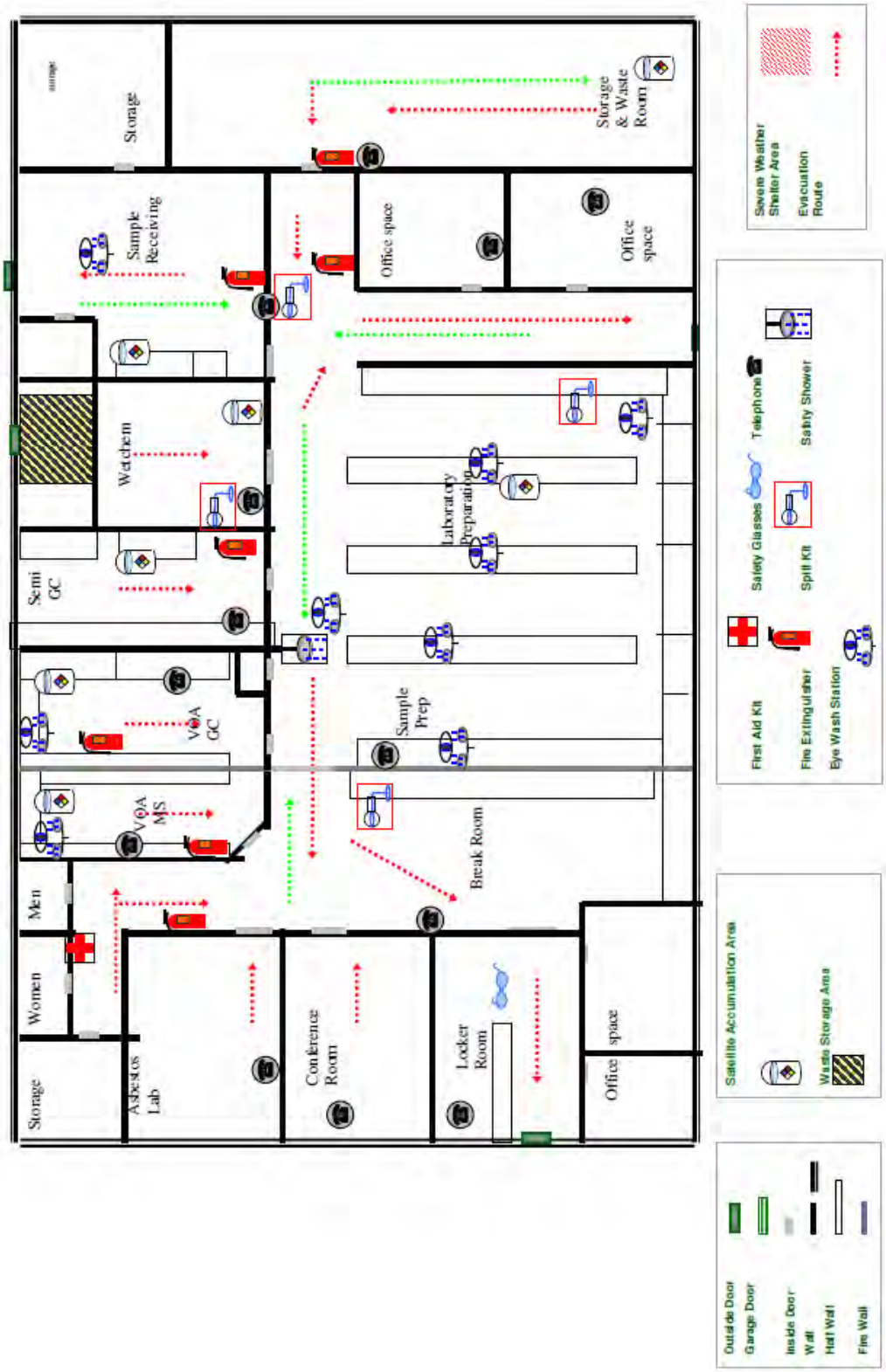
# ATTACHMENT III- EQUIPMENT LIST (CONTINUED)

| DEPT | INSTRUMENT | ID | MANUFACTURER | MODEL NUMBER | DETECTOR(S) | ANALYSIS |
|---|---|---|---|---|---|---|
| Montana | Autosampler pump | 11MT06 | Perstorp | 502 | NA | N+N, NH3, TKN |
| Montana | Autosampler power supply | 11MT06 | Perstorp | 509 | NA | N+N, NH3, TKN |
| Montana | VOA glassware oven | 11MT07 | Sargent Welch | | NA | General - Montana |
| Montana | Spectrophotometer | 11MT08 | Thermo | Aquamate | NA | Cr VI, N02, Tphos, Ophos |
| Montana | Oven | 11MT10 | Fischer | Isotemp 255D | NA | General - Montana |
| Montana | Oven | 11MT11 | Fischer | Isotemp 630F | NA | General - Montana |
| Montana | Muffle Furnace | 11MT12 | Sybron | Thermolyne | NA | General - Montana |
| Montana | Concentrator | 11MT13 | Zymark | TurboVap II | NA | Oprep |
| Montana | Concentrator | 11MT14 | Zymark | TurboVap II | NA | Oprep |
| Montana | Concentrator | 11MT28 | Zymark | Turbo Vap II | NA | Oprep |
| Montana | Furnace | 11MT15 | Sybron Thermolyne | 1300 | NA | General - Montana |
| Montana | Evaporator | 11MT16 | Organomation | N-Evap 112 | NA | Fractions |
| Montana | Waterbath | 11MT17 | Northwest Fixtures | | NA | General - Montana |
| Montana | pH meter | 11MT18 | Fischer | AR50 | NA | pH |
| Montana | Sonicator | 11MT19 | Fischer | FS60 | NA | General - Montana |
| Montana | Centrifuge | 11MT20 | Fischer | Centific | NA | General - Montana |
| Montana | Oven | 11MT21 | Despatch | 288A | NA | General - Montana |
| Montana | Furnace | 11MT22 | Leco | S-144DR | NA | General - Montana |
| Montana | Turbidimeter | 11MT23 | HF Scientific | Micro 1000 | NA | Turbidity |
| Montana | Sonicator | 11MT24 | Heat Systems | Sonicator XL | NA | General - Montana |
| Montana | Sonicator | 11MT25 | Branson | Sonfier 450 | NA | General - Montana |
| Montana | Acetone Vaporizer | 11MT26 | Energy Technology | NA | NA | |
| Montana | VPH GC | 11MT27 | Hewlett-Packard | 5890 | PID/FID | VPH |
| Montana | Sample Concentrator | 11MT27 | Tekmar | 3100 | NA | VPH |
| Montana | Autosampler | 11MT27 | Varion | Archon | NA | VPH |
| Montana | VOA GC | 11MT33 | Aglient | 6890 | FID/PID | VPH |
| Montana | Sample Concentrator | 11MT33 | Tekmar/Dohrmann | Tekmar 3000 | FID/PID | VPH |
| Montana | Autosampler | 11MT33 | OI analytical | Archon | NA | VPH |
| Montana | Microscope | 11MT28 | Olympus | BH-2 | NA | Asbestos |
| Montana | Vacuum Pump | | Edwards | E2M2 | NA | |
| Montana | Microscope | 11MT32 | Olympus | BH-2 | NA | Asbestos |
| Montana | Microscope | 11MT29 | Olympus | BH-2 | NA | Asbestos |
| Montana | Stereoscope | 11MT30 | Fischer | NA | NA | Asbestos |
| Montana | Microscope | 11MT31 | Olympus | G10X | NA | Asbestos |
| Montana | Block Digestor | 11MT34 | Lachat | BD-46 | NA | TKN |
| Montana | Oven | 11MT35 | Precision | NA | NA | General - Drying oven |
| Montana | AutoSampler | 11MT38 | O-I-Analytical | 4552 | NA | 8260 |
| Montana | Concentrator | 11MT38 | Tekmar Dohrmann | 3100 | NA | 8260 |
| Montana | GC System | 11MT38 | Agilent | 6890 | GC | 8260 |
| Montana | MS Detector | 11MT38 | Agilent | 5973 | MS | 8260 |

## ATTACHMENT IV- LABORATORY FLOOR PLAN (CURRENT AS OF ISSUE DATE)



## ATTACHMENT IV – CONT. MONTANA FACILITY



# ATTACHMENT V- LABORATORY SOP LIST (CURRENT AS OF ISSUE DATE)

| | |
|---|---|
| Determination of Methane, Ethane, and Ethene in Air Modified TO-3 | S-MN-A-002 |
| Analysis of Air Samples for Volatile Organic Compounds by Gas Chromatography/PID-FID method TO-3 | S-MN-A-003 |
| Cleaning, Certification, Leak Checking and Preparation for Shipment of SUMMA Passivated Canisters | S-MN-A-004 |
| Determination of Fixed Gases in Air by Modified 3C | S-MN-A-005 |
| Methane, Ethane, Ethene, and Propane in Water by GCFID mod. 3810 and RSK 175 | S-MN-A-007 |
| Analysis of Whole Air Sample for Volatile Organic Compound by GC/MS EPA TO15/TO14 | S-MN-A-013 |
| Determination of Hydrocarbons in Air using Radiello Passive Sample Tubes | S-MN-A-017 |
| Analysis of TO17 Active Air Samples | S-MN-A-018 |
| Sample Management | S-MN-C-001 |
| Bottle Preparatation | S-MN-C-003 |
| Subcontracting Samples | S-MN-C-004 |
| Internal Chain of Custody | S-MN-C-005 |
| The Determination of Specific Aromatic Compounds and Gasoline Range Organic in Water and Soils | S-MN-O-427 |
| Purgeable Total Petroleum Hydrocarbons in Water (8015 Mod / CA LUFT) | S-MN-O-525 |
| Purgeable Total Petroleum Hydrocarbons in Water (NWTPH) | S-MN-O-555 |
| Determination of Gasoline Range Organices by Method AK101 | S-MN-O-556 |
| Volatiles Sample Compositing Procedure | S-MN-O-541 |
| Analysis of Volatile Petroleum Hydrocarbons (VPH) | S-MN-O-575 |
| Analysis of Polychlorinated Biphenyls in Oil, Soil, Water, Wipe and Air Matrixes | S-MN-O-432 |
| Determination of Diesel Range Organics in Water and Soil (Wisconsin modified DRO) | S-MN-O-466 |
| Determination of Diesel Range Organics In Water & Soil SW8015 (Modified) | S-MN-O-489 |
| Ethylene glycol, Propylene Glycol, Triethylene Glycol by Modified 8015 | S-MN-O-533 |
| The Determination of Extractable Petroleum Hydrocarbons by Method NwTPH-Dx | S-MN-O-553 |
| The Determination of Diesel Range Organics and Residual Range Organics by AK102-AK103 | S-MN-O-554 |
| Saturated Hydrocarbons (Alkanes/Isoprenoids Compounds) and Total Extractable Hydrocarbons | S-MN-O-567 |
| Preparation and Analysis of Samples for the Determination of Dioxins and Furans by USEPA Method 8290 | S-MN-H-001 |
| Preparation and Analysis of Samples for the Determination of Dioxins and Furans using USEPA Method 1613B | S-MN-H-002 |
| Preparation and Analysis of Samples for the Determination of 2,3,7,8-TCDD using USEPA Method 1613B, Drinking Water | S-MN-H-003 |
| Percent Lipids Determination | S-MN-H-004 |
| Preparation and Analysis of Samples for the Determination of PCDDs, PCDFs, and PCBs by modified USEPA Method 23, TO9, or NY State Guidelines | S-MN-H-005 |
| Preparation and Analysis of Samples for the Determination of Dioxins and Furans by USEPA Method 8280A | S-MN-H-007 |
| Method 1668, PCB Congenger (WHO List) | S-MN-H-009 |
| Preparation and Analysis of Samples for the Determination of Chlorinated Biphenyl Congeners by USEPA Method 1668A | S-MN-H-014 |
| Preparation and Analysis of Samples for the Determination of Polybrominated Diphenyl Ether Congeners | S-MN-H-016 |
| Preparation and Analysis of Samples for the Determination of Dioxins and Furans by USEPA Method 8290A | S-MN-H-019 |
| Preparation and Analysis of Samples for the Determination of Dioxin and Furans by USEPA Method DLM2.0 | S-MN-H-021 |
| Preparation and Analysis of Samples for the Determination of Chlorinated Biphenyl Congeners | S-MN-H-022 |
| Operation and Maintenance of the Perkin Elmer ELAN 9000 ICP-MS | S-MN-I-525 |
| TCLP/SPLP | S-MN-I-312 |
| Inductively Coupled Plasma Atomic Emission Spectroscopy (RCRA) | S-MN-I-313 |
| Hardness by Calculation | S-MN-I-338 |
| Mercury im Liquid and Solid/Semis-Solid Waste | S-MN-I-359 |
| Digest Procedure for Aqueous Samples to be Analyzed by Induct Coupled Plasma (SW-846) | S-MN-I-458 |
| Metals Preparation for Solid samples, Wipes and Filters | S-MN-I-460 |
| Metals Analysis by ICP/MS - Method 6020 and 200.8 | S-MN-I-492 |
| Mercury in End Caps and Glass Samples | S-MN-I-517 |
| Preparation of Aqueous Samples for ICPMS Analysis by Method 3030C | S-MN-I-523 |
| Operation of the DEENA automated Prep System | S-MN-I-531 |
| Mercury in Solid Waste by CLP | S-MN-I-557 |
| Operation and Maintenance of the Perkin Elmer Optima 4300 ICP | S-MN-I-567 |
| Operation and Maintenance of the Thermo ICPMS | S-MN-I-578 |
| Operation and Maintenance of the CETAC M-7500 Analyzer | S-MN-I-580 |
| Extractable Base/Neutral and Acid Organic Compounds in Liquid, Solid, and TCLP Matrices by Gas Chromatography/Mass Spectrometry Capillary Column Technique | S-MN-O-436 |
| 8270-L Extractable Base/Neutral and Acid Organic Compounds in Water and Liquid Matrices by GC/MS Capillary Column Technique w/Selective Ion Monitoring | S-MN-O-507 |

## ATTACHMENT V- LABORATORY SOP LIST (CONTINUED)

| | |
|---|---|
| Extractable Base/Neutral and Acid Organic Compounds in Liquid by EPA Method 625 | S-MN-O-532 |
| Determination of Parent and Alkylated PAH Compounds in Solid and Liquid Matrices by GC/MS SIM | S-MN-O-561 |
| Analysis of Air samples by GC/MS - Method TO-13 | S-MN-O-534 |
| Qualitative ID of Biomarkers by SIM | S-MN-O-568 |
| Sulfolane Extraction and Analysis in Liquid Matrices by GCMS | S-MN-O-569 |
| High Volume Injection for 8270C SIM | S-MN-O-570 |
| Sulfolane Extraction and Analysis in Solid Matrices by GC/MS: Capillary Column Technique | S-MN-O-572 |
| Analysis of Volatile Organic Compounds by GC/MS Method 8260 | S-MN-O-521 |
| Analysis of Volatile Organic Compounds by GC/MS Method 624 | S-MN-O-529 |
| Analysis of Volatile Organic Compounds in Water Method 524.2 | S-MN-O-546 |
| Analysis of 1,4 Dioxane by Selective Ion Monitoring (SIM) GC/MS SW846 Method 8260B Modified | S-MN-O-558 |
| Method For Sonicator Tuning | S-MN-O-414 |
| Cleaning Glassware in the Organic Laboratory | S-MN-O-465 |
| Determination of Acid Cleanup of PCB Extracts | S-MN-O-494 |
| Sonication Extraction Technique (SW3550) for Base/Neutral and Acid Compounds | S-MN-O-495 |
| Continuous Liquid-Liquid Extraction (SW3520) for Base/Neutral and Acid Compounds | S-MN-O-496 |
| Spike Verification in the Organic Prep Lab | S-MN-O-497 |
| Preparation of Anhydrous Sodium Sulfate for Extraction Purposes | S-MN-O-500 |
| Nitrogen Evaporation Technique | S-MN-O-503 |
| Sample Concentration Technique | S-MN-O-504 |
| Separatory Funnel Extraction for Polyaromatic Hydrocarbons by 8270-SIM | S-MN-O-506 |
| Solvent Exchange into Hexane | S-MN-O-509 |
| Copper Cleanup Procedure for Polychlorinated Biphenyls | S-MN-O-527 |
| Continuous Liq/Liq extraction for Method 8270C (Dual pH) by SW 3520C | S-MN-O-539 |
| Soxhlet Extraction for PAH Analysis by GC/MS:SIM | S-MN-O-540 |
| DrieRite Regeneration Procedure | S-MN-O-557 |
| Percent Solids (Moisture) | S-MN-I-367 |
| Separatory Funnel Extraction | S-MN-O-566 |
| Data Archiving | S-MN-L-106 |
| Reagent Water Quality | S-MN-L-110 |
| Generation of EDD | S-MN-L-112 |
| Preventative, routine, and non-routine maintenance | S-MN-L-114 |
| Receipt and Storage of Laboratory Supplies | S-MN-L-117 |
| Common Laboratory Calculations and Statistical Evalation of Data | S-MN-L-125 |
| Data Reduction, Validation, and Reporting in the Env Lab | S-MN-L-132 |
| Syringe Technique | S-MN-L-139 |
| Procedure for Handling Aqueous Organic Extractable Samples Containing Sediment | S-MN-L-142 |
| Purchasing Laboratory Supplies | S-MN-L-143 |
| Calculating Acodes and Data Sensibility | S-MN-L-146 |
| Quality Manual | Quality Manual |
| Precision and Accuracy Measurement, Evaluation, and Trend Assessment | S-MN-Q-205 |
| Manual Integration | S-MN-Q-214 |
| Control of Hazardous Energy Program - Lockout/Tagout | S-MN-Q-249 |
| Method Validation and Modification Studies | S-MN-Q-252 |
| Procedure for Handling of USDA regulated soils | S-MN-Q-253 |
| Estimation of Measurement Uncertainty | S-MN-Q-255 |
| Management of Change | S-MN-Q-257 |
| PT Program | S-MN-Q-258 |
| Evaluation and Qualification of Vendors | S-MN-Q-259 |
| Use of A2LA Terms and Symbols | S-MN-Q-260 |
| Conflict of Interest Plan | S-MN-Q-261 |
| Corrective Action and Preventative Action | S-MN-Q-262 |
| Monitoring Storage Units | S-MN-Q-263 |
| Support Equipment | S-MN-Q-264 |
| Method Detection Limit Studies | S-MN-Q-269 |
| Review of Analytical Requests | S-MN-Q-270 |
| Internal and External Audits | S-MN-Q-271 |
| MCL Violation Reporting | S-MN-Q-272 |
| Preparation of Standard Operating Procedures | S-MN-Q-273 |
| Software Validation | S-MN-Q-274 |
| Chemical Hygiene Plan/Safety Manual | S-MN-S-001 |
| Waste Training Management Requirements | S-MN-S-002 |

## ATTACHMENT V- LABORATORY SOP LIST (CONTINUED)

| | |
|---|---|
| Waste Handling | S-MN-S-003 |
| MN Contingency Plan | 2011 |
| MT Contingency plan | 2011 |
| Biochemical Oxygen Demand (BOD) | S-MN-I-348 |
| Phenols | S-MN-I-354 |
| Oil & Grease - 1664 | S-MN-I-357 |
| Hexavalent Chromiumin in Water, Wastewater, and Soil | S-MN-I-358 |
| Alkalinity, Titrimetric | S-MN-I-365 |
| Fluoride in Water and Wastewater | S-MN-I-470 |
| Determination of Total and Ortho Phosphorus in Aqueous Samples by SmartChem | S-MN-I-473 |
| Specific Conductivity | S-MN-I-474 |
| Ortho Phosphorus | S-MN-I-477 |
| Particulate Matter (PM10) (Method 5) in the Atmosphere | S-MN-I-484 |
| Settleable Solids | S-MN-I-486 |
| Standard Test Method for Screening Apparent Specific Gravity and Bulk Density Waste | S-MN-I-493 |
| Determination of Total Recoverable Phenolics by Flow Injection Colorimetry | S-MN-I-494 |
| Turbidity in Water | S-MN-I-501 |
| Chlorine, Total Residual in Water | S-MN-I-502 |
| Use and Maintenance of the Konelab | S-MN-I-507 |
| Determination of Nitrate/Nitrite in surface/wastewaters by Flow Injection Analysis by SmartChem | S-MN-I-508 |
| Determination of Chloride by Konelab | S-MN-I-509 |
| Determination of Sulfate by Konelab | S-MN-I-510 |
| Determination of Nitrite by Konelab(Spectrophotometric Method) | S-MN-I-514 |
| Paint Filter Liquids Test | S-MN-I-516 |
| Gravimetric Determination of Oil and Grease by SPE | S-MN-I-520 |
| Dissolved Oxygen | S-MN-I-524 |
| Measurement of pH in Water, Soil, and Waste | S-MN-I-526 |
| Determination of TSP and PM 10 | S-MN-I-527 |
| Measurement of Solids in Water and Wastewater | S-MN-I-528 |
| Total CN in Water - Macro Distillation | S-MN-I-529 |
| Weak Acid Disociable Cyanide in Water - Macro Distillation | S-MN-I-530 |
| Total Coliform Bacteria | S-MN-MB-001 |
| Fecal Coliform by MF | S-MN-MB-002 |
| Heterotrophic Plate Count | S-MN-MB-003 |
| Total Coliform Bacteria by MF | S-MN-MB-005 |
| Sample Container Sterility Verification | S-MN-MB-006 |
| The Determination of Ammonia by SmartChem | S-MN-I-559 |
| Determination of NO3/NO2 by SmartChem | S-MN-I-560 |
| Cation - Anion Balance | S-MN-I-562 |
| COD by Hach 2700 | S-MN-I-563 |
| Cyanide in Water by SmartChem | S-MN-I-564 |
| Flashpoint | S-MN-I-569 |
| Delta Airlines Anodizing Line | S-MN-I-582 |
| Quality Control Recordkeeping For Bulk Asbestos Analysis | S-MN-I-533 |
| Bulk Analysis Using Polarized Light Microscopy | S-MN-I-534 |
| Microscope Adjustment - Phase Contrast | S-MN-I-535 |
| Microscope Alignment | S-MN-I-536 |
| Fiber Counts By NIOSH 7400 Using Excel Spreadsheet | S-MN-I-537 |
| Asbestos Data Review | S-MN-I-545 |
| Particle Size Analysis | S-MN-I-549 |
| Coarse Fragment | S-MN-I-552 |
| Volatile Petroleum Hydrocarbons (VPH) | S-MN-O-559 |
| The Determination of Extractable Petroleum Hydrocarbons by Method MA-EPH | S-MT-O-001 |
| Petroleum Hydrocarbons as Diesel in Water and Soil | S-MT-O-002 |
| Purgeable Total Petroleum Hydrocarbons in Water and Soil | S-MT-O-003 |
| Determination of Inorganic Anions by Ion Chromatography | S-MN-I-532 |
| Volatile Organic Compounds by 8260B | S-MT-O-004 |
| Determination of Ammonia Nitrogen by Automated Phenate | S-MN-I-542 |
| Fluoride Distillation | S-MN-I-551 |
| Water Soluble Sulfate and Chloride | S-MN-I-554 |
| Nitrite by SM4500 NO2B | S-MN-I-556 |
| Chlorophyll-a | S-MN-I-566 |
| Acidity | S-MN-I-571 |

## ATTACHMENT V- LABORATORY SOP LIST (CONTINUED)

| | |
|---|---|
| Turbidity | S-MN-I-572 |
| Available Nitrate and Ammonia | S-MN-I-573 |
| Sulfate Sulfur | S-MN-I-574 |
| The Determination of Percent Moisture in Soil and Solid Samples | S-MN-I-579 |
| Measurement of pH in Water, Soil, and Waste | S-MN-I-581 |
| Organic Matter | S-MT-I-001 |
| Phosphorus, Ortho and Total | S-MT-I-002 |
| Vegetative Fluoride | S-MT-I-003 |
| Acid-Base Accounting - Sobek | S-MT-I-004 |
| Sulfides | S-MT-I-005 |
| pH Paste | S-MT-I-006 |
| Specific Conductivity SW2510B | S-MT-I-007 |
| Measurement of Solids in Water and Wastewater | S-MT-I-008 |
| The Determination of Nitrate-Nitrite by Flow Analyzer | S-MT-I-009 |
| TKN By Colorimetry | S-MT-I-010 |
| Colormetric Hexavalent Chromium | S-MT-I-011 |
| Total Sufur by LECO | S-MT-I-012 |
| Water Extraction of Soil | S-MN-I-561 |
| BP Course Fragment | S-MN-I-565 |
| Water Soluble Sulfate and Chloride | S-MT-I-013 |
| The Determination of Percent Moisture in Soil and Solid Samples | S-MT-I-014 |
| Volatile Petroleum Hydrocarbons (VPH) | S-MT-O-005 |
| Purgeable Total Petroleum Hydrocarbons in Water (8015 Mod / CA LUFT) | S-MT-O-006 |

## ATTACHMENT VI- LABORATORY CERTIFICATION LIST (CURRENT AS OF ISSUE DATE)

| Pace-Minnesota EPA ID: MN00064 | | | | |
|---|---|---|---|---|
| State | Agency | Program | Cert # | Expiration |
| A2LA | ISO 17025 | Dioxin-DW, WW, HW | 2926.01 | 10/31/2011 |
| Alabama | Dept of Environmental Mgmt | Dioxin-DW | 40770 | 11/30/2011 |
| Alaska | Dept. of Environmental Conservation | Contaminated Sites (6010B, 6020, 8260B, PCBs, PAHs) | UST-078 | 8/10/2011 |
| Alaska | Dept. of Environmental Conservation | Dioxin-DW | MN00064 | 8/29/2011 |
| Arizona | Dept of Health Services | Dioxin-DW, WW, HW | AZ0014 | 12/14/2011 |
| Arkansas | Dept of Environmental Quality | Dioxins | 88-0680 | 6/19/2011 |
| California | Dept of Health Services | Dioxin-DW, WW, HW | 01155CA | 8/31/2011 |
| Colorado | Dept. of Public Health & Environment | Dioxin-DW | Pace Analytical | 12/31/2011 |
| Connecticut | Dept of Public Health | Dioxins | PH-0256 | 12/31/2011 |
| Delaware | Health & Social Services | Dioxin-DW | | |
| EPA Region 5 | Water Division | Dioxin-DW | WD-15J | 2/17/2012 |
| EPA Region 8 | Water Division | Dioxin-DW, DW | | 12/31/2011 |
| Florida (NELAC) | Dept of Health Services | Diox-DW, WW, HW, Air<br>Envir-DW, WW, HW, Air | E87605 | 6/30/2011 |
| Georgia | Environmental Protection Division | Dioxin-WW, HW via NELAP | E87605 | 6/30/2011 |
| Georgia | Dept of Natural Resources | Dioxin-DW | 959 | 6/30/2010 |
| Guam | Guam EPA | Dioxin-DW | Pace Analytical | 10/21/2011 |
| Idaho | Dept. of Health & Welfare | Dioxin-DW | Pace Analytical | 12/31/2011 |
| Hawaii | Dept of Health | Dioxin-DW | SLD | 6/30/2011 |
| Illinois | Illinois EPA | Dioxin-DW, HW, WW via NELAP | 200011 | 12/11/2011 |
| Indiana | Dept of Health | Dioxin-DW via EPA Region 5 | C-MN-01 | 2/11/2011 |
| Iowa | Dept.of Natural Resources | Dioxin-DW | 368 | 6/1/2011 |
| Kansas | Dept of Health and Environment | Dioxin-DW<br>Envir-DW, WW, HW | E-10167 | 10/31/2011 |
| Kentucky | Dept of Environmental Protection | Dioxin-DW | 90062 | 12/31/2011 |
| Louisiana | Department of Environmental Quality | Dioxin-WW, HW, Air | 3086 | 6/30/2011 |
| Louisiana | Department of Health and Hospitals | Dioxin-DW | LA090015 | 12/31/2011 |
| Maine | Dept of Human Services | Dioxin-DW via EPA Region 5 | 2007029 | 5/27/2011 |
| Maryland | Dept. of Heath and Mental Hygiene | Dioxin-DW | 322 | 6/30/2011 |
| Michigan | Dept. of Public Health | Dioxin, Metals-DW | 9909 | 12/31/2011 |
| Minnesota (NELAC) | Dept of Health | Envir-DW, WW, HW | 027-053-137 | 12/31/2011 |
| Minnesota | Department of Commerce | Petrofund | 1240 | 12/31/2011 |
| Mississippi | Dept. of Health and Environmental Control | Dioxin-DW | Pace | 6/30/2011 |
| Montana | Dept of Health | Dioxin-DW | 92 | 1/1/2012 |
| Nebraska | Dept. of Health & Human Services. | Dioxin-DW | Pace | 6/30/2011 |
| Nevada | Health Division | Dioxin-DW, WW | MN_00064_2000_72 | 7/31/2011 |
| New Jersey | Dept of Environmental Protection | Dioxin-DW, WW, HW<br>Envir-WW, HW, Air | MN002 | 6/30/2011 |
| New Mexico | NM Environment Dept. | Dioxin-DW, Env-DW | Pace | 6/30/2011 |
| New York | Dept of Health | Dioxin-DW, WW, Air<br>Envir-Air | 11647 | 4/1/2011 |
| North Carolina | Dept of Environment, Health and Natural Resources | Envir-WW, HW | 530 | 12/31/2011 |

## ATTACHMENT VI- LABORATORY CERTIFICATION LIST (CURRENT AS OF ISSUE DATE) CONTINUED

| State | Agency | Program | Cert # | Expiration |
|---|---|---|---|---|
| | | | | |
| North Carolina | State Public Health Laboratory | Dioxin-DW | 27700 | 7/31/2011 |
| North Dakota | Dept of Health and Consolidated Labs | Envir-DW, WW, HW | R-036 | 12/31/2011 |
| Ohio | Ohio EPA | Dioxin-DW via EPA Region 5 | 4150 | 2/21/2011 |
| Ohio Vap | VAP | Dioxin and Air | CL101 | 7/15/2012 |
| Oklahoma | Dept of Environmental Quality | Dioxin-DW | D9921 | 8/31/2011 |
| | | Envir-HW | 9507 | 8/31/2011 |
| Oregon | ORELAP | Dioxin-DW, WW, HW, Air Enviro: Air | MN200001-005 | 8/14/2011 |
| Oregon | ORELAP | NWTPH | MN300001-001 | 5/27/2011 |
| Pennsylvania | Dept of Environmental Protection | Dioxin-DW, WW, HW Envir: DW, WW, HW | 68-00563 | 3/31/2011 |
| Puerto Rico | Hygiene Laboratories Certification Program | Dioxin, DW metals | MN00064 | 1/31/2012 |
| Saipan (CNMI) | Div. Of Environmental Quality | Dioxin-DW | MP0003 | 9/18/2011 |
| South Carolina | Dept. of Health and Environmental Control | Dioxin-DW, WW, HW | 74003001 | 6/30/2011 |
| Texas | Department of Health | Dioxin-DW, WW, HW | T104704192-08A-TX | 2/28/2012 |
| Tennessee | Dept of Health | Dioxin-DW Envir-DW | 2818 | 4/11/2012 |
| Utah | Department of Health | Dioxin-DW, WW, HW | ID# PAM Account# 6126071700 | 6/30/2011 |
| Virginia | Dept of General Services | Dioxin-DW | 251 | 6/30/2011 |
| Washington | Dept of Ecology | Dioxin-DW, WW, HW Envir-DW, WW, HW | C754 | 2/18/2011 |
| Wisconsin | Dept of Natural Resources | Dioxin-DW, WW, HW Envir-DW, WW, HW | 999407970 | 8/30/2011 |
| Wyoming | Via EPA Region 8 | Dioxin DW | | 12/31/2011 |
| West Virginia | Dept of Health and Human Resources | Dioxin-DW | 9952C | 12/31/2011 |

| Pace-Montana EPA ID: MT00012 | | | | |
|---|---|---|---|---|
| Colorado-MT | Colorado Dept of Public Health and Environment | Asbestos Registration | 17119 | 3/15/2011 |
| EPA Region 8-MT Lab | Water Division | Dioxin-DW | | 6/30/2012 |
| Idaho-MT Lab | Dept. of Health & Welfare | Dioxin-DW | MT00012 | 6/30/2011 |
| Minnesota - MT Lab | Department of Health | Envir-DW, WW, HW | 030-999-442 | 12/31/2011 |
| Montana-MT Lab | Department of Health | DW | 40 | 6/30/2012 |
| NVLAP-MT Lab | | Asbestos | 101292-0 | 3/31/2011 |

The scope and application certificates are maintained in the filing cabinets in the QA Department.

# ATTACHMENT VI- LABORATORY CERTIFICATION LIST (CURRENT AS OF ISSUE DATE) CONTINUED

## MN00064 NELAC Accreditation*

### Drinking Water Methods

| | | | |
|---|---|---|---|
| EPA 524.2 | SM 4500 Cl-E | SM 4500 NO2-B | SM 2320B |
| EPA 1613 | SM4500 Cl-G | SM 4500 P-E | SM 2340B |
| | SM 4500 CN-E | EPA 120.1 | SM 2540C |
| | SM 4500 CN-G | EPA 180.1 | SM 9215B |
| | SM 4500 F-C | EPA 200.7 | SM 9223B |
| | SM 4500 H+-B | EPA 200.8 | ASTM D516-02 |
| | | EPA 245.1 | EPA 353.2 |

### Non-Potable Water

| | | | |
|---|---|---|---|
| EPA 1613B | EPA 8270 SIM | SM 2320B | SM 3500 Cr-B |
| EPA 1668A | EPA 120.1 | SM 2340B | SM 4500 Cl-E |
| EPA 624 | EPA 160.4 | SM 2540 B | SM 4500 Cl-G |
| EPA 625 | EPA 180.1 | SM 2540 C | SM 4500 CN-E |
| EPA 8015C | EPA 350.1 | SM 2540 D | SM 4500 CN-G |
| EPA 8021B | EPA 410.4 | SM 2540 F | SM 4500 H+-B |
| EPA 8082 | EPA 420.1 | SM 5220D | SM 4500 NO2-B |
| EPA 8260B | EPA 420.4 | SM 5210B | SM 4500 NO3-H |
| EPA 8270C | EPA 1664A | EPA 6010 | SM 4500 P-E |
| EPA 8280 | EPA 200.7 | EPA 6020 | SM4500 O-G |
| EPA 8290A | EPA 200.8 | EPA 7470A | SM9222B |
| WiDRO | EPA 245.1 | EPA 7196A | SM9222D |
| WiGRO | EPA 353.2 | ASTM D516-02 | ASTM D516-02 |
| NWTPH-Dx | WiGRO | | |
| NWTPH-Gx | WiDRO | | |

### Solid/Chemical Materials

| | | | |
|---|---|---|---|
| EPA 8015C | EPA 8270 SIM | EPA 1311 | EPA 9045C |
| EPA 8021B | EPA 1613B | EPA 1312 | EPA 7196A |
| EPA 8082 | EPA 1668A | EPA 6010B | EPA 9071 |
| EPA 8260B | WiDRO | EPA 6020 | EPA 9095B |
| EPA 8270C | WiGRO | EPA 7471A | |
| EPA 8280 | NWTPH-Dx | WiGRO | |
| EPA 8290 | NWTPH-Gx | WiDRO | |
| EPA 8290A | | | |

### Biological Tissues

| | | |
|---|---|---|
| EPA 8290 | EPA 1613B | EPA 1668A |
| EPA 8290A | | |

### Air and Emissions

| | | | |
|---|---|---|---|
| EPA TO3 | EPA TO9A | EPA TO14A | RSK-175 |
| EPA TO4A | EPA TO13A | EPA TO15 | Method 23 |
| Method 3C | | | |

*Pace-MN carries primary NELAC accreditation for these tests in one or more states. Actual coverage in a specific state or territory should be verified prior to performing analysis.

## ATTACHMENT VI- LABORATORY CERTIFICATION LIST (CURRENT AS OF ISSUE DATE) CONTINUED

### MT00012 NELAC Accreditation*

**Drinking Water Methods**

| | | |
|---|---|---|
| EPA 300.0 | EPA 353.2 | SM 4500 H+-B |
| SM 4500 P-E | | |

**Non-Potable Water**

| | | |
|---|---|---|
| EPA 300.0 | EPA 353.2 | SM 4500 NO2-B |
| EPA 350.1 | SM2310B | SM 4500 P-E |
| EPA 351.2 | SM 4500 H+-B | SM 4500 S2-D |
| Total Organic Nitrogen (calc.) | | |

*Pace-MT carries primary NELAC accreditation for these tests in one or more states. Actual coverage in a specific state or territory should be verified prior to performing analysis.

# ATTACHMENT VII- PACE CHAIN-OF-CUSTODY (CURRENT AS OF ISSUE DATE)

**CHAIN-OF-CUSTODY / Analytical Request Document**

The Chain-of-Custody is a LEGAL DOCUMENT. All relevant fields must be completed accurately.

Pace Analytical® www.pacelabs.com

**Section A** Required Client Information:
Company:
Address:
Email To:
Phone: Fax:
Requested Due Date/TAT:

**Section B** Required Project Information:
Report To:
Copy To:
Purchase Order No.:
Project Name:
Project Number:

**Section C** Invoice Information:
Attention:
Company Name:
Address:
Pace Quote Reference:
Pace Project Manager:
Pace Profile #:

Page: of

REGULATORY AGENCY
☐ NPDES ☐ GROUND WATER ☐ DRINKING WATER
☐ UST ☐ RCRA ☐ OTHER

Site Location
STATE:

**Section D** Required Client Information

Matrix Codes MATRIX / CODE: Drinking Water DW; Water WT; Waste Water WW; Product P; Soil/Solid SL; Oil OL; Wipe WP; Air AR; Tissue TS; Other OT

SAMPLE ID (A-Z, 0-9 / ,-) Sample IDs MUST BE UNIQUE

Requested Analysis Filtered (Y/N)

| ITEM # | SAMPLE ID | MATRIX CODE (see valid codes to left) | SAMPLE TYPE (G=GRAB C=COMP) | COLLECTED COMPOSITE START DATE | TIME | COMPOSITE END/GRAB DATE | TIME | SAMPLE TEMP AT COLLECTION | # OF CONTAINERS | Unpreserved | $H_2SO_4$ | $HNO_3$ | HCl | NaOH | $Na_2S_2O_3$ | Methanol | Other | Analysis Test (Y/N) | Residual Chlorine (Y/N) | Pace Project No./ Lab I.D. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | | | | | | | | | | | | | | | | | | | |
| 2 | | | | | | | | | | | | | | | | | | | | |
| 3 | | | | | | | | | | | | | | | | | | | | |
| 4 | | | | | | | | | | | | | | | | | | | | |
| 5 | | | | | | | | | | | | | | | | | | | | |
| 6 | | | | | | | | | | | | | | | | | | | | |
| 7 | | | | | | | | | | | | | | | | | | | | |
| 8 | | | | | | | | | | | | | | | | | | | | |
| 9 | | | | | | | | | | | | | | | | | | | | |
| 10 | | | | | | | | | | | | | | | | | | | | |
| 11 | | | | | | | | | | | | | | | | | | | | |
| 12 | | | | | | | | | | | | | | | | | | | | |

| ADDITIONAL COMMENTS | RELINQUISHED BY / AFFILIATION | DATE | TIME | ACCEPTED BY / AFFILIATION | DATE | TIME | SAMPLE CONDITIONS | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Temp in °C | Received on Ice (Y/N) | Custody Sealed Cooler (Y/N) | Samples Intact (Y/N) |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |

SAMPLER NAME AND SIGNATURE
PRINT Name of SAMPLER:
SIGNATURE of SAMPLER: DATE Signed (MM/DD/YY):

## ATTACHMENT VIII- METHOD HOLD TIME*, CONTAINER AND PRESERVATION GUIDE (CURRENT AS OF ISSUE DATE)

* THE HOLDING TIME INDICATED IN THE CHART BELOW IS THE MAXIMUM ALLOWABLE TIME FROM COLLECTION TO EXTRACTION AND/OR ANALYSIS PER THE ANALYTICAL METHOD(S). FOR METHODS THAT REQUIRE PROCESSING PRIOR TO ANALYSIS, THE HOLDING TIME IS DESIGNATED AS 'PREPARATION HOLDING TIME/ANALYSIS HOLDING TIME'.

| Parameter | Method | Matrix | Container | Preservative | Max Hold Time |
|---|---|---|---|---|---|
| 2, 3, 7, 8-TCDD | 1613B | Soil | 8oz Glass | None | 1 yr |
| 2, 3, 7, 8-TCDD | 1613B | Water | 1L Glass | $\leq 6^oC$; $Na_2S_2O_3$ if Cl present | 1 yr |
| 2, 3, 7, 8-TCDD | 8290 | Water | 1L Glass | $\leq 6^oC$; $Na_2S_2O_3$ if Cl present | 30/45 Days |
| Acidity | SM2310B | Water | Plastic/Glass | $\leq 6^oC$ | 14 Days |
| Alkalinity | SM2320B/310.2 | Water | Plastic/Glass | $\leq 6^oC$ | 14 Days |
| Alpha Emitting Radium Isotopes | 9315/903.0 | Water | Plastic/Glass | pH<2 $HNO_3$ | 180 days |
| Anions by IC, including Br, Cl, F, $NO_2$, $NO_3$, $SO_4$ | 300.0/300.1/ SM4110B | Water | Plastic/Glass | $\leq 6^oC$ | Br, Cl, F, $SO_4$ (28 Days) $NO_2$, $NO_3$ (48 Hours) |
| Anions by IC, including Br, Cl, F, $NO_2$, $NO_3$, $SO_4$ | 300.0/9056 | Soil | Plastic/Glass | $\leq 6^oC$ | Br, Cl, F, $SO_4$ (28 Days) $NO_2$, $NO_3$ (48 Hours) |
| Aromatic and Halogenated Volatiles | 8021 | Soil | 5035 vial kit | See 5035 note* | 14 days |
| Aromatic and Halogenated Volatiles | 601/602/8021 | Water | 40mL vials | pH<2 HCl; $\leq 6^oC$; $Na_2S_2O_3$ if Cl present | 14 Days |
| Acid Volatile Sulfide | Draft EPA 1629 | Soil | 8oz Glass | $\leq 6^oC$ | 14 Days |
| Bacteria, Total Plate Count | SM9221D | Water | Plastic/WK | $\leq 6^oC$; $Na_2S_2O_3$ | 24 Hours |
| Base/Neutrals and Acids | 8270 | Soil | 8oz Glass | $\leq 6^oC$ | 14/40 Days |
| Base/Neutrals and Acids | 625/8270 | Water | 1L Glass | $\leq 6^oC$; $Na_2S_2O_3$ if Cl present | 7/40 Days |
| Base/Neutrals, Acids & Pesticides | 525.1/525.2 | Water | 1L Glass | $\leq 6^oC$; $Na_2S_2O_3$ if Cl present | 7/30 Days |
| BOD/cBOD | SM5210B | Water | Plastic/Glass | $\leq 6^oC$ | 48 hours |
| BTEX/Total Hydrocarbons | TO-3 | Air | Summa Canister | None | 14 Days |
| BTEX/Total Hydrocarbons | TO-3 | Air | Tedlar Bag | None | 48 Hours |
| Cation/Anion Balance | SM1030E | Water | Plastic/Glass | None | None |

| Parameter | Method | Matrix | Container | Preservative | Max Hold Time |
|---|---|---|---|---|---|
| Chloride | SM4500Cl/9250/ 9251/9252 | Water | Plastic/Glass | None | 28 Days |
| Chlorinated Herbicides | 8151 | Soil | 8oz Glass Jar | $\leq 6^oC$ | 7/40 Days |
| Chlorinated Herbicides | 8151 | Water | 1L Amber Glass | $\leq 6^oC$; $Na_2S_2O_3$ if Cl present | 7/40 Days |
| Chlorinated Herbicides | 515.1 | Water | 1L Amber Glass | $\leq 6^oC$; $Na_2S_2O_3$ if Cl present | 14/28 Days |
| Chorine, Residual | SM4500Cl | Water | Plastic/Glass | None | 15 minutes |
| Chlorophyll-a | SM10200H | Water | 1L Opaque Jar | If pH $\geq$ 7, frozen; if acidic process promptly after filtration | 28 days if frozen |
| COD | SM5220C/ 410.3/410.4 | Water | Plastic/Glass | pH<2 $H_2SO_4$; $\leq 6^oC$ | 28 Days |
| Color | SM2120B,C,E | Water | Plastic/Glass | $\leq 6^oC$ | 48 Hours |
| Condensable Particulate Emissions | EPA 202 | Air | Solutions | None | 6 Months |
| Cyanide, Reactive | SW846 chap.7 | Water | Plastic/Glass | None | 28 Days |
| Cyanide, Total and Amenable | SM4500CN/9010/ 9012/335.4 | Water | | pH>12 NaOH; $\leq 6^oC$; ascorbic acid if Cl present | 14 Days, 24 Hours if Sulfide present |
| Diesel Range Organics- TPH DRO | 8015 | Soil | 8oz Glass Jar | $\leq 6^oC$ | 14/40 Days |
| Diesel Range Organics- TPH DRO | 8015 | Water | 1L Glass | $\leq 6^oC$ | 7/40 Days |
| Diesel Range Organics (WI) | WI MOD DRO | Soil | 8oz Glass Jar | $\leq 6^oC$ | 10/47 Days |
| Diesel Range Organics (WI) | WI MOD DRO | Water | 1L Glass | $\leq 6^oC$ | 14/40 Days |
| Dioxins & Furans | TO-9 | Air | PUF | None | 7/45 Days |
| EDB & DBCP | 504.1/8011 | Water | 40mL vials | $\leq 6^oC$; $Na_2S_2O_3$ if Cl present | 14 Days |
| Explosives | 8330/8332 | Water | 1L Glass | $\leq 6^oC$ | 7/40 Days |
| Explosives | 8330/8332 | Soil | 8oz Glass Jar | $\leq 6^oC$ | 14/40 Days |
| Fecal Coliform | SM9222D | Water | 100mL Plastic | $\leq 6^oC$ | 6 Hours |
| Fecal Coliform | SM9222D | Soil | 100mL Plastic | $\leq 6^oC$ | 6 Hours |
| Ferrous Iron | SN3500Fe-D | Water | Glass | None | Immediate |
| Flashpoint/Ignitability | 1010/1030 | Water | Plastic/Glass | None | 28 Days |
| Fluoride | SM4500Fl-C,D | Water | Plastic | None | 28 Days |
| Gamma Emitting Radionuclides | 901.1 | Water | Plastic/Glass | pH<2 $HNO_3$ | 180 days |
| Gas Range Organics | 8015 | Water | 40mL vials | pH<2 HCl | 14 Days |
| Gasoline Range Organics | 8015 | Soil | 5035 vial kit | See 5035 note* | 14 days |

| Parameter | Method | Matrix | Container | Preservative | Max Hold Time |
|---|---|---|---|---|---|
| Gross Alpha (NJ 48Hr Method) | NJAC 7:18-6 | Water | Plastic/Glass | pH<2 $HNO_3$ | 48 Hrs |
| Gross Alpha and Gross Beta | 9310/900.0 | Water | Plastic/Glass | pH<2 $HNO_3$ | 180 days |
| Haloacetic Acids | 552.1/552.2 | Water | 40mL Amber vials | $NH_4Cl$; $\leq 6^oC$ | 14/7 Days |
| Hardness, Total ($CaCO_3$) | SM2340B,C/130.1 | Water | Plastic/Glass | pH<2 $HNO_3$ | 6 Months |
| Heterotrophic Plate Count (MPC) | EPA 9215B | Water | 100mL Plastic | $\leq 6^oC$ | 24 Hours |
| Hexavalent Chromium | 7196/218.6/ SM3500Cr | Water | Plastic/Glass | $\leq 6^oC$ | 24 Hours |
| Hydrogen Halide & Halogen Emissions | EPA 26 | Air | Solutions | None | 6 Months |
| Lead Emissions | EPA 12 | Air | Filter/Solutions | None | 6 Months |
| Low Level Mercury | 1631 | Water | Glass | BrCl | 90 days (if preserved and oxidized) |
| Mercury | 7471 | Soil | 8oz Glass Jar | $\leq 6^oC$ | 28 days |
| Mercury | 7470/245.1/245.2 | Water | Plastic/Glass | pH<2 $HNO_3$ | 28 Days |
| Metals | 7300/7303 | Air | Filters | None | 6 Months |
| Metals (and other ICP elements) | 6010 | Soil | 8oz Glass Jar | None | 6 months |
| Metals (and other ICP elements) | 6010/6020/200.7/ 200.8 | Water | Plastic/Glass | pH<2 $HNO_3$ | 6 Months |
| Methane, Ethane, Ethene | EPA Mod 8015 | Water | 40mL vials | HCl | 14 Days |
| Methane, Ethane, Ethene | RSK-175 | Water | 40mL vials | HCl | 14 Days |
| Methane, Ethane, Ethene | EPA 3C | Air | Summa Canister | None | 14 Days |
| Methane, Ethane, Ethene | EPA 3C | Air | Tedlar Bag | None | 48 Hours |
| Methanol, Ethanol | EPA 8015 | Water | 40mL vials | $\leq 6^oC$ | 14 Days |
| Methanol, Ethanol | EPA 8015 | Soil | 2oz Glass | $\leq 6^oC$ | 14 Days |
| Nitrogen, Ammonia | SM4500NH3/350.1 | Water | Plastic/Glass | pH<2 $H_2SO_4$; $\leq 6^oC$ | 28 Days |
| Nitrogen, Kjeldahl | SM4500-Norg; 351.1/351.2 | Water | Plastic/Glass | pH<2 $H_2SO_4$; $\leq 6^oC$ | 28 Days |
| Nitrogen, Nitrate | SM4500-NO3/ 352.1 | Water | Plastic/Glass | $\leq 6^oC$ | 48 Hours |
| Nitrogen, Nitrate & Nitrite | SM4500-NO3/ 353.2 | Water | Plastic/Glass | pH<2 $H_2SO_4$; $\leq 6^oC$ | 28 Days |
| Nitrogen, Nitrite | SM4500-NO2/ 353.2 | Water | Plastic/Glass | $\leq 6^oC$ | 48 Hours |
| Nitrogen, Organic | SM4500-Norg/ 351.2 | Water | Plastic/Glass | pH<2 $H_2SO_4$; $\leq 6^oC$ | 28 Days |
| Non-Methane Organics | EPA 25C | Air | Summa Canister | None | 14 Days |
| Non-Methane Organics | EPA 25C | Air | Tedlar Bag | None | 48 Hours |
| Odor | SM2150B | Water | Glass | $\leq 6^oC$ | 24 Hours |
| Oil and Grease/HEM | 1664A/SM5520B/ 9070 | Water | Glass | pH<2 $H_2SO_4$; $\leq 6^oC$ | 28 Days |
| Organochlorine Pesticides & PCBs | TO-4 | Air | PUF | None | 7/40 Days |

| Parameter | Method | Matrix | Container | Preservative | Max Hold Time |
|---|---|---|---|---|---|
| Organochlorine Pesticides & PCBs | 8081/8082/608 | Water | 1L Glass | ≤6°C; $Na_2S_2O_3$ if Cl present | 7/40 Days |
| Organochlorine Pesticides & PCBs | 8081/8082 | Soil | 8oz Glass Jar | ≤6°C | 14/40 Days |
| Organophosphorous Pesticides | 8141 | Soil | 8oz Glass Jar | ≤6°C | 14/40 Days |
| Organophosphorous Pesticides | 8141 | Water | 1L Amber Glass | ≤6°C; $Na_2S_2O_3$ if Cl present | 7/40 Days |
| Oxygen, Dissolved (Probe) | SM4500-O | Water | Glass | None | 15 minutes |
| Paint Filter Liquid Test | 9095 | Water | Plastic/Glass | None | N/A |
| Particulates | PM-10 | Air | Filters | None | 6 Months |
| Permanent Gases | EPA 3C | Air | Summa Canister | None | 14 Days |
| Permanent Gases | EPA 3C | Air | Tedlar Bag | None | 48 Hours |
| pH | SM4500H+B/9040/ 9041/150.2 | Water | Plastic/Glass | None | 15 minutes |
| Phenol, Total | 420.1/420.4/9065/ 9066 | Water | Glass | pH<2 $H_2SO_4$; ≤6°C | 28 Days |
| Phosphorus, Orthophosphate | SM4500P/365.1/365.3 | Water | Plastic | Filter; ≤6°C | Filter within 15 minutes, Analyze within 48 Hours |
| Phosphorus, Total | SM4500P/ 365.1/365.3/365.4 | Water | Plastic/Glass | pH<2 $H_2SO_4$; ≤6°C | 28 Days |
| Phosphorus, Total | EPA 365.4 | Soil | Plastic/Glass | ≤6°C | 28 Days |
| Polynuclear Aromatic Hydrocarbons | TO-13 | Air | PUF | None | 7/40 Days |
| Polynuclear Aromatic Hydrocarbons | 8270 SIM | Soil | 8oz Glass Jar | ≤6°C | 14/40 Days |
| Polynuclear Aromatic Hydrocarbons | 8270 SIM | Water | 1L Glass | ≤6°C; $Na_2S_2O_3$ if Cl present | 7/40 Days |
| Radioactive Strontium | 905.0 | Water | Plastic/Glass | pH<2 $HNO_3$ | 180 days |
| Radium-226 Radon Emanation Technique | 903.1 | Water | Plastic/Glass | pH<2 $HNO_3$ | 180 days |
| Radium-228 | 9320/904.0 | Water | Plastic/Glass | pH<2 $HNO_3$ | 180 days |
| Silica, Dissolved | SM4500Si-D | Water | Plastic | ≤6°C | 28 Days |
| Solids, Settleable | SM2540F | Water | Glass | ≤6°C | 48 Hours |
| Solids, Total | SM2540B | Water | Plastic/Glass | ≤6°C | 7 Days |
| Solids, Total (FOC) | ASTM D2974 | Soil | Plastic/Glass | ≤6°C | 7 Days |
| Solids, Total Dissolved | SM2540C | Water | Plastic/Glass | ≤6°C | 7 Days |
| Solids, Total Suspended | SM2540D | Water | Plastic/Glass | ≤6°C | 7 Days |
| Solids, Total Volatile | SM2540E | Water | Plastic/Glass | ≤6°C | 7 Days |
| Specific Conductance | SM2510B/9050/120.1 | Water | Plastic/Glass | ≤6°C | 28 Days |
| Stationary Source Dioxins & | EPA 23 | Air | XAD Trap | None | 30/45 Days |

| Parameter | Method | Matrix | Container | Preservative | Max Hold Time |
|---|---|---|---|---|---|
| Furans | | | | | |
| Stationary Source Mercury | EPA 101 | Air | Filters | None | 6 Months, 28 Days for Hg |
| Stationary Source Metals | EPA 29 | Air | Filters | None | 6 Months, 28 Days for Hg |
| Stationary Source PM10 | EPA 201A | Air | Filters | None | 6 Months |
| Stationary Source Particulates | EPA 5 | Air | Filter/Solutions | None | 6 Months |
| Sulfate | SM4500SO4/9036/ 9038/375.2/ASTMD516 | Water | Plastic/Glass | $\leq 6^oC$ | 28 Days |
| Sulfide, Reactive | SW-846 Chap.7 | Water | Plastic/Glass | None | 28 Days |
| Sulfide, Total | SM4500S/9030 | Water | Plastic/Glass | pH>9 NaOH; ZnOAc; $\leq 6^oC$ | 7 Days |
| Sulfite | SM4500SO3 | Water | Plastic/Glass | None | 15 minutes |
| Surfactants | SM5540C | Water | Plastic/Glass | $\leq 6^oC$ | 48 Hours |
| Total Organic Carbon (TOC) | SM5310B,C,D/ 9060 | Water | Glass | pH<2 $H_2SO_4$ or HCl; $\leq 6^oC$ | 28 Days |
| Total Organic Halogen (TOX) | SM5320/9020/ 9021 | Water | Glass; no headspace | $\leq 6^oC$ | 14 Days |
| Tritium | 906.0 | Water | Glass | pH<2 $HNO_3$ | 180 days |
| Turbidity | SM2130B/180.1 | Water | Plastic/Glass | $\leq 6^oC$ | 48 Hours |
| Uranium Radiochemical Method | 908.0/ASTM D5174-97 | Water | Plastic/Glass | pH<2 $HNO_3$ | 180 days |
| Volatiles | TO-14 | Air | Summa Canister | None | 30 Days |
| Volatiles | TO-14 | Air | Tedlar Bag | None | 48 Hours |
| Volatiles | TO-15 | Air | Summa Canister | None | 30 Days |
| Volatiles | 8260 | Soil | 5035 vial kit | See 5035 note* | 14 days |
| Volatiles | 8260 | Water | 40mL vials | pH<2 HCl; $\leq 6^oC$; $Na_2S_2O_3$ if Cl present | 14 Days |
| Volatiles | 8260 | Conc. Waste | 5035 vial kit or 40mL vials | $\leq 6^oC$ | 14 Days |
| Volatiles | 624 | Water | 40mL vials | pH<2 HCl; $\leq 6^oC$; $Na_2S_2O_3$ if Cl present | 14 Days (7 unpreserved) |
| Volatiles | 524.1/524.2 | Water | 40mL vials | pH<2 HCl; $\leq 6^oC$; $Na_2S_2O_3$ if Cl present | 14 Days |
| Alaska DRO | AK102 | Soil | 8oz Glass | $\leq 6^oC$ | 14/40 Days |
| Alaska DRO | AK102 | Water | 1L Glass | pH<2 HCl; $\leq 6^oC$ | 14/40 Days |
| Alaska RRO | AK103 | Soil | 8oz Glass | $\leq 6^oC$ | 14/40 Days |

| Parameter | Method | Matrix | Container | Preservative | Max Hold Time |
|---|---|---|---|---|---|
| Alaska GRO | AK101 | Soil | 5035 vial kit | See 5035 note* | 14 Days |
| Alaska GRO | AK101 | Water | 40mL vials | pH<2 HCl; ≤6°C | 14 Days |

**5035 Note**: 5035 vial kit typically contains 2 vials water, preserved by freezing **or**, 2 vials aqueous sodium bisulfate preserved at 4°C, **and** one vial methanol preserved at ≤6°C **and** one container of unpreserved sample stored at ≤6°C.