

Quality Assurance Project Plan

Underground Storage Tanks Programs

June 2016



**Operations Division
Cleanup and Tanks
Programs**

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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

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Bruce Gilles Manager, Cleanup and Emergency Response Program	
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Donald M. Brown Quality Assurance Manager, EPA Region 10	
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Signed Copy on File at DEQ

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1.3 Distribution List

The following DEQ and EPA personnel will be emailed regarding all aspects of this QAPP/SAP. Final reports from the third party laboratories will be faxed/emailed and mailed to the DEQ Hazardous Waste Inspector. Final reports from the DEQ laboratory may also be faxed/emailed and mailed to the HW Inspector.

This QAPP will be posted on both the DEQ internal and external websites. As prescribed by the laboratory's document control procedures, the official signed document will be filed at the DEQ laboratory. The DEQ is not responsible for the control of reprinted copies from web sites or photo copies of the original plan. It is the responsibility of the reader to ensure that they are using the most current QAPP. The QAO will replace posted network files as the plan is revised.

Table 1-1 Distribution List

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Others that must have access to this QAPP:

UST and HOT Program Regional Office project managers

DEQ LEAP Managers and Staff

Environmental consultants under contract with DEQ for field work on tank sites

Laboratories under contract with the State of Oregon or DEQ that analyze samples from tank sites

1.4 Acronyms

CFR – Code of Federal Regulations

CLP – Contract Laboratory Program (EPA)

DEQ – Oregon Department of Environmental Quality

DQI – Data Quality Indicator

DQL – Data Quality Level

DQO - Data Quality Objectives

EPA (or USEPA) – United States Environmental Protection Administration

HCID – Hydrocarbon Identification method

HOT – Heating Oil Tank

LEAP – Laboratory and Environmental Assessment Program (DEQ)

LCS – Laboratory Control Sample

LUST – Leaking Underground Storage Tank

MCL – Maximum Contaminant Level

MS/MSD – Matrix Spike / Matrix Spkie Duplicate

NELAP – National Environmental Laboratory Accreditation Program

NWTPH – Northwest Total Petroleum Hydrocarbon methods

OCE – Office of Compliance and Enforcement

QA – Quality Assurance

QC – Quality Control

QAPP – Quality Assurance Project Plan

QL –Quantitation Limit – (sometimes refered to as Limit of Quantitation (LOQ) or Reporting Limit (RL)

QMP – Quality Management Plan

RCRA – Resource Conservation Recovery Act (EPA)

RPD – Relative Percent Difference

SARA - Superfund Amendments and Reauthorization Act

SDS – Safety Data Sheet

SOP – Standard Operating Procedure

TCLP – Toxicity Charachteristic Leaching Procedure

TNI – The NELAC Institute

UST – Underground Storage Tanks

1.5 Project/Task Organization

- UST and HOT program site investigations and corrective actions involve DEQ staff from the following divisions:
- Operations Division;
- Laboratory and Environmental Assessment Division;
- Northwest Region;
- Western Region; and
- Eastern Region.

An organizational chart for relevant personnel in these divisions is provided in Figure 1.

1.5.1 UST Program Staff in Headquarters

UST Program staff in DEQ headquarters shall:

- Provide policy oversight and training;
- Prepare reports for EPA; and
- Secure EPA grant funding.

1.5.2 Regional Office Staff

UST program staff in the regional offices shall:

- Provide project management for oversight of responsible parties
- Serve as project managers for responsible party-lead UST cleanup sites within their respective regions;
- Evaluate responsible parties' compliance with all rules and regulations governing the cleanup of petroleum-contaminated sites;
- Manage state contractor cleanups at sites where the responsible party is unable or unwilling to comply with the regulations;
- Provide policy oversight and training;
- Provide technical assistance;

1.5.3 Laboratory and Environmental Assessment Program Staff

DEQ Laboratory and Environmental Assessment Program staff shall:

- Perform requested test methods on samples submitted by agency staff;
- Perform requested test methods on samples that have been split with either contractors for state-managed sites or with responsible parties;
- Provide technical assistance to agency staff;
- Review analytical results for data quality upon request;
- Prepare DEQ laboratory reports for program and regions;
- Assist in department training program for proper sample collection, preservation, handling, and documentation requirements;
- Assist in the preparation or evaluation of site-specific Quality Assurance Project Plans;
- Serve as the QA office for the program; and
- Initiate corrective action through program and regions when deficiencies in sample collection, preservation, handling, test methods, and documentation are identified.

1.6 Problem Definition/Background

The U.S. Environmental Protection Agency provides funding to states for both Underground Storage Tank compliance and Leaking Underground Storage Tank cleanup program activities. In order to use federal LUST Trust Funds for sampling and analysis activities, EPA requires states to have an approved Quality Assurance Project Plan. In addition to funding, approval of this QAPP is an essential component of the Oregon Department of Environmental Quality's EPA approved underground storage tank program 40 CFR part 282.87.

The program was approved by EPA September 16, 2011 where DEQ obtained primacy through EPA to implement the UST programs covered within Subtitle I of the Resource Conservation and Recovery Act Section 9003, as amended by the Superfund Amendments and Reauthorization Act. In this capacity, DEQ is responsible for the implementation of EPA's rules and regulations for USTs.

The activities conducted under this project plan are subject to the requirements of 40 CFR Parts 35, 280, 281 and 282. Implementation will require the involvement of staff from the DEQ's Operations Division, Regional Offices, and Laboratory and Environmental Assessment Program.

1.7 Project Task/Description

The majority of investigations carried out by the DEQ UST/LUST program involve USTs that contain petroleum hydrocarbons. Project managers must evaluate this QAPP and assess whether it meets the specific needs of the project. Site-specific QAPPs will be developed by DEQ or outside contractors for those investigations that require sampling and analytical protocols not addressed in this plan. For samples not routinely sent to the DEQ laboratory, the project manager must notify the laboratory prior to sample submittal and ensure that the DEQ laboratory receive site-specific QAPPs as needed.

The Heating Oil Tank Program allows third party certification of cleanups and decommissionings of heating oil tanks by DEQ licensed service providers. When a licensed contractor completes a cleanup or decommissioning, the company submits a certification to DEQ. DEQ will then issue a letter to the tank owner registering the contractor's certification. The combination of the contractor's certification and DEQ's registration is equivalent to the "No Further Action" letter.

This QAPP defines the duties and responsibilities of DEQ staff and establishes standard operating procedures for sample collection, preservation, handling, documentation, and analysis for UST site investigations conducted by responsible parties and/or DEQ contractors. The objective is to ensure that all data obtained during UST site investigations are representative of actual site conditions. The data also must be of known quality and, where necessary, legally defensible.

Data obtained under this QAPP will be used to confirm releases from petroleum-containing USTs. This QAPP is also applicable to the activities of DEQ's Heating Oil Tank Program. The data will be used to evaluate the nature, magnitude, and extent of the petroleum contamination, determine the extent of remedial action that is required, and measure the adequacy of the remedial actions undertaken by responsible parties or DEQ contractors.

Responsible parties and contractors may choose to follow the requirements outlined in this QAPP or prepare and submit a QA Plan for approval by DEQ. All data reported to DEQ must reference what QA Plan was used for the project.

1.8 Quality Objectives and Criteria

The purpose of this section is to provide qualitative and quantitative information that defines the goals for

data quality for the UST and HOT programs.

The primary goal of sampling and analysis is to determine if a site is contaminated due to leaks from USTs and HOTs. The data collected will be used to support decisions for site closures or where necessary, support the need for additional data collection activities to make decisions regarding how to remedy the site.

In order for proper decisions to be made, the data for this project plan must be of known quality. To ensure that the quality can be assessed, the sampling organization and the laboratory conducting the analyses must retain sufficient documentation to enable DEQ to recreate the sampling activities and analytical results for review.

Site specific sampling activities must be described in a work plan or sampling plan.

The laboratory quality system should be defined and documented in a quality manual that would meet National Environmental Laboratory Accreditation Program standards¹ or ISO Guide 17025². The NELAP Standards are currently available from The NELAC Institute's website at <http://www.nelac-institute.org/>. The laboratory should also perform quality control measures found in the referenced analytical methods and those found in the most current TNI standards for Chemical Testing³. Quality control measures found in ISO guide 17025 is an acceptable alternative to the TNI standard.

Specific Quality Assurance (QA) objectives include collecting a sufficient number of transport (trip) blanks, rinsate blanks, and duplicate samples to evaluate the potential for contamination from sampling equipment and sampling technique. (Note: Blanks may be collected and held for analysis until it is determined contamination may be a concern.) In addition, the laboratory conducting the analyses must analyze a sufficient number of Quality Control (QC) standards, blanks, replicates and spikes internally to evaluate results against numerical QA goals established for precision and accuracy as shown in Table 1-2. The objective is to follow sampling techniques in such a manner that the analytical results are representative of the media and conditions being measured.

¹ Currently: 2009 TNI Standard, Volume 1 Module 2 (V1M2)

² ISO IEC 17025 – 2005 General requirements for the competence of testing and calibration laboratories

³ Currently: TNI Standard - Volume 1 Module 4 - Chemical Testing (EL-V1M4-2009)

Table 1-2 Field and Laboratory QC Elements and Assessment Criteria

	QC Element	Frequency	Matrix [#]	Analyte Type [*]	Criteria
Field QC	Trip Blank	1 per cooler	All	Organic	Only required when collecting VOCs < QL, or <10% of the lowest concentration identified in any sample
	Rinsate Blank	5% for each matrix sampled (but at least one sample per field event)	All	All	< QL, or <10% of the lowest concentration identified in any sample
	Field Duplicate	5% for each matrix sampled (but at least one sample per field event)	Air, water	Inorganic	RPD +/- 20% for concentrations > 5X the QL, or Absolute difference ≤ QL for average concentrations ≤ QL
				Organic	RPD +/- 30% for concentrations > 5X the QL, or Absolute difference ≤ QL for average concentrations ≤ QL
			Solids, non-aqueous liquids	Inorganic	RPD +/- 30% for concentrations > 5X the QL, or Absolute difference ≤ 2X QL for average concentrations ≤ 5X QL
				Organic	RPD +/- 35% for concentrations > 5X the QL, or Absolute difference ≤ 2X QL for average concentrations ≤ 5X QL
Laboratory QC	Method Blank	5% for each preparation	All	All	< ½ QL or <10% of the lowest concentration identified in any sample
	Laboratory Duplicates or Matrix Spike Duplicates	5% for each matrix sampled	Air, water	Inorganic	RPD +/- 20% for concentrations > 5X the QL, or Absolute difference ≤ QL for average concentrations ≤ QL
				Organic	RPD +/- 30% for concentrations > 5X the QL, or Absolute difference ≤ QL for average concentrations ≤ QL
			Solids, non-aqueous liquids	Inorganic	RPD +/- 30% for concentrations > 5X the QL, or Absolute difference ≤ QL for average concentrations ≤ 5X QL
				Organic	RPD +/- 35% for concentrations > 5X the QL, or Absolute difference ≤ 2X QL for average concentrations ≤ 5X QL
	Laboratory Fortified Sample	5% for each preparation	Air, water	Inorganic	Recovery: 80-120%
Organic				Recovery: 60-140%	

QC Element	Frequency	Matrix [#]	Analyte Type [*]	Criteria
(Matrix Spike)		Solids, non-aqueous liquids	Inorganic	Recovery: 70-130% for at least 80% of the analytes in a single method
			Organic	Recovery: 50-120% for at least 80% of the analytes in a single method
Surrogates	Each sample	All	Organic	Recovery: 50-150%
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 non-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 (including soil vapors).

^{*} Inorganic analytes include all metals. Organic analytes include petroleum hydrocarbons, volatile/semi-volatile organic compounds, PCBs, Not all analytes may be covered by this list. For additional information, contact the QA chemist at the DEQ laboratory. Variances from this list should be documented in site specific QA Plans.

^{**} May not apply to compounds that are known to be problematic. Obtain approval from the UST or HOT project manager or contact DEQ LEAP to obtain approval for wider acceptance limits.

1.9 Training

a) Safety Training

Safety training courses relevant to UST cleanup project activities are readily available. Contractors are responsible for ensuring that their personnel are informed about and trained on relevant OSHA guidelines. All DEQ UST project managers are required to have a minimum of 24 hours of initial health and safety training and receive an annual 8-hour refresher course. Staff should contact the DEQ Health and Safety Manager or their Premises Safety Representative for questions about health and safety practices.

Field activities can create unexpected risks. Staff should approach any sampling event as a potentially hazardous event and obtain the proper training to recognize, deal with, and protect themselves from hazardous materials. If you have questions about what you might be dealing with, use existing resources (*e.g.*, SDS, literature, laboratory staff, the Health and Safety Plan that the consultant and/or contractor has prepared for the site, etc.) and contact the appropriate authority (*e.g.*, DEQ Health & Safety Manager, Laboratory Managers, Safety Committee). The Health & Safety Manager can recommend and supply the most appropriate personal protective equipment and is responsible for managing the respiratory protection program.

b) Training Field Personnel

All field personnel must be trained in acceptable sampling techniques, sample collection, preservation and handling procedures, and field instrument operation and documentation procedures prior to collection of samples under the UST or HOT programs. Proper training is critical to ensure representative samples are collected, documented and contamination is minimized.

1.10 Documentation and Records

1.10.1 Introduction

Documents and records produced from UST and HOT projects must be properly managed. Documents and records typically produced may include, but are not limited to:

- Site-specific QA plans or sampling and analysis plans;
- Design certification;
- Photo logs;
- Transportation documents (manifests and bills of lading)
- 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.

(**Note:** Documentation, required in the HOT program regulations to be submitted to DEQ, constitutes a satisfactory sampling plan for HOT projects.)

The project manager maintains project records in both printed and electronic formats whenever practicable. Printed records serve as the official record and will be maintained in the site's file for a period of no less than 30 years after site closure. 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, UST, LUST and HOT programs will follow guidance and procedures established in the agencies records retention schedule if they differ from the above retention requirements.

Each organization should have their own specific procedures for presenting and controlling data. However, the record keeping system must allow 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 shall include inter-laboratory transfers of samples or extracts.

All sampling and analysis records must be maintained for at least 5 years after project completion and be available to DEQ upon request.

Laboratories shall have their own chain of custody form, which must contain the sample identification, the location, date and time of collection, collector's name, preservation type, sample type, and any special remarks concerning the sample. The DEQ's custody form (DEQ06-LAB-0054-FORM) must be filled out if samples will be analyzed by DEQ or if data is going to be uploaded into the labs information management system. Certain information on the form is absolutely necessary. Such information as the Sampling Project Location/Site should be kept short but be as descriptive as possible. These data elements are necessary for accurately posting data in the agency's databases.

1.10.2 Sample Acceptance Policy

It is DEQ laboratory policy to accept samples for analysis, and report analysis results, for samples that meet the following *requirements* upon receipt at the DEQ laboratory. Non-DEQ laboratories should have their own written policy which the DEQ's project manager should receive (it may also be in a submitted QA Plan or as part of their Quality Manual). The policies of the contracted laboratories should have similar content.

1. Complete sample documentation must be provided including:

- Name and address of the project site,
 - Program/project Q-time number
 - Sample description;
 - Sample matrix (air, liquid, solid, sludge, sediment);
 - QC Type (Trip Blank, Equipment (rinsate) Blank, Field Duplicate, etc)
 - Special remarks describing the sample, if appropriate.
 - Sample classification (grab, continuous, composite);
 - Date and time of collection;
 - Sampling location (including latitude, longitude, and elevation), or permanent station ID number; and brief description of each sampling location
 - Name of contact person for the project,
 - Name of sample collector,
 - Container ID numbers used at each location, and
 - Requested analyses for each sample (or, if sample is to be held for possible future analysis).
 - The date and time that each person received or relinquished the sample(s), including their signed name.
 - Information must be legible
 - All information must be written on the field form in waterproof blue or black ink.
2. Samples must be properly labeled
 - Use durable labels
 - Include a unique identification number traceable back to the COC.
 - Include preservative used (Container codes are acceptable if defined).
 - Use indelible ink
 - Information must be legible
 3. Sample container(s) must be appropriate for sample type and analysis requested, including preservative(s) as needed.
 4. Parameter/Method recommended holding times must not be exceeded.
 5. Adequate quantities of samples must be supplied to accommodate tests requested by collector, stipulated in site-specific QAPP by project manager or judged appropriate by laboratory management.
 6. A site-specific QAPP or SAP must be prepared when more than ten (10) field samples are submitted, including:
 - The number of samples by matrix, including QA (sample duplicates, matrix spikes and duplicates, blanks, *etc.*);
 - The name of the project manager and sample collector (if different);
 - The name of the person to whom the data are to be reported;
 - The analyses (tests) requested; and
 - The detection limit needed [qualitative screen, drinking water MCL, T, NPDES permit compliance, *etc.*].
 - Refer to EPA QA division documents for additional information on preparing site-specific QAPPs (http://www.epa.gov/quality/qa_docs.html).

(Note: For smaller projects (< 10 samples), the work plan may be used as a SAP to identify site specific needs as long as the requirements in this QAPP are followed. Otherwise a site specific SAP must be submitted.

(**Note:** HOT program requirements for sampling documentation constitute a Sampling plan, no additional plan needs to be provided as long as the other QC requirements in this QAPP (or an alternative DEQ approved QAPP) are followed.)

Sample(s) failing to meet the sample acceptance criteria may be analyzed, depending on the circumstances, but the data must 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 these elements may be furnished at any time up to the release of the final decision on the site from DEQ, but preferably as soon as possible. When all acceptance criteria are consequently met, the qualifying flag will be expunged from the report, if the quality of the data is not affected.

7. Third party laboratory analytical reports must include the following information for DEQ review (Note: When DEQ LEAP provides the analytical work, the same information is evaluated prior to reporting results):
 - 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.
 - The report must definitively link the samples with their associated QC results.

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 thrown away, 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 QAPPs, 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. Changes to electronic records must mirror appropriate changes in printed records. (Alternatively, a revised document may be created as long as the revision is clearly noted and supersedes the previous document. Both original and revised versions must be maintained in the project files.

2. Data Generation and Acquisition

2.1 Sampling Process Design

Site assessments generally require the collection of several types of samples including soils, vapors, surface and ground water, water from industrial, municipal, or residential wells, and tank contents (i.e. sludge).

Field sampling personnel will make arrangements with the analyzing laboratory for proper sample containers, sampling request forms, and sampling equipment at least two weeks in advance of a sampling event. If a specific event has more than 10 field samples or will occur more than once, a site-specific QAPP or SAP will be required.

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

- All equipment will be checked for proper calibration, assembly, and operation prior to use.
- All sampling equipment that may potentially contact the samples will be decontaminated according to the procedures outlined in the Mode of Operation Manual (MOM), DEQ03-LAB-0036-SOP, which is available from the water quality monitoring group at the DEQ laboratory or it can be found on-line at <http://www.deq.state.or.us/lab/techrpts/docs/DEQ03LAB0036SOP.pdf>.
- Sampling equipment will be transported in such a manner as to maintain its cleanliness.

2.1.1 Parameter-Specific Sampling Requirements

Table 2-1 lists the sample containers that are to be used, sample volumes required, preservation requirements, and special handling requirements for the parameters most commonly tested at petroleum-contaminated sites. Additional information on sampling requirements is contained in the DEQ laboratory's *Field Sampling Reference Guide* (FSRG) DEQ86-LAB-0002-QAG

The required order of sample collection, regardless of matrix being sampled, is:

1. Volatile Organic Compounds (VOC);
2. Total Petroleum Hydrocarbons (NWTPH-Dx and Gx) and Hydrocarbon Identifications (HCIDs);
3. Extractables (PCBs); and (PAH)
4. Total Recoverable Metals.

2.2 Sampling Methods

It is very 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. Also, when the container is filled, the analyzing laboratory will have sufficient sample to do the requested test. Samples submitted to the laboratory that are not in a laboratory 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. It is acceptable under NELAP standards to accept such as long as the data is qualified as such. Acceptability will be

determined by the DEQ project manager Refer to Table 2-1 for information on proper containers, preservatives, and holding times. If sampling for volatile organics in soil, additional guidance can be found in DEQ Program Policy: *Soil Sampling Requirements for Volatile Organics in Land Quality Programs (DEQ15-LQ-0053-QAG)* and the follow-up [clarification memo](#).

Table 2-1 Sample Containers, Preservation and Holding Time

PARAMETER	CONTAINER ⁽¹⁾	PRESERVATIVE	HOLDING TIMES
Volatile Organics (8260C, NWTPH-Gx,)			
Liquids	2 40-ml vials with Teflon-lined septum caps	Conc. HCL to pH<2 Cool, >0° ≤ 6°C No headspace	14 days
Soils (extraction EPA 5035A)	2 40-ml vials with Teflon-lined septum caps (approximately 5 g sample in each vial)	High level: Methanol & Cool, >0° ≤ 6°C or Low level: Cool, >0° ≤ 6°C	14 days 48hr / 14 days
Pure Product	1 40-ml vial with Teflon-lined septum caps	Cool, >0° ≤ 6°C	14 days
Soil Vapors (EPA TO-15)	Tedlar Bag	None	72 hours
	Summa Canister	None	30 days
Semi-Volatile Organics			
NWTPH-Dx			
Liquids	1-Liter amber glass bottle with Teflon liner	5 ml HCl, pH<2 Cool, >0° ≤ 6°C	14 days to extraction/ analysis within 40 days of extraction
Soils	4 - 8 oz glass glass jar with Teflon liner	Cool, >0° ≤ 6°C	14 days to extraction/ analysis within 40 days of extraction
NWTPH-HCID			
Liquids	1-Liter glass bottle with Teflon liner	5 ml HCl, pH<2 Cool, >0° ≤ 6°C	7 days to extraction/ analysis within 40 days of extraction
Soils	4 - 8 oz glass glass jar with Teflon liner	Cool, >0° ≤ 6°C	14 days to extraction/ analysis within 40 days of extraction

PARAMETER	CONTAINER ⁽¹⁾	PRESERVATIVE	HOLDING TIMES
PAHs (8270D)			
Liquids	1-Liter glass bottle with Teflon liner	Cool, $>0^{\circ} \leq 6^{\circ}\text{C}$	7 days to extraction/ analysis within 40 days of extraction
Solids	4 - 8 oz glass glass jar with Teflon liner	Cool, $>0^{\circ} \leq 6^{\circ}\text{C}$	7 days to extraction/ analysis within 40 days of extraction
PCBs (8082A)			
Liquids Extraction (3510A, 3520A)	1-Liter glass bottle with Teflon liner	Cool, $>0^{\circ} \leq 6^{\circ}\text{C}$	1 year
Soils Extraction (3550B, 3545A)	4 - 8 oz glass glass jar with Teflon liner	Cool, $>0^{\circ} \leq 6^{\circ}\text{C}$	1 year
Metals (6010/6020)			
Liquids	250-ml polyethylene	HNO ₃ , pH<2	6 months
Soils	Polyethylene or glass with Teflon liner	None	6 months

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

2.2.1 Sampling Soils

Sampling will be performed to determine the nature, magnitude, and extent of the soil contamination. Use a stainless steel spoon to collect samples from surface soils. Subsurface soils can be collected while wells are being drilled, during excavation and removal of the tanks, from shallow test pits, or using a hollow-core soil drill. The DEQ laboratory has no special equipment to collect subsurface soils, beyond using augers and core samplers. A sufficient number of samples must be taken to represent the area that is being evaluated. Samples will be collected according to procedures outlined in *A Compendium of Superfund Field Operations Methods* (EPA/540/P-87/001). **Note:** for DEQ staff, this compendium document may be found on Q-Net under the tracking number of EPA87-LAB-0008-RGD.

All soil samples will be discrete samples unless a site-specific plan has been developed to collect composite samples for a specified purpose. Composite sampling, achieved by collecting several roughly equal sub-samples and thoroughly mixing to form one sample, is **NOT** acceptable for the analysis of volatile materials in any situation. Soil samples should contain as few cobbles or stones as possible, unless you wish them to be included in the analysis.

a) Hand Augers

Hand augers can be used to collect samples at depths up to approximately 3 feet. The sample is extruded into an aluminum or stainless steel pan followed by immediate placement into appropriate sample

containers. It is possible to obtain discrete depths by forcing the soil core from the auger and collecting the depth of interest. The project manager shall assess whether a lined or stainless steel auger is necessary.

b) Test Pits

Test pits may be excavated by hand or by using power equipment such as a backhoe to permit detailed examination and a better understanding of the nature and extent of the contamination. Samples are collected from the walls or floor of the pit after removing approximately 3 inches of the exposed surface layer. Samples are placed directly into the appropriate sample containers. Samplers must be made aware of the hazards of entering a test pit. Safety training courses should cover confined space entry and sloping/shoring of test pits.

c) Boreholes

Subsurface soil samples can be collected from boreholes using a split-spoon sampler during drilling operations. Drill cuttings are screened using an organic vapor analyzer (OVA) to determine where samples should be collected. **Note:** Most screening is done using a photo-ionization detector (PID) with a 10.2eV lamp. The split-spoon sample will be collected according to the ASTM D1586 standard penetration test method and the sample will be transferred directly from the split spoon into the appropriate sample containers. All soil classifications will be performed using the ASTM D2487 soil classification method.

2.2.2 Petroleum in Soils

Methods for analysis are designated in Oregon's *Cleanup Rules for Leaking Petroleum UST Systems* (OAR 340-122-0205 through 340-122-0360). Petroleum products in soil are first identified by a hydrocarbon identification test, and then quantified by the appropriate total petroleum hydrocarbon method. The procedures for several of these methods were developed jointly with the Washington Department of Ecology and are referred to as the Northwest Total Petroleum Hydrocarbon Methods.

a) NWTPH Methods

- NWTPH-HCID is a qualitative screen used to determine which petroleum products (if any) are present, and what subsequent quantitative methods may be required.
- NWTPH-Gx is the quantitative method for gasoline.
- NWTPH-Dx is the quantitative method for diesel.
- TPH- 1664 Modified is the quantitative method for soils containing lubricating oils and bunker fuels.
- TPH-1664 is for quantification of generic petroleum hydrocarbons in water.

b) Other Organics

Other common analyses used to identify or characterize unknown organic contaminants include MTBE, MBAS, glycol/fluorescein, lignin-tannin, total organic carbon, chemical oxygen demand, total organic halogens, and formaldehyde.

- **Oxygenated Fuel Additives** such as Methyl Tertbutyl Ether or Ethanol: MTBE was recently phased out as a fuel additive and replaced most commonly with Ethanol. There may be other oxygenates of interest depending on the fuel blend. MTBE, Ethanol and other oxygenates have been included with the constituents that can be measured by Method 8260C.
- **Methylene Blue Active Substances:**
MBAS includes anionic surfactants such as LAS (linear alkylbenzene sulfonates), other

sulfonates and sulfate esters. This is a non-specific colorimetric test that can detect the presence of detergents.

- **PCBs and Chlorinated Pesticides:**
PCBs and chlorinated pesticides are both extracted by the same method, therefore a single container may be used to sample for these two analyses. Other organic tests require a separate container for each method of extraction.
- **Polynuclear aromatic hydrocarbons**
PAHs are semivolatile compounds that are associated with petroleum products and some are known carcinogens. They are solvent extracted and can be analyzed by GC/MS or GC/MS in SIM mode (lower detection limits)

2.2.3 Sampling Water

Sampling water for petroleum constituents may be necessary to determine whether contamination has migrated to groundwater or nearby surface water. Physical evidence such as odors, organic films on the surface of water, and soil discoloration are good indicators of the migration of contaminants to water.

Surface water locations may include streams, brooks, or wetland areas that are adjacent to or downgradient from underground storage tanks. Groundwater samples are typically collected from the uppermost aquifer, but may also include samples from deeper aquifers, and from nearby residential, industrial, and municipal wells.

Note: Fuel oxygenates are much more soluble in water than petroleum products and often migrate faster and farther than petroleum hydrocarbon related constituents.

All long-term surface water sampling requires an approved site-specific QAPP.

a) Surface water

Surface water samples are best collected using a stainless steel bucket (unless sample for metals). 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 the bottle into the sample. If possible, pour from the collection container, with minimal agitation, into the sample bottle. Residue from the outside surface of the bottle, or your hands, could contaminate samples or expose you to hazardous materials. If a stainless sampling container is not available, dip the sample bottle directly into the water, install lid, and wipe off the outside of the container with a paper towel.

b) Groundwater

Monitoring wells without dedicated pumps may be sampled using dedicated or disposable bailers. DEQ personnel who are performing the sampling event may request disposable bailers from the DEQ laboratory Sample Coordinator.

Before collecting drinking water or irrigation well samples, purge the water lines. Fill the sample container directly from the tap unless the sample is to be split. Ensure that split samples are homogeneous by filling a large clean container, shake container to mix, and pour into appropriate bottles. 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.

All monitoring wells must be properly installed and developed as specified in the DEQ's *Groundwater Monitoring Well Drilling, Construction, and Decommissioning* guidance document. Construction of wells must also meet Water Resource Division's rules and regulations. Nonstandard wells or problems encountered during sampling should be noted in the field log and in subsequent reports.

c) Residential Water Samples

The following procedures should be employed when sampling residential water supplies:

- Obtain permission to access property and obtain samples for analysis.
- Inspect the water system to locate the tap nearest to the wellhead. Samples should be collected prior to any treatment units (UV units, reverse osmosis, *etc.*) if possible.
- Purge the system for a few minutes to flush the plumbing and holding tanks so that the sample collected is as representative of the ground water as that system can produce. Remove any faucet aerators and reduce water flow prior to collecting samples. Collect the sample directly from the tap into the sample containers. Samples for VOCs are to be collected according to procedures outlined in DEQ's *Field Sampling Reference Guide* (DEQ86-LAB-0002-QAG).

Additional sampling procedures may be found in DEQ's Water Quality Monitoring section's *Mode of Operation Manual* (DEQ03-LAB-0036-SOP)

(<http://www.deq.state.or.us/lab/techrpts/technicaldocs.htm>), which includes procedures for sampling rivers, streams, estuaries, lakes, groundwater wells, soil, shellfish, fish, and sediment.

2.2.4 Sampling Vapors

Refer to the DEQ *Guidance for Assessing and Remediating Vapor Intrusion in Buildings* to make appropriate risk-based decisions about vapor intrusion into indoor air at environmental cleanup and Underground Storage Tank (UST) cleanup sites when the Conceptual Site Model (CSM) shows the potential for vapor intrusion.

2.3 Sample Handling and Custody

Sample integrity 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 should be maintained 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 notes or logbooks
- Site observations and photographs (with written descriptions)
- Names, titles, organization, and roles of sample collectors
- 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
- Chain of custody / Analytical request form

2.3.2 Field Custody Procedures

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

- Sample bottles from containers that appear to have been compromised shall 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 on the appropriate field forms;
- A site team leader will assess if additional samples are required;
- All samples requiring thermal preservation must be shipped with an appropriate temperature blank (in each cooler), which will (at a minimum) consist of a 100-mL polyethylene bottle filled with clean water; Alternatively, a random sample container will be used as the temperature blank.
- 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; and
- Freight bills and bills of lading will be maintained as part of the permanent project record.

2.3.3 Laboratory Custody Procedures

Transfer of the samples into laboratory custody will follow standard custody procedures and be fully documented on a Chain-of-Custody form. (The DEQ lab uses DEQ06-LAB-0054-FORM, available on Q-Net). The sample receiver shall note the condition of the shipping containers and the custody seals (i.e., broken, unbroken). The laboratory individual responsible for sample intake shall document the condition of individual samples in the shipping container as well as the temperature of the container upon receipt (recording the temperature of the temperature blank or if no temperature blank is present, recording the temperature of one of the samples in the cooler). If the shipping container, any individual sample containers, or the shipping temperature is out of control, the laboratory should contact their client 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.

2.4 Analytical Methods

2.4.1 Introduction

All analytical methods used on samples from UST inspections must comply with relevant requirements of applicable federal or state programs for which they were collected (e.g., 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, adopted methods under RCRA SW-846 can be obtained from the EPA website at <https://www.epa.gov/hw-sw846/sw-846-compendium>.

All results for analytical testing on soil and solid matrix samples for Organic and Inorganic analyses must be reported on a dry weight basis and identified as such in the final report.

Wet weight result / % solids = Dry weight result [Equation 2-1]

2.4.2 Methods

Table 2-2 below lists the classes of analytes that are typically of the greatest interest for the UST and HOT programs, as well as the preferred analytical methods. This table provides a starting point for selecting analytical methods for site specific QA Plans.

A list of the routine analytical methods that the DEQ laboratory uses is contained in the *Field Sampling Reference Guide* (DEQ86-LAB-0002-QAG). Laboratories performing analyses of UST samples must employ the methods referenced or use approved methods from the source documents. Current, adopted methods under RCRA SW-846 can be obtained from the EPA website at <https://www.epa.gov/hw-sw846/sw-846-compendium>. Since the list of adopted analytical methods is subject to periodic update, contact the UST or LUST project manager or DEQ laboratory for a list of currently approved methods. Sites specific QA plans should outline the specific analytes and quantitation limits (QL) that are expected.

Table 2-2 Analytical Methods References⁴

Parameters	Method	Technique	QL ⁵ (approximate)
Inorganic Analysis			Water (Soil)
Lead	EPA 6010C (or D)	ICP	0.1 mg/L (10 mg/Kg)
Lead	EPA 6020A (or B)	ICP/MS	0.005 mg/L (1 mg/Kg)
Organic Analysis			
HCID	NWTPH-HCID	Capillary GC/FID	not quantified
NWTPH-G as gasoline	NWTPH-GX	Purge & Trap GC/FID	0.25 mg/L (20 mg/Kg)
NWTPH-D as diesel	NWTPH-DX	Sonic Ext. GC/FID	0.25 mg/L (25 mg/Kg)
NWTPH-O as motor oil	NWTPH-DX	Sonic Ext. GC/FID	0.5 mg/L (100 mg/Kg)
PCBs	EPA 8082A (8000C or D) Alternative – 8270D	Solvent Ext. GC/EC Alt: GC/MS	0.001 ug/L

⁴ *Test Methods for Evaluation of Solid Waste*, Physical/Chemical Methods, USEPA SW-846, 3rd edition (Updates I-IV), February 2007 (**Note:** Methods from Update V (August 2015) can also be used)

⁵ QL = Quantitation Limit (also referred to as Limit of Quantitation (LOQ) or Reporting Limit (RL))

Parameters	Method	Technique	QL ⁵ (approximate)
Oil & Grease (Hexane Extractable Material)	EPA 1664	Hexane Ext. GC	5 mg/L
Semi Volatiles (PAH)	EPA 8270D (or 8270D-SIM)	GC/MS	0.001 – 0.005 mg/L
Volatile Organics (includes BTEX)	EPA 8260C (2006)	Purge & Trap GC/MS	0.0005 – 0.001 mg/L 0.005 – 0.010mg/L (ketones)
Volatile Organics in air	EPA TO-15	GC/MS	0.5 ppbv
MTBE, Ethanol and Oxygenates	EPA 8260C (2006)	Purge & Trap GC/MS	0.001 – 0.025 mg/L (varies by compound)
Percent solids (for Dry weight correction)	CLP – ILM05.3 (or equivalent)	Gravimetric	0.1%

2.5 Quality Control

Because of the role data plays in determining regulatory courses of action and decision-making, a QA/QC program to ensure data reliability and quality data is essential. These efforts are based on Department policy outlined in DEQ's *Agency Quality Management Plan (DEQ03-LAB-0006-QMP)*.

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 (DEQ03-LAB-0006-QMP). 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 UST and HOT programs. Site-specific quality objectives are often further defined by site specific QA Plans or sampling and analysis plans. 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. All site specific QA Plans or sampling and analysis plans are to receive a quality assurance review and be approved by the DEQ project manager and quality assurance officer (or QA designee).

It is understood that project/sampling plans for voluntary clean-up activities will be submitted to DEQ after the work has been performed, however, DEQ must still review and approve the activities prior to issuing final decision on the site. For projects initiated by DEQ or those having direct DEQ oversight, the QA Plans should be approved prior to the start of the project.

2.5.2 Field QC Requirements

Field transport (trip) blanks will be submitted for each site survey requiring volatile organics analysis. The blanks are prepared by the analyzing laboratory using distilled, de-ionized water and shipped with the other sample bottles to the field and then returned to the analyzing laboratory with the samples for analysis. Do not separate transport blanks from other samples. They must be packaged with the environmental samples collected during the sampling event.

Transfer blanks will be collected for each site survey. The transfer blank consists of two VOC purge vials filled with purified water at the site and shipped back with the samples. Transfer blanks are used to assess potential contamination of samples from the site environment.

Specific procedures for VOC sampling are outlined in the DEQ *Field Sampling Reference Guide* (DEQ86-LAB-0002-QAG).

Field duplicates will be collected when the site survey has more than ten samples or the sample collection takes more than one day to complete. If more frequent duplicates are required, it must be stated in the site specific QA Plan or Sampling and Analysis Plan. Field duplicate samples are taken within five minutes of collecting the original samples and include all the 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 DEQ's Field Sampling Reference Guide (DEQ86-LAB-0002-QAG).

2.5.3 Laboratory QC Requirements

Routine quality control procedures shall be outlined in the analyzing laboratory's *Quality Manual* (*however named*) and are used for all samples that are submitted for this project. Routine procedures shall follow TNI standards⁶, which include:

1. Daily instrument calibration and/or calibration verification prior to analysis of any samples.
2. Calibrations must be verified according to the analytical methods using a standard source other than the source used for the instrument calibration
3. Method blank analysis daily or at a frequency of 1/20 samples, whichever is greater.
4. Analysis of a Laboratory Control Sample (LCS) at a frequency of 1/ per batch of 20 or fewer samples This sample is sometimes referred to a blank spike.
5. 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.
6. 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.
7. Determination of the minimum reporting limit based on detection limit studies and the concentration range of calibration standards.

The expectations for analytical precision and accuracy fall within the overall expectations for precision and accuracy as described in Table 1-2. Precision and accuracy will vary with the analytical method and laboratory procedures. The laboratory must qualify any results that do not meet the acceptance criteria on the analytical reports. The analyzing laboratory must make precision and accuracy statements available upon request.

Most project will only require the information necessary for a Stage 2A validation as defined in EPA-540-R-08-005 (*Guidance for Labeling Externally Validated Laboratory Analytical Data for Superfund Use*) to be submitted. This means the analyzing laboratory must include, in addition to sample results, sample receipt conditions and sample-related QC results (method blanks, LCS, matrix spikes and laboratory

⁶ TNI Standard, Environmental Laboratory Sector EL-V1-2009 or current version

duplicate). If additional validation is required for a specific project, it should be defined in a QA plan or sampling and analysis plan.

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. In the event that the analytical data is compromised in some way, data qualifying flags must be used to explain the variance. If unsure, the DEQ project manager will contact the DEQ LEAP staff to assist in the analytical data assessment.

Laboratories must qualify all results that are affected by QC exceptions, as noted above, or other events that affect the interpretation of the analytical results. The following data qualifying flags are standard USEPA validation flags that can be used by analytical laboratories providing services for UST and HOT projects. 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.

Note: Laboratories may use different or additional data flags; however, each flag must be defined unambiguously in the analytical report.

- **J** - the result is an estimate because the measured sample concentration is less than the laboratory's method reporting limit but greater than the method detection limit, or laboratory QC criteria were not satisfied.
- **J+** - the result is an estimate (see "J"), and may be biased high.
- **J-** - the result is an estimate (see "J"), and may be biased low.
- **B** - the blank was contaminated with the analyte being reported.
- **U** - the measured sample concentration is less than the laboratory's reported quantitation limit (QL).
- **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 assessments are done by evaluating data against five Quality Assurance elements:

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

The generic data assessment criteria for project data is discussed and defined in sections B5.3.1 to B5.3.5. DEQ validates the data against performance measures and DQOs established in this QAPP and in site-specific SAPs, may assign QC data quality levels of A, B, C, D, E, and F following the criteria detailed in DEQ guidance document; *Data Validation and Qualification* (DEQ09-LAB-0006-QAG) used by DEQ's QA section, which is specific to the analytical method, sample matrix, and the analyte of interest:

- **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 the “J+”/”J-“ (estimated) qualifiers used by EPA see above)**
- **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)**
 - **Note:** In rare instances, a project manager may still be able to use some “C” data (mostly Field generated) in their project if the data can still support the decisions that need to be made. In these cases, the project manager should document in their project report the basis as to why the “C” data was found to be acceptable.
- **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).

DEQ uses the validation criteria found in *Data Validation and Qualification* (DEQ09-LAB-0006-QAG) as guidance for applying DQLs to the data. The DEQ QA section should be contacted when developing DQL criteria for site-specific SAPs that are different than that found in this QA Plan.

a) Precision measurements

Precision is a measure of the scatter of the data when more than one measurement is made on the same sample. Scatter is commonly attributed to sampling activities or chemical analysis. Duplicate samples are collected in the field to assess precision attributable to sampling activities. Replicate analyses are performed with each test to assess data variability attributable to laboratory analysis. Precision will be expressed as the relative percent difference. Project managers should indicate their preference as to what sample should be duplicated.

Site-specific QAPPs may request tighter control limits to initiate corrective action. For concentrations well above the reporting limit (5x the QL), 20% RPD for water samples and 35% RPD for Soil samples is normally acceptable. If concentrations are low, precision will be assessed by difference. The analyzing laboratory shall determine their control limit as specified in section 4.1.1. Until the analyzing laboratory has collected sufficient data, it is acceptable to arbitrarily set the control limit to that presented in the cited method. The DEQ QA section will review agency sampling events with duplicate samples and prepare a QA report when requested.

b) Accuracy measurements

Accuracy is a measure of the difference between observed test results and true sample concentration. Inasmuch as true concentrations are not known, accuracy is inferred from recovery data determined from standard reference materials and by matrix spikes.

Some methods specify control limits. For those methods that do not, routine accuracy for inorganic parameters is $100 \pm 20\text{-}25\%$ recovery for LCS, and $100 \pm 10\text{-}15\%$ for calibration verification. For organic parameters the routine accuracy is $\pm 30\%$ for LCS and $100 \pm 20\%$ for calibration verification.

Matrix spike/matrix spike duplicates are used on analyses where contaminants are not routinely detected. Samples that are collected for this project plan may not be spiked. However, accuracy shall be assessed from other samples analyzed at the same time. A site-specific QAPP may require a sample from the project be spiked. Some organic methods require surrogate spikes on each sample, from which accuracy is assessed. Inorganic parameters typically have an accuracy limit of $100 \pm 25\%$, organic parameters are $100 \pm 30\text{-}50\%$. The analyzing laboratory shall determine their control limit as specified in section 4.1.2. Until the analyzing laboratory has collected sufficient data, it is acceptable to arbitrarily set the control limit to that presented in the cited method.

c) Representativeness

Representativeness is a measure of how closely the observed test results on the sample matrix reflect the actual site conditions. Sampling procedures must be designed so results represent the matrix being measured. Sample handling protocols for storage, preservation, and transportation have been developed to preserve the representation of the collected samples. Proper documentation will establish that protocols have been followed and sample identification and integrity assured. Transfer blanks, transport blanks, and field duplicates will be used to assess field and transport contamination and method variation. Laboratory method-blanks will be run on a daily basis.

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 to the representativeness of the analyses. Tests that describe the sample matrix may be requested on a site-specific basis.

d) Comparability

The objective of this parameter is to assure that data developed during the investigation are either directly comparable, or comparable with defined limitations, to literature data or other applicable criteria. Comparability of the data will be maintained by using EPA approved procedures. The analyzing laboratory shall list analytical methods used in their *Quality Manual (however named)*. If a site-specific QAPP requires a new method, it should include how the method compares to other methods. The analyzing laboratory shall measure comparability of test methods not cited in EPA or DEQ documentation by evaluating inter-laboratory splits or alternate test procedures.

e) Completeness

Completeness is a measure of the amount of useable⁷ data obtained from the analytical measurement system compared to the amount that you expected to obtain. It is defined as the total number of samples taken for which valid analytical data are obtained divided by the total number of samples collected and multiplied by 100. For this project at least 90% of all samples tested should yield useable data.

⁷ Useable data is data that is of sufficient quality and can be relied on for decision making even if the data is qualified.

2.6 Instrument/Equipment Testing, Inspection, and Maintenance

All instruments and equipment will be tested, inspected, and maintained according to the manufacturer's guidelines and recommendations. Regular analytical performance audits will be carried out as prescribed by TNI/NELAP standards.

2.7 Instrument/Equipment Calibration and Frequency

All instruments and equipment will be operated and calibrated according to the manufacturer's guidelines and recommendations as prescribed by the analytical methods and the TNI/NELAP standards. Only personnel who have been properly trained in these procedures will operate and calibrate the instruments. Calibration records must be made available to the DEQ project manager or his/her representative upon request.

2.7.1 Instrument Calibration

Instruments are calibrated and/or verified each time they are used. The degree of calibration and verification depends upon the instrument and method. Additionally:

- Thermometers are referenced periodically to an NIST certified thermometer. Results are documented.
- pH meters are calibrated with pH 7.0, pH 4.0, and pH 10.0 buffers. Results are documented in logbooks.

2.7.2 Field Screening Instruments

Field screening data are generally qualitative in nature and often used to provide real-time data for health and safety purposes. Data generated from this type of sampling provides:

- Identification of soil, water, air, and waste locations that have a high likelihood of showing contamination through subsequent laboratory analysis;
- Information used for health and safety consideration during site reconnaissance and subsequent intrusive activities; and
- Qualitative data if the contaminant is known and the instrument is calibrated to that substance.

Instruments will be calibrated and maintained according to manufacturer's instructions.

2.8 Inspection/Acceptance of Supplies and Consumables

The analyzing laboratory shall have written procedures for inspecting and accepting supplies and consumables.

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 the Department in a site-specific QAPP or a Corrective Action Plan that complies with the requirements of OAR 340-122-0250.

2.10 Data Management

Data management includes data entry, validation, transfer, storage, and reporting. Precautions shall be taken each time the data are reduced, recorded, calculated, or transcribed to prevent introduction of errors or loss of information.

1. **Collection:** For both manual data and computerized data acquisition systems, internal quality control checks shall be developed and implemented to avoid errors in the data collection process.
2. **Validation:** Data validation is defined as the "process whereby data are accepted or rejected based on a set of criteria."
3. **Transfers:** Data transfer steps shall be minimized. Procedures shall be established to ensure that data transfer is error free (or there is an acceptable error rate), no information is lost in transfer, and data output is 100% recoverable from data input.
4. **Storage:** At each stage of data processing, procedures shall be established to ensure data integrity and security. Raw data sheets must be retained on file or stored electronically. Physical samples should be stored for 30 days after the data has been released from the laboratory with appropriate attention to proper disposal of potentially hazardous materials.
5. **Reduction:** Data reduction includes any process that changes either the form of expression, the numerical value of data results, or the quantity of data. This includes validation, verification, and statistical or mathematical analysis of the data. *Reduction* is distinct from *data transfer* in that it entails a change in the dimensions of the data set.

Data reported to the DEQ for posting on line must be submitted with the prescribed data elements. The (project manager must determine whether the analytical data should be loaded into a web accessible database. The project manager's decision to submit the data for database upload shall be based on whether the data measures an impact on the environment. This data may prove useful for multimedia decision and should be available for the entire agency. Data that is used to determine composition of unreleased sources need not be loaded into an external database.

When samples are split between a contractor and the DEQ laboratory, the project manager shall ensure that the analytical data of contract laboratories will be submitted to the DEQ laboratory

3. Assessment and Oversight

3.1 Assessment and Response Actions

The analyzing laboratory shall document assessment procedures as prescribed in TNI/NELAP standards. Such documentation shall be made available to DEQ personnel upon request.

3.1.1 Technical System Audits

EPA conducts triennial on-site evaluations of the DEQ laboratory to assess analytical capabilities for inorganic, TTHM, and VOC parameters under the SDWA. Any substantive deficiencies cited will be corrected immediately, or within the time frame set by the evaluator. Substantive recommendations will be implemented as soon as possible.

Laboratories must be participating in at least annual proficiency testing studies for the UST parameters (twice per year is strongly suggested). Laboratories that are accredited under NELAP are required to perform 2 studies per year for accredited parameters.

- **Water Pollution (WP) Performance Evaluation Studies**
This study is used for laboratories that analyze non-potable water (surface water, ground water, waste water).
- **Soil Solid Waste Performance Evaluation per 2009 TNI Standard (or current version)**
standard for select analytes.

Laboratories that are accredited under NELAP have a general assessment performed by their accrediting agency

The DEQ project manager may perform (or arrange for) random site specific TSAs or TSA's based on document review or complaints.

3.1.2 Quality Systems Audits of DEQ

The DEQ UST program staff and DEQ QA officer shall participate in system audits conducted by the EPA Region 10 QA Team, on a quadrennial basis, or as requested by Program Management, and in National Performance Audit Programs (NPAPs) when they are made available. Additional audits on random projects may be performed by the agency QA officer as directed by the DEQ Internal Audit Advisory Committee (IAAC). Such evaluations provide the opportunity for an objective assessment of the adequacy of resources, adherence to data generating and processing procedures, and review of quality control and quality assurance activities. It shall be scheduled through the QA officer and conducted according to a pre-determined audit plan.

3.1.3 Performance Evaluation Audits

Laboratories should perform routine audits as prescribed in 2009 TNI standards.

3.2 Reports to Management

Project managers are responsible for reporting UST cleanup activities in their respective regions. Procedures for preparing these reports may vary between regions. The UST Program also provides EPA Region 10 with semi-annual activity reports.

4. Data Validation and Usability

4.1 Data Review, Verification, and Validation

Upon completion of the analyses, the analyzing laboratories will review the data packet and provide a specific report for that sampling event. The analyzing laboratory will submit this QA/QC report with the analytical data report. This report may also be loaded into an electronic database for use by DEQ personnel.

Each laboratory shall have their own procedure for validating the quality of data they generate. The analyzing laboratory must check precision and accuracy prior to reporting data. Acceptance criteria from calibrations and verifications are based on control limits found in the analytical methods. Replicate analyses for precision, and QC standard or spike recoveries for accuracy or on limits specified in this QAPP or by approved site-specific QAPPs or SAPs.

Note: Laboratory historical control limits may be used if they are at least as restrictive as the QAPP limits or have been approved by the Project Manager. Procedures for establishing control limits are described in this section.

Data review, verification, and validation procedures and requirements are discussed in Section B5 - Quality Control. For the purposes of this QA Plan, analytical data with DQLs of A, or B will normally be acceptable for use. If the DEQ project manager feels that data with the Quality level of "C" is satisfactory for their needs it must be clearly documented in their final report as to how the DQOs can still be met.

4.1.1 Precision

The absolute Relative Percent Difference (RPD) is used to assess the precision of the analytical method, calculated using the equation:

$$RPD = \frac{X_s - X_d}{[X_s + X_d]/2} \times 100\% \quad \text{[Equation 4-1]}$$

Where:

X_s = result for the sample; and

X_d = result for the duplicate sample.

The units of X_s must equal to those of X_d

The average RPD is calculated using the previous year's data. Outliers should be excluded from the data set using either Grubb's or Dixon's Q test for outliers. A maximum of ten percent of the data can be excluded from the data set using this procedure. Control limits are calculated by multiplying the average RPD by 3.27, which represents the 99% confidence limit. Alternatively, or if insufficient data is available, it is acceptable to set the control limits to those presented in the cited DEQ-approved method.

4.1.2 Accuracy

The accuracy of the data set is determined using spiked samples. The accuracy is calculated using the equation:

$$A = \frac{X_{ss} - X_s}{T} \times 100\% \quad \text{[Equation 4-2]}$$

Where:

- A = recovery for the added spike;
 X_{SS} = result for the spiked sample;
 X_S = result for the sample;
T = true value of the added spike.

Average percent recovery is calculated using the previous year's data (at least 20 data points). Outliers are excluded from the data set by the use of Dixon's test. A maximum of ten percent of the data may be excluded from the data set using this procedure. If insufficient data is available it is acceptable to arbitrarily set the control limit to that presented in the cited DEQ-approved method. Warning and Control Limits are set as follows:

Warning limits = $A (\text{avg.}) \pm 2s_x$

Control limits = $A (\text{avg.}) \pm 3s_x$

Where: s_x = standard deviation of the mean of the data set.

4.2 Corrective Action

Corrective action is initiated whenever an "out of control" condition is identified (*e.g.*, either control limits or holding time has been exceeded). Corrective action generally consists of:

- Calibrating the analytical system and repeating the analysis, if holding time permits.
- The laboratory or field staff are responsible to document the "out of control" conditions and the corrective action taken. During the investigation of the "out of control" condition, determine the course of corrective action..
- If time for reanalysis exceeds the allowable holding time for the analyte, the project manager and sampler are notified and resampling is requested.
- However, 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.

The analysis of error may also conclude that the sampling method was either incorrect or "out of control". In these cases, the project manager is notified and either training at the analyzing laboratory or in the field with the field staff is recommended.

4.3 Data Usability / Reconciliation with User Requirements

All data that meets the criteria outlined in this QA Plan or a site specific plan is determined to be useable. Any data that is qualified shall be assessed by the project manager to ensure that the data collected addresses the DEQ's needs to evaluate the UST or HOT site. In other words, ensure the data is still suitable to make appropriate agency determinations (such as site closure).

5. Revision History

Revision	Date	Changes	Editor
1.0	01/2002	New Document	
2.0	09/08/2010	Updated agency structure. Expanded applicability to include LUST and HOT programs. Added sample acceptance criteria and lab report requirements. Updated methods and preservations tables. Removed non-UST tests. Updated data assessment section.	SCH, et.al
3.0	04/08/2016	Updated agency structure and references to TNI. Updated methods table. Updated data quality level criteria, Added Acronym table, updated regulation references in Project Background. Updated record retention to match DEQ Schedule. Removed reference to LASAR. Updated document format overall	SCH, MS
3.1	6/20/2016	Based on EPA comments: Added EPA program staff to approval and distribution list. Minor edits to preservation tables. Fixed link to EPA SW846 web page. Clarified SAP requirements for small projects (1.10.2 (6))	SCH

Figure 1 Organizational Chart

Oregon Department of Environmental Quality Organizational Chart – UST Programs

