

QUALITY ASSURANCE PROJECT PLAN
Environmental Sampling at
EMF Site

Prepared for:
THE BOEING COMPANY
SHARED SERVICES GROUP

Prepared by:
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Revision 4

Project No. K0561001

SECTION A – PROJECT MANAGEMENT

A1. Title and Approval Page

Quality Assurance Project Plan for Environmental Sampling at EMF Site

Prepared by: _____

Telephone Number: _____

Signed: _____ Date: _____

CALIBRE Site Manager: Tom McKeon _____

Signature: _____

Date: _____

CALIBRE QA Manager: John Frerich _____

Signature: _____

Date: _____

Other Relevant Project Team: _____

Signature: _____

Date: _____

Other Relevant Project Team: _____

Signature: _____

Date: _____

Other Relevant Project Team: _____

Signature: _____

Date: _____

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Appendix A Formulas For Evaluating Precision, Accuracy, Representativeness, Completeness, and Comparability

Appendix B EMF Site, Quality Assurance Project Plan, Quality Control Criteria for Data Quality Assessment

A3. Distribution List

Official copies of this QAPP, accompanying documents and any subsequent revisions will be provided to:

Name: Tom McKeon
Title: Site Manager
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Phone: 425/643-4634 Email: tom.mckeon@calibresys.com

Name: John Frerich
Title: QA Manager
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Title: Project Manager
Organization: Boeing
Phone: 206/898-0438 Email: carl.m.bach@boeing.com

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Title: EPA Project Manager
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Phone: 206/553-4323 Email: castrilli.laura@epa.gov

Name: _____
Title: _____
Organization: _____
Phone: _____ Email: _____

A4. Project/Task Organization

Table A-1. Project Responsibilities

Name	Organization	Title	Contact Information
Tom McKeon, P.E.	CALIBRE	Site Manager & CALIBRE Project Manager	425/643-4634
John Frerich	CALIBRE	QA Manager	425/226-6435
Grant Dawson, PE	CALIBRE	Field Supervisor	253/277-0739
Jeff Dawson Justin Neste	CALIBRE	Field Technicians	509/430-4649 360/981-5606
Grant Dawson, PE	CALIBRE	Field Engineer/Scientist	253/277-0739
Kelly Bottem	ARI	ARI Project Manager (Lab)	206/695-6211
Carl Bach	Boeing	Boeing Project Coordinator	206/898-0438
Laura Castrilli	US EPA	EPA Project Manager	206/553-4323

Responsibilities

Boeing will be responsible for the overall project management of the investigation and remedial action work on the EMF site. Key Boeing personnel are as follows:

Carl Bach is the Project Coordinator for Boeing. Mr. Bach is Boeing's designated Project Coordinator, responsible for overseeing the implementation of necessary actions to meet the requirements of the Settlement Agreement. To the extent possible, all documents, reports, approvals, and other correspondence concerning the activities performed pursuant to the Settlement Agreement will be directed through Mr. Bach

Tom McKeon of CALIBRE will be the **Site Manager and Project Manager** for the Boeing environmental work. Mr. McKeon is a licensed civil engineer with 25 years experience as an environmental engineer with work related to hydrogeologic investigations, Remedial Investigation/ Feasibility Studies, risk assessments and remedial actions in soil, groundwater, and sediments. The Site Manager (SM) will be in direct contact with the Boeing Project Manager and EPA Project Manager. The SM is fully responsible for the technical quality of the work, as well as project budget and schedule. He will direct, coordinate, and monitor the efforts of the Project Team members to assure the technical quality of the work and accurate reporting to management. Specific responsibilities related to QA/QC include:

- Assure availability of technical standard operating procedures (SOPs) and training of staff to SOPs;
- Prepare project work plans (WPs);
- Assure project activities are conducted according to SOPs/QAPP;
- Review and evaluate data and verify data quality;
- Implement corrective actions resulting from QA audits;
- Report QA problems to client's PM; and
- Supervise preparation of project deliverables.

The SM reports any quality issues to the Quality Assurance Manager (QAM) and technical issues to the Corporate Principle Engineer (Gaynor Dawson, P.E) in the Environmental Technology Solutions (ETS) division at CALIBRE Systems.

John Frerich of CALIBRE will be the **Quality Assurance Manager** for the Boeing environmental work. Mr. Frerich is an environmental scientist with more than 25 years experience including extensive work related to CERCLA site characterization activities with EPA Region 10. The QAM is responsible for developing and implementing the project QA program. The QAM prepares the project QAPP and its subsequent revisions. The QAM will communicate QA responsibilities to all project staff and provide guidance for implementation of the QAPP. The QAM has authority to terminate specific project activities if the quality of data to be collected is jeopardized. Specific responsibilities of the QAM related to QA /QC include:

- Serve as point-of-contact for all matters involving QA;
- Provide guidance and technical information concerning QA issues to project staff;
- Review project activities for proper implementation of the WP and SOP;
- Plan and conduct QA audits; and
- Identify QA deficiencies to SM and assist in identification of corrective actions.

The QAM reports to the corporate Quality Program Manager at CALIBRE. The corporate Quality Program Manager at CALIBRE is Art Geis.

Grant Dawson of CALIBRE will be the **Field Supervisor** for the Boeing environmental work. Mr. Dawson is a licensed environmental engineer with more than 5 years experience in environmental sampling and remediation. The Field Supervisor (FS) will provide day-to-day supervision of all field sampling and analysis activities. Specific responsibilities of the FS related to QA/QC include:

- Supervise all field sampling and analysis activities to assure proper implementation of SOPs;
- Supervise sample collection, logging, and documentation of field activities and test results;
- Assure all field activities identified in work plans are implemented, required environmental and QC samples are collected, and required field measurements are taken;
- Coordinate with analytical laboratory(ies) for scheduling of analyses and receipt of samples;
- Supervise subcontractor staff involved with field activities; and
- Coordinate transfer of field data and records to SM for data reduction and validation.

The FS reports to the SM. If the FS is not present during specific field activities (i.e., based on the number of personnel required to complete the work), the SM will designate an alternate FS for those activities. The alternate FS will have all responsibilities identified above.

Jeff Dawson and Justin Neste of CALIBRE will be the **Field Technicians** for the Boeing environmental sampling and remediation work. Mr. Dawson is an environmental scientist with more than 15 years of environmental sampling experience. Mr. Neste is a biologist with 2 years experience. Field technicians (FTs) will report to and perform field sampling and analysis activities under the supervision of the FS. Responsibilities of the FT related to QA/QC include:

- Perform field tasks according to WP and applicable SOPs; and
- Prepare and maintain records of field activities.

Grant Dawson of CALIBRE will be the **Field Engineer/Scientist** for the Boeing environmental sampling and remediation work. Mr. Dawson is a licensed environmental engineer with 5 years experience. Field engineers/scientists (FES) will perform a variety of field activities including sampling, well logging, supervising installation of wells, performing aquifer tests, and installing and starting up treatment and test equipment. Responsibilities related to QA/QC include:

- Conduct activities in accordance with WP and applicable SOPs;
- Coordinate activities with FS and SM to assure integration of field operations; and
- Generate and maintain documentation of field activities and test results.

Kelly Bottem of Analytical Resources, Inc. (ARI) will be the **Laboratory Project Manager** for the Boeing environmental sampling work. ARI is a State of Washington Ecology-accredited laboratory. The Laboratory Project Manager is responsible for the timely completion of the required fixed-laboratory analyses with adherence to the SW-846 procedures and any additional project-specified SOPs and program requirements.

Laura Castrilli will be the **EPA Region 10 Project Manager** for the Boeing environmental sampling work. The EPA Project Manager is responsible for overseeing the project and reviewing/approving the Data Gap Sampling Work Plan, to which this QAPP is attached. The EPA Region 10 QA Manager or designee will review the QAPP and recommend approval or disapproval of the QAPP to the EPA Project Manager.

Other key project staff includes Gaynor Dawson, P.E. (CALIBRE project coordinator with over 35 years experience in environmental engineering) and Christina Jensen of Validata LLC with 19 years of experience in environmental and analytical chemistry including quality assurance review, data validation and data management support.

A project organization chart is provided below.

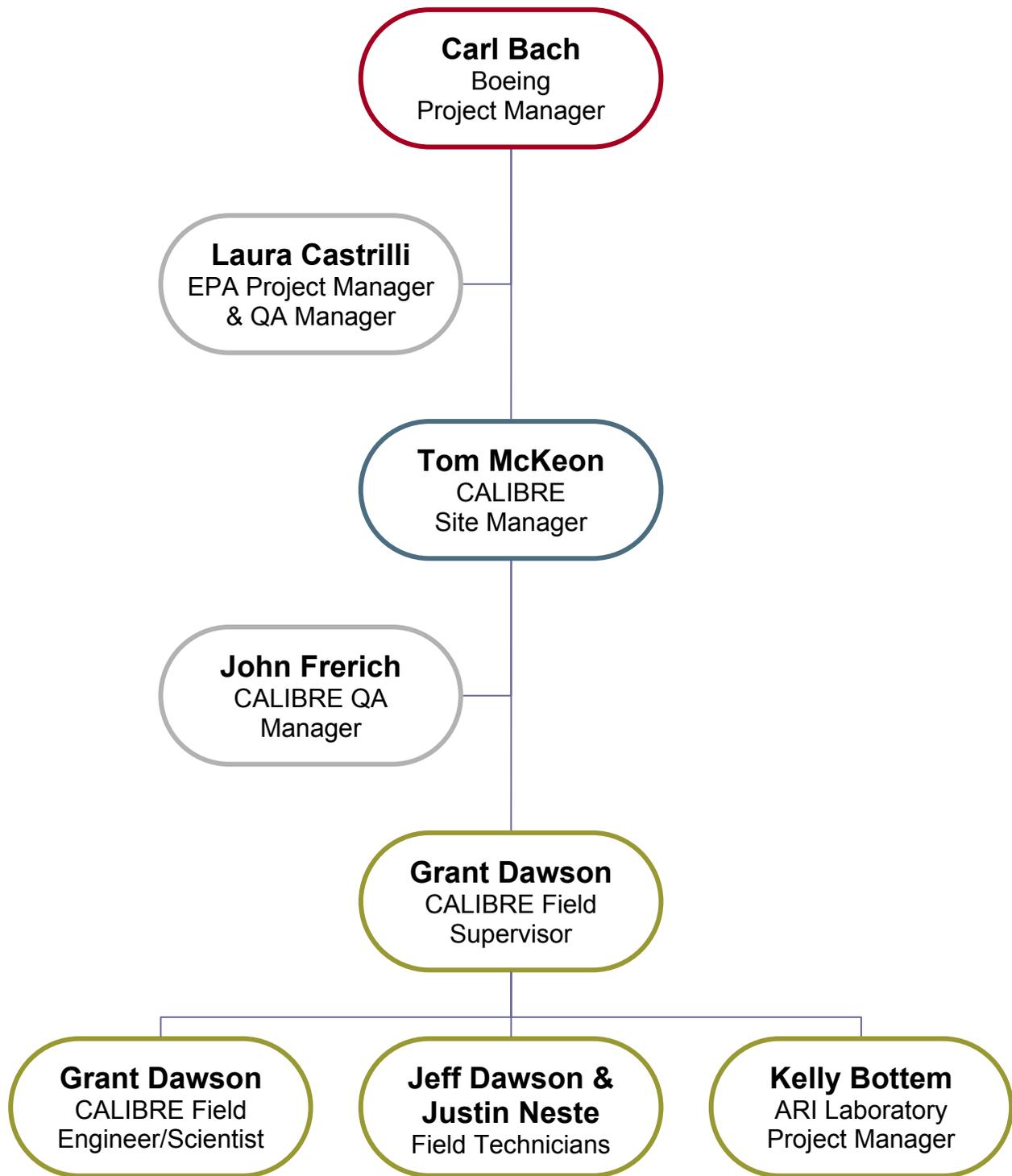


FIGURE A-1: Project Organization Chart

A5. Problem Definition/Background

The EMF property is located on the east side of KCIA. The facility is situated between the active runways/taxiways and Perimeter Road located to the east, which forms the eastern boundary of the airport and ancillary support operations (see Figure 2-1). Past industrial activities at the EMF property resulted in the release of trichloroethene (TCE) to the ground and to groundwater beneath the property. The VOC plume has been transported by natural groundwater movement southwest from the EMF property, across KCIA, passing under Boeing Plant 2 towards the Lower Duwamish Waterway (LDW) located approximately 3,600 feet southwest of the former EMF property.

The site consists of the EMF property and the portions of KCIA and Boeing Plant 2 impacted by the EMF VOC plume that is located in a west to southwest direction from the EMF property. The down gradient boundary of the site is the LDW. The contaminants of concern (COCs) that have been identified in the EMF VOC plume are TCE, cis-1,2-dichloroethene (cis-1,2-DCE), trans-1,2-dichloroethene (trans-1,2-DCE), and vinyl chloride.

The site characterization data, exposure pathways and ARARs were used to develop a conceptual site model (CSM). As reflected in the CSM, the historical site data indicated that the contamination in the EMF plume at the point of discharge had reached concentrations in excess of ARARs and remedial action was required to meet those ARARs. The site remedial action needs to address contamination in a way that ensures against any unacceptable risks and meet ARARs.

The boundaries of the study (necessary to define the DQOs) are that portion of the Duwamish valley watershed that is impacted by releases from the EMF facility from the EMF property to the ultimate discharge at the LDW.

Boeing has initiated voluntary remedial actions for the EMF VOC plume following completion of site investigations, pilot studies and Feasibility Studies (FS). The remedial actions have included source control actions and multiple transects across the VOC plume consisting of injection and monitoring wells to remediate VOCs in groundwater by enhanced reductive dechlorination (ERD).

A6. Project/Task Description

This Quality Assurance Project Plan (QAPP) describes activities that will be implemented to assure integration of applicable Quality Assurance/Quality Control (QA/QC) requirements into sampling activities conducted in support of field investigations and remediation optimization. The objective of this QAPP is to present procedures, organization, objectives, functional activities, and specific QA/QC activities to assure that data collected during field activities are of known and sufficient quality to meet project objectives. Specific sampling activities are expected to include soil sampling, groundwater sampling from wells or borings, and soil vapor sampling. Details for each sampling event will be presented in Sampling and Analysis Plans (SAPs) that will define DQOs, the specific sampling locations, tasks, and requirements and will reference this project QAPP.

A7. Data Quality Objectives and Criteria for Measurement Data

Identifying the intended use of the data is necessary to establish a variety of the data requirements and corresponding quality objectives. For the EMF project two types of intended use are expected: decision-making and estimation.

Decision Making. In this context, decision making is defined as making a choice between two alternative conditions. The primary decision anticipated is whether or not an exposure point concentration exceeds established criteria. Examples include;

- a. Does the discharge concentration from the EMF plume exceed the AWQC?
- b. Does the groundwater concentration at a point near a structure exceed a criteria that would indicate a potential risk from vapor intrusion?

Other decision making uses of the data are expected but these two examples describe the general form that is anticipated.

Estimation. In this context, estimation is defined as data use to evaluate the magnitude or more general interpretation of some environmental parameter or characteristic. Examples applied to this project include such parameters as:

- a. Relevant hydrogeological conditions (the groundwater flow direction and velocity).
- b. Relevant geochemical conditions in the aquifer (pH, dissolved oxygen content, redox level).
- c. The plume position and boundary (the peak concentrations in the central area of the plume and general boundaries defining the plume edges).
- d. Performance evaluation of remedial actions implemented (performance data such as time series of VOC concentrations at a monitoring point).

All of these parameters will require monitoring data for estimation and are known/expected to vary in space and time. However, the estimated parameter (and the monitoring data used to estimate it), is not generally to be compared with a regulatory threshold as a pass/fail decision based on an established criteria. The defining characteristic of an estimation problem (versus a decision-making problem) is that the intended use of the estimate is not directly associated with a well-defined decision. Uncertainty in estimates is unavoidable due to a variety of factors, such as imperfect measurements, inherent variability in the characteristics of interest of the parameters measured, and limits on the number of, or position of, samples that can be collected.

A7.1 Measurements

Measurements will be made to collect data for both decision making and estimation needed to meet project objectives. Some data to support estimation parameters will be collected using field analytical methods. Some data to support estimation and virtually all decision making parameters will be collected using approved laboratory analytical methods (e.g., SW-846, ASTM, or PSEP protocols). Examples of measurements commonly performed and the procedures/basis for use in decision making and/or estimation are summarized in Table A-2.

Table A-2. Examples of Measurements

Measurement Type	Data Collected	Intended Data Use
Laboratory Analytical	Concentrations of VOCs in water samples.	Decision ⁽¹⁾ & Estimation ⁽²⁾
	Concentrations of semivolatile organics in water	Decision ⁽¹⁾ & Estimation ⁽²⁾
	Concentrations of metals in water samples	Decision ⁽¹⁾ & Estimation ⁽²⁾
	Concentrations of VOCs in soil/sediment	Decision ⁽¹⁾ & Estimation ⁽²⁾
	Concentrations of semivolatiles in soil/sediment	Decision ⁽¹⁾ & Estimation ⁽²⁾
	Concentrations of PCBs in soil/sediment	Decision ⁽¹⁾ & Estimation ⁽²⁾
	Concentrations of metals in soil/sediment	Decision ⁽¹⁾ & Estimation ⁽²⁾
Field Analytical Measurements	Concentration of dissolved oxygen (DO) in groundwater samples.	Estimation ⁽³⁾
	Hydrogen ion activity (pH) of groundwater	Estimation ⁽³⁾
	Oxidation-reduction potential (ORP) of groundwater samples.	Estimation ⁽³⁾
	Specific conductance of groundwater samples.	Estimation ⁽³⁾
	Temperature of groundwater samples.	Estimation ⁽³⁾
	Photo-ionization detector (PID) reading of headspace and soil cores for field screening	Estimation ⁽³⁾
Field Physical Measurements	Instantaneous discharge rate of groundwater	Estimation ⁽³⁾
	Piezometric head in monitoring wells.	Estimation ⁽³⁾
	Air injection and extraction rates.	Estimation ⁽³⁾

(1) Data from samples analyzed by an analytical laboratory with QA/QC documentation following standard methods such as U.S. EPA SW-846;

(2) Data from calibrated analytical instrument for contaminant delineation such as field GC, portable XRF, or PID analysis for vapors to include added QA such as calibration curves, field duplicates, custody documentation (field sample tracking sheets) and a representative sample (typically 10%) submitted for laboratory verification;

(3) Data from calibrated field instruments such as a water quality meter for DO, pH, temperature, or PID for organic vapors.

The EMF project has included over 900 samples to characterize the VOC plume by EPA Method 8260B (or prior equivalent methods). Based on the existing data, the chemicals of concern within the plume are known and include the compounds TCE, cis-1,2-DCE, trans-1,2-DCE and vinyl chloride, all of which are included in the target list for VOC reporting for the 8260C analysis.

A7.2 Data Quality Objectives

The sampling design, field procedures, laboratory procedures, and quality control procedures are set up to provide sufficient-quality data for use in this project. Data quality objectives (DQOs) define the decisions necessary to resolve the defined site problem (from the problem statement) and describe the quality of data needed to meet project objectives. The DQOs depend on how the data will be used and the specific decisions that have been defined as the basis for data collection. Analytical data will generally be used to identify the areal extent and types and concentrations of contaminants. Important parameters associated with the data quality (primarily associated with decision-making data) are (1) quantitation limit, (2) precision, (3) accuracy, (4) representativeness, (5) comparability, and (6) completeness. These are discussed below. The arithmetic formulae used to evaluate these data quality parameters are presented in Appendix A.

A7.2.1 Quantitation Limit

The sensitivity of an analytical method is expressed as the quantitation limit. In order for analytical data to be of sufficient quality, the quantitation limit of the analytical method used must be less than the quantitation limit required to meet project objectives. The former depends on site-specific matrix effects and is commonly expressed as the reporting limit (RL) or sometimes the estimated quantitation limit (EQL). Examples of RLs for the methods and matrices specified for this project are summarized in Table A-3. The required quantitation limit is related to the use of the data. It is necessary to select and utilize analytical methods (and corresponding RLs) that can be used to support the likely project decisions at the concentration levels suitable for planned risk characterization/remedial performance evaluation. The anticipated range of threshold criteria (i.e., applicable concentration based regulatory criteria) for the site chemicals concern are presented in Table A-4. The RLs listed in Table A-3 are sufficiently low to evaluate the site conditions relative to the threshold criteria listed in Table A-4.

A7.2.2 Precision

Analytical precision is calculated by expressing, as a percentage, the difference between the results of analysis of duplicate samples relative to the average of those results for a given analyte. Precision is expressed as the relative percent difference (RPD).

A7.2.3 Accuracy

Analytical accuracy is calculated by expressing, as a percent, the recovery of a standard reference material or an analyte that has been added to the sample (or standard matrix) at a known concentration before analysis. Examples of the required recovery are specified in Table A-3. The spiked (fortified) concentration used will be specified by laboratory quality control requirements as detailed in the analytical method. Samples for matrix spikes will be collected at the frequency specified in the project objectives.

Table A-3. Examples of Laboratory Analytical Methods, Performance, and Quality Goals

Analyte	Matrix	Method	RL ⁽¹⁾	Precision ⁽²⁾		Accuracy ⁽²⁾	
				LCS/LCSD RPD	MS/MSD RPD	LCS % Recovery	MS % Recovery
Volatiles	Water	SW8260C	0.2 ug/L	<55	<27	50 – 150	50 - 125
Semivolatiles	Water	SW8270D	5 ug/L	<50	<25	50-150	50 - 125
Metals, in general	Water	SW6010/6020	0.1 - 50 ug/l ⁽³⁾	<20	<20	75-125	75 - 125
Dissolved gasses (methane, ethane , ethane)	Water	EPA method RSK-175	1.2 ug/L	<55	<28	50 – 150	50 - 125
Iron, ferrous	Water	SM 3500-FED	0.04 mg/L	<20	<20	75-125	75 - 125
Anions	Water	300.0	0.1mg/L	<20	<20	75-125	75 - 125
Metals, in general	Soil/sediment	SW6010/3050	0.02 – 20 mg/kg ⁽³⁾	<30	(2)	75 – 125	(2)
Volatiles	Soil/sediment	8260/5035A collection	0.1 mg/kg	<30	(2)	75 – 125	(2)
Semivolatiles	Soil/sediment	8270/3540	0.1 mg/kg	<30	(2)	76 – 110	(2)
PCBs (aroclors)	Soil/sediment	8082	10 ug/kg	<30	(2)	26-167	(2)
Soil Property/Geotechnical Tests							
Physical Property	Test Method		Physical Property	Test Method			
USCS soil classification	ASTM D2487		Organic carbon content	Plumb (1981)			
Density	ASTM D698		Moisture content	ASTM D2216			
			Grain size distribution	ASTM D422			

Acronyms and Notes:

Precision and accuracy information for metals MS/MSDs is provided in Appendix B; LCS/LCSD Laboratory control sample/laboratory control sample duplicate MS/MSD Matrix spike/matrix spike duplicate, RPD Relative percent difference

⁽¹⁾ Target values for RLs are listed above, actual values may vary for some analytes if high levels of VOCs in sample require dilution.

⁽²⁾ Values for RPD and % recovery for Precision and Accuracy are typical ranges for the analytical methods, details for specific EMF analytes are included in Appendix B. For analytes not currently included in Appendix B, criteria for relative percent difference (RPD) and % recovery will be provided to and approved by EPA prior to sample collection. Once approved by EPA, the criteria shall be included at the end of Appendix B. Alternately, the criteria may be included in the SAP submitted for EPA approval.

⁽³⁾ Reference Table B-3 for specific reporting limits for individual metals.

Table A-4. Applicable Criteria and Laboratory Reporting Limits

EMF COC in Groundwater	Plant 2 Screening levels ⁽⁵⁾	Federal Standards		State Standards	Applicable Standard or Criteria ⁽³⁾	Lab Reporting Limits	
		National Toxics Rule ⁽¹⁾	National Recommended Water Quality Criteria ⁽¹⁾	Modified MTCA Method B Surface Water ⁽²⁾ (if applicable)			
		40 CFR 131	CWA §304(a)	WAC 173-340-730			
		ug/L	ug/L	ug/L			
Volatile Organic Chemicals							
CAS	Constituents						
156-59-2	cis-1,2-dichloroethene	1,550		10,000 ⁽⁶⁾	4,500 ⁽⁷⁾	10,000	0.2
156-60-5	trans-1,2-dichloroethene	na ⁽⁶⁾	14,000	10,000	6,300 ⁽⁷⁾	10,000	0.2
79-01-6	Trichloroethene	0.3	81	30	5.2 ^(4,7)	30	0.2
75-01-4	Vinyl chloride	0.73	525	2.4	3.7	2.4	0.2
108-88-3	Toluene	15,000	200,000	15,000	8,700 ⁽⁷⁾	15,000	0.2

Notes:

- (1) Human health criteria set for consumption of organisms only based on nonpotable water.
- (2) MTCA risk-based formula for nonpotable water, only applies if other protective ARARs have not been established (i.e., AWQCs do not exist or are not considered protective).
- (3) Based on ARARs and MTCA risk-based formula (when applicable), all human health values listed are lower than applicable criteria set for protection of aquatic species.
- (4) The MTCA risk-based formula for TCE is based on a provisional oral cancer potency factor of 0.09 kg-dy/mg, this value is under review and has not yet been accepted in IRIS. This value may change.
- (5) The Plant 2 screening levels were developed (under the RCRA Permit) to allow Plant 2 to conduct ongoing business operations and to complete interim measures at Solid Waste Management Units and Areas of Concern until such time as the Target Media Cleanup Levels (TMCLs) were developed.
- (6) No Plant 2 screening levels developed for these compounds because they are not a COC in Plant 2
- (7) Modified MTCA Method B (surface water based on consumption of fish/organisms) modified to use the BCF from The Hazardous Waste Companion Database to the Human Health Risk Assessment Protocol (HHRAP) for Hazardous Waste Combustion Facilities, Final. (EPA520-R-05-006).
- (8) The AWQC for trans-1,2-DCE (a different isomer of 1, 2 DCE) is used as a surrogate for cis-1,2-DCE.

A7.2.4 Representativeness, Completeness, and Comparability

Representativeness expresses the degree to which data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, a process condition, or an environmental condition. Data representativeness will be attained through the proper design of the sampling program.

Completeness is a measure of the relative number of analytical data points that meet all the acceptance criteria for accuracy, precision, and any other criterion required by the specific analytical methods used. Data completeness may be affected by unplanned loss of samples such as container breakage during shipment, laboratory accidents, insufficient sample volume, or other factors that result in incomplete sample data sets (relative to the work plan). The quality assurance objective for analytical data completeness is 95%. To help assure completeness, the following steps will be implemented:

- 1) Project sampling work plans will define the number of locations, samples, and bottle types for the planned analysis.

- 2) Samples will be labeled appropriately.
- 3) Samples will be packaged to minimize potential for breakage.
- 4) At the completion of a sampling event, the planned sample collection as defined in Item 1) above will be re-reviewed to verify completeness.
- 5) Chain-of-custody (COC) forms will be used to document and trace possession of samples from the time of collection through delivery to the analytical laboratory.

Comparability expresses the confidence with which one data set can be compared to another. Data comparability will be achieved through the use of standard sampling procedures defined in SOPs and analytical procedures (such as SW-846 methods or other approved standards). Data results will be reported in appropriate units consistent with existing site data and applicable regulatory levels

A8. Training Requirements and Certification

Specialized training/certification for field sampling and analyses is not identified as necessary for this project, but appropriate experience is a requirement. No field sampling activities will be implemented unless one or more of the staff have prior experience with the specific procedures, equipment, and methods necessary to complete the work. Accreditation is required for the analytical laboratory (NELAP or WDOE) and for any project elements which require engineering or geologic interpretation/judgment (professional engineer or geologist/hydrogeologist).

The SM is responsible for determining appropriate personnel categories for the project and for ensuring that qualified individuals fill those positions. Only qualified personnel will be assigned responsibility to complete project tasks. Part of the qualification process is experience/training. Experience/training requirements are separated into three general categories:

1. Experience/training dictated by good business practices to promote safe and efficient work practices and minimize any procedural or recordation errors.
2. Training required by specific tasks or the use of specific specialized equipment, tools, or materials.
3. Training/certification/licensing mandated by legal and regulatory requirements.

It is the responsibility of the SM to ensure that project personnel maintain the proper level of training to meet quality requirements for projects under their management. The SM will identify any staff training requirements during initial project planning. It is the responsibility of the CALIBRE Health and Safety Officer to ensure that all CALIBRE personnel meet the required training requirements for work performed.

The CALIBRE SM will be responsible for ensuring that all members of the field team have valid and current training required by the OSHA/WISHA regulations for work associated with sampling at sites that contain hazardous materials. All personnel are required to be familiar with and possess a copy of SOPs for the specific work activity planned. All personnel are required to be familiar with and possess a copy of project contingency plan and appropriate Boeing waste management procedures. All personnel working on-site will require a security badge by Boeing security regulations.

A9. Documentation and Records

All data gathered during this project is recorded on site at the time sampling occurs using a datasheet printed on write-in-the-rain paper. The minimum required data to be recorded for each method is identified in each method's SOP (Attachment A).

The records for this project will include miscellaneous correspondence, field logs and field data worksheets, laboratory analytical reports, and technical memorandums for each sampling event. All reports will be submitted to the EPA Project Manager. Field logs will be recorded with the minimum required data according to the relevant SOP. Field logs will include observations about weather conditions at the site when samples are collected and field analyses are conducted. If there are deviations from the procedures in the QAPP there shall be documentation that the field supervisor was notified and also documentation as to when the deviation was reported to the Boeing project manager. Each page of the field logs and field data worksheets will be dated and signed by the person making the entries.

The analytical data reports will include an original signed report of the analytical results, a narrative report about the analysis, original complete chain of custody forms, and any other documentation received with the samples. A summary of the calibration data and laboratory quality control data will also be included in the analytical report. The raw analytical data (e.g., instrument printouts and manual records) will be available upon request. Laboratory analytical report will be submitted to the SM within 30 calendar days after receipt of samples who will then forward the analytical report to the EPA Project Manager upon verification of its completeness. The narrative report will describe at least:

1. The dates of sample receipt, preparation, and analysis,
2. The condition of the samples upon receipt,
3. Sample preparation and analytical procedures,
4. Any problems encountered during sample handling, storage, preparation, or analysis, and their solutions,
5. Any deviations from standard operating procedures, and
6. A discussion of the quality of the reported analytical.

SECTION B – MEASUREMENT AND DATA ACQUISITION

B1. Sampling Process Design

Details for each sampling event will be presented in Sampling and Analysis Plans (SAPs) that will define the specific sampling locations, tasks, and requirements and will reference this project QAPP. Each SAP will include the following elements:

- Number, type, and location of samples,
- Number of composites (if any),
- Justification for the sample location,
- Number of QC samples (field replicates, etc.); and,
- Description of how samples will be obtained and treated before shipping to the laboratory for analysis.

B2. Sampling Methods

Environmental sampling will be conducted in accordance with the event-specific SAP and applicable CALIBRE Sampling SOPs.

Environmental samples collected at the site typically will be analyzed for VOCs. Tables B-1 and B-2 summarize typical analyses that may be conducted, and requirements for sample containers, sample preservation, and sample holding times. Table B-3 presents the typical analytical methods and target reporting limit for the analyses that may be conducted. Additional analytes (beyond the planned VOCs, dissolved gasses, and metals) are included in Tables B-1, B-2, and B-3 in the event that they are deemed necessary during the project.

Table B-1. Water Sample Analytical Methods, Sample Volumes, Containers, Preservation, Containers and Holding Times

Parameter	Method Reference	Method	Minimum Sample Amount	Container Type	Preservation	Extraction Holding Time	Analysis Holding Time
Volatile Organic Compounds (VOCs)	SW-846	8260C and 8260-SIM	20 ml	5-40 ml VOA glass vials with teflon septum ¹ (No Headspace)	HCl pH<2, cool to 4°C	NA	14 days
Non-Halogenated Semi-Volatile Organic Compounds	SW-846	8015 Mod.	5 ml	2-40 ml VOA glass vials with teflon septum	Cool to 4°C	NA	7 days
Semivolatile Organic Compounds (SVOCs) and 1,4-Dioxane	SW-846	8270D	1 L	2-500 ml amber glass, Teflon lined cap	Cool to 4°C	7 days	40 days*
Polynuclear Aromatic Hydrocarbons (PAHs)	SW-846	8270-SIM	1 L	2-500 ml amber glass, Teflon lined cap	Cool to 4°C	7 days	40 days*
Polynuclear Aromatic Hydrocarbons (PAHs)	SW-846	8270-SIM (Low-Level)	1 L	2- 500 ml amber glass, Teflon lined cap	Cool to 4°C	7 days	40 days*
Phosphate Based Hydraulic Oil Compounds and Butylated Hydroxytoluene (BHT)	SW-846	8270D Mod. & 8270-SIM	1 L	2-1 L amber glass, Teflon lined cap	Cool to 4°C	7 days	40 days*
Polychlorinated Biphenyls ² (PCBs)	SW-846	8082 (standard and MTCA)	500 ml	2-500 ml amber glass, Teflon lined cap	Cool to 4°C	7 days	40 days*
Polychlorinated Biphenyls ² (PCBs) Low Level	SW-846	8082 Low-Level (1-liter hexane extraction)	1 L	2-1 L amber glass, Teflon lined cap	Cool to 4°C	7 days	40 days*
Gasoline-Range Total Petroleum Hydrocarbons	WA Dept. of Ecology	NWTPH-Gx	5 ml	2-40 ml VOA glass vials with teflon septum (No Headspace)	HCl pH<2, cool to 4°C	NA	14 days
Diesel-, Jet A Fuel- and Heavy Oil-Range Total Petroleum Hydrocarbons (TPH)	WA Dept. of Ecology	NWTPH-Dx	500 ml	2-500 ml amber glass, Teflon lined cap	Cool to 4°C	7 days	40 days*

Table B-1. Water Sample Analytical Methods, Sample Volumes, Containers, Preservation, Containers and Holding Times

Parameter	Method Reference	Method	Minimum Sample Amount	Container Type	Preservation	Extraction Holding Time	Analysis Holding Time
Purgeable Aromatic Compounds ³ (BETX)	SW-846	EPA 8021B	5 ml	2-40 ml VOA glass vials with teflon septum (No Headspace)	HCl pH<2, cool to 4°C	NA	14 days
Total and Dissolved Metals ⁴	SW-846	EPA 6010B / 7000A Series	250 ml	500 ml HDPE	HNO ₃ to pH <2, cool to 4°C, & see #4 below	NA	6 months (Mercury is 28 days)
Alkalinity (total, bicarbonate, carbonate)	EPA	EPA 310.1	150mL	500 mL poly (small OJ)	Cool to 4°C, no headspace	NA	14 days
Chloride ⁵	EPA	EPA 300.0	100mL	500 mL poly (small OJ)	Cool to 4°C	NA	28 days
Nitrate ⁵	EPA	EPA 300.0	100mL	500 mL poly (small OJ)	Cool to 4°C	NA	48 hours
Sulfate ⁵	EPA	EPA 300.0	100mL	500 mL poly (small OJ)	Cool to 4°C	NA	28 days
Iron, Ferrous	SM	SM 3500-FED	500 mL	500 mL amber glass	HCL to pH<2.0	NA	On Receipt
Total Organic Carbon (TOC)	EPA	EPA 415.1	150mL	250 mL amber glass	H ₂ SO ₄ pH<2, cool to 4°C	NA	28 days
Dissolved Organic Carbon (DOC) ⁴	EPA	EPA 415.1	150mL	250 mL amber glass	H ₂ SO ₄ pH<2, cool to 4°C & see #4 below	NA	28 days
Total Suspended Solids ⁶ (TSS)	SM	SM 2540D	1,000mL	1,000 mL poly (large OJ)	Cool to 4°C	NA	7 days

* - Days from extraction date.

- 1 If analysis for VOCs and low-level VOCs are required on the same sample, collect 5-40 mL vials.
- 2 Unless there is a known PCB contamination issue, the low-level sampling will be performed for the water matrix.
- 3 Compounds include benzene, toluene, ethylbenzene, and xylenes.
- 4 Samples for dissolved metals or DOC analysis will be filtered in the field prior to chemical preservation.
- 5 Sample volume for chloride, nitrate, and sulfate can be combined into one sample bottle; however, nitrate analysis must be performed within the 48-hour holding time.
- 6 This analysis (TSS) has also been completed using EPA method 160.2 in the EMF project.

Table B-2. Soil Sample Analytical Methods, Sample Volumes, Containers, Preservation, Containers and Holding Times

Parameter	Method Reference	Method	Minimum Sample Amount	Container Type	Preservation	Extraction Holding Time	Analysis Holding Time
Volatile Organic Compounds (VOCs) ⁽³⁾ (Using Easy-Draw Syringe)	SW-846	5035A 8260C Mod. and 8260-SIM	15 g (5 g per vial)	3-40 mL VOA vials (Pre-preserved with Sodium Bisulfate and Methanol by lab)	Sodium Bisulfate ⁽⁴⁾ (2 vials) Methanol (1 vial) Cool to 4°C	NA	Analyze within 14 days ⁽⁴⁾
Total Solids ⁽⁵⁾	SM	SM 2540B	2-oz.	2 oz. glass jar with septa lid	Cool to 4°C	NA	Same holding time as the analytical parameter
Non-Halogenated Semi-Volatile Organic Compounds	SW-846	8015 Mod.	30 g	2-oz glass jar with teflon-lined lid	Cool to 4°C	7 days	7 days from extraction
Semivolatile Organic Compounds (SVOCs) and 1,4-Dioxane	SW-846	8270D	30 g	8-oz glass jar with teflon-lined lid	Cool to 4°C	14 days	40 days ⁽¹⁾
Polynuclear Aromatic Hydrocarbons (PAHs)	SW-846	8270-SIM	30 g	8-oz glass jar with teflon-lined lid	Cool to 4°C	14 days	40 days ⁽¹⁾
Phosphate Based Hydraulic Oil Compounds and Butylated Hydroxytoluene (BHT)	SW-846	8270D Mod.	30 g	8-oz glass jar with teflon-lined lid	Cool to 4°C	14 days	40 days ⁽¹⁾
Polychlorinated Biphenyls (PCBs)	SW-846	8082	30 g	8-oz glass jar with teflon-lined lid	Cool to 4°C	14 days	40 days ⁽¹⁾
Gasoline-Range ⁽³⁾ Total Petroleum Hydrocarbons and/or BTEX ⁽²⁾ (Using Easy-Draw Syringe)	WA Dept. of Ecology, SW-846	5035A NWTPH-Gx EPA 8021B	15 g (5 g per vial)	3-40 mL VOA vials (Pre-preserved with Sodium Bisulfate and Methanol by lab)	Sodium Bisulfate ⁽⁴⁾ (2 vials) Methanol (1 vial) Cool to 4°C	NA	Analyze within 14 days ⁽⁴⁾
Diesel-, Jet A Fuel- and Heavy Oil-Range Total Petroleum Hydrocarbons	WA Dept. of Ecology	NWTPH-Dx	30 g	8-oz glass jar with teflon-lined lid	Cool to 4°C	14 days	40 days ⁽¹⁾
Purgeable Aromatic Compounds ⁽²⁾ (BETX) (Using Easy-Draw Syringe)	SW-846	5035A EPA 8021B	10 g (5 g per vial)	2-40 mL VOA vials (Pre-preserved with Sodium Bisulfate and Methanol by lab)	Sodium Bisulfate ⁽⁴⁾ & Methanol; 2 separate vials Cool to 4°C	NA	Analyze within 14 days ⁽⁴⁾

Table B-2. Soil Sample Analytical Methods, Sample Volumes, Containers, Preservation, Containers and Holding Times							
Parameter	Method Reference	Method	Minimum Sample Amount	Container Type	Preservation	Extraction Holding Time	Analysis Holding Time
Metals	SW-846	EPA 6010B / 7000A Series	5 g	4-oz glass jar with teflon-lined lid	Cool to 4°C	NA	6 months (28 days for Mercury)
Total Organic Carbon (TOC)	Plumb, 1981	Plumb, 1981	2 g	4-oz glass jar with teflon-lined lid	Cool to 4°C	NA	28 days
Grain Size	ASTM	D422-63	32 oz	two 16 oz glass jars	Ambient Temperature	NA	NA
Soil Vapor VOCs (Tedlar Bags)	SW-846	8260C	0.5 L	1L Tedlar Bag	Ambient Temperature	NA	2 days
Soil Vapor VOCS (SUMMA)	Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air, Second Edition (EPA/625/R-96/01)	TO-15	1 L	6L SUMMA Canister	Ambient Temperature	NA	14 days

(1) - Days from extraction date.

(2) - Compounds include benzene, toluene, ethylbenzene, and xylenes.

(3) Total Solids analyses must be conducted with 5035A analyses. If another sample container is being submitted for the same sample this analysis can be conducted on soil from that container (e.g. Total Solids analyses can be run on soil from metals container).

(4) For carbonate-containing soils (or soils suspected as such), acidic preservatives added to samples can cause effervescence (fizzing) and loss of VOCs due to the acid-carbonate reactions. If effervescence is observed, preservation by acidification is inappropriate. In general, calcareous soils have not been observed in other samples from the Duwamish Valley, however, if sufficient carbonates are present or effervescence is observed, the following options can be evaluated:

- i) Sample may be extruded into a vial containing reagent water and cooled to $4 \pm 2^\circ\text{C}$ for 48 hours or less then analyzed or preserved by freezing ($< -7^\circ\text{C}$) by placing vials in horizontal position.
- ii) Samples may be collected without chemical preservation using an EnCore™ sampler (or equivalent) and delivered to the lab for freezing or analysis within 48 hours.

(5) This analysis (Total solids) has also been completed using EPA method 160.3 in the EMF project.

Note: Other allowable containers for soil samples include stainless steel rings with teflon-lined plastic caps for analyses other than volatile parameters.

TABLE B-3 Parameters of Interest and Project Data Quality Objectives- Soils/Accumulated Solids and Water
Quality Assurance Project Plan, Boeing EMF

Parameter	Method	MDL 10 mL purge		RL 10 mL purge	
		Soil/ Solids	Water	Soil/ Solids	Water
<u>Volatile Organic Compounds</u>	<u>USEPA</u>	<u>ug/kg</u>	<u>ug/L</u>	<u>ug/kg</u>	<u>ug/L</u>
Acetone	8260C	NA	0.720	NA	5
Benzene		NA	0.056	NA	0.2
Bromodichloromethane		NA	0.053	NA	0.2
Bromoform		NA	0.070	NA	0.3
Bromomethane		NA	0.090	NA	0.2
2-Butanone (methyl ethyl ketone)		NA	0.808	NA	5
Carbon Disulfide		NA	0.087	NA	0.2
Carbon Tetrachloride		NA	0.075	NA	0.2
Chlorobenzene		NA	0.042	NA	0.2
Chloroethane		NA	0.152	NA	0.2
2-Chloroethylvinylether		NA	0.086	NA	1.0
Chloroform		NA	0.081	NA	0.2
Chloromethane		NA	0.098	NA	0.5
Dibromochloromethane (chlorodibromomethane)		NA	0.090	NA	0.2
1,1-Dichloroethane		NA	0.053	NA	0.2
1,2-Dichloroethane		NA	0.075	NA	0.2
1,1-Dichloroethene		NA	0.091	NA	0.2
cis-1,2-Dichloroethene		NA	0.100	NA	0.2
trans-1,2-Dichloroethene		NA	0.085	NA	0.2
1,2-Dichloropropane		NA	0.093	NA	0.2
cis-1,3-Dichloropropene		NA	0.058	NA	0.2
trans-1,3-Dichloropropene		NA	0.059	NA	0.2
Ethylbenzene		NA	0.094	NA	0.2
2-Hexanone		NA	0.310	NA	5
Methylene Chloride		NA	0.391	NA	0.5
4-Methyl-2-pentanone (methyl isobutyl ketone)		NA	0.384	NA	5
Styrene		NA	0.066	NA	0.2
1,1,2,2-Tetrachloroethane		NA	0.067	NA	0.2
Tetrachloroethene		NA	0.088	NA	0.2
Toluene		NA	0.056	NA	0.2
1,1,1-Trichloroethane		NA	0.089	NA	0.2
1,1,2-Trichloroethane		NA	0.035	NA	0.2
Trichloroethene		NA	0.076	NA	0.2
Trichlorofluoromethane		NA	0.092	NA	0.2
1,1,2-Trichloro-1,2,2-trifluoroethane		NA	0.107	NA	0.2
Vinyl Acetate		NA	0.068	NA	1.0
Vinyl Chloride		NA	0.075	NA	0.2
m,p-Xylene		NA	0.144	NA	0.4
o-Xylene		NA	0.057	NA	0.2

TABLE B-3 Parameters of Interest and Project Data Quality Objectives- Soils/Accumulated Solids and Water
Quality Assurance Project Plan, Boeing EMF

<u>Metals (Dissolved and Total)</u>	<u>USEPA 6000/6020/ 7000 Series</u>	MDL		RL	
		<u>mg/kg</u>	<u>mg/L</u>	<u>mg/kg</u>	<u>mg/L</u>
Aluminum	6010B	2.27	0.01665	5	0.05
Aluminum	6020	NA	0.00138	20	0.02
Antimony	6010	0.38	0.00695	5	0.05
Antimony	6020	0.01	0.00001	0.2	0.0002
Arsenic	6010B	0.52	0.00427	5	0.05
Arsenic	6020	0.17	0.00007	0.5	0.0005
Barium	6010B	0.28	0.00064	0.3	0.003
Barium	6020	0.01	0.00002	0.5	0.0005
Beryllium	6010B	0.01	0.00009	0.1	0.001
Beryllium	6020	0.04	0.00003	0.2	0.0002
Cadmium	6010B	0.02	0.00026	0.2	0.002
Cadmium	6020	0.016	0.00001	0.2	0.0002
Chromium	6010B	0.28	0.00240	0.5	0.005
Chromium	6020	0.03	0.00004	0.5	0.0005
Cobalt	6010B	0.09	0.00043	0.3	0.003
Cobalt	6020	0.01	0.00001	0.2	0.0002
Copper	6010B	0.04	0.00055	0.2	0.002
Copper	6020	0.04	0.00009	0.5	0.0005
Iron	6010B	3.42	0.01522	5	0.05
Iron	6020	NA	0.00460	20	0.02
Lead	6010B	0.20	0.00126	2	0.02
Lead	6020	0.078	0.00010	1	0.001
Manganese	6010B	0.02	0.00035	0.1	0.001
Manganese	6020	0.01	0.00002	0.5	0.0005
Mercury	7471A/7470A	0.004	0.000015	0.05	0.0001
Nickel	6010B	0.31	0.00281	1.0	0.01
Nickel	6020	0.08	0.00008	0.5	0.0005
Selenium	6010B	1.01	0.00721	5	0.05
Selenium	6020	0.07	0.00006	0.5	0.0005
Silver	6010B	0.11	0.00040	0.3	0.003
Silver	6020	0.006	0.00001	0.2	0.0002
Thallium	6010B	0.52	0.00310	5	0.05
Thallium	6020	0.01	0.00001	0.2	0.0002
Vanadium	6010B	0.04	0.00038	0.3	0.003
Vanadium	6020	0.03	0.00004	0.2	0.0002
Zinc	6010B	0.28	0.00416	1	0.01
Zinc	6020	0.44	0.00040	4	0.004
Calcium	6010B	0.55	0.00578	5.0	0.0500

TABLE B-3 Parameters of Interest and Project Data Quality Objectives- Soils/Accumulated Solids and Water

Quality Assurance Project Plan, Boeing EMF

Magnesium	6010B	0.77	0.01672	5.0	0.05
Potassium	6010B	7.78	0.11900	50	0.50
Sodium	6010B	1.88	0.02330	50	0.05

Analysis	Method	Target Reporting Limit
TOC	EPA 415.1	1.5 mg/L
Dissolved gasses	EPA method RSK-175	1.2 ug/L
Anions	300.0	0.1 mg/L
Bio-Dechlor Census Test	RT-PCR	~10 ² organisms/ml

Notes:

A - MDLs and RLs will vary based on purge volume (water) or sample weight (soil and accumulated solids). Limits shown are for 10 mL purge (water, 8260C), and 5 g sample weight (soil and accumulated solids).

MDL - Method Detection Limit

NA - Not applicable or not available

NE - Not Established

Target values for MDLs, and RLs are listed above, actual values may vary for some analytes if high levels of VOCs in sample require dilution.

MDLs/ RLS are subject to change based on yearly MDL studies

The RLs for some compounds may have to be reduced pending final cleanup levels.

B3. Sample Handling and Custody

Sample handling will be conducted in accordance with applicable CALIBRE SOPs. Collected samples will be checked to ensure all required data has been recorded on the label and chain-of-custody (COC) form and will then be transported to the laboratory for analyses. Whenever feasible (local laboratory), samples will be hand delivered to the laboratory. When hand delivery is not feasible (out-of-town laboratory), the SOPs for sample packing and shipping will be followed with particular care to minimize sample loss due to breakage in transport.

B4. Analytical Methods

The analytical laboratory(ies) will be responsible for performing all analyses exactly as specified in the appropriate analytical methods (Table B-3). In addition, the analytical laboratory(ies) must comply with applicable requirements of this QAPP, including the following:

- Equipment Calibration (Section B7),
- Data Reduction (Section D1),
- Data Validation (Section D2),
- Data Reporting (Section B10),
- Internal Quality Control Checks (Section B5), and
- Corrective Action (Section C1.2).

The analytical laboratory(ies) will also meet any data quality objectives outlined in the sampling and analysis plan (SAP) as pertaining to the specific sampling event.

B4.1 Laboratory Analytical Methods

Water and soil samples collected will be analyzed according to standard methods such as EPA Method 8260C and other analytical methods defined in Table B-3. Any changes and modifications to procedures will be documented thoroughly in the narrative summary for the data package. All parameters specified by the analytical methods will be determined.

All analytical methods/procedures used are to follow methods presented in the most current version of SW-846 (EPA, 2002), where applicable. Table B-3 shows the target reporting limit for each analytical method. The laboratory analyses will be completed by Analytical Resources Inc. (ARI). ARI is a Washington State accredited/certified laboratory. Other labs will be used for specialized analyses (RT-PCR), as necessary.

B4.2 Field Analytical Methods

No sample analyses will be conducted in the field. A direct reading water quality instrument will be used to determine DO concentration, ORP, pH, specific conductance, and temperature of groundwater samples. Prior to a groundwater sampling event, the water quality meter will be calibrated daily according to the manufacturers' specifications to ensure accuracy of parameters.

B5. Quality Control

Internal quality control checks will allow evaluation of the consistency and validity of generated data.

B5.1 Laboratory Analytical Activities

Internal quality control of laboratory analyses will conform to SW-846 requirements for the analytical methods used.

B5.2 Field Sampling Quality Control Activities

Quality control activities for field sampling provides a means of evaluating the integrity of a sample from the time of collection through analysis at the analytical laboratory. Field sampling quality control activities involve maintenance of chain-of-custody, documentation of activities, use of appropriate sample containers and preservatives, submission of samples to laboratories in a timely manner, use of a consistent sample numbering system, and collection of appropriate quality control samples. These activities are discussed in more detail below.

Chain-of-custody involves documenting the possession and handling of a sample from the time of collection through analysis. This documentation will be made through use of the COC form. In addition to the chain-of-custody forms, a master sample logbook will be maintained for all samples collected during the project.

SOPs specify requirements for collection of field data. Forms for collecting most field data are contained in the applicable SOPs. Any additional data collected will be recorded in personal or field team logbooks.

Field team members will keep written records of sample collection activities and other field data collection activities. All data entries will be legible and will be written in waterproof ink. All entries to summarize field sampling events will be dated and initialed. Errors will not be erased but will be crossed out with a single line and the change initialed and dated.

Sample containers, preservatives, storage requirements, and holding times are summarized in Tables B-1 and B-2. Samples from nonpermanent locations (e.g., soil borings) will be identified using the following 10-character identification scheme:

EMF NNNN XXX

where:

EMF designates samples from the EMF site;

NNNN are four alpha-numeric characters identifying the sample location (e.g., GP45)

XXX are three other characters for identifying other parameters such as depth or other.

Samples from monitoring wells will be identified using the permanent location designation assigned in the groundwater sampling program (i.e., the well ID/name), and a date.

The quality control samples that will be collected are summarized in Table B-4 and described below.

Field replicate soil, water, and gas samples will be given a unique alphanumeric identifier and submitted to the laboratory. These samples will serve as field splits and will be used to evaluate laboratory reproducibility and field reproducibility.

Equipment (rinsate) blanks will be included as part of the field QA/QC program for groundwater sampling activities. These samples will serve as a check on the sampling device cleanliness.

Ambient blanks and trip blanks will be included for analysis of groundwater samples for VOCs. Ambient blanks are collected by pouring organic-free water into a sample container in the field at the time and location of sampling. These blanks are used to assess the potential for contamination of samples by ambient sources. Trip blanks are prepared in the laboratory and consists of organic-free water that is placed in the same type of sample container as the groundwater samples. The trip blanks are transported to the field and handled and packaged in the same manner as the groundwater samples. Trip blanks serve as a check on sample contamination originating from sample transport, shipping, and from site conditions.

Additional sample volume will be required to perform matrix spikes and matrix spike duplicates (MS/MSD) for samples. Samples for MS/MSD will consist of three times the normal sample volume specified in Tables B-1/B-2. Samples for MS/MSD will be collected at a frequency of one per 20 samples or one per analytical batch, whichever is more frequent.

B6. Instrument/Equipment Testing, Inspection, and Maintenance

The field equipment for water quality measurements which requires testing, inspection, and maintenance is the Horiba U-22 water quality meter. Other water quality testing instruments (which are functionally equivalent) may be substituted as appropriate. This meter will be used to measure pH, temperature, redox potential, dissolved oxygen, and conductivity for water samples while in the field. The project SOP for groundwater sampling describes the procedures for testing and inspecting the meter. These procedures include a battery check, verification that the meter was successfully calibrated during its previous use, and ensuring preventative maintenance has been completed per the manufacturer's recommendations.

Vapor measurements of total organic vapors or oxygen/lower-explosive limit (O₂/LEL) may be conducted with a PID. Various PIDs may be used including a RAE Systems ppb PID and a Thermoelectron 580B PID. The project may also use a RAE Systems Multi-meter for O₂/LEL measurements. The project SOPs describe the procedures for testing and inspecting these field instruments. These procedures include a battery check, verification that the meter was successfully calibrated during its previous use, and ensuring preventative maintenance has been completed per the manufacturer's recommendations.

Table B-4. Summary of Field Quality Control Samples

QC Sample Type	Sample Matrix	Applicable Analysis	Frequency	Purpose	Acceptance Criteria	Corrective Action
Field Duplicate	Water	SW8260C	One per 20 samples or sample batch	Monitor sample variability	<50% RPD	Evaluate source of variability. Evaluate whether sampling frequency needs to be increased.
		SW8270D			<50% RPD	
		SW6010/6020			<30% RPD	
		SW8260C			<67% RPD	
		SW8270D			<67% RPD	
		SW6010/6020			<50% RPD	
		SW 8082			<67% RPD	
Soil Ambient Blank	Water	SW8260C	One per 20 samples	Monitor potential for contamination from ambient sources	See note (a, b)	Evaluate source of contamination and determine procedure changes, if needed.
Equipment Rinsate Blank	Water	SW8260C	One per 20 samples	Monitor decon effectiveness and sample cross contamination	See note (a, b)	Evaluate source of contamination and determine procedure changes, if needed.
		SW8270D				
		SW6010/6020				
		E300.0				
Trip Blank	Water	SW8260C	One per sample shipment	Monitor contamination from sample handling and shipment	See note (a, b)	Evaluate source of contamination and determine procedure changes, if needed.

Notes:

- (a) Sample must exhibit contaminant at a level equal to or greater than the method detection limit to be considered detectable.
- (b) Blank acceptance criteria will be based on the most recent published Functional Guidelines. Data may be qualified if sample results are less than five times the associated blank result.

B7. Instrument/Equipment Calibration and Frequency

B7.1 Laboratory Equipment Calibration

Before any instrument is used as a measuring device, the instrument response to known reference materials must be determined. The manner in which various instruments are calibrated is dependent on the particular type of instrument and its intended use. All sample measurements will be made within the calibrated range of the instrument.

Routine calibration standards will be used in the analytical laboratory(ies) to demonstrate that the performance of an instrument does not cause unnecessary error in the analysis. This calibration will indicate instrument stability and sensitivity. The methods for verification and documentation of instrument conditions prior to and during testing will be described by the analytical laboratory(ies) in specific laboratory procedures.

Laboratory instrument calibrations typically consist of two types, initial calibration and continuing calibration. Initial and continuing calibration criteria must meet the method acceptance criteria before sample analysis can begin. Initial calibration procedures establish the calibration range of the instrument and determine instrument response over that range. Typically, three to five analyte concentrations are used to establish instrument response over a concentration range. The instrument response over that range is expressed as a correlation coefficient (e.g. for atomic absorption, inductively coupled plasma, UV-visible/infrared spectrophotometry, ion chromatography) or by a response factor, amount/response (e.g., for gas chromatography, gas chromatography/mass spectrometry, high performance liquid chromatography).

Continuing calibration usually includes measurement of the instrument response to one or more calibration standards and requires instrument response to compare within certain limits (e.g., +/- 10% of the initial measured response or true value of standard). Continuing calibration is performed at least once per operating shift for all analyses.

Specific instrument calibration procedures for various analytical instruments are described in detail in analytical procedures.

B7.2 Field Equipment Calibration

All instruments and equipment used to perform field measurements will be operated, calibrated, and maintained according to manufacturer's guidelines and recommendations. Operation, calibration, and maintenance will be performed by personnel who have appropriate experience in these procedures. All field instruments that require calibration (water quality meters, PIDs, O₂/LEL meters) will be calibrated in accordance with the project SOPs and manufacturers' requirements (both the frequency and the procedures).

B8. Inspection/Acceptance of Supplies and Consumables

The field team leader will be responsible for inspecting sample containers before leaving for the field. Only new sample containers accompanied by the manufacturer's certification of precleaning will be used. The sample containers will also be inspected for cracks, ill-fitting lids, and other obvious defects before use and will be discarded if defects are found to be present.

The ARI laboratory project manager will be responsible for inspecting equipment and supplies upon receipt. The manufacturer's specifications for product performance and purity will be used as the acceptance criteria.

B9. Non-Direct Measurements

Data or information that has been collected previously on this project is placed in a category of "non-direct measurements." However, much of it is still directly relevant to this project's current and projected future needs. The historical data covers a long time span, thereby allowing decision makers to have a greater understanding of the situation and providing a greater statistical basis for any decision to be made.

Examples of the types and sources of existing information to be utilized include the following:

- Data from published literature, reports, and handbooks
- Data generated and submitted by prior work or third parties, when such data are of known and suitable quality (following approved QA protocols analytical methods)
- Data from state and local monitoring programs
- Output generated by executing existing models
- Data obtained from previously performed pilot studies, and
- Existing maps, plots, photographs, or land surveys.

B10. Data Management

The standard analytical laboratory data reports for organic and inorganic analyses will consist of a transmittal letter and the following, as appropriate for the analyses performed:

- Cover page describing data qualifiers, sample collection, sample receipt, extraction and analysis dates, and a description of any technical problems encountered with the analyses;
- Copies of the chain-of-custody forms;
- Copies of the analytical forms;
- Spreadsheet sample analytical results and quality control summaries;
- Calculated recoveries for all quality control samples, method duplicate or duplicate spike and method blank results;
- All laboratory quality control data including method blank, method blank spike, matrix spike, laboratory duplicate or spike duplicate, and surrogate recovery data;
- Method quantitation limits for all parameters and dilutions; and
- Five-peak library search report for GC/MS volatiles and semi-volatiles.

Analytical results will be reported in ug/L for aqueous samples, mg/kg for soil samples, and ppbv for gas samples.

Non-analytical data will consist of results of physical measurements or tests (e.g., depth-to water, flow rates, etc.). The results of these tests will be reported in the formats and units indicated in the specific procedure used.

The project work plans will describe how the data collected during the project will be analyzed to meet specific project objectives. All calculations will be performed on standard calculation sheets that will include the name of the person performing the calculations and the date of the calculations. All calculations will be checked by a second person. This person's name and the date that the calculations were checked will be entered on each calculation sheet. All calculation sheets will be retained in the project file.

All raw laboratory data will be held on file at the laboratory for a period of ten years, data files are also archived on tape and compact disk, the lifetime of these media is not yet known. All project laboratory summary data will be maintained at the Boeing Administrative Documentation holding facility for a period of ten years after the EPA's notice of completion of work, pursuant to Section XXVIII of the Agreed Order.

SECTION C – ASSESSMENT AND OVERSIGHT

C1. Assessments and Response Actions

C1.1 Performance and System Audits

Field activities will be monitored by the project QAM to ensure compliance with the requirements of this QAPP.

An on-site audit of project-specific monitoring activities will be conducted at least once per project by a CALIBRE staff member not otherwise involved in the activities being audited. The focus of the audit will be on actual QC activities of data collection, and will use the QAPP as a reference. The following specific activities will be reviewed in the audit:

- Sample collection and analytical activities;
- Equipment calibration techniques and records;
- Decontamination and equipment cleaning;
- Equipment suitability and maintenance/repair;
- Background and training of personnel;
- QC samples; and
- Sample containers, preservation techniques, and chain-of-custody.
- Sampling and Analysis Plan

The requirements for performance audits will be satisfied by taking measures to ensure measurement accuracies are being achieved and maintained. These measures primarily include the provisions identified in Sections B5, B6 and B7 of this QAPP including the submission of blanks and duplicate samples for analysis. The performance of these activities will be performed or witnessed, as appropriate, by the QAM.

C1.2 Corrective Action Plan

Corrective action is initiated when the following situations arise:

- Specific requirements of the analysis method or sampling/analysis procedure are not met;
- Data quality objectives for precision, accuracy, and completeness are not achieved; and/or
- Laboratory or field data review indicates that data are incomplete or that improper calculation, methodology, or technique was employed, or that an instrument malfunction has occurred.

When deficiencies are found, the QAM and SM will determine if the data in question are essential to the project and what corrective action will be taken. Corrective action may include one or more of the following:

- Additional information or recalculations are supplied.

- Instrument operation and calibration are checked. Calibration standards are checked and new standards are obtained, if necessary. Instrument malfunctions are corrected.
- Personnel repeat the task using the same procedure.
- A different individual repeats the task using the same procedure.
- Samples are re-analyzed (if holding time permits).
- Sampling and/or analytical procedures are evaluated and amended.
- Personnel repeat the task using a validated new or modified procedure.
- If practical, a new sample is collected and analyzed.

If the anomaly is not resolved after the above steps are taken, the data are reported with qualifying statements. In some cases, depending on the nature and degree of deviation, no data may be reported.

C1.2.1 Laboratory Corrective Action

The initial responsibility for monitoring the quality of an analytical system lies with the analyst. The analyst will verify that all quality control procedures are followed and that the results of analysis of quality samples are within acceptance criteria. This requires that the analyst assess the correctness of all the following items, as appropriate:

- Sample preparation procedures,
- Initial calibration,
- Calibration verification,
- Method blank result, and
- Laboratory control standard.

If the assessment by the analyst reveals that any of the quality control acceptance criteria, as defined by the most recent edition and updates of the analytical method are not met, the analyst must immediately assess the analytical system to correct the deficiency. The analyst must notify his/her supervisor and the laboratory quality assurance coordinator of the deficiency and, if possible, identify potential causes and corrective action. Analytical data quality concerns that may require corrective action will be documented and reported as specified in the laboratory data reports (see Section B10-Data Management).

The nature of the corrective action obviously depends on the nature of the deficiency. For example, if a continuing calibration verification is determined to be out of control, the corrective action may require recalibration of the analytical system and re-analysis of all samples since the last acceptable continuing calibration standard.

Quality control samples (e.g., matrix spikes and matrix spike duplicates) provide an indication of matrix effects on analyses. Failure to achieve method specific performance on quality control samples will trigger corrective action or additional re-analysis, as appropriate.

When the appropriate corrective action measures have been defined and the analytical system is determined to be in control, the analyst will document the problem, the corrective action, and the data demonstrating that the analytical system is in control. Copies of this documentation will be provided to the laboratory supervisor and the laboratory quality assurance coordinator.

C1.2.2 Field Corrective Action

The initial responsibility for monitoring the quality of field measurements and observations lies with the field personnel. The FS is responsible for verifying that all quality control procedures are followed. This requires that the FS assess the correctness of field methods and the ability to meet quality assurance objectives. If a deficiency occurs that might jeopardize the integrity of the project or cause some specific quality assurance objective not to be met, it is the responsibility of all project staff to report the noted deficiency to their immediate supervisor (on this project) and propose corrective actions to remedy the problem/deficiency.

C2. Reports to Management

All reports will include a summary description of all project activities, a summary of all data, a discussion of any problems encountered and associated corrective actions, a discussion of the conclusions drawn from the results of this project and the rationale for those conclusions, and the results of the data quality assessment. Reports will be generated by CALIBRE and submitted to the EPA Project Manager at the completion of field activities. Laboratory analytical reports will be generated by ARI and submitted to the CALIBRE SM 30 calendar days after receipt of the samples who will then forward the analytical information to the EPA Project Manager in conjunction with the field information. Any significant QA problems encountered in the laboratory or in the field, as deemed by the ARI laboratory project manager or the CALIBRE QA Manager (respectively), will be reported immediately to the CALIBRE SM via telephone.

SECTION D – DATA VALIDATION AND USABILITY

D1. Data Review, Verification, and Validation

The following sections describe required data reduction, data validation, and data reporting.

D1.1 Data Reduction

Data reduction consists of those activities involving conversion of raw data to reportable units, transfer of data between recording media, and computation of summary statistics, standard errors, confidence intervals, tests of hypotheses relative to the parameters, and model validation. Statistically-acceptable data analysis procedures will be implemented for all data reduction steps.

D1.1.1 Laboratory Data Reduction

Data reduction is the process by which analytical measurements are converted or reduced to a specified format or unit for reporting of final results. Data reduction may be performed manually (calculator, hand-entry to worklist, hand-entry to computer templates) or electronically (transfer of raw data from instrument to computer system(s) with established calculations). Data reduction requires that all aspects of sample preparation be taken into account in the final result, including sample volumes, extract or digest volumes, dilution factors, and calibration factors. It is the responsibility of laboratory analyst to perform these data reductions and document data reduction requirements in the associated data analytical report. If performed electronically, all software used must be demonstrated to be true and free from unacceptable error. All data is subject to further review by the laboratory data reviewer, the laboratory PM, the CALIBRE PM and possibly independent reviewers.

D1.1.2 Field Technical Data Reduction

Field technical data (i.e., non-laboratory generated) can generally be characterized as either objective or subjective data. Objective data include all direct measurements such as field analyses and water level measurements. Subjective data include descriptions and observations. Some activities, for example, test boring and well logs, include both types of data in that the data recorded in the field are descriptive but can be reduced using the standardized lithologic coding system.

All field data necessary to meet project objectives will be recorded by field personnel. As appropriate, field data will be recorded on forms included with the SOPs. At the completion of a task, copies of all field records will be checked and the data reduced to tabular form wherever possible by entering the data into database files. Subjective data will be filed as hard copies for incorporation into technical reports as appropriate.

D2. Verification and Validation Methods

Data validation, an after-the-fact review of data, is the process whereby data are determined to be of acceptable or unacceptable quality based on a set of predefined criteria. These criteria depend upon the type(s) of data involved and the purpose for which data are collected.

D2.1 Laboratory Data Validation

Laboratory data review will be performed as described in the data review procedures stipulated in the project SOPs.

D2.2 Field Data Validation

Validation of objective field and technical data will be performed at two different levels. On the first level, data will be validated at the time of collection by following standard procedures and quality control checks. At the second level, data will be validated by the SM or his designee who will review the data to ensure that the correct codes and units have been included. After data reduction into tables or arrays, the SM will review data sets for anomalous values. Any inconsistencies or anomalies discovered by the SM will be resolved immediately, if possible, by seeking clarification from the field personnel responsible for collecting the data.

Subjective field and technical data will be validated by the SM, who will review field reports for reasonableness and completeness. In addition, random checks of sampling and field conditions will be made to confirm the recorded observations. Whenever possible, peer review will also be incorporated into the data validation process, particularly for subjective data, to maximize consistency among field personnel. For example, during drilling activities, the SM may schedule periodic reviews of archived lithologic samples to ensure that the appropriate lithologic descriptions and codes are being consistently applied by all field personnel. In addition, for field analyses and tests, an independent review of the applicable items described previously for laboratory data validation will be conducted (e.g., calibration methods, control limits, instrument checks, etc.). A record of field data validation will be made using the data validation/review form contained in CALIBRE's QAPP.

D3. Reconciliation with User Requirements

Once the data results are compiled, the CALIBRE QAM will review the field duplicates to determine if they fall within the acceptance limits as defined in this QAPP. Completeness will also be evaluated to determine if the completeness goal for this project has been met. If data quality indicators do not meet the project's requirements as outlined in this QAPP (including the accuracy for lab spikes), the data may be discarded and re-sampling may occur. The project manager will evaluate the cause of the failure (if possible) and make the decision to discard the data and re-sample. If the failure is tied to the analysis, calibration and maintenance techniques will be reassessed as identified by the appropriate lab personnel. If the failure is associated with the sample collection and re-sampling is needed, the samplers will be retrained.

D4. Design / Deliverable Quality Control

The SM will determine requirements for project-specific design control and deliverable quality control procedures. Projects with a design component are required to have formal design control procedures in place within two weeks of project initiation. Other projects should disseminate a deliverable checking and validation process to each member of the project team as soon as possible after initiation of a project.

Each staff member is responsible for the style and content of documents they prepare. Documents and other deliverables are to meet CALIBRE standards, be responsive to clients' needs and requirements, conform to applicable industry standards and practices, and fulfill

contractual obligations. Technical reviewers are to ensure that the content of documents, which they review, is accurate and relevant for the subject document and that their review is limited to the subject area of their expertise. Project Managers are responsible for ensuring that appropriate review procedures are in place and used by the project staff.

The following sections describe required procedures for design control applicable to projects that have a design component. All engineering and design work should be performed according to the requirements and specifications of the state in which the design will be implemented.

D4.1 Design Input

The Project Manager will develop design input requirements, including technical, regulatory, and process requirements. The Project Manager will seek and obtain peer review of these requirements and document final specifications.

D4.2 Design Review

At appropriate stages of the design process (as defined by the Project Manager), formal documented reviews of the design will be conducted. Project Technical Reviews will be performed to assess validity of the technical basis for a given technology prior to acquisition, optimal design parameters for individual technologies, optimal configuration for specific installations, and strategic recommendations to clients. Staff with expertise in areas that are critical to the design, and who can provide an objective evaluation of the particular activity, will perform these reviews. It is the responsibility of the Project Manager to determine the specific review requirements and to ensure that personnel certified in the relevant state, as appropriate, perform the reviews.

Documents prepared for submittal to clients are subject to a formal, controlled, and traceable review process. Authors will identify reviewers at the beginning of the document preparation process and establish a schedule for document delivery and review. Authors will identify appropriate individual(s) to serve as Technical Reviewer(s) for a document; some documents may require review by more than one individual, based on the breadth of issues discussed in the document. Reviewers shall be knowledgeable and qualified to review the document's subject area by virtue of education and/or work experience.

D4.3 Design Verification

The Project Manager will ensure that design verification measures are incorporated into project activities to ensure that design output meets input requirements. These measures will be applied to the process at critical stages of design, as determined by each Project Manager. Design verification may include, but is not limited to, such activities as comparison of design with a similar proven design, performance of alternative calculations, tests and demonstrations, and peer review. The Project Manager or designated Quality Assurance Manager will maintain records of design verification measures. A copy will be sent to the Quality Manager to be included in the ETS QA project file.

D4.4 Design Changes

Design changes and modifications that are of a permanent nature will be identified, documented, reviewed, and approved by Project Managers and appropriate technical staff before they are implemented. Where appropriate, technical personnel will prepare a technical

memorandum detailing changes and distribute the memorandum to appropriate project staff. Design changes of a site-specific nature will be noted on the design materials, initialed, and dated.

Appendix A
Formulas For Evaluating Precision, Accuracy, Representativeness,
Completeness, And Comparability

Performance criteria discussed in Section A7 (precision, accuracy, representativeness, completeness, and comparability) will be evaluated and calculated in accordance with methods and/or procedures specified in Section A7, or as specified below.

Analytical Precision. Analytical precision of the laboratory procedure will be expressed as the relative percent difference between a sample and its field duplicate. RPD is calculated as follows:

$$RPD = \left| \frac{X_1 - X_2}{(X_1 + X_2) / 2} \right| \bullet 100\%$$

where: X_1 = measured concentration in the first sample, and
 X_2 = measured concentration in the second sample.

Analytical Accuracy. The accuracy of the laboratory procedure will be estimated from the analyses of the percent recovery of the MS/MSD sample. Accuracy is calculated based on the percentage of the spike recovered (REC) in the analysis as follows:

$$\%REC = \left(\frac{X_s - X_u}{SA} \right) \bullet 100\%$$

where: X_s = measured amount in the spiked sample;
 X_u = measured amount in the unspiked sample; and
SA = spiked amount.

Several EPA methods do not include a MS/MSD analysis. The accuracy for analytical procedures that do not included a MS analysis will be monitored by the percent difference of the true value for a laboratory control sample from its measured value. Accuracy is calculated based on the percentage difference of the laboratory control sample in the analysis as follows:

$$\%D = (TV - R) / TV \bullet 100\%$$

where: TV = true value of laboratory control sample
R = result

Completeness. Completeness will be calculated and expressed as the percentage of number of samples that were judged to be valid, i.e., not rejected, and acceptable for all intended data use. Completeness (%C) is calculated for each type of measurement/analysis as follows:

$$\%C = \frac{(SE - SR)}{SE} \times 100\%$$

where: SE = number of samples collected; and

SR = number of samples rejected

Sensitivity. Sensitivity is to be expressed in terms of detection and quantitation limits for each type of measurement/analysis.

The analytical laboratory is to notify the SM and QAM if the laboratory anticipates or experiences any difficulties in achieving the detection/quantitation limits specified in the approved QAPP.

Matrix effects should be considered in assessing the analytical laboratory's compliance with sensitivity specifications. The laboratory is to provide a detailed discussion of all failures to meet sensitivity specifications in the data package narrative.

If a sample dilution results in non-detect values for analytes that had been detected in the original analysis, then the results of the original run and the dilution are to be reported with the appropriate notations in the data package narrative.

Appendix B
EMF Site, Quality Assurance Project Plan
Quality Control Criteria for Data Quality Assessment

Quality Control Criteria for Data Quality Assessment
Volatile Organic Compounds (USEPA 8260C)

Method	Analyte	QC	Water			Soil		
			10 mL			Medium Level		
			Lower Control Limit	Upper Control Limit	RPD Limit	Lower Control Limit	Upper Control Limit	RPD Limit
<u>Surrogate Recoveries</u>								
8260C	d4-1,2-Dichloroethane	Sample Surrogate	80	120	30	30	160	30
8260C	d8-Toluene	Sample Surrogate	80	120	30	80	120	30
8260C	4-Bromofluorobenzene	Sample Surrogate	80	120	30	76	128	30
8260C	d4-1,2-Dichlorobenzene	Sample Surrogate	80	120	30	80	120	30
8260C	d4-1,2-Dichloroethane	MB/LCS Surrogate	80	120	30	76	120	30
8260C	d8-Toluene	MB/LCS Surrogate	80	120	30	80	120	30
8260C	4-Bromofluorobenzene	MB/LCS Surrogate	80	120	30	80	120	30
8260C	d4-1,2-Dichlorobenzene	MB/LCS Surrogate	80	120	30	80	120	30
<u>LCS Recoveries</u>								
8260C	Vinyl Chloride	LCS	80	120	30	66	123	30
8260C	trans-1,2-dichloroethene	LCS	80	120	30	78	125	30
8260C	cis-1,2-dichloroethene	LCS	80	120	30	80	125	30
8260C	Trichloroethene	LCS	80	120	30	80	125	30
8260C	All Other Analytes	LCS	80	120	30	50	150	30
<u>Matrix Spike Recoveries</u>								
8260C	Vinyl Chloride	MS	80	120	30	66	123	30
8260C	1,1-Dichloroethene	MS	80	120	30	73	133	30
8260C	Chloroform	MS	80	120	30	80	124	30
8260C	Benzene	MS	80	120	30	80	120	30
8260C	Trichloroethene	MS	80	120	30	80	125	30
8260C	1,2-Dichloropropane	MS	80	120	30	80	122	30
8260C	Toluene	MS	80	120	30	80	122	30
8260C	Chlorobenzene	MS	80	120	30	80	121	30
8260C	Ethylbenzene	MS	80	120	30	80	126	30
8260C	All Other Analytes	MS	80	120	30	50	150	30

LCS - laboratory control sample
MB - method blank

**Quality Control Criteria for Data Quality Assessment
EPA- Method RSK-175**

Method	Analyte	QC	Water		
			Lower Control Limit	Upper Control Limit	RPD Limit
<i>Sample Surrogate Recovery</i>					
EPA method RSK-175	Propane	Surrogate	72	122	NA
			-	-	
<i>LCS Recoveries</i>					
EPA method RSK-175	Methane	LCS	80	120	NA
	Ethane	LCS	80	120	NA
	Ethene	LCS	80	120	NA
<i>Method Blank /LCS Surrogate Recovery</i>					
EPA method RSK-175	Propane	Surrogate	79	132	NA
<i>Matrix Spike Recoveries^a</i>					
EPA method RSK-175	Methane	MS	80	120	NA
	Ethane	MS	80	120	NA
	Ethene	MS	80	120	NA

LCS - laboratory control sample

MB - method blank

MS - matrix spike

NA - not applicable

QC - quality control parameter

RPD - relative percent difference

^a Matrix spike recoveries are target limits. If limits are not met, corrective action may or may not be performed and will be assessed on a case-by-case basis.

**Quality Control Criteria for Data Quality Assessment
Total and Dissolved Metals (USEPA 6000/6020/7000 Series)**

Method	Analyte	QC	Water / Soil / Sediment		
			Lower Control Limit	Upper Control Limit	RPD Limit
<u>Duplicate Analyses</u>					
6000/6020/7000 Series	All Metals	Duplicate Analyses	-	-	20
<u>LCS Recoveries</u>					
6000/6020/7000 Series	All Metals	LCS	80	120	20
<u>Matrix Spike Recoveries^a</u>					
6000/6020/7000 Series	All Metals	MS	75	125	20

LCS - laboratory control sample

MB - method blank

MS - matrix spike

NA - not applicable

QC - quality control parameter

RPD - relative percent difference

^a Matrix spike recoveries are target limits. If limits are not met, corrective action may or may not

be performed and will be assessed on a case-by-case basis.

LCS Recoveries: Note that LCS providers typically specify recoveries for soil/sediment that may be different than the general 80%-120% recoveries noted above.

**Quality Control Criteria for Data Quality Assessment
Conventional Parameters**

Method	Analyte	QC	Water		
			Lower Control Limit	Upper Control Limit	RPD Limit
<u>Duplicate Analyses</u>					
EPA 310.1	Alkalinity (total, bicarbonate, carbonate)	Duplicate Analysis	-	-	20
EPA 300.0	Chloride	Duplicate Analysis	-	-	20
SM 3500-FED	Iron , Ferrous	MS	-	-	20
EPA 300.0	Nitrate	Duplicate Analysis	-	-	20
EPA 300.0	Sulfate	Duplicate Analysis	-	-	20
EPA 415.1	Total Organic Carbon (TOC)	Duplicate Analysis	-	-	20
<u>LCS Recoveries</u>					
EPA 310.1	Alkalinity (total, bicarbonate, carbonate)	LCS	75	125	20
EPA 300.0	Chloride	LCS	75	125	20
SM 3500-FED	Iron , Ferrous	MS	75	125	20
EPA 300.0	Nitrate	LCS	75	125	20
EPA 300.0	Sulfate	LCS	75	125	20
EPA 415.1	Total Organic Carbon (TOC)	LCS	75	125	20
<u>Matrix Spike Recoveries</u>^a					
EPA 310.1	Alkalinity (total, bicarbonate, carbonate)	MS	75	125	20
EPA 300.0	Chloride	MS	75	125	20
EPA 300.0	Nitrate	MS	75	125	20
SM 3500-FED	Iron , Ferrous	MS	75	125	20
EPA 300.0	Sulfate	MS	75	125	20
EPA 415.1	Total Organic Carbon (TOC)	MS	75	125	20

LCS - laboratory control sample

MB - method blank

MS - matrix spike

NA - not applicable

QC - quality control parameter

RPD - relative percent difference

^a Matrix spike recoveries are target limits. If limits are not met, corrective action may or may not be performed and will be assessed on a case-by-case basis.