Quality Assurance Project Plan

EPA PA/SI Investigations

December 2017

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DEQ is a leader in restoring, maintaining and enhancing the quality of Oregon's air, land and water

State of Oregon
Department of Environmental Quality

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1. Project Management

1.1. Approval Sheet

Lydia Emer: Administrator, Operations Division	Date:
Bruce Gilles: Manager, Cleanup Program	Date:
Gil Wistar: Site Assessment Coordinator, Cleanup Program	Date:
Brian Boling: Manager, Laboratory and Enviromental Assessment Program	Date:
Scott Hoatson: Agency Quality Assurance Officer	Date:
Joanne LaBaw: Manager, EPA Region 10 Site Assessment	Date:
Donald M. Brown, Manager, EPA Region 10 Quality Assurance	Date:

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1.2. Table of Contents

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1.3. Distribution List

The following DEQ personnel will be emailed regarding all aspects of this QAPP.

- Lydia Emer, DEQ Operations Division Administrator
- Bruce Gilles, DEQ HQ Cleanup Manager
- Katie Robertson, DEQ Eastern Region Project Manager
- David Anderson, DEQ Eastern Region Program Manager
- Kevin Parrett, DEQ Northwest Region Program Manager
- Paul Seidel, Acting DEQ Northwest Region Program Manager
- Don Hanson, Acting DEQ Western Region Program Manager
- Mallory Ott, DEQ Western Region Site Assessment Program
- Ray Hoy, DEQ Northwest Region Site Assessment Program
- Scott Hoatson, DEQ Quality Assurance Officer
- Joanne LaBaw, USEPA Region 10 Site Assessment Manager
- Donald M. Brown, EPA Region 10 Quality Assurance Manager
- Environmental consultants under contract with DEQ for field work on PA/SI sites
- Laboratories contracted with the State of Oregon or DEQ to analyze samples from PA/SI sites

1.4. Acronyms

CERCLA	Comprehensive environmental Response, Compensation and Liability Act (Superfund)
CFR	Code of Federal Regulations
CLP	Contract Laboratory Program (EPA program)
CWA	Clean Water Act
DEQ	Oregon Department of Environmental Quality (also ODEQ)
DQI	Data Quality Indicator
DQL	Data Quality Level
DQO	Data Quality Objective
ECSI	Environmental Cleanup Site Information (Database)
EDD	Electronic Data Deliverable
EPA	United States Environmental Protection Agency (also USEPA)
FSRG	Field Sampling Reference Guide
IDW	Investigation-derived Wastes
ISM	Incremental Sampling Methodology
LCS	Laboratory Control Sample
LIMS	Laboratory Information Management System
LEAP	Laboratory and Environmental Assessment Program
LOD	Limit of Detection
LOQ	Limit of Quantitation
LPM	Laboratory Project Manager
MB	Method Blank
MDL	Method Detection Limit
MRL	Method Reporting Limit
MS	Matrix Spike
MSD	Matrix Spike Duplicate

NELAP	National Environmental Laboratory Accreditation Program
NIST	National Institute of Standards and Technology
NPL	National Priorities Lists (EPA Superfund sites)
PA	Preliminary Assessment
PAH	Polycyclic Aromatic Hydrocarbons (or polynuclear aromatic hydrocarbons)
PM	Project Manager
QA	Quality Assurance
QAO	Quality Assurance Officer
QC	Quality Control
QAPP	Quality Assurance Project Plan
QC	Quality Control
QMP	Quality Management Plan
RBC	Risk Based Concentration
RCRA	Resource Conservation Recovery Act
RSL	Regional Screening Level
SAP	Sampling and Analysis Plan
SDWA	Safe Drinking Water Act
SI	Site Investigation
SOP	Standard Operating Procedure
SRM	Standard reference Material
SVOC	Semi-volatile Organic Compounds
TCLP	Toxic Characteristic Leaching Procedure
UST	Underground Storage Tanks
VOC	Volatile Organic Compounds
WQM	Water Quality Monitoring

1.5. Project/Task Organization

Preliminary Assessment/Site Inspection (PA/SI) investigations may involve DEQ staff or contract staff outside the agency, as well as EPA Region 10 staff, including:

- EPA Region 10's Project Officer
- Cleanup Program staff at headquarters;
- DEQ regional office staff;
- Environmental contractors;
- Laboratory contractors; and
- DEQ Laboratory Program staff.

1.5.1 EPA Region 10's Project Officer

EPA's Project Officer will:

- Act as the overall project coordinator and decision-maker;
- Approve site-specific SAPs and reports for PA/SI projects before field work begins; and
- Award and manage cooperative agreement and amendments.
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1.5.2 Cleanup Program staff at DEQ's headquarters

Cleanup Program staff at DEQ's headquarters office will:

- Provide policy oversight and training;
- Provide technical assistance; and
- Secure funding.

1.5.3 DEQ Regional Office Staff

Cleanup Program staff in DEQ's regional offices will:

- Serve as Project Managers for PA/SI projects, and in some cases secure funding;
- Communicate with the EPA Region 10 Project Officer about project progress and to work out any problems that arise;
- Develop site-specific SAPs, assemble project teams, implement field work, and coordinate sample analyses for PA/SI projects;
- Obtain approval for site-specific SAPs from the EPA Region 10 Project Officer before field work begins;
- Train environmental contractors on the requirements of this PA/SI Quality Assurance Project Plan (QAPP) and site-specific SAPs;
- Review and approve site-specific SAPs (and potentially QAPPs) prepared by DEQ's environmental contractors performing work for the agency on PA/SI projects;
- Oversee environmental contractor field implementation, including sample management, for PA/SI projects;
- For projects performed by DEQ staff, communicate project Data Quality Objectives (DQOs) to contract laboratories analyzing samples collected during PA/SI projects;
- Develop objectives for the sampling program and verify that the sampling program is designed to meet those objectives, and that sampling objectives are described in the project SAP;
- Assess laboratory performance in satisfying the specified project DQOs;
- Initiate Technical Assessments of the performance of environmental contractors and contract laboratories on a scheduled basis or as warranted;
- Prepare and/or review reports evaluating and summarizing PA/SI activities, sample results, and recommending further actions if any; and
- Update DEQ's Environmental Cleanup Site Information (ECSI) database in a timely manner.

1.5.4 Environmental Contractors

Within the scope of their project involvement, environmental contractors conducting field work for PA/SI projects will:

- Develop site-specific SAPs in accordance with this QAPP, working closely with the DEQ Project Manage to ensure sampling objectives will be met by the sampling program;
- Communicate DQOs to contract laboratories analyzing samples collected during PA/SI projects;
- Assemble project teams, implement field work, and coordinate sample collection and analyses;
- Verify the proper functioning of all equipment before beginning field activities;
- Ensure that the proper number, type, and quantity of sample containers, including preservation requirements, are available for field activities;

- Follow standard sampling protocols as defined in this QAPP or the site-specific SAP;
- Record all field data in the manner specified in this QAPP;
- Following applicable Standard Operating Procedures (SOPs), ensure that all samples are collected, preserved, labeled, packaged, and shipped to laboratories in a manner acceptable to the EPA Region 10 Project Officer; and
- Prepare reports evaluating and summarizing PA/SI activities, sample results, and further-action needs.

1.5.5 Laboratory Contractors

Contract laboratories analyzing and reporting on samples collected for PAs and SIs will:

- Understand and follow the sampling procedures and DQOs outlined in this QAPP and site-specific SAPs;
- Perform requested analyses using appropriate test methods specified in the QAPP and SAP;
- Satisfy all laboratory and analytical Quality Assurance/Quality Control (QA/QC) objectives and activities;
- Prepare laboratory reports for the DEQ Project Manager or environmental contractor project officer, including all relevant data and QC reports;
- Perform data validation consistent with QA requirements set forth in this plan and site-specific project plans.
- Provide electronic data deliverables (EDDs), on request from the DEQ PM, in a format specified by the DEQ PM.

Communicate any analytical problems, issues, or concerns to the DEQ Project Manager and/or environmental contactor in a timely manner; and

- Initiate corrective action when deficiencies in sample collection, preservation, handling, test methods, or documentation are identified internally, by the contract laboratory, by the DEQ Project Manager, or by the EPA Region 10 Project Officer.

1.5.6 DEQ Laboratory and Environmental Assessment Program (LEAP) Staff

DEQ's LEAP staff will:

- Assist in the preparation and evaluation of site-specific SAPs and DQOs;
- Provide technical assistance as needed to agency or contractor staff;
- Assist with training on proper sample collection, preservation, handling, and documentation requirements;
- File and maintain originals of the approved PA/SI QAPP;
- If requested, perform required test methods on samples in accordance with this QAPP;
- Prepare laboratory reports and/or QA reports for DEQ Project Managers, including data validation, if requested;
- Review contract laboratory analytical results and QC data, if requested;
- Where applicable, report deficiencies in sample collection, preservation, handling, test methods, or documentation to the DEQ Project Manager and/or environmental contractor; and
- Initiate and support technical audits and corrective action that may arise from deficiencies in sample collection, preservation, handling, test methods, or documentation.

1.6. Problem Definition/Background

The Preliminary Assessment (PA) and Site Inspection (SI) are used to evaluate the potential release of hazardous substances at a site. During the limited-scope investigation of the PA, readily available information about a site and the surrounding areas, including potential contamination and targets/receptors is gathered to differentiate between sites that pose little or no threat to human health or the environment and those that may pose a serious threat and require further investigation. A limited number of samples may be collected during a PA, although this is not required by EPA. Information gathered during the PA will be used to determine a preliminary Hazard Ranking System (HRS) score for the site. If the PA determines that further investigation is warranted, a SI is conducted. The SI typically involves the collection and analysis of environmental samples to determine whether sources of contamination is present and if targets/receptors are impacted. This information will be also be used to determine a Hazard Ranking System (HRS) score for the site. With this QAPP in place, DEQ or contractor staff need prepare only a streamlined sampling and analysis plan that incorporates this QAPP by reference for EPA-funded PA/SI projects covered by this QAPP. Moreover, approval of this PA/SI QAPP authorizes DEQ to conduct and oversee sampling activities at sites covered by site assessment grants from EPA. This authority derives from EPA's approval of DEQ's Quality Management Plan (QMP).

DEQ will use data obtained under this QAPP and site-specific SAPs to evaluate the nature and magnitude of contamination at sites that are pre-approved by the EPA Project Officer. Sampling activities may be performed in more than one event, depending on sample results and EPA funding limitation.

Media to be sampled most frequently under this QAPP are:

- Soil;
- Groundwater; and
- Soil gas.

Additional media that may be sampled infrequently under this QAPP are:

- Sludge;
- Sediment;
- Porewater;
- Surface water;
- Air; and
- Man-made materials such as concrete.

Categories of contaminants to be analyzed for typically include:

- Volatile and semi-volatile organic compounds;
- Pesticides and herbicides;
- Polychlorinated biphenyls (PCBs);
- Polychlorinated Dioxins and polychlorinated furans; and
- Metals.

This QAPP is applicable to any EPA-funded PA/SI project that DEQ conducts in Oregon.

Site-specific SAPs should define the problem/background for each individual project and define the goals of the sampling program. Site plans, maps, and other supporting documentation should be included with the completed SAP.

1.7. Project Task/Description

This QAPP defines the duties and responsibilities of staff at DEQ, environmental and laboratory contractors, and DEQ Laboratory staff involved in PA/SI projects funded by EPA. The objective of all

QA activities is to ensure that data obtained from PA/SI projects are of known quality, represent actual site conditions, and are adequate and appropriate for making informed environmental decisions, including whether the subject sites are eligible for NPL listing. In general, PA/SI projects will include the following tasks:

- Development of the appropriate SAP;
- Approval of the SAP;
- Collection of background information;
- Sample collection;
- Laboratory analysis;
- Data verification and validation;
- Data assessment; and
- Preparation of a final report.

1.7.1 Sampling and Analysis Plans

Site-specific SAPs must describe field activities, including the elements listed below. As appropriate, the SAP can incorporate by reference standard operating procedures for any of these elements.

- A description of the project with relevant background information.
- A list of project members, their responsibilities, and contact information.
- A description of the sampling plan, including the location, number, and type (i.e., soil, water, air, etc.) of samples to be collected.
- Sample collection procedures and rationale.
- Field documentation procedures.
- Management procedures for investigation-derived wastes (IDW) that may be generated.
- Field equipment calibration and analyses.
- The number and type of QC samples to be collected and submitted for analysis (e.g., trip and rinsate blanks, duplicate samples, matrix spikes and duplicates, etc.). The collection rate for quality-control samples may not be less than 5% (one QC sample from all appropriate QC categories for every 20 field samples). Regardless of the number of samples collected, at least one rinsate blank and one field duplicate should be collected for each media sampled for each field event.
- The analytical methods that laboratories analyzing the samples must use, and the minimum detection limits they must achieve.
- The analytical QC elements (e.g., laboratory blanks, laboratory replicates, fortified samples, etc.) and assessment criteria that the laboratories must meet, if these differ from those described in the laboratories' quality systems manual. The default laboratory QC requirements for analyses of samples from PA/SI projects appear in Table 1.
- Reporting requirements and formats for laboratory data (e.g., reporting units, electronic or printed formats, data flagging, etc.); all laboratory data must be accompanied by supporting QC data and a discussion about data quality.
- Special safety or cautionary information.
- Any additional sampling, analytical, or QA/QC requirements that deviate from those established in this QAPP.

1.8. Quality Objectives and Criteria

The purpose of this section is to provide qualitative and quantitative guidelines that should be used to define sampling goals and DQOs of site-specific SAPs for PA/SI projects.

The primary goals of sampling and analysis for PA/SI projects include: 1) providing valid data of known and documented quality to meet the defined objectives of any sampling program or other assessment, which may include characterization of sources; 2) determining off-site migration of contaminants; 3) gathering data that EPA uses to determine whether sites are eligible for EPA's National Priority (Superfund) List; or 4) documentating any threats or potential threats that site contamination may pose to human health or the environment.

Data for PA/SI projects must be of known quality as defined by the standard Data Quality Indicators (DQIs) presented in the EPA *Guidance for Quality Assurance Project Plans* (EPA/240/R-02/009), *Guidance on Systematic Planning Using the Data Quality Objectives Process* (EPA/240/B-06/001), and *Data Quality Objectives Process for Hazardous Waste Site Investigations* (EPA/600/R-00/007). Data quality, as defined by the DQIs, is a function of both field and laboratory operations and can be addressed through the following seven elements, each of which is described in detail below:

- Precision;
- Bias;
- Accuracy;
- Representativeness;
- Comparability;
- Completeness; and
- Sensitivity.

1.8.1 Precision

Description: Precision is a measure of the scatter of the data when multiple measurements are made on the same property under identical, or substantially similar, conditions. Precision is generally reported as a range or standard deviation; however, it may also be expressed as a percentage of a mean or a relative standard deviation. Appropriate methodologies for measuring precision may include:

1. Duplicate (or collocated) samples collected in the field and submitted to a single laboratory and analyzed by identical methods that are used to assess precision attributable to sampling activities.
2. Replicate lab analyses performed on subsamples of a single sample by one laboratory following identical laboratory procedures to assess data variability attributable to laboratory analysis.
3. Replicate lab analyses performed on subsamples of a single sample by different laboratories following identical laboratory analytical procedures.
4. Replicate lab analyses for a specific property (or analyte) on subsamples of a single sample by one laboratory using different analytical technologies.

Subsamples used for replicate analyses may be split in the field by the sample collectors or by the analyzing laboratory.

Frequency: All PA/SI projects should include at least one duplicate or collocated sample (option 1) for every 20 samples collected by matrix. Replicate laboratory analyses by a single laboratory using a single analytical method (option 2) should be performed at a frequency of 10%. The Project Manager should specify if higher frequencies are required. Precision measurement options 3 and 4 are not required, but may be included at the discretion of the Project Manager; the frequency and control limits for these

samples should be specified in the SAP. Site-specific SAPs may specify the frequency of sample splitting, and indicate which samples are to be replicated.

Control Limits: Unless otherwise specified in a site-specific SAP, for concentrations or measurements that are five times greater than the method reporting limit (MRL), the control limit for precision measurement options 1, 3, and 4 is set at a relative percent difference (RPD) of 20%. For concentrations or measurements less than five times greater than the MRL, the control limits are set at a difference no greater than twice the absolute value of the difference. Precision measurements above these control limits should be confirmed or disproved through a corrective-action investigation. The Project Manager may set looser or stricter quality-control limits in site-specific SAPs. Control limits may be varied based upon sampling location, sample matrix, analytical method, and/or analyte/property of measurement. The analytical laboratory will determine its own control limit for precision measurement 2. Until the analyzing laboratory has collected sufficient data, it is acceptable to arbitrarily set the control limit to that presented in the cited method.

A Matrix Spike/Matrix Spike Duplicate (MS/MSD) pair may be used for precision measurements for analyses where contaminants are not routinely detected.

Reporting: Each analytical laboratory must report precision data with its analytical results. Upon request from EPA, DEQ's QA section will review precision data and summarize all findings in a QA report.

1.8.2 Bias

Description: Bias is a systematic or persistent distortion of the measurement process (including sample collection) that results in errors in one direction. Bias is generally identified with the precision and accuracy measurements.

Reporting: The QA report will include a statement of data bias if bias is observed during data validation.

1.8.3 Accuracy

Description: Accuracy is a measure of the difference between observed test results and true sample concentrations. Inasmuch as true concentrations are not known, accuracy is inferred from recovery data determined from the analysis of standard reference materials (SRMs) and by matrix spikes (MS). Some organic methods require surrogate spikes on each sample, from which accuracy is assessed.

Frequency: Unless specified in the SAP, the analytical laboratory is not required to spike samples collected from a PA/SI project. However, accuracy will be assessed from other samples of the same analytical matrix that were spiked and analyzed by the laboratory at the same time. The frequency of MSs must be at least 5%. In the absence of MS samples, accuracy must be assessed using SRMs at a frequency of at least 5%. A site-specific SAP may specify different frequencies and/or require specific samples from the project to be spiked.

Control Limits: The analyzing laboratory will determine its own control limits based on its own laboratory data. Until the analyzing laboratory has collected sufficient data, it is acceptable to arbitrarily set the control limit to that presented in the cited method. For those methods that do not, the default accuracy limits for inorganic parameters is 100 ± 20% recovery for spikes, and 100 ± 10% recovery for standard reference materials. For organic parameters, the default accuracy is ± 30% for standard reference materials, and 100 ± 50% for matrix spikes.

Reporting: Each analytical laboratory will report accuracy data with its analytical results. When requested, the DEQ QA section will review the accuracy data and summarize all findings in a QA report.

1.8.4 Sensitivity

Description: Sensitivity is the ability of an analytical method and/or instrument to discriminate between measurement response representing different levels of the variable of interest. Sensitivity will be expressed by the analytical laboratory for each analyte-matrix-method combination of interest as the Method Detection Limit (MDL), as defined by 40 CFR Part 136, Appendix B[1], and the Method Reporting Limit (MRL) (or Limit of Quantitation LOQ[2]). The analytical laboratory must have a statistically determined MRL that is greater than the MDL and is at least 10 times lower than the decision level. The decision levels (required MRLs and MDLs) for a project are based on concentrations in the risk based concentration (RBC) tables for the specific pathways of concern. **The site-specific SAP will identify these decision levels for each analyte-matrix that will be sampled.** Sensitivity will also be assessed by the analysis and reporting of Laboratory Control Samples at or below the decision level.

Frequency: MDLs and MRLs will be determined by the laboratory initially with the development of any new analytical methods or whenever any major changes in procedure or equipment occur. A Laboratory Control Sample must be analyzed at a concentration equal to or less than the concentration of interest with every analytical batch.

Control Limits: Percent recovery of the LCS should be within 80-120%, unless specified otherwise in a site-specific SAP. Each analytical laboratory must have an acceptable MDL study on file prior to the analysis of any PA/SI project samples submitted for analysis. Moreover, this data must be available for review upon request of the DEQ QA section and/or Project Manager.

Reporting: The analytical report submitted by the analyzing laboratory must include its MRLs and the results of the LCS analyses (and the percent recovery). The QA section will review the LCS results submitted with the analytical data, the MDL, and MRLs, as well as other supporting analytical data to assess the sensitivity of the analytical methodology and analytical results. Conclusions will be included in the QA summary report.

To meet these specific DQI objectives, field personnel and laboratories analyzing samples must perform and retain sufficient notes and QC documentation to demonstrate and support the level of data quality required for these projects. Before initiating any PA/SI project, contractors tasked for field work, analytical work (i.e., laboratories), and data-assessment activities must submit a Quality Management Plan (QMP) or Quality Systems Manual for DEQ approval. The QMPs of contractors responsible for planning, field work, and data assessment should adequately describe their policies and procedures for ensuring data quality in their activities, including, but not limited to: 1) their QA policy; 2) a description of their Quality Management System structure; 3) Quality Management System activities; and 4) document- and record-management procedures. Laboratories analyzing samples must have a quality system that meets the requirements in the standards developed by The NELAC Institute and adopted by the Environmental Laboratory Accreditation Program (NELAP) (http://www.nelac-institute.org).

[1] MDL as defined in 40 CFR part 136 – 2017 EPA Method Update Rule.

[2] LOQ as described in the 2009 or 2016 TNI standard for laboratory accreditation.

Table 1 Field and Laboratory QC Elements and Assessment Criteria

	QC Element	Frequency	Media#	Analyte Type*	Criteria
Field QC	Trip Blank	1 per cooler	All	Organic	Only required when collecting VOCs
	Rinsate Blank	5% for each media sampled (but at least one sample per field event)	All	All	< method reporting limit, **or** <10% of the lowest concentration identified in any sample
	Field Duplicate	5% for each media sampled (but at least one sample per field event)	Air, water	Inorganic	RPD +/- 20% for concentrations > 5X the MRL, **or** Absolute difference ≤ MRL for average concentrations ≤ MRL
				Organic	RPD +/- 35% for concentrations > 5X the MRL, **or** Absolute difference ≤ MRL for average concentrations ≤ MRL
			Solids, non-aqueous liquids	Inorganic	RPD +/- 35% for concentrations > 5X the MRL, **or** Absolute difference ≤ MRL for average concentrations ≤ MRL
				Organic	RPD +/- 50% for concentrations > 5X the MRL, **or** Absolute difference ≤ 2X MRL for average concentrations ≤ MRL
Laboratory QC	Method Blank	5% for each preparation	All	All	< method reporting limit or <10% of the lowest concentration identified in any sample
	Laboratory Duplicates or Matrix Spike Duplicates	5% for each media sampled	Air, water	Inorganic	RPD +/- 20% for concentrations > 5X the MRL, **or** Absolute difference ≤ MRL for average concentrations ≤ MRL
				Organic	RPD +/- 35% for concentrations > 5X the MRL, **or** Absolute difference ≤ MRL for average concentrations ≤ MRL
			Solids, non-aqueous liquids	Inorganic	RPD +/- 35% for concentrations > 5X the MRL, **or** Absolute difference ≤ MRL for average concentrations ≤ MRL
				Organic	RPD +/- 50% for concentrations > 5X the MRL, **or** Absolute difference ≤ 2X MRL for average concentrations ≤ MRL
	Laboratory Fortified Sample (Matrix Spike)	5% for each preparation	Air, water	Inorganic	Recovery: 80-120%
				Organic	Recovery: 60-140%
			Solids, non-aqueous liquids	Inorganic	Recovery: 70-130% for at least 80% of the analytes
				Organic	Recovery: 50-120% for at least 80% of the analytes
	Surrogates	Each sample	All	Organic	Recovery: 30-150%
	Laboratory Control Sample	1 per analytical batch	All	Inorganic	Recovery: 85-115%
				Organic	Recovery: 70-130%

Notes:

#Water applies to all aqueous media containing less than 15% settleable solids, including drinking water, groundwater, surface water, waste effluent, etc. Solids applies to all aqueous media containing 15% or more settleable solids, including soils, sediments, and sludges. Non-aqueous liquids applies to any non-water substance containing less than 15% solids, including solvents, fuels, oils, etc. Air applies to all media in the gaseous state at ambient conditions at the time of sampling.

*Inorganic analytes include all metals, nutrients, anions. Organic analytes include petroleum hydrocarbons, volatile/semi-volatile organic compounds, pesticides, herbicides, PCBs, and dioxins/furans. Not all analytes may be covered by this list. For additional information, contact the QA chemist at the DEQ laboratory.

1.8.5 Representativeness

Description: Representativeness is a measure of how closely observed test results for a given sample matrix reflect actual site conditions. Representativeness is ensured by designing and following sampling procedures so that the final analytical results are appropriate for the matrix being measured and represent what the sample was collected from in the field. Sample handling protocols such as storage, preservation, sample processing and sub-sampling, and transportation described in both sampling and analytical SOPs have been developed to preserve the representativeness of collected samples.

Since special or unusual sample conditions might affect the accuracy of an analysis, it is helpful to have information about the sample matrix. Results of such matrix tests may give additional insight into the representativeness of the analyses. Tests describing the sample matrix may be requested on a site-specific basis.

When appropriate, other QA tools such as ion balance reports, solid balances, conductivity-dissolved solid comparisons, etc. will be used to establish the representativeness of the data.

Reporting: Field and laboratory documentation will be used to confirm that proper sampling and analytical protocols have been followed. Trip blanks, rinsate blanks, and field duplicates will be used to assess whether field and transport activities may have impacted the representativeness of the sample. Laboratory QC will also be evaluated to ascertain if the analytical results are representative.

The DEQ QA section and Project Manager will review field and analytical notes and data to ensure that representativeness is maintained. Conclusions will be included in the final project report.

1.8.6 Comparability

Description: Comparability is a qualitative term that expresses the degree to which data accurately and precisely represent a characteristic of a population, parameter variation at a sampling point, a process condition, or an environmental condition. Comparability is determined by reviewing sampling collection and handling methods, sample preparation and analytical procedures, holding times, stability issues, and QA protocols. The development of new field or laboratory methods requires validation against accepted reference methods before being adopted. Method performance data from analytical laboratories must be available for review upon request of the DEQ QA section or Project Manager. The analyzing laboratory will measure comparability of test methods not cited in EPA or agency documentation by evaluating inter-laboratory splits and/or alternate test procedures.

1.8.7 Completeness

Description: Completeness measures the amount of valid data obtained from the sample collection and analytical measurement systems compared to the quantity expected. Completeness is defined as the total number of samples taken for which valid analytical data are obtained, divided by the total number of samples collected, multiplied by 100. At least 90% of all samples tested (for each analyte) should yield valid data.

Reporting: A completeness statement should be reported in QA reports written by the QA section.

1.8.8 Modeling

If the project includes modeling, it must be described in the project QAPP or SAP. Include how not detected results are handled (e.g. counted as 0, ½ the MRL or MRL, or imputation methods). A basic description of likely modeling methods should included and the number or type of samples needed to control variability using those methods (e.g., regression, hypothesis tests or simulations, etc).

1.9. Special Training and Certification

Field activities pose certain risks. Staff must obtain the proper training to recognize, and protect themselves from, hazardous chemicals known or suspected to be present at contaminated sites. Staff with questions about risks they might be dealing with should use existing resources (*e.g.*, Material Safety Data Sheets [MSDS], literature, laboratory staff) and contact the appropriate authority (*e.g.*, DEQ's Health & Safety Manager, Laboratory Managers, or Safety Committee). DEQ's Safety Committee continually reviews health and safety needs. The Health & Safety Manager can recommend and supply the most appropriate personal protective equipment for work at specific sites, and is responsible for managing the respiratory protection program.

Safety and training courses relevant to PA/SI projects, and, more broadly, for hazardous-substance site investigations, are readily available. All DEQ field personnel and environmental contractors conducting PA/SI investigations are required to have appropriate OSHA health and safety training for hazardous waste sites, supplemented by annual refresher courses. In addition, DEQ staff must have attended EPA's PA training or equivalent. Contractors are responsible for ensuring that their personnel are informed about and trained on relevant OSHA guidelines. For sites where DEQ staff perform field activities, a site-specific Health and Safety Plan (HASP) will be approved by DEQ's Health and Safety Manager and the appropriate Program Manager before field work begins. For sites where an environmental contractor performs field activities, the contractor will prepare and approve its own HASP.

1.10. Documentation and Records

1.10.1 Introduction

Documents and records produced during PA/SI projects must be properly managed. Documents and records typically produced may include, but are not limited to:

- Site-specific SAPs;
- Preliminary Assessment and/or Site Inspection reports;
- Field notes and records;
- Chain-of-custody forms;
- Laboratory analytical reports;
- Field and laboratory QC data;
- Data validation reports; and
- Records of communication such as phone logs, memos, e-mails, or other written correspondence.

All documents associated with a specific project will be filed with the Project Manager and will be uniquely identified by the Site ID number in DEQ's ECSI database. Project records will be maintained in both printed and electronic formats whenever practicable. Printed records[1] serve as the official record and will be maintained in the site's ECSI file for a period of no less than 30 years after site closure or otherwise as according to the DEQ Record Retention Schedule. Electronic records, wherever possible, will be maintained in write-protected formats such as the Portable Document Format (.PDF). In maintaining and archiving these electronic records, Project Managers will follow any guidance and procedures that DEQ's Cleanup Program has established for electronic records.

[1] Printed records may be converted to electronic format and designated as the official record and maintained for 30 years or as according to the DEQ Record Retention Schedule. If this is done, all security protections must be in place to conform with agency records policies.

Each contracted organization must have its own record-keeping system to present, organize, and store data. This system should be described in each organization's QMP or Quality Systems Manual (however named). The described record-keeping system must permit the historical reconstruction of all activities that produced the resultant sample analytical data. The history of the sample must be readily understood through the documentation. This includes field and inter-laboratory transfers of samples and/or extracts.

Each laboratory must document its record-handling policies in its Quality System Manual. Samples submitted to laboratories from PA/SI projects must be accompanied by a Chain of Custody form that identifies each sample, its location, date/time of collection, collector's name, preservation type, sample type, requested analytes, and any special remarks concerning the sample. The Chain of Custody form(s) for each contracted laboratory must be adequate for potential enforcement purposes, and must be reviewed and approved by the DEQ Project Manager before field activities begin.

1.10.2 Required Project Documentation

Each contract laboratory must have a documented sample acceptance policy (usually in its Quality Systems Manual). This policy must describe the minimum data elements for samples submitted to the laboratory for analyses. The policy should state that the following conditions will be met for all samples received at the laboratory:

- proper, full, and complete documentation, which includes sample identification, the location, date and time of collection, collector's name, preservation type, sample type and any special remarks concerning the sample;
- proper sample labeling to include unique identification and a labeling system for the samples with requirements concerning the durability of the labels (water resistant) and the use of indelible ink;
- use of appropriate sample containers;
- adherence to specified holding times;
- sufficient sample volume to perform the necessary tests; and
- procedures to be used when samples show signs of damage, contamination or inadequate preservation.

Sample(s) failing to meet the above criteria may be analyzed, depending on the circumstances, but the data will be *clearly flagged* when reported as having been compromised due to a deficiency in one or more of the elements listed above. Release of data from compromised samples will be deferred, awaiting the necessary documentation.

Documentation of any of missing information or instructions may be furnished to the laboratory *in writing* at any time up to the release of the data by the laboratory. When all sample acceptance criteria are met, the qualifying data flag will be expunged from the report, provided the quality of the data has not been compromised.

1. Complete sample documentation must be provided, including:
    - Unique sample identification;
    - Sample location;
    - Sample matrix (e.g., liquid, solid, sludge, sediment);
    - Sample classification (grab, continuous, composite);
    - Date and time of collection;
    - Sampler’s name(s);
    - Analytes to be analyzed and, when appropriate, the specific analytical method; and
    - Special remarks describing the sample, if appropriate.

2. Adequate quantities of properly preserved sample material must be supplied to accommodate analytical tests requested by the collector, as stipulated in a SAP. Exceptions, such as allowing analyses of improperly preserved samples or using non-standard quantities (i.e., processing samples with less volume than stated in the laboratory's SOPs), may be allowed at the discretion of laboratory management and approval of the DEQ Project Manager. Changes will be noted in the final report.

3. Every PA/SI project will include a SAP with the following:

   - A brief site description;
   - Description of contaminants of concern, sampling rationale, and sample locations;
   - Number of samples by matrix, including QA (duplicates, matrix spikes & duplicates, blanks, etc.);
   - Anticipated field work schedule;
   - Name of the DEQ Project Manager;
   - Name of the person to whom the data are to be reported;
   - Analyses requested; and
   - Detection limits needed (e.g., EPA Regional Screening Levels (RSLs) or DEQ Risk-Based Concentrations (RBCs), drinking water Maximum Contaminant Levels (MCLs), Toxicity Characteristic Leaching Procedure (TCLP), etc.
   - Documentation of changes to the original site specific sampling plan (if there are any changes).

4. Laboratory analytical reports must include the following information:

   - A QA summary of the report, including a discussion of sample conditions upon arrival, as well as any QA/QC issues that may have arisen during analysis.
   - Complete result package that identifies the result, the units, and any qualifying data flags.
   - A complete QC package for each analyte-matrix combination that includes the QC data identified by the project's DQOs and DQIs.

1.10.3 Corrections to Documentation

All original data recorded in field notebooks, chain-of-custody records, and other forms will be written in waterproof ink. None of these documents will be destroyed or discarded, even if they are illegible or contain inaccuracies that require a replacement document. If an error is made on a document assigned to one individual, that individual will make corrections by crossing a single line through the error, entering the correct information, and initialing the correction. Alterations or changes to SAPs, analytical reports, or any other formal written documentation will be accomplished by attaching an Erratum or Addendum to the *front* of the original document. All Errata and Addenda must be signed and dated by the DEQ Project Manager. Changes to electronic records must mirror appropriate changes in printed records.

2. Data Generation and Acquisition

2.1. Sampling Process Design

PA/SI investigations primarily involve sampling of subsurface soil and groundwater, and occasionally require sampling of surface soil, surface water, sediment, porewater, sludge, hard surfaces that are potentially contaminated (e.g., concrete), or air (soil gas or vapors).

From a QA/QC standpoint, the primary purpose of PA/SI sampling is to generate sufficient information for EPA to determine if further assessment is necessary. Data from PA/SI investigations may be used for enforcement purposes. As a result, all elements of sample collection, analysis, and reporting must be designed to withstand potential legal scrutiny.

Sampling plans for individual PA/SI sites are designed to document site conditions related to the known or potential releases of hazardous substances. PA/SI investigations are intended to include the collection of enough samples to determine if historic releases have occurred, and if resulting contamination is likely to be present above background levels.

Field sampling personnel will make arrangements with their laboratory for proper sample containers, sampling request forms, and sampling equipment at least two weeks before field work begins. All projects involving the collection and analysis of samples should be described in a site-specific QAPP or SAP. All QAPPs or SAPs must be reviewed and approved by the appropriate DEQ Manager or his/her designee, the DEQ QA Officer, and the EPA Project Officer. Document the review using the *QA Project Plan or Sampling Plan Review Checklist* DEQ15-LAB-0016-FORM. Available on DEQ's Intranet site: (http://deqsps:808/lab/documents.asp)

Equipment should be assembled based on the type of samples to be collected. Preparation and assembly of required equipment and materials should follow these steps:

1. All equipment will be checked for proper calibration, assembly, and operation before use.
2. Sampling equipment will be transported in such a manner as to maintain its cleanliness.

To the greatest extent possible, disposable and/or dedicated personal protective and sampling equipment will be used to avoid cross-contamination. All sampling equipment will be cleaned between sample locations. Decontamination will be conducted in a central location, upwind and away from suspected contaminant sources. Investigation-derived wastewater (IDW) from decontamination of soil probing or augering equipment, if used, will be stored in 55-gallon drums prior to disposal. A water sample will be collected from the IDW and analyzed for disposal purposes. The following procedures will be used for all equipment used to collect routine samples undergoing trace organic or inorganic constituent analyses:

1. Clean with tap water and nonphosphate detergent using a brush if necessary to remove particulate matter and surface films. Equipment may be steam-cleaned (using high-pressure hot water) as an alternative to brushing. Sampling equipment that is steam cleaned should be placed on racks or saw horses at least two feet above the floor of the decontamination pad. PVC or plastic items

should not be steam cleaned.[1]
2. Rinse thoroughly with tap water.
3. Rinse thoroughly with analyte-free water.
4. Rinse with a 10% nitric acid/deionized water mix, if the sample will be analyzed for trace inorganics. Do not rinse PVC or plastic items with acid.
5. Rinse thoroughly with analyte free water.
6. Rinse with a pesticide-grade acetone/deionized water mix if the sample will be analyzed for organics.
7. Rinse again with distilled/deionized water.
8. Air-dry the equipment completely.
9. Remove the equipment from the decontamination area and cover with plastic. Equipment stored overnight should be wrapped in aluminum foil and covered with clean, unused plastic.

a) Parameter-Specific Sampling Requirements

Parameter-specific sampling requirements, including container type, preservation requirements, and holding times, will be documented in a site-specific SAP whenever they depart from those defined in the DEQ *Field Sampling Reference Guide*, Doc ID# DEQ86-LAB-0002-QAG, available internally on DEQ's intranet site: http://deqsps:808/lab/documents.asp. Exceptions to standard sampling requirements may be made with written approval of the DEQ Project Manager.

The order of sample collection, regardless of the matrix, should be from the most volatile to the least volatile, as follows:

1. VOCs;
2. SVOCs (PAHs);
3. Chlorinated phenolics;
4. Pesticides and PCBs;
5. Total recoverable metals; and
6. Cyanide.

2.2. Sampling Methods

All samples must be collected in a manner consistent with the media being sampled and the analytes of interest. Collection methods must follow a DEQ or EPA-approved sampling protocol. Additional methods may be used with the approval of the Project Manager. Some sources for the appropriate sampling methods include:

- DEQ LEAP *Water Monitoring and Assessment Mode of Operations Manual* - describes collection methods for surface waters, groundwaters, sediments, benthic infauna, fish, benthic macro invertebrates, and aquatic invertebrates.
- EPA SW-846, Chapter 10 - describes sampling techniques for various media, including soils, sediments, air, water, etc.

It is important to use proper sample containers and appropriate preservation techniques when collecting samples. Samples should always be collected in containers supplied by the analyzing laboratory. This ensures that the container has been properly cleaned and that the analyzing laboratory will have sufficient sample material to do the requested test. Samples submitted to the laboratory that are not in a laboratory-

[1] See SOP for Field Equipment Cleaning and Decontamination, EPA Region 4 Science and Ecosystem Support Division (2015) - https://www.epa.gov/sites/production/files/2016-01/documents/field_equipment_cleaning_and_decontamination205_af.r3.pdf

supplied container (e.g., mayonnaise, pickle, or peanut butter jars) are likely to be rejected. Samples must also be properly preserved, or they may be rejected. Table 2 summarizes required sample containers, preservation techniques, and holding times for the most commonly requested analytes in PA/SI investigations. For information about analytes not listed in Table 2, check with the analyzing laboratory. If a required sampling or field method is not documented in either of the documents referenced above, the appropriate Standard Operating Procedure (SOP) must be identified or developed, and then approved before initiating field activities.

Specific sampling methods for media of interest are discussed in greater detail in Sections 2.2.2 to 2.2.6.

Table 2 Sample Containers, Preservation, and Holding Times ‡

PARAMETER	CONTAINER (1)	PRESERVATIVE	HOLDING TIMES
Volatile Organics, including BTEX & MTBE and NWTPH-Gx (and NWTPH-HCID)			
Liquids	(2 or 3) x 40-ml vials with Teflon-lined septum caps	4 drops conc. HCL to pH <2 Cool, ≤ 6°C No headspace	14 days
	(2 or 3) x 40-ml vials with Teflon-lined septum caps	Cool, ≤ 6°C No headspace	7 days
Solids	2 x 40ml pre-tared VOA vials with Teflon-lined septum caps containing approx 5 g sample and: a) low level: 10 mL DI water or empty,	Cool, ≤ 6°C / -7°C	48 hrs /14 days
	b) high level: 10 mL Methanol	Cool, ≤ 6°C	14 days
Pure Product	One 40-ml vial with Teflon-lined septum caps	Cool, ≤ 6°C	14 days
Air	Consult specific analytical method		
Semi-Volatile Organics, including Chlorinated Phenols			
Liquids	1-Liter brown/amber glass jar with Teflon liner	Cool, ≤ 6°C	7 days to extraction; 40 days thereafter
Solids	4 to 8 oz brown/amber glass jar with Teflon liner (widemouth)	Cool, ≤ 6°C	14 days to extraction; 40 days thereafter
Air	Consult specific analytical method		
Fuel-Range Hydrocarbons (NWTPH-Dx)			
Liquids	1-Liter brown/amber glass jar with Teflon liner	4 drops conc. HCl to pH<2 Cool, ≤ 6°C	14 days
Solids	4 to 8 oz amber or clear glass widemouth jar with Teflon liner	Cool, ≤ 6°C	14 days
Air	Consult specific analytical method		
PCBs, Chlorinated Pesticides, and Dioxins/Furans			

PARAMETER	CONTAINER (1)	PRESERVATIVE	HOLDING TIMES
Liquids	1-Liter brown/amber glass jar with Teflon liner (widemouth)	Cool, ≤ 6°C	7 days extract analysis within 40 days of extraction – Pest. 1 yr. - PCB, Dioxins/Furans
Solids	4 to 8 oz brown/amber glass jar with Teflon liner (widemouth)	Cool, ≤ 6°C	14 days extract, analysis within 40 days of extraction – Pest 1 yr – PCB, Dioxins/Furans
Air	Consult specific analytical method		
Organophosphorus Pesticides			
Liquids	1-Liter brown/amber glass jar with Teflon liner (widemouth)	Adjust pH to 5-8 with NaOH or H_2SO_4 Cool, ≤ 6°C	7 days to extraction; analysis within 40 days of extraction
Solids	4 to 8 oz brown/amber glass jar with Teflon liner (widemouth)	Cool, ≤ 6°C	7 days to extraction; analysis within 40 days of extraction
Air	Consult specific analytical method		
Metals (except Cr^{+6} and Hg)			
Liquids	250-ml polyethylene	Total aqueous - unfiltered Dissolved aqueous - filter on-site (15 min) HNO_3, pH<2*	6 months
Solids	Polyethylene or glass jar	None	6 months
Air	Consult specific analytical method		
Hexavalent Chromium (Cr^{+6})			
Liquids	250-ml polyethylene	Cool, ≤ 6°C	24 hours
Solids	Polyethylene or glass jar	Cool, ≤ 6°C	30 days to extraction; 7 days after extraction
Air	Consult specific analytical method		
Mercury (2)			
Liquids	250-ml polyethylene	Total aqueous - unfiltered Dissolved aqueous - filter on-site(15 min) HNO_3, pH<2*	28 days
Solids	Polyethylene or glass jar	Cool, ≤ 6°C	28 days
Air	Consult specific analytical method		
Cyanide			
Liquids	1000-ml polyethylene	NaOH pellets, pH>12 Cool, ≤ 6°C	14 days
Solids	4 to 8 brown/amber glass jar with Teflon liner	Cool, ≤ 6°C	14 days
Air	Consult specific analytical method		

‡Always consult the specific analytical method for special sample collection, handling, and storage requirements.

Cool ≤ 6ºC implies samples are held above freezing and at or below 6ºC.

(1) Collect duplicate containers on at least 5% of the water samples for matrix spike/matrix spike duplicate analysis.

(2) Methyl mercury - consult with the analytical laboratory.

* Samples may be shipped unacidified and the lab acidify the samples at the time of receipt. In this case, the samples must be held for 24 hours after acidification prior to subsequent processing (e.g. subsampling or preparation and analysis).

2.2.1 Sampling Soil

For discrete, (i.e., grab) samples, a stainless steel spoon may be used to collect samples from surface soils. Other sampling tools may be used as appropriate to the sampling procedure being employed. Subsurface soils can be collected during advancement of soil borings, during excavation of test pits using a variety of equipment including direct push technology, hollow stem, air rotary, or sonic drilling technology, excavation equipment or hand auger. Samples will be collected according to procedures outlined in *A Compendium of Superfund Field Operations Methods* (EPA/540/P-87/001).

All soil samples will be discrete samples, unless a site-specific plan has been developed to collect composite or incremental samples for a specified purpose. Soil samples should contain as few cobbles or stones as possible, unless the DEQ Project Manager wishes them to be included in the analysis. In this instance, the DEQ Project Manager must decide how the sample is to be processed to ensure appropriate inclusion of larger particles, such as sand or gravel (i.e., should samples be ground and subsampled to reduce particle size prior to extraction)? Composite sampling is achieved by collecting several roughly equal sub-samples and thoroughly mixing to form one sample. Soil sample compositing is generally not recommended at sites where VOCs are the contaminants of concern as volatiles may be lost during the extra sample handling required to composite samples.

Incremental sampling methodology (ISM) is not normally used for preliminary assessments but may be an appropriate way to evaluate certain sites during investigations. ISM is a structured composite sampling and processing protocol that can reduce data variability and provide a reasonable estimate of a chemical's mean concentration for an area/volume of soil being sampled. Representativeness is established by collecting numerous (typically 30 to 100) increments of soil that are combined, processed, and subsampled according to specific protocols. The use of ISM should be discussed with and approved by the DEQ Project Manager and EPA Project Officer.

For samples collected for VOC analysis, a sample of the soil should be collected following EPA Method 5035A using an extrusion tool. This procedure involves field extraction of approximately 5 grams of sample placed in a pre-tared vial containing preservative and with a septum-sealed screw cap. Once sealed, the sample is not exposed to the atmosphere until analysis is conducted. See DEQ Policy DEQ15-LQ-0053-QAG Ver1.1 "*Soil Sampling Requirements for Volatile Organics in Land Quality Programs*", http://www.oregon.gov/deq/FilterDocs/VOCpolicy.pdf.

a) Hand Augers

Hand augers can be used to collect soil samples to depths of about 10 feet. The sample is extruded into an aluminum or stainless steel pan followed by immediate placement into appropriate sample containers. Samples may be obtained from discrete depths by forcing the soil core from the auger and collecting soil from the depth of interest. The Project Manager for DEQ or the environmental contractor will assess whether a lined or stainless steel auger is necessary.

b) Test Pits, Excavations, and UST Removals

This pertains to test pits, large excavations to remove contaminated media, and actions to remove a UST system (tanks and pipes). Such excavation activities may be conducted by hand or more commonly with

heavy equipment such as a backhoe or excavator. For excavations that staff may enter safely, collect samples from the wall or floor of the excavated area after removing 1 inch of the exposed surface layer, and place the material directly into appropriate sample containers. Do not enter test pits deeper than 4 feet for sample collection; in these circumstances, use mechanized equipment to bring an undisturbed volume of soil to the surface. For excavations that cannot be entered by staff, collect samples from an undisturbed volume of soil using a backhoe or excavator bucket.

c) Boreholes

Subsurface soil samples can be collected from boreholes using a sampler specific to the drilling technology used (liners, split-spoon sampler), and transferred to appropriate lab-supplied jars. During drilling, cuttings or sample materials are sealed in a plastic bag and screened using a photoionization detector (PID) or a flame ionization detector (FID) to guide where samples should be collected. Perform all soil classifications using the ASTM D2487 Soil Classification Method.

2.2.2 Sampling Sediments

There are many factors to consider when choosing sediment sampling equipment, including, but not limited to: sample site access, sample volume requirements, sediment texture, and target depth for sediment collection. In general, piston samplers are best used for soft, fine-grained sediments where sediments at depth are required. Grab/dredge samplers are best for course, shallow sediments and where large volumes of sediment are required. Detailed information on sediment sampling is available in *Methods for Collection, Storage and Manipulation of Sediments for Chemical and Toxicological Analyses: Technical Manual* (EPA/823/B-01/002).

2.2.3 Sampling Sludge

Sampling of sludge could involve a variety of situations, and sampling equipment will be site-specific. One of the more common sludge-sampling situations is for catch-basin materials. Equipment might include stainless steel trowels or spoons, hand augers, or dredges. More information can be found in the SOP *Guidance for Sampling of Catch Basin Solids* H2M03-LQ-0054-SOP available on DEQ's intranet site.

2.2.4 Sampling Water

Water sampling is usually needed to determine whether hazardous substance releases have migrated to nearby surface water or groundwater. Physical evidence such as odors, organic films on the surface of water, and discoloration of soil in the vicinity of surface water or groundwater are indicators of likely contamination.

Surface water samples are typically acquired from streams, brooks, drainage ways, and wetlands determined to be downgradient (or downstream) from contamination sources. Groundwater samples are typically collected from wells screened within the uppermost aquifer, but may also be collected from deeper aquifers, and from nearby residential, industrial, irrigation, or municipal/community wells or from excavations.

Surface water and/or groundwater sampling events that are performed on a project-specific frequency require an approved site-specific SAP.

General procedures of the most common types of water sampling are described below. Additional sampling procedures may be found in the DEQ *Water Quality Monitoring (WQM) section's Mode of Operation Manual* (DEQ03-LAB-0036-SOP V3), which includes procedures for sampling rivers, streams, estuaries, lakes, groundwater wells, soil, shellfish, fish, and sediment.

a) Surface Water

Surface water samples are best collected using a stainless steel bucket. Before collecting a sample, the container should be rinsed out with water from the area to be sampled. Then collect a fresh sample. Avoid dipping sample bottles into the collection container, since residue from the outside surface of the bottle, or your hands, could contaminate samples and/or expose you to hazardous materials. Instead, pour from the collection container, with minimal agitation, into the sample bottle. If a stainless sampling container is not available, dip the sample bottle directly into the water, install a lid, and wipe off the outside of the container with a paper towel.

b) Groundwater (excluding Water-Supply Wells)

Monitoring wells may be sampled using dedicated pumps, disposable bailers, peristaltic pumps with new tubing, bladder pumps, foot-valve inertia pumps with polyethylene tubing, or 2-inch submersible pumps. DEQ staff performing the sampling may request disposable bailers or tubing from the Sample Tracker at DEQ's laboratory.

If collecting split samples, ensure they are homogeneous by filling a large clean container and gently swirling the contents before pouring into appropriate bottles. For VOC analytes, the sample containers will be filled directly from the sample source in the following manner: one from the primary sample bottle set, then one from the split-sample bottle set, and so forth. Samples used to measure field parameters (temperature, pH, DO, etc.), or samples collected in purge vials for VOC analyses, cannot be split in this manner. They must be filled individually, directly from the tap or bailer. All samples from a given site should be representative of the water source from which they're collected.

All monitoring wells must be properly installed and developed in accordance with Oregon Water Resource Department rules and regulations. Nonstandard wells or problems encountered during sampling should be noted in the field log and in subsequent reports.

Groundwater samples from soil borings may be collected by: 1) grab samples; or 2) temporary well points using a stainless steel or PVC screen. Groundwater samples can be obtained by using a small bladder pump, peristaltic pump, small stainless steel or Teflon bailers, or polyethylene or Teflon tubing and foot valve. All soil borings advanced must meet Oregon Water Resources Department (WRD) rules and regulations regarding Geotechnical Holes.

c) Water-Supply Wells, including Drinking-Water Wells

The following procedures should be employed when sampling a water-supply well:

- Obtain permission to access property and obtain samples for analysis.
- Inspect the water system to locate the tap nearest the wellhead. Samples should be collected prior to any treatment units (UV units, reverse osmosis, *etc.*) if possible.
- Before collecting samples from drinking water, irrigation, or industrial wells, purge the water lines for a few minutes to flush the plumbing and holding tanks -- so that the sample collected is as representative as possible. Remove any faucet aerators, and reduce water flow prior to collecting samples. Then fill the sample container directly from the tap (unless the sample is to be split, in which case the sample should be homogenized before distributing into the duplicate split containers). Collect all samples intended for VOC analyses according to SOPs in DEQ's *Field Sampling Reference Guide* (DEQ86-LAB-0002-QAG).

2.2.5 Sampling Porewater

Porewater is water within the upper few centimeters of sediments below surface water bodies. This zone

is known as the *hyporheic zone*, and represents the groundwater/surface water interface. Sampling of this zone can be done with various equipment such as seepage meters and push-point porewater samplers. Discharge of groundwater to surface water through the hyporheic zone is unlikely to be homogeneous; therefore, determining locations for sampling can involve additional investigative steps.

2.2.6 Sampling Air

Air sampling can consist of, but is not limited to, collecting samples of ambient air, sub-slab air, crawlspace air, and soil gas. Ambient air sampling should always be approached with caution as the source of contamination is often not readily apparent, such as at operating dry cleaners or auto fueling/servicing facilities. Air samples collected to evaluate vapor intrusion from contaminated soil or groundwater should be collected in general accordance with DEQ's *Guidance for Assessing and Remediating Vapor Intrusion in Buildings* (March 2010). However, more recent information from the State of Hawaii on Large Volume Purge (LVP) methods may be considered if appropriate to the site and sampling objectives *(Hawaii, Department of Health, Technical Guidance and Fact Sheets, LVP Soil Vapor Field Study (2017).* Air sampling equipment depends on sampling objectives, the nature of the site itself, the contaminants of concern, and analytical methods. Typical sampling containers include tedlar bags[1], stainless steel SUMA canisters, and glass sorbent traps used with sampling pumps. More information on air sampling and analysis is available in DEQ's *Guidance for Assessing and Remediating Vapor Intrusion in Buildings* (see link above)(.

2.3. Sample Handling and Custody Procedures

Sample quality must be maintained throughout the collection, transport, storage, and analysis process. Consequently, all field activities must be fully documented, the samples must be clearly identified, and custody procedures followed in both field and laboratory operations.

The primary objective of chain-of-custody procedures is to provide an accurate written or computerized record that can be used to trace the possession and handling of a sample from collection through completion of all required laboratory analyses. A sample is considered in custody when it is:

- In someone's physical possession;
- In someone's view; or
- Locked up or kept in a secured area that is restricted to authorized personnel.

All changes in sample possession must be fully and completely documented, with the date, time, and persons relinquishing and receiving the samples on the appropriate chain-on-custody record.

2.3.1 Field Documentation

The following types of field documentation must be maintained where applicable as part of the sample handling and custody record. Additional types of documentation may be relevant and should be identified in the site-specific SAP.

- Field logbooks;
- Site observations and photographs (with written descriptions);
- Sample collectors;

[1] Verify that tedlar bags are appropriate for the specific analytes and data quality objectives.

- Date/time of sample collection;
- Sample number;
- Location of sampling station (include latitude/longitude);
- Number and type of samples shipped;
- Number of shipping containers sent;
- Equipment numbers and/or calibration information;
- Sample collection forms; and
- Analytical request forms.

2.3.2 Sample Identification

All samples must be uniquely identified as assigned by the DEQ Project Manager.

2.3.3 Custody Seals

Custody seals must be present on all shipping containers. These seals are designed to show evidence of tampering or disturbance and must be present on the shipping container in as many places as necessary to ensure security. The seals must be dated and signed before application to the shipping containers. The seals may be covered in clear tape to prevent accidental damage during the shipping process.

2.3.4 Field Custody Procedures

To ensure proper custody while in the field, the following custody procedures will be followed:

- As few people as possible will handle the samples;
- Coolers or boxes containing clean sample containers will be sealed with the appropriate custody seals until opened in the field;
- Sample bottles from containers that appear to have been compromised must not be used;
- The sample collector will assume responsibility for the samples until transferred to another person following the appropriate chain-of-custody procedures;
- All sample data will be recorded in ink in a field notebook and/or on the appropriate field forms;
- A site team leader will assess whether additional samples are required;
- All samples requiring thermal preservation will be shipped with an appropriate temperature blank, which will (at a minimum) consist of a 100-mL polyethylene bottle filled with clean water;
- Each cooler (shipping container) in which samples are packed will be sealed and accompanied by one copy of the chain-of-custody record that is sealed in a zip-lock bag and taped to the inside lid of the shipping container;
- A separate chain-of-custody record will accompany each shipment of samples;
- Packaging, marking, labeling, and shipping of samples will comply with all regulations promulgated by the U.S. Dept. of Transportation, 49 CFR 171-177, and International Air Transport Association (IATA); and
- Freight bills and bills of lading will be maintained as part of the permanent project record.

2.3.5 Laboratory Custody Procedures

Transfer of the samples into laboratory custody will follow standard custody procedures and be fully documented on the Chain-of-Custody form. The sample receiver must note the condition of the shipping containers and the custody seals (i.e., broken, unbroken). The laboratory individual responsible for sample intake must document the condition of individual samples in the shipping container as well as the temperature of the container upon receipt. If the shipping container, any individual sample containers, or the shipping temperature is out of control, the laboratory should contact the Project Manager for instructions on how to proceed with sample processing. The laboratory should follow the procedures

documented in its Quality Manual for chain-of-custody sample handling, unless otherwise specified by the DEQ Project Manager.

2.4. Analytical Methods

All analytical methods used on samples from PA/SI investigations must comply with relevant requirements of applicable federal or state programs for which they were collected (e.g., Comprehensive Environmental Response, Compensation, and Liability Act – CERCLA, Clean Water Act – CWA, Safe Drinking Water Act - SDWA, Resource Conservation and Recovery Act - RCRA, Clean Air Act - CAA, etc.), or EPA-approved alternate methods. The most recently approved methods under the CWA and SDWA were promulgated in the Code of Federal Regulations (40 CFR Part 136) on July 21, 2003. Current, approved methods under RCRA SW-846 are on the EPA website at https://www.epa.gov/hw-sw846/sw-846-compendium. Since the list of approved analytical methods is subject to routine update, contact the Project Manager or DEQ laboratory for a list of currently approved methods. Table 3 below lists the classes of analytes that are typically of the greatest interest during PA/SI investigations, as well as DEQ's preferred analytical methods. This table provides a starting point for selecting analytical methods for PA/SI investigations. In addition to the analytical methods listed in Table 3, the Statement of Work (SOW) documents issued by EPA under the Contract Laboratory Program (CLP) include detailed analytical instructions that may be used to quantify parameters of interest in PA/SI projects. The most recently approved versions of those documents may be found on EPA's website at https://www.epa.gov/clp/superfund-clp-analytical-statements-work-sows. Additional methods not mentioned here may also be available and appropriate; consult with the Project Manager for approval of alternate methods.

Any specific analytical methods required by the project must be explicitly identified in the site-specific SAP. Laboratories must use any methods specifically identified in the SAP unless an exception is given to the laboratory *in writing* by the Project Manager.

Table 3 Preparation and Analytical Methods for Common Analytes of Interest

Analytes of Interest	DEQ Preferred Method
Inorganics - general	**Preparation Methods:** 1311 Rev 0 (7/92) - Toxicity Characteristic Leaching Procedure 3010A Rev 1 (7/92) - Acid Digestion of Aqueous Samples and Extracts for Total Metals for Analysis by FLAA or ICP Spectroscopy 3020A Rev 1 (7/92) - Acid Digestion of Aqueous Samples and Extracts for Total Metals for Analysis by GFAA Spectroscopy 3031 Rev 0 (12/96) - Acid Digestion of Oils for Metals Analysis by Atomic Absorption or ICP Spectrometry 3050B Rev 2 (12/96) - Acid Digestion of Sediments, Sludges, and Soils 3051A Rev 1 (2/2007) - Microwave Assisted Acid Digestion of Sediments, Sludges, Soils, and Oils

Analytes of Interest	DEQ Preferred Method
Metals	**Analytical Methods:** 6010D Rev 4 (7/2014) - Inductively Coupled Plasma-Atomic Emission Spectrometry 6020B Rev 2 (7/2014) - Inductively Coupled Plasma - Mass Spectrometry 7061A Rev 1 (7/92) - Arsenic (Atomic Absorption, Gaseous Hydride) 7062 Rev 0 (9/94) - Antimony and Arsenic (Atomic Absorption, Borohydride Reduction) 7741A Rev 1 (9/94) - Selenium (Atomic Absorption, Gaseous Hydride) 7742 Rev 0 (9/94) - Selenium (Atomic Absorption, Borohydride Reduction) 7470A Rev 1 (9/94) - Mercury in Liquid Waste (Manual Cold-Vapor Technique) 7471B Rev 2 (2/2007) - Mercury in Solid or Semisolid Waste (Manual Cold-Vapor Technique) 7472 Rev 0 (12/96) - Mercury in Aqueous Samples and Extracts by Anodic Stripping Voltammetry (ASV) 7473 Rev 0 (2/2007) - Mercury in Solids and Solutions by Thermal Decomposition, Amalgamation, and Atomic Absorption Spectrophotometry. 7474 Rev 0 (2/2007) – Mercury in Sediment and Tissue Samples by Atomic Fluorescence Spectrometry.
Mercury speciation (elemental vs. organic/ methylmercury)	Contact the DEQ Project Manager and DEQ Laboratory
Hexavalent Chromium (Cr+6)	**Preparation Methods:** 3060A Rev 1 (12/1996) - Alkaline Digestion for Hexavalent Chromium **Analytical Methods:** 7196A Rev 1 (07/1992) – Chromium Hexavalent , Colorimetric 7199 Rev 0 (12/1996) - Chromium Hexavalent , Ion Chromatography
Cyanide	**Preparation Methods:** 9010C Rev 3 (11/2004) - Total and Amenable Cyanide: Distillation 9013 Rev 0 (7/92) - Cyanide Extraction Procedure for Solids and Oils 9013A Rev 1 (11/2004) - Cyanide Extraction Procedure for Solids and Oils **Analytical Methods:** 9012B Rev 2 (11/2004) - Total and Amenable Cyanide (Automated Colorimetric, with Offline Distillation) 9014 Rev 0 (12/96) - Titrimetric and Manual Spectrophotometric Determinative Methods for Cyanide 9213 Rev 0 (12/96) - Potentiometric Determination of Cyanide in Aqueous Samples and Distillates with Ion-Selective Electrode
Sulfides	9030B Rev 2 (12/96) Acid-Soluble and Acid-Insoluble Sulfides: Distillation 9034 Rev 0 (12/96) Titrimetric procedure for Acid-Soluble and Acid-Insoluble Sulfides 9215 Rev 0 (12/96) Potentiometric Determination of Sulfide in Aqueous Samples and Distillates with Ion-Selective Electrode

Analytes of Interest	DEQ Preferred Method
Organics - general	**Preparation Methods:** 3500C Rev 3 (2/2007) - Organic Extraction and Sample Preparation 3510C Rev 3 (12/96) - Separatory Funnel Liquid-Liquid Extraction 3520C Rev 3 (12/96) - Continuous Liquid-Liquid Extraction 3535A Rev 1 (2/2007) - Solid-Phase Extraction (SPE) 3540C Rev 3 (12/96) - Soxhlet Extraction 3541 Rev 0 (9/94) - Automated Soxhlet Extraction 3542 Rev 0 (12/96) or 3542A Rev 1 (5/2005) - Extraction of Semivolatile Analytes Collected Using Method 0010 (Modified Method 5 Sampling Train) 3545A Rev 1 (2/2007) - Pressurized Fluid Extraction (PFE) 3550C Rev 3 (2/2007) - Ultrasonic Extraction 3560 Rev 0 (12/96) - Supercritical Fluid Extraction of Total Recoverable Petroleum Hydrocarbons 3561 Rev 0 (12/96) - Supercritical Fluid Extraction of Polynuclear Aromatic Hydrocarbons 3562 Rev 0 (2/2007) Supercritical Fluid Extraction of Polychlorinated biphenyls (PCBs) and Organochlorine Pesticides. 3580A Rev 1 (7/92) - Waste Dilution 3585 Rev 0 (12/96) - Waste Dilution for Volatile Organics 5035A Rev1 (7/2002) – Closed-system Purge and Trap and Extraction for Volatile Organics in Soil and Waste Samples.
Volatile organics, including BTEX and MTBE	**Analytical Methods:** 8260B Rev 2 (12/96) or 8260C Rev 3 (8/2006) Volatile Organic Compounds by Gas Chromatography/Mass Spectrometry (GC/MS) (Note: 8260D Rev (2/2017) has been approved for use though, at the time of publication, has not yet been added to the SW-846 comendium)
Stoddard solvent or Mineral Spirits	**Analytical Methods:** 8015C Rev 3 (02/2007) - Nonhalogenated Organics by Gas Chromatography 8015D Rev 4 (06/2003) - Nonhalogenated Organics by Gas Chromatography by GC/FID 8260B Rev 2 (12/96) or -8260C Rev 3 (8/2006) Volatile Organic Compounds by Gas Chromatography/Mass Spectrometry (GC/MS)
Semivolatile organics	**Analytical Methods:** 8270D Rev 4 (2/2007) - Semivolatile Organic Compounds by Gas Chromatography/Mass Spectrometry (GC/MS) 8275A Rev 1 (12/96) - Semivolatile Organic Compounds (PAHs and PCBs) in Soils/Sludges and Solid Wastes Using Thermal Extraction/Gas Chromatography/Mass Spectrometry (TE/GC/MS)
Chlorinated phenols	**Analytical Methods:** 8041A Rev 1 (2/2007) - Phenols by Gas Chromatography
Dioxins/furans	**Analytical Methods:** 8280B Rev 2 (2/2007) - The Analysis of Polychlorinated Dibenzo-*p*-Dioxins and Polychlorinated Dibenzofurans by High Resolution Gas Chromatography/Low Resolution Mass Spectrometry (HRGC/LRMS) 8290A Rev 1 (2/2007) - Polychlorinated Dibenzodioxins (PCDDs) and Polychlorinated Dibenzofurans (PCDFs) by High-Resolution Gas Chromatography/-High-Resolution Mass Spectrometry (HRGC/HRMS) 1613B Rev 2 (10/94) - Tetra- through Octa-Chlorinated Dioxins and Furans by Isotope Dilution HRGC/HRMS
PCBs/Aroclors and PCB/congeners	**Analytical Methods:** 8082A Rev 1 (2/2007) - Polychlorinated Biphenyls (PCBs) by Gas Chromatography 1668B Rev 2 (11/2008) – 1668C Rev 3(Apr 2010) Chlorinated Biphenyl Congeners in Water, Soil, Sediment, Biosolids, and Tissue by HRGC/HRMS

Analytes of Interest	DEQ Preferred Method
Pesticides & herbicides (chlorinated and organophosphorus)	**Analytical Methods:** 8081B Rev 2 (2/2007) - Organochlorine Pesticides by Gas Chromatography 8141B Rev 2 (2/2007) - Organophosphorus Compounds by Gas Chromatography: Capillary Column Technique 8151A Rev 1 (12/96) - Chlorinated Herbicides by GC Using Methylation or Pentafluorobenzylation Derivatization 8270D Rev 4 (2/2007) - Semivolatile Organic Compounds by Gas Chromatography/Mass Spectrometry (GC/MS). 1699 Rev 0 (12/2007) Pesticides in Water, Soil, Sediment, Biosolids, and Tissue by HRGC/HRMS.
Chemical Agents	**Preparation Methods:** 3571 Rev 0 (7/2007) Extraction of solid and Aqueous Samples for Chemical Agents 3572 Extraction of Wipe Samples for Chemical Agents **Analytical Methods:** 8170 Rev 0 (7/2007) – Assay of Chemical Agents in Solid and Aqueous Samples by Gas Chromatography/Flame Photometric (GC/FID) Detection 8271 Rev 0 (7/2007) – Assay of Chemical Agents in Solid and Aqueous Samples by Gas Chromatography/Mass Spectrometry/Electron Impact (GC/MS/EI)
Asbestos	**Analytical Methods:** EPAl600/R·93/116 (07/1993)- Method for the Determination of Asbestos in Bulk Building Materials (used for solid matrices) NIOSH 7400 – (Issue 2, 08/1994) Asbestos and other Fibers by Phase Contract Microscopy (used for air particulates)

The *DEQ Field Sampling Reference Guide* (FSRG) (DEQ86-LAB-0002-QAG) documents the analytical methods currently used by DEQ's laboratory.

2.5. Quality Control

DEQ recognizes that regulatory actions and environmental decision-making requires data and information of the highest possible quality. Consequently, DEQ has implemented an agency-wide Quality Management System, which is documented in the DEQ Quality Management Plan. Every procedural aspect, from project planning, sample collection, laboratory analysis, to data assessment, imparts a significant and often critical bearing on environmental decisions.

2.5.1 Project Planning:

DEQ employs a team-based project planning approach that draws together diverse interests and participants to define the scope and framework of a project before actual work begins. This QAPP describes and defines the general quality objectives of the PA/SI investigation program. Site-specific quality objectives are often further defined by individual Project Managers in SAPs. This "graded" approach to quality system management ensures that quality activities are conducted throughout the project, but allows for the flexibility to tailor quality-related activities to individual projects.

2.5.2 Field QC Requirements

a) Training Field Personnel

DEQ LEAP can train DEQ personnel in acceptable water sampling techniques, sample collection, preservation and handling procedures, and field instrument operation and documentation procedures. This is coordinated through DEQ's Quality Assurance Officer and the Water Quality Monitoring Section.

b) Field QC Samples

Field transport (trip) blanks must be submitted for each PA/SI project that involves sampling for VOCs. These blanks are prepared by the analyzing laboratory using distilled, de-ionized water, shipped with the other sample bottles to the field, and then returned to the analyzing laboratory with the samples for analysis. Field transport blanks are not separated from other samples, but are packaged with the environmental samples collected during the sampling event.

Rinsate blanks will also be collected for each PA/SI project. Rinsate blanks are generated by pouring purified water over decontaminated equipment and collecting the rinsate. They are used to assess potential contamination of samples resulting from improperly decontaminated sampling equipment.

Transfer blanks may be used, depending on site-specific circumstances and project DQO needs. Transfer Blanks consist of sample containers filled at the site with purified water. Transfer blanks are used to assess the potential for airborne contamination at a site. Transfer blanks are most beneficial when sampling for VOCs or if there is a significant amount of particulates in the air (blowing dust) and sampling is for metals.

Field duplicates will be collected at a rate of one per 20 samples in each media, with a minimum of one duplicate within each media per sampling event. Field duplicates for water samples are taken within five minutes of collecting the original samples, and include all sub-samples. These samples are shipped back with the other sample bottles for analysis. The use of matrix spikes and matrix spike/duplicates are described in the *DEQ Field Sampling Reference Guide*.

Table 1 summarizes the required field QC samples, their frequency, and control limits. The SAP must clearly document any deviations from the QC measurements specified in this QAPP.

In addition to the abovementioned field QC, any field measurements (e.g., conductivity, pH, dissolved oxygen, etc.) will be made following accepted field protocols using documented and calibrated equipment. Instrument calibration information and field QC measurements must be documented in the field notebook and/or on the appropriate field forms.

2.5.3 Laboratory QC Requirements

Routine laboratory QA activities are documented in the analyzing laboratory's *Quality Manual* (however named). Laboratory quality manuals must adhere to consensus standards adopted by the National Environmental Laboratory Accreditation Program (NELAP), which include at a minimum the following elements:

1. Daily instrument calibration or calibration verification prior to analysis of any samples.
2. Method blank analysis daily or at a frequency of 1/20 samples, whichever is greater.
3. Analysis of an independent reference standard daily to assess the accuracy of the calibration. This reference standard check should cover low, mid-level, and high ranges when appropriate.
4. Analysis of a matrix spike at a frequency of 1/20 samples, or as the matrix changes, to assess accuracy and identify possible matrix interferences.
5. Analysis of laboratory sample duplicates or matrix spike/matrix spike duplicates (MS/MSD) on a frequency of 1/20 samples to assess the precision of the analysis.

6. Determination of the minimum reporting limit based on detection limit studies and the concentration range of calibration standards.

QC assessment criteria are presented in Table 1. Precision and accuracy will vary with the analytical method and laboratory procedures. The analyzing laboratory must make precision and accuracy statements available upon request. The analyzing laboratory must prepare a quality assurance report evaluating the QC measurements listed above. Any deviations from the QC requirements presented in this QAPP must be documented in a site-specific SAP.

2.5.4 Data Assessment

Data processing, verification, and validation are the quality-management tools used to determine if project data meet the planned DQOs and requirements defined in this QAPP and in site-specific SAPs. During data processing and validation, project data should be evaluated for completeness, correctness, and compliance against the method, and procedural or contractual requirements of the project.

As soon as possible after each sampling event, calculations, and determinations for precision, completeness, and accuracy will be made and corrective action implemented if needed. If data quality indicators do not meet the project's specifications, data may be discarded and re-sampling may occur. The cause of the failure will be evaluated. If the cause is found to be equipment failure, calibration and/or maintenance techniques will be reassessed and improved. If the problem is found to be sampling team error, team members will be retrained. Any limitations on data use will be detailed in both interim and final reports, and other documentation as needed. If failure to meet project specifications is found to be unrelated to equipment, methods, or sample error, specifications may be revised for the next sampling event.

Corrective action is initiated whenever an “out of control” condition is identified (e.g. either control limits or holding time has been exceeded). The analyst is responsible for initiating corrective action, which generally consists of:

- Analytical system recalibrated or verified and analysis repeated, if holding time permits.
- Documentation of “out of control” condition and corrective action taken. Include who investigated the “out of control” condition, along with the analyst, and the decision of a course of corrective action.
- If corrective action procedures do not rectify “out of control” conditions, the analytical data may be reported with a data qualifier flag. A comment of explanation must be provided for all flagged data.

If time for reanalysis exceeds the allowable holding time for the analyte, use this procedure:

- Sampler is notified and resampling is requested, or
- If resampling is not feasible, and the particular analytical results are not critical, initial analytical results are flagged and reported as an “estimate.” Indicating that all QC criteria have not been met.

Data identified as violating the data quality objective criteria will be reviewed by the QA officer, and a recommendation will be made to the Project Manager. The Project Manager will make a decision on the suitability and use of the data. Situations requiring corrective action for sample collection will be dealt with immediately, such as equipment malfunction. Sample collection events requiring corrective action

that cannot occur immediately will be considered a long-term corrective action. The corrective actions will be detailed on the Sampling Collection Form.

If there are any issues that occur that may affect the quality of the data and the samples cannot be re-analyzed, the Data qualifers the analytical laboratories providing services for PA/SI investigations must appropriately flag the data indicating the issue and whether the data should be considered estimated. Laboratories may use their own data flags; however, each flag must be defined unambiguously in the analytical report.

The following data qualifying flags are standard EPA data validation flags and are provided as an example for the analytical laboratories but should be used by third party validation organizations. The "Q" flag should be used to identify QC issues that may be relevant to interpretation of the analytical and are not identified using one of the other flags. All "Q" flags must have explanatory statements.

Table 4 EPA Data Validation Flags

- **J** - the result is an estimate because the measured sample concentration is less than the laboratory's method reporting limit (MRL) but greater than the method detection limit (MDL), or laboratory QC criteria were not satisfied.
- **J+** - the result is an estimate (see "J"), and may be biased high (not used for results between MDL and MRL).
- **J-** - the result is an estimate (see "J"), and may be biased low (not used for results between MDL and MRL).
- **B** - the blank was contaminated with the analyte being reported.
- **U** - the measured sample concentration is less than the laboratory's reported quantitation limit (MRL).
- **N** - the analysis indicates the presence of an analyte for which there is sufficient evidence to make a "tentative identification."
- **R** - the data are unusable due to serious QC failures. The presence or absence of an analyte cannot be verified. Resampling and/or reanalysis is required for verification.
- **UJ** - the analyte was analyzed for but not detected at the reported quantitation limit. Result is also estimated because of QC failures.
- **NJ** - the analysis has indicated the presence of an analyte that has been "tentatively identified" and the associated value represents its approximate concentration.
- **Q** - not all quality control criteria were satisfied.

Data validation and qualification are done by evaluating data against the Quality Assurance elements below:

- Precision;
- Accuracy and Bias;
- Representativeness;
- Comparability; and
- Completeness.
- Sensitivity

Verified data can then be validated against performance measures and DQOs established in this QAPP and in site-specific SAPs. The generic data assessment criteria for project data is discussed and defined in sections 1.7.1 through 1.7.7.

For projects involving the DEQ Laboratory or where the data may be loaded to the DEQ LIMS (Element™ database). The data is validated against established performance measures (DQOs in this QAPP, site-specific QAPPs, or SAPs and assigned QC data quality levels (DQLs) of A, B, C, D, E, and F. The criteria used for assigning DQLs are outlined in DEQ guidance document; *Data Validation and Qualification* (DEQ09-LAB-0006-QAG). These DQLs (Table 5) follow the same general criteria as those established in USEPA's *Contract Laboratory Program National Functional Guidelines for Superfund Organic Methods Data Review (USEPA-540-R-2017-002)* and *USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review* (EPA 540-R-2017-001) (See Table 4). Below are the established DQLs used in the DEQ Labortory's LIMS:

Table 5 DEQ Laboratory Data Quality Levels

- **A – Data of known Quality**; meets QC limits established in a DEQ approved QAPP
- **B – Data of known but lesser quality**; Data may not meet established QC but is within marginal acceptance criteria; or data value may be accurate, however controls used to measure Data Quality Objective (DQO) elements failed (e.g., batch failed to meet blank QC limit); the data is generally usable for most situations or in supporting other, higher quality data. (**Equivalent to EPA J flags: J, J+ or J-**)
- **C – Data of unacceptable quality**; Generally due to QC failures but may be related to other known information about the sample. Data should not be used for quantitation purposes but may have qualitative use. (**Equivalent to the "R" (rejected) validation qualifier used by EPA**)
- **D – No data available**; No sample collected or no reportable results. Samples are either voided or canceled.
- **E – Data of unknown quality**; Insufficient QA/QC or other information available to make determination. Data could be acceptable; however, no evidence is available to prove either way. Data is provided for "Educational Use Only".
- **F – Exceptional Event**; "A" quality data (data is of known quality), but not representative of sampling conditions as required by project plan.(e.g., an air particulate sampler fails to sample the full time period because adverse conditions such as a forest fire overloaded the sampling equipment)

Use of this data is purely dependent on the intended use of the data. In many cases, as long as there is proper documentation on how the sample was handled, the data may still be useable. The Project Manager should document in their project report the basis as to why the "F" data was found to be acceptable.

The criteria for data quality levels are subject to routine updates. The DEQ QA section should be contacted when developing grading criteria for site-specific SAPs.

2.6. Instrument/Equipment Testing, Inspection, and Maintenance

All field and laboratory analytical instruments and equipment will be tested, inspected, and maintained according to the manufacturer's guidelines and recommendations. Data collected from improperly

functioning equipment will not be used. The equipment testing, inspection, and maintenance logs for all contractor equipment must be made available to the DEQ Project Manager or his/her representative upon request.

2.7. Instrument Calibration and Frequency

All field and laboratory instruments and equipment used for measurement data will be operated and calibrated according to manufacturer's guidelines and recommendations. Calibration records must include the following information (whenever available and appropriate for the specific instrument or equipment):

- calibration date
- test method
- instrument
- analysis date
- each analyte's name
- analyst's initials or signature
- concentration and response
- calibration curve or response factor

Only personnel properly trained in these procedures should operate and calibrate the instruments. Calibration records must be made available to the DEQ Project Manager or his/her representative upon request.

2.8. Inspection/Acceptance of Supplies and Consumables

All supplies and consumables should be examined for damage or other characteristics that would otherwise compromise data quality. Contractors and laboratories must have written procedures for inspecting and accepting supplies and consumables in their Quality Management Plans or Quality System Manuals.

2.9. Non-direct Measurements

Data from non-measurement sources, such as computer databases, computer programs, or scientific publications, must be approved for use by DEQ in a site-specific SAP. The SAP must:

- Identify the data sources;
- Describe the intended purpose and use of the data;
- Cite any acceptance criteria for the data; and
- Clearly describe any limitations for use of the data.

2.10. Data Management

Field data from PA/SI investigations, such as sample ID and latitude/longitude coordinates, are recorded on field data sheets or hand-held computers. Field data is reported to the Project Manager through submission of field notebooks or field sampling data sheets, if used, by DEQ or contractor field staff. Laboratory analytical data should be submitted to the DEQ Project Manager in both printed and in an electronic format suitable to DEQ. The Project Manager or his/her designee will update the ECSI

database with field and analytical data, both in a narrative form and in the appropriate hazardous-substance fields in ECSI. Alternatively, the Project Manager or his/her designee may record analytical data from PA/SI investigations in the DEQ Laboratory's LIMS (Element™) database, or in other DEQ databases that may be designed to store analytical data from specified locations.

3. Assessment and Oversight

3.1. Assessment and Response Actions

For long-term sampling projects (which are expected to be rare for PA/SI investigations), the DEQ Project Manager will meet at least weekly with field crews to discuss any problems, and ensure that all planned samples are being collected. For such sites, the Project Manager will review data weekly, observe sampling, and arrange re-sampling as needed. Contract laboratories will participate in Performance Evaluation studies twice yearly and satisfy NELAP requirements. Personnel responsible for data assessment will check the results of every sampling event for precision and completeness. Technical and/or quality system audits of environmental or laboratory contractors may be initiated on a prescribed schedule or on an as-needed basis in response to identified or suspected problems. Assessment and response actions will be documented and submitted to the DEQ Project Manager. Identified deficiencies will be followed up by written corrective action plans.

3.2. Reports

Project Managers are responsible for final PA reports and reporting PA/SI activities to Program Managers in their respective DEQ regions. Procedures for preparing these reports may vary between regions.

4. Data Validation and Usability

4.1. Data Review, Verification and Validation

Data review, verification, and validation procedures and requirements are discussed in Section 2.5.4 - Data Assessment.

If corrective action procedures do not mitigate the error, associated environmental data must be flagged and/or assigned QC data quality levels as described in Section 2.5.4.

4.2. Verification and Validation Methods

Verification and validation method are discussed in Section 2.5 - Quality Control.

4.3. Reconciliation with User Requirements

The Project Manager will ensure that data collected during a PA or SI investigation address the DEQ's and EPA's needs for evaluating that site. Moreover, the Project Manager will ensure that all environmental and laboratory contractors satisfy requirements specified in this QAPP, in site-specific

SAPs, and in any binding contracts between parties. The laboratory conducting sample analyses must submit all QC data identified in this plan (Section 2) with its analytical data.

The Project Manager should review flagged data and use professional judgment and/or consultation with the QA Officer and others in deciding what DQL is acceptable for the project. In most cases data flagged with "J" or having a DQL of "B" is considered useable. In addition, the Project Manager and the QA Officer will determine if the data collected meets QA Plan objectives. Decisions to accept, qualify, or reject questionable data will be made by the Project Manager and QA Officer.

The Project Manager will verify that all parameters requested were reported and that data were reported to the requested target levels and with the appropriate units.

5. Revision History

Table 6 Revision History

Revision	Date	Changes	Editor
2.0	07/06/2012	Updated Signatories, minor edits to roles A4, updated section on project documentation A9.2, Added option for ISM, updated methods table B4-1, Added additional information into Field QC section B5.2.2, Added additional information to Data Assessment section B5.4, Added additional information to section D3, Editorial edits throughout.	SCH, AD, KR
3.0	11/1/2017	Reformated to current DEQ format and numbering. Added Acronyms (section 1.4), made consistent with DEQ 5035 soil sampling policy for VOCs, updated MDL to 2017 method update rule (consistent with 2016 TNI standard). Updated DEQ data quality levels-Table 5,	SCH, PS
3.1	11/16/2017	Minor edits to some document and method references based on EPA R10 QA feedback.	SCH
3.2	12/4/2017	Clarifications on EPA regional titles and responsibilities, problem definition and background, other minor editorial changes based on EPA R10 Project Officer feedback.	SCH, GMW