CDM Transmittal

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To: Ms. Louise Bardy
Organization/ Address: Washington State Dept. of Ecology
Northwest Regional Office
3190 160th Avenue SE
Bellevue, WA 98008-5452

From: Lance Peterson
Date: May 10, 2005

Re: Ellisport Creek Greenspace Project Site – 53616 SE 116th Vashon Island, Washington

Job #: 19897-45486

Mail: XXX *Overnight:* *Courier:*

Enclosed please find: One copy of SQAP and Site Assessment Report

For your information	XXX	**Approved**	
For your review		**Approved as noted**	
For your signature		**Returned to you with Signature**	

- **Message:**

cc: Lucy Sandler Auster

Signed Lance Peterson

Sampling and Quality Assurance Plan
For the
Site Assessment – Ellisport Creek Greenspace Project Site
53616 SE 116th
Vashon Island, Washington

Prepared by: CDM Camp Dresser & McKee Inc.
11811 NE 1st Street, Suite 201
Bellevue, Washington 98005
(425) 453-8383

Prepared for: King County Solid Waste Division
Department of Natural Resources
King Street Center
201 South Jackson Street, Suite 701
Seattle, Washington 98104-3855

_____ Date: _____
King County Project Manager

_____ Date: 5/5/05
CDM Project Manager

_____ Date: 5-2-05
EPA Project Manager

_____ Date: 4-26-05
EPA QA Officer

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A3. DISTRIBUTION LIST

Name	Affiliation	Phone/E-mail
Ms. Laura Caparroso	EPA Project Manager	
Mr. Bruce Woods	EPA QA Officer	
Mr. James Neely	Project Manager, King County Solid Waste Division	(206) 296-4472
Lance Peterson, P.G.	Project Manager, CDM	(425) 453-8383

A4. PROJECT/TASK ORGANIZATION

PROJECT PERSONNEL AND THEIR RESPONSIBILITIES

King County Project Manager (Mr. James Neely) - Will be the responsible official for this project. Responsible for overseeing the overall project, budget, and tasking CDM with the work required to complete this project. Will communicate needs to the CDM's project manager.

EPA Project Manager (Ms. Laura Caparroso) - Will be the EPA's responsible official for this project. She will be responsible for overseeing the project's technical requirements. Will communicate needs to the King County's project manager.

EPA QA Officer (Mr. Bruce Woods) - The EPA QA Officer will be responsible for reviewing and approving the QA Plan. He may provide technical input on proposed sampling design, analytical methodologies, and data review.

CDM Project Manager (Mr. Lance Peterson) - Will communicate with the King County Project Manager on work accomplished in this plan and any problems or deviations that need to be resolved. He will have overall responsibility for assigning appropriate personnel to complete the tasks included in this plan. He will ensure that the project budget is adhered to.

CDM Field Sampling Lead (Mr. Scott Adamek) - Will be responsible for assigning field samplers their specific tasks and objectives. He will have overall responsibility for all field activities. He will report to the CDM's Project Manager.

PROJECT SCHEDULE

After county review and approval, this SQAP will be reviewed by EPA Region 10. Following approval of the SQAP and subsequent consultation with the Washington State Department of Ecology regarding cleanup requirements under the Model Toxics Control Act (MTCA), CDM will perform the fieldwork within approximately three weeks. The entire field effort will require approximately four to five days. The draft investigation report will be available for review approximately two weeks after obtaining final laboratory results.

A5. PROBLEM DEFINITION/BACKGROUND

PURPOSE

The purpose of this study is to conduct a Phase II assessment of residual soil contamination at the Ellisport Greenspace Project Site (the site) on Vashon Island (**Figure 1**). The King County Brownfields Program has received EPA Brownfields grant funding to perform the assessment in support of future cleanup of the site. The County's Department of Natural Resources and Parks, Water and Land Resources Division and the Vashon Park District have identified this site as a natural habitat restoration site. Cleanup and development of this site as a greenspace has many supporters amongst the residents of Vashon Island as well as the Vashon-Maury Island Audubon Society and the Vashon-Maury Island Land Trust. Remediation of contamination and replacement of existing drainage restrictions will allow restoration of the creek to original intertidal habitat with salt marsh vegetation and eelgrass beds in the lower reaches to provide habitat for juvenile sea-run cutthroat and Coho.

The site consists of four privately owned contiguous parcels totaling 8.66 acres of which 5.65 acres are tide land at the northwest head of Tramp Harbor on the east coast of Vashon Island (**Figure 1**). The remaining 3.01 acres are mostly wetland bisected by Ellisport Creek. A paved road, Chautauqua Beach Road SW, crosses the lower end of the upland property at just above the beach. Ellisport Creek currently flows under Chautauqua Beach Road through a pair of 3 foot diameter pipe culverts.

PREVIOUS ACTIVITIES

The Vashon Park District commissioned a Limited Phase II Environmental Site Assessment for the property from CDM (formerly AGI Technologies) in 1999. Soil samples were collected at 17 hand auger drill sites (**Figure 2**). In addition six test pits were excavated. Soil samples were collected from each hand auger site at a depth of six inches. The test pits were dug up to five feet deep to make observations of groundwater conditions. Groundwater depths were from several inches to three feet below surface. The 17 soil samples and one water sample were submitted for analytical testing. Hydrocarbons in both the diesel and oil-ranges were detected in seven of the soil samples and in the one groundwater sample (**Table 1**). Polycyclic Aromatic Hydrocarbons (PAHs) were also detected for one of the soil samples and in the one groundwater sample (**Table 2**). The principal contaminants at the site, total petroleum hydrocarbons (TPH) and PAHs are likely associated with Bunker C Oil. These were released into the soil as a result of leaks and spills from a fuel oil storage faculty that operated on the site in the 1940s and 1950s. The tanks were removed in the early 1960s.

Data from the investigation were used to delineate a zone of about 220 feet long by up to 110 feet wide in the area of the former tanks that contains soil in excess of MTCA Method A

residential cleanup standards for total petroleum hydrocarbons (200 milligrams per kilogram at the time of the investigation).

REMEDIAL ACTION PLAN

At the completion of the field investigation and laboratory testing a draft remedial action plan (RAP) will be developed. The RAP will document field methods and include figures showing sample locations, areas of contamination, and summary tables. A formal feasibility study (FS) will not be developed; however, general cleanup options to address the identified contamination will be presented. Analytical reports and photographs will be included as appendices. The report will be finalized after county review and approval.

A6. PROJECT/ TASK DESCRIPTION

SURFACE SOIL INVESTIGATION/SITE RECONNAISSANCE

Utilizing information from the 1999 investigation, CDM will perform a site reconnaissance to delineate and mark the extent of the spilled Bunker C release based on visual observations (stained soil and hydrocarbon odors). We will also utilize aerial photos from 1936 and 1960 to aid in determining the location of former aboveground oil storage tanks to insure all potential source areas have been adequately assessed. Five surface soil samples may be collected at proposed locations (**Figure 2**), if appropriate, and analyzed for the analytical method appropriate for Bunker C (diesel and oil-range TPH by Northwest Method NWTPH-Dx). Surface soil samples will be collected using hand tools (i.e., shovels, stainless steel spoons).

TEST PIT INVESTIGATION

Following the surface soil investigation/site reconnaissance, we will conduct a one to two-day test pit investigation using a mini-excavator. The purpose of the test pits is to define the depth of the Bunker C contamination. The test pit depths will be less than 10 feet below ground surface (bgs). We estimate up to 20 test pits will be excavated following a proposed 50 foot square grid pattern for locations (**Figure 2**). All removed soil will be replaced in the respective test pit and compacted with the backhoe bucket. The location of each test pit will be marked with a wooden stake labeled with the test pit identification.

As each test pit is excavated, field screening will be performed on soil samples to check for evidence of contamination. Field screening will be performed by noting any staining or odor. Soil samples will be collected for possible analytical laboratory testing at the base of each test pit or below where contaminated soil is noted. Soils encountered in each test pit will be classified in accordance with the Unified Soil Classification System. A geologic log will be developed for each test pit.

One soil sample from each test pit may be submitted for analytical testing of diesel and oil-range TPH by Northwest Method NWTPH-Dx. An estimated 5 samples will also be analyzed for PAHs by U.S. Environmental Protection Agency Method 8270C/SIM. Appropriate quality assurance analysis will be performed according to the SQAP. However, observations may be made during our investigation that will necessitate minor modifications to the planned test pit number/ locations/analytical testing.

At the completion of field activates the existing site map will be updated to show surface and test pit sample locations and areas containing noticeable Bunker C. Field measurements will be made with respect to fixed site features such as former concrete structures.

A7. QUALITY OBJECTIVES AND CRITERIA FOR MEASUREMENT DATA

The overall QA objective for this project is to develop and implement procedures for field sampling, chain-of-custody, laboratory analysis, and reporting that will provide results that are legally defensible in a court of law. Specific procedures for sampling, chain-of-custody, laboratory instrument calibration, laboratory analysis, reporting of data, internal quality control, audits, preventive maintenance of field equipment, and corrective action are described in later sections of the SQAP. This section discusses QA objectives for this project.

Specific data quality objectives (DQOs) are presented for each activity followed by general QC requirements for this project. The DQOs are qualitative and quantitative statements that specify a required level of field and laboratory data quality designed to meet the data use needs of each activity. QC objectives describe general goals for sample representativeness and comparability and analytical accuracy, precision, sensitivity, and completeness. Adherence to DQOs and QC controls is required so that project data and conclusions drawn from that data can be used to evaluate project effectiveness.

PRECISION

Definition

Precision is a measure of reproducibility of measurements of the same characteristic, usually under a given set of conditions.

Field Precision Objectives

Field precision will be assessed by the collection and analysis of field duplicates and will be expressed as relative percent difference (RPD).

Duplicate samples are analyzed to check for matrix variability and analytical method reproducibility. At a minimum, one field duplicate will be collected for every 10 investigative samples by media and analyzed for the same parameters listed for other media samples.

Laboratory Precision Objectives

The control limits for accuracy automatically identify the precision of a method. In the analysis of samples in a batch, if the recoveries of the analytes of interest are within control limits, then the precision is also within control. Precision may also be calculated in terms of Relative Percent Difference (RPD).

Precision will be assessed by comparing the analytical results between matrix spike and matrix spike duplicate (MS/MSD) for organic analysis, and between laboratory duplicates for inorganic analysis. The relative percent difference (RPD) will be calculated for each pair of duplicate analyses using the following equation:

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

Where:

RPD = relative percent different
X_1, X_2 = value of sample 1 and sample 2

RPDs may be compared to the laboratory-established RPD control limits for the analysis. Precision of duplicates depends on sample homogeneity.

ACCURACY

Definition

Accuracy is the degree of agreement of a measurement or average of measurements with an accepted reference or "true" value and is a measure of bias in the system. The accuracy of a measurement system is impacted by errors introduced through the sampling process, field contamination, preservation, handling, sample matrix, sample preparation, and analytical techniques.

Field Accuracy Objectives

The achievement of accurate data in the field can be addressed using field and trip blanks and through the adherence to all sample handling, preservation, and holding times. Because no sampling of aqueous matrices for volatile organic compounds will be performed, no field blanks will be collected.

Laboratory Accuracy Objectives

Results for blank, matrix spikes, LCS, and surrogates will be the primary indicators of accuracy. These results will be used to control accuracy by requiring that they meet specific criteria. As spiked samples are analyzed, spike recoveries will be calculated and compared to acceptance limits.

The calculation formula for percent recovery is:

$$R\% = \frac{(C_1 - C_2)(100\%)}{C_3}$$

Where:

R% = Spike amount recovered
C_1 = Concentration of analyte in spiked sample
C_2 = Concentration of analyte in unspiked sample
C_3 = Concentration of spike added

Acceptance limits will be based upon previously established laboratory performance for similar samples and are located in **Tables 3 and 4**. In this approach, the control limits reflect the minimum and maximum recoveries expected for individual measurements for an in-control system. Recoveries outside the established limits indicate some assignable cause, other than normal measurement error, and possible need for corrective action. Corrective actions may include recalibration of the instrument, reanalysis of the QC sample, reanalysis of the samples in the batch, repreparation of samples in the batch, or flagging the data as suspect if the problems cannot be resolved. For contaminated samples, recovery of matrix spikes may depend on sample homogeneity, matrix interference, and dilution requirements for quantitation.

COMPLETENESS

Definition

Completeness is a measure of the amount of valid data obtained from a measurement system compared to the amount expected under normal conditions.

Field Completeness Objectives

Field completeness is a measure of the amount of valid measurements obtained from all the measurements taken in the project. Field completeness for the project will be greater than 90 percent.

Laboratory Completeness Objectives

The project laboratories will provide data meeting QC acceptance criteria for a minimum of 90 percent of the samples tested using the SW-846 and other standard methods. Completeness data quality goals are listed in **Table 3**. At the completion of sample analysis testing, the percent completeness will be calculated by the following equation:

$$C\% = \frac{S}{R}(100\%)$$

Where:

C = completeness
S = number of successful analyses
R = number of requested analyses

Successful laboratory analyses can only be accomplished if both the field and laboratory portions of the project are successful. Factors that adversely effect completeness include:

- Receipt of samples in broken containers.
- Receipt of samples in which chain of custody or sample integrity is compromised in some way.
- Samples received with insufficient volume to perform initial analyses or repeat analyses, if initial efforts do not meet QC acceptance criteria.
- Improperly preserved samples.
- Samples held in the field or laboratory longer than expected, thereby jeopardizing holding time requirements.
- Samples that have unclear analyses requests.
- Incomplete or unapproved SQAP.

Completeness for the entire project also involves completeness of field and laboratory documentation.

REPRESENTATIVENESS

Definition

Representativeness qualitatively 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.

Representativeness expresses the degree to which a sample represents a source material, an environmental media, or a geochemical process. Representativeness is a qualitative parameter, dependent upon the proper design of the sampling program and proper choice of extraction and analytical methods. The sampling network described in Section B1 was designed to provide data representative of site conditions. During development of this network, consideration was given to past waste disposal practices, existing analytical data, and physical setting and processes. Representativeness will be satisfied by following the methods and procedures discussed in Section A7.

The characteristic of representativeness cannot be quantified. Subjective factors to be taken into account are as follows:

- Degree of homogeneity of a site.
- Degree of homogeneity of a sample taken from one point in a site.
- Available information on which a sampling plan is based.

Measures to Ensure Representativeness of Field Data

Field duplication and field replication, as defined under precision, are also used to assess representativeness. Two samples that are collected at the same location and at the same time are considered equally representative of this condition, at a given point in space and time.

Measures to Ensure Representativeness of Laboratory Data

Representativeness in the laboratory is ensured by using the proper analytical procedures, meeting sample holding times, and analyzing and assessing duplicated samples.

Within the laboratory, precautions are taken to extract from the sample container an aliquot representative of the whole sample. This includes premixing the sample and discarding foreign material (i.e., stones, twigs, pebbles, etc) from soil samples. For samples requiring volatiles analysis, premixing or homogenization is not performed.

COMPARABILITY

Definition

Comparability expresses the confidence with which one data set can be compared with another. The extent to which existing and new analytical data will be comparable depends on the similarity of sampling and analytical methods. The new physical and chemical data, however, may not be directly comparable to existing data because of temporal changes in the environment and differences in analytical procedures and QA objectives.

Measures to Ensure Comparability of Field Data

Comparability is dependent upon the proper design of the sampling program and will be satisfied by ensuring that the field procedures (presented in Section B2) are followed and that proper sampling techniques are used.

Measures to Ensure Comparability of Laboratory Data

Planned analytical data will be comparable when similar sampling and analytical methods are used and documented in the SQAP. Comparability is also dependent on similar QA objectives.

LEVEL OF QUALITY CONTROL EFFORT

Trip blank, method blank, duplicate, standard reference materials (SRM) and matrix spike samples will be analyzed to assess the quality of the data resulting from the field sampling and analytical programs.

Trip blanks consisting of purchased distilled water that is purged with an inert gas will be submitted to the analytical laboratory to provide the means to assess the quality of the data resulting from the field sampling program.

Solid samples collected and analyzed during the project will be used to evaluate nature and extent of site-related contamination in soil.

A8. SPECIAL TRAINING REQUIREMENTS/ CERTIFICATION

No special training or certification is required other than all field personnel will be Washington State HAZWOPER trained.

A9. DOCUMENTATION AND RECORDS

We will document field activities and analytical laboratory sample results in a draft report once the field investigation is completed and the laboratory results are received. The report will be finalized after King County review and approval.

DATA REPORTING

Data reporting procedures shall be carried our for field and laboratory operations as indicated below:

Field Data Reporting

Field data reporting shall be conducted principally through the transmission of report sheets containing tabulated results of all measurements made in the field, and documentation of all field calibration activities.

Laboratory Data Reporting

It is OnSite's intent to provide paper and electronic deliverables that meet the requirements of our clients and regulators. OnSite has designed a standard MTCA deliverables format that incorporates required QA/QC elements for definitive data. For samples requiring rigorous data validation, an extended data validation deliverables format has been developed.

For the project, OnSite will provide a standard deliverable unless an extended data validation deliverable is requested at the time of project set-up. Laboratory reports will contain acceptance limits for surrogates, LCS, and matrix spikes and will report method blanks whenever they are used. The laboratory report will unambiguously link batch quality control with samples of that batch.

Each laboratory report will have a narrative section that summarizes comments pertinent to the batch of samples reported. The narrative section will be used to document corrective actions.

FINAL EVIDENCE FILES

The final evidence file will be the central repository for all documents that constitutes evidence relevant to sampling and analysis activities as described in this SQAP. CDM is the custodian of the evidence file and maintains the contents of evidence files for the project, including all relevant records, reports, logs, field notebooks, pictures, subcontractor reports and data reviews in a secured, limited access area and under custody of the CDM site manager.

The final evidence file will include at a minimum:

- Field logbooks
- Field investigation daily reports
- Photographs

- Drawings
- Test pit logs and soil sampling records
- Laboratory data deliverables
- Data validation reports
- Data assessment reports
- Progress reports, QA reports, interim project reports, etc.
- All custody documentation (tags, forms, airbills, etc.).

PART B - MEASUREMENT/ DATA ACQUISITION

B1. SAMPLING PROCESS DESIGN (EXPERIMENTAL DESIGN)

The sample network design and rationale for sample locations are grouped by media and described below.

Site Maps of Project Sampling Locations/Network
Location of areas for proposed surface soil sampling and test pit locations are shown on **Figure 2.**

Rationale of Selected Project Sampling Locations/Network
The rationale for selected project sampling locations is summarized in **Table 5**.

B2. SAMPLING METHODS REQUIREMENTS

SAMPLING PROCEDURES

The sampling procedures used for this project will be consistent with the project objectives described in Section A6. A separate field sampling plan has not been prepared for this SQAP. Therefore, this section provides a detailed description of the investigations that will be performed. Standard operating procedures (SOP) to guide field personnel are available upon request.

Soil Sample Collection Methods

For surface soil samples, hand tools (shovel and stainless steel spoon) will be used to collect samples. For test pits, a backhoe bucket will be used for gathering soil where safety concerns will preclude collecting soil samples from the excavation. CDM's field representative will direct the equipment operator to collect the soil sample from the correct location and desired depth within the excavation. Once the soil is brought to ground surface, the CDM field representative will scrape away surface soil using stainless steel spoons to expose undisturbed soil. Samples for chemical analysis will be collected using stainless steel spoons. Soil will be placed into one 4-ounce pre-cleaned glass jar. The jar will be filled so zero headspace exists between the soil and the Teflon-lined cap. Filled sample jars will be placed in a cooler containing Blue Ice. The samples will be labeled, secured, and shipped as described in Section B2. The sampling spoons will be decontaminated between each sampling point using decontamination procedures described in Section B2.

SAMPLE CONTAINERS

Table 4 lists the sample containers, preservatives, and holding times for this project. Samples will be cooled with ice packs in the field as soon as practical. The holding times listed are maximum times that samples may be held before analysis and still be considered compliant with method guidelines. Samples may be held for longer periods of time only if data are available to show that the specific types of samples under study are stable for the longer time and CDM and EPA Region 10 have agreed to the extended holding time.

Preparation holding times listed in **Table 6** are from date of sample collection and analysis times are from date the extraction process was initiated. Many preparation procedures involve multiple steps (e.g. extraction, concentration, clean-up) but the preparation holding time given in **Table 6** is for extracting the sample and does not include sample clean-up and concentration.

Obtaining Contaminant-Free Sample Containers

All sample containers for this project will be supplied to OnSite by Eagle-Picher and are prepared to Eagle-Picher's Level 1 standards. Level 1 containers are cleaned by Cleaning Procedure A, as described below:

1. Sample containers and contact components are washed in laboratory-grade, non-phosphate detergent.
2. Rinsed three times with water.
3. Rinsed with diluted nitric acid.
4. Rinsed three times with ASTM Type 1 organic-free water.
5. Air dried in a contaminant-free area
6. Rinsed with hexane.
7. Rinsed three times with ASTM Type 1 organic-free water.
8. Oven-dried for one hour.

Eagle-Picher Level 1 containers are analyzed for SVOCs, inorganics, pesticides, and VOCs, and are found to comply with or to be lower than the EPA detection limits as stated in OSWER Directive 9240.0-05A "Specifications And Guidance For Contaminant-Free Sample Containers 12/92". Each container lot is label for traceability and Eagle-Picher will provide a certified analysis for each sample container lot upon request.

QUALITY CONTROL SAMPLES

This section describes the purpose of QC samples and discusses how they will be collected.

Field Blanks

Field blanks, consisting of distilled water poured into sample containers in the field, will not used to assess whether aqueous samples have been compromised by airborne contaminants because no such samples will be collected.

Field Duplicate Collection

Duplicate samples are analyzed to check for matrix variability and analytical method reproducibility. One field duplicate will be collected for every 10 investigative samples by media and analyzed for the same parameters listed for other media samples.

B3. SAMPLE HANDLING AND CUSTODY REQUIREMENTS

Custody is one of several factors necessary for the admissibility of environmental data as evidence in a court of law. Custody procedures help to satisfy the two major requirements for admissibility: relevance and authenticity. Sample custody is addressed in three parts: field sample collection, laboratory analysis, and final evidence files. Final evidence files, including all originals of laboratory reports and purge files, are maintained under document control in a secure area.

A sample or evidence file is under your custody if:

- The item is in actual possession of a person.
- The item is in the view of the person after being in actual possession of the person.
- The item was in actual physical possession but is locked up to prevent tampering.
- The item is in a designated and identified secure area.

FIELD CUSTODY PROCEDURES

Field Log Book

Field forms will be used to document data collection activities. Entries will be described with sufficient detail so that field activities can be reconstructed without reliance on memory.

Log books will be assigned to CDM's field team leader but will be stored in the document control center at CDM when not in use. Each log book will be identified by the project-specific document number. The title page of each log book will include the following information:

- Person to whom the log book is assigned
- Log book number
- Project name
- Project start and end dates.

A Daily Field Investigation Form will begin each entry into the logbook. This form will include the date, start time, weather, names of all sampling team members present, level of personal protection being used, and the signature or initials of the person making the entry. The names of visitors to the site, field sampling or investigation team personnel, and the purpose of their visit will also be recorded in the field logbook.

Field measurements and sample collection procedures will be recorded on appropriate forms and entered into the logbook. All entries will be made in ink, and no erasures will be made. If an incorrect entry is made, the information will be crossed out with a single line. Whenever a

sample is collected or a measurement made, a detailed description of the sample location shall be recorded. The number of the photographs taken of the sample location, if any, will also be noted. All equipment used to make measurements will be identified, along with the date of calibration.

Samples will be collected using the procedures described above. The type of sampling equipment will be noted, along with the sampling time, sample description, sample depth, and volume and number of containers. A sample identification number will be assigned prior to sample collection. Field duplicate samples will receive an entirely separate sample identification number.

Chain-of-Custody Protocol

Chain-of-custody protocol will be followed to maintain and document sample possession. The principal documents used include:

- Sample labels and seals
- Field Sampling Records
- Chain-of-Custody Records
- Shipping Records.

Examples of these documents can be found in the **Appendix B** of this SQAP.

Each sample will be labeled and have a custody seal affixed to its container cap immediately after collection. All bottle/jar labels and seals will be provided by CDM. A representative label is shown in **Appendix B.** Each label will include, at a minimum, the following information:

- Project name
- CDM project number
- Name of collector
- Date and time of collection
- Number, which uniquely identifies the sample and its collection location. An example of the sample numbering system for this project is: EC-S1-8/05. Where "EC" is the project identifier; S1 indicates it is a soil sample (the sample numbering sequence will be blind and will not indicate to the laboratory which samples are duplicates, splits, or field blanks); and "8/05" denotes the month/year the sample was collected.
- Preservative (if any).

A custody seal will be affixed to all samples to prevent tampering during shipment to the laboratory. **Appendix B** shows a representative custody seal. If any custody seals are found broken when the laboratory receives a sample shipment, no analysis will be performed unless there is incontrovertible evidence the samples were not compromised. Broken or missing custody seals will be noted on the Chain-of-Custody Records by the receiving analytical laboratory.

A sample label (**Appendix B**) with a unique number will be affixed to each sample container. This tag will be returned to CDM by the laboratory analyzing the sample and will be retained in the project file. The sample tags will contain the following information:

- Project number
- Station number
- Station location
- Date and time of collection
- Sample type
- Signature of collector
- Preservative
- Requested analyses
- Laboratory number
- Remarks.

Samples will be kept in CDM's possession until the end of each day or the following morning, when they will be shipped to OnSite by courier. A sample will be considered in CDM's custody if it is in the field team's possession or it is in a designated secure area, under CDM's control.

A Chain-of-Custody Record must be completed for and accompany every sample and every shipment of samples to the analytical laboratory to establish the documentation necessary to trace sample possession from the time of collection. The Chain-of-Custody Records will contain, at a minimum, the following information:

- Sample number
- Signature of collector
- Date and time of collection
- Place of collection
- Sample matrix
- Signatures of persons involved in the chain of possession
- Inclusive dates of possession

The Chain-of-Custody Record will also be used to indicate what analyses are required by checking the appropriate box(es) on the form.

Following proper sealing and labeling, sample containers will be placed on Blue Ice in a cooler. The cooler will be closed and sealed with a custody seal.

Shipping

All samples are to be accompanied by a properly completed chain-of-custody form. The original record and yellow copy will accompany the shipment, and the pink copy will be retained by the sampler for return to CDM's office. When transferring the possession of samples, the individuals relinquishing and receiving will sign, date, and note the time on the record. This

record documents transfer of custody of samples from the sampler to another person, to the permanent laboratory, or to/from a secure storage area.

Samples will be properly packaged for shipment and dispatched to the laboratory for analysis, with a separate, signed custody record enclosed in each sample box or cooler. Shipping containers will be locked and secured with strapping tape and custody seals for shipment to the laboratory. The preferred procedure includes use of a custody seal attached to the front right and back left of the cooler. The custody seals are covered with clear plastic tape. The cooler is strapped shut with strapping tape in at least two locations.

Samples will be shipped to the laboratory using a courier under a bill of lading. Receipts of bills of lading will be retained as part of the permanent documentation. The courier will not sign off on the custody form as it will be sealed inside the sample cooler and the custody seals remain intact.

LABORATORY CUSTODY PROCEDURES

Sample custody starts in the field as the samples are taken, but sample *container* custody records, in preparation of sampling, start at the lab and bottle manufacturer. The integrity of the sample containers depends on the preparation, storage, shipment, and documentation by the bottle manufacturer. The laboratory documentation of custody starts when preservative-prepared sample containers are shipped to the field under custody. Successful sample custody is initiated by field personnel using traceable containers and relies on the fastidious completion of field custody protocols.

Samples shipped or delivered to OnSite are received by the sample custodian. The sample custodian inspects the shipping container and samples for integrity and custody seals. The samples are checked for breakage, leakage, damage, and preservatives (except sample containers for VOA, TOX, or TOC analyses). The temperature inside the cooler is measured using a laser thermometer with digital readout. The contents of the shipping container are verified against the chain-of-custody documentation. Documentation of custody seal integrity, temperature, and sample preservations are made on the sample control worksheet or condition upon receipt form. Any problems are documented on the sample control communication form.

The OnSite project manager will either resolve the problem internally or contact CDM's project QA officer for resolution.

If the samples and documentation are acceptable, each sample is assigned a unique laboratory identification number from OnSite's laboratory information management system (LIMS). When the LIMS log-in has been completed, the samples are transferred to the appropriate refrigerators where applicable (aqueous metals and hexavalent chromium samples require no refrigeration). For samples receiving analysis for volatile compounds, sample containers are placed in separate

refrigerators. The sample refrigerators are kept at 4°±2°C. The refrigerators storing samples for volatile analysis are monitored for contamination with holding blanks.

Sample distribution is controlled and is described in site-specific SOPs. Thirty to sixty days after a laboratory report has been generated and mailed to CDM, the samples are transferred from cold storage to the sample disposal area.

OnSite's sample processing flow chart and sample control condition upon receipt/narrative are presented in discussed in **Appendix C.**

B4. ANALYTICAL METHODS REQUIREMENTS

ANALYTICAL PROCEDURES

This section contains a general description of the preparation and instrumental procedures to be used for the project. Section B6 contains a general description of instrument calibration procedures. Detailed method-specific applications of the procedures described in laboratory SOPs in **Appendix C.**

The analytical laboratory for the project is OnSite Environmental. Their address is 14648 NE 95th Street, Redmond, Washington 98052. OnSite's telephone number is (425) 883-3881.

FIELD ANALYTICAL PROCEDURES

The standardization and QA information for field measurements are described in Sections B4, B6, and B7 of this SQAP. Field analytical procedures are provided in the relevant SOPs.

Organic Sample Preparation Procedure

SW 3510C - Separatory Funnel Liquid-Liquid Extraction

Method 3510C is applicable to the isolation and concentration of organic compounds from aqueous samples. A measured volume of sample is placed into a separatory funnel, adjusted if necessary to a specific pH, and serially extracted with methylene chloride. The extract is then dried with anhydrous sodium sulfate, exchanged into a solvent compatible with the analysis (if necessary), and concentrated to the appropriate volume.

SW 3520C - Continuous Liquid-Liquid Extraction

Method 3520C is a procedure for isolating organic compounds from aqueous samples. A measured volume of sample is placed into a continuous liquid-liquid extractor, adjusted, if necessary, to a specific pH, and extracted with methylene chloride for 18 hours to 24 hours. The extract is then dried and concentrated.

SW 3540C - Soxhlet Extraction

The procedure extracts nonvolatile and semivolatile organic compounds from solids such as soils, sludges, and wastes. It is applicable to the isolation of water insoluble and slightly soluble organics for further analysis by gas chromatography. The solid sample is mixed with anhydrous sodium sulfate, placed in an extraction thimble and extracted using an appropriate solvent in a Soxhlet extractor. The extract is then dried, concentrated and, as necessary, exchanged into a solvent compatible with the determinative method.

SW 3550B - Sonication Extraction

Method 3550B is a procedure for extracting nonvolatile and semivolatile organic compounds from solids such as soils and sludges. The sonication process ensures intimate contact of the sample matrix with the extraction solvent. A weighed sample of the solid material is ground, mixed with the anhydrous sodium sulfate and then dispersed into the solvent using sonication. Methylene chloride:acetone is the typically used solvent, although other solvents may be used for specific analytical applications. The extract is dried with anhydrous sodium sulfate and concentrated to the appropriate volume. The resulting solution is analyzed using the appropriate method.

SW 5030B - Purge and Trap

An aliquot of a liquid sample, or soil sample and the appropriate amount of water, is placed in the purge chamber and an inert gas is bubbled through the sample at ambient temperatures for waters and 40°C for soils. The volatile components are transferred from the aqueous matrix to a sorbent column where they are trapped. After purging is completed, the sorbent column is heated and backflushed with an inert gas to desorb the components onto a gas chromatographic column. The gas chromatographic column is heated to elute the components that are detected by the appropriate detector. An extraction method can be employed for nonaqueous and solid samples when high concentrations are expected. This involves dilution or extraction of the sample into methanol. An aliquot of this methanol extract is then added to reagent water and purged as discussed above.

Organic Instrumental Methods

Most organic methods rely on gas chromatography for target analyte separation. Once the compounds of interest have been separated, various detectors are used to identify and quantitate the target.

Gas Chromatography

Gas chromatographs achieve separation by partitioning solutes between a mobile gas phase and a stationary liquid phase on solid support material. A typical analysis would proceed as follows. The organic extract of a sample is injected into a heated injection port. The solvent and solutes are immediately vaporized and swept onto a separation column by inert carrier gas. The solutes are adsorbed onto the stationary phase of the column and then are desorbed by fresh carrier gas. The sorption-desorption process occurs repeatedly as the sample moves through the column and each analyte will be retained based on its unique solubility with the stationary phase. After passing through the column, the solutes are eluted into a detector system.

Compound identification is based on the time it takes a compound to travel through a column. The retention time of a compound is determined during instrument calibration with target analytes. Since not all compounds have unique retention times, non-mass spectrometer GC methods often require sample extracts to be analyzed on a second, dissimilar column to decrease the probability of false positives.

Detector Systems

Detector systems detect target analytes in the column effluent. Some are specific to classes of compounds (e.g., photoionization and electron capture) and some are relatively unselective (e.g., flame ionization). Selective detectors often provide lower reporting limits by increasing the signal to noise ratio and by their selectivity and provide an additional level of confidence during compound identification. Mass spectrometers provide a high level of confidence in compound identification because they provide a characteristic ion pattern for fragmented target analyte molecules.

Once they are calibrated, detectors enable quantitation of target analytes. Calibration consists of the establishment of a dynamic working range and periodic continuing standards to show that the instrument is still operating within acceptable limits.

LABORATORY ANALYTICAL AND MEASUREMENT PROCEDURES FOR METALS ANALYSES

Two techniques, inductively coupled plasma (ICP) atomic emission spectroscopy and atomic absorption (AA) spectroscopy, will be employed to measure levels of specified metals in the samples. Sample digestion is required prior to most ICP and AA analyses.

Metals Sample Preparation Procedures

SW 3005B - Acid Digestion of Waters and Ground Waters For Total Recoverable Metals

This digestion method is used to prepare surface water and groundwater samples for analysis by ICP, flame AA and GFAA analysis of antimony. For the analysis of dissolved metals the sample must be filtered at the time of collection.

A 50-mL aliquot of the acidified sample is heated with 1 mL concentrated HNO_3 and 5 mL 1:1 HCl until the volume is reduced to 15 mL to 20 mL. Filtering may be performed if insoluble material is present. The final volume is adjusted to 50 mL.

SW 3010A - Acid Digestion of Aqueous Samples for Total Metals by FLAA or ICP

This digestion method is used to prepare surface water and groundwater samples for analysis by ICP, flame AA and GFAA analysis of antimony. For the analysis of dissolved metals the sample must be filtered at the time of collection.

A 50-mL aliquot of the acidified sample is heated with 3 mL concentrated HNO_3 and 5 mL 1:1 HCl until the volume is reduced to 20 mL. Filtering may be performed if insoluble material is present. The final volume is adjusted to 50 mL.

SW 3020A and SW7060A - Acid Digestion of Aqueous Samples and Extracts for Total Metals for Analysis by GFAA Spectroscopy

These digestion procedures are used for the preparation of aqueous samples for analysis by GFAA. Method SW7060A is used to prepare samples prior to the GFAA analysis of arsenic or selenium. Method SW3020A is used prior to the analysis of lead, thallium, and other GFAA analytes. In the SW3020A procedure, a mixture of nitric acid and the sample to be analyzed is refluxed with additional portions of nitric acid until the digestate is light in color or until its color has stabilized. After the digestate has been brought to a volume less than 20 mL, it is cooled and brought up to volume. If the sample digestate contains suspended solids, it must be centrifuged, filtered, or allowed to settle.

In the SW7060A protocol, the sample is processed similarly to SW3020A except that hydrogen peroxide is used in addition to nitric acid and the sample digestate has been brought down to less than 20 mL.

SW 3050A - Acid Digestion of Sediments, Sludges, and Solids

This digestion method is used to prepare sediment and soil samples for analysis by ICP, graphite furnace atomic absorption (GFAA) and flame atomic absorption (FLAA). A portion of the sample is digested with nitric acid. A final reflux procedure is performed using concentrated hydrochloric acid or concentrated nitric acid based on the chosen analytical method: ICP, Flame AA or GFAA. The final volume is adjusted to 100 mL.

Metals Instrumental Methods

SW 6010B - ICP Procedures

Inductively coupled plasma atomic emission spectroscopy determines elements in solution. All matrices including groundwater, surface water, aqueous samples, industrial wastes, soils, sludges, and sediments require digestion by Methods 3005A (water) or 3050A (soil) prior to analysis.

Method 6010B provides a simultaneous multi-element determination by ICP or Trace ICP. Samples are nebulized and the resulting aerosol is transported to the plasma. Element-specific atomic line emission spectra are produced by radio-frequency inductively coupled plasma. The spectra are dispersed and the lines monitored by photomultiplier tubes. The background will be measured and the results corrected for background levels.

SW 7000 Series-Graphite Furnace Atomic Absorption Spectroscopy Procedures

Graphite furnace atomic absorption spectroscopy determines elements in solution. Groundwater samples require the digestion by Method 3005A prior to analysis.

The basis of the method is the measurement of atomic absorption by an optical spectroscopic technique. A representative aliquot of a sample is placed in a graphite tube in the furnace, evaporated to dryness, charred and atomized, causing the atoms to be vaporized and dissociated within the graphite tube. The intensity of the transmitted radiation decreases in proportion to the amount of the ground state atoms in the vapor contained within the graphite tube. Because the wavelength of the light beam is characteristic of the metal being determined, the light energy absorbed by the sample in the tube is a measure of the concentration of that metal in the sample. Concentration of the analyte in the sample is determined by comparison of the sample absorbance to the calibration curve.

DETECTION AND QUANTITATION LIMITS

There are variety of terms used to express detection and reporting limits in environmental chemistry. The work performed under this SQAP will use the following terms:

- Instrument detection limit (IDL)
- Method detection limit (MDL
- OnSite standard reporting limit (RL)
- Project-specific reporting limit (PSRL).

The IDL is an empirically derived value which measures the sensitivity of an instrument (in contrast to a method) by repeatedly analyzing standards over several days and multiplying by a factor of three the standard deviation of the instrument response. IDLs are used for metals methods, except mercury.

The MDL is an empirically derived value used to estimate the lowest concentration a method can detect in a matrix-free environment. SW846 defines the MDL as the minimum concentration of a substance that can be measured and reported with 99% confidence that the analyte concentration is greater than zero. The MDL is determined from the analysis of replicate samples of a given matrix, containing analytes, which have been processed through the preparation or extraction procedure. The guidance in 40 CFR136 Appendix B, with additional lab-specific requirements, is used to produce MDLs and these are annually updated by the laboratory.

The RL and PSRL are reporting limit terms used within OnSite. The RL is a uniform reporting limit based on method Practical Reporting Limits (PQLs), actual performance at OnSite laboratories, and expected method performance in routine water and soil samples. The PQL is the lowest concentration a method can reliable achieve within limits of precision and accuracy. Although the RL is primarily based on the PQL, the RL also evaluates empirical data for soil and water methods; the SW846 PQLs often extrapolate soil PQLs from water PQLs, and are not strictly based on the determinant method. RLs are highly matrix dependent.

The PSRL is a project-specific, DQO-based RL. The PSRL is often the same as the RL, but it also may be greater than or less than the RL, but it always must be greater than the MDL. Estimation flags are routinely applied to values falling below the *RL* because it is this value that implies a known level of precision and accuracy. Below the RL the precision and accuracy decrease, and hence a flag is used to denote this decrease in precision and accuracy.

B5. QUALITY CONTROL REQUIREMENTS

This section describes field and laboratory QC checks.

FIELD QUALITY CONTROL CHECK

QC procedures for VOC headspace measurement of soil samples will include calibrating the instruments (as described in Section B6 of the SQAP) and checking the reproducibility of the measurements by taking multiple reading on a single sample or reference standard. The QC information for field equipment is stated in Section B6 of this SQAP. Assessment of field sampling precision and bias will be made by collecting field duplicates for laboratory analysis. Collection of these samples will be accordance with the applicable procedures and frequency described in Section B2 of this SQAP.

LABORATORY QUALITY CONTROL CHECKS

Method quality control determines whether a method is performing within acceptable limits of precision and accuracy. There is a laboratory component and a "matrix" component to this determination. The laboratory component measures the performance of the laboratory analytical processes during the sample analyses. The matrix component measures the method performance on a specific matrix. Some quality control elements uniquely measure the laboratory component of method performance, but all QC elements that measure the matrix component also contain the laboratory component.

Method blanks and laboratory control samples uniquely measure the laboratory component of method performance. Matrix spikes, matrix spike duplicates, laboratory sample duplicates, surrogates, and post-digestion spikes measure the matrix component of method performance.

On a project or sampling event level, additional quality control elements are used to assess field sampling techniques and environmental conditions during sample collection and transportation. Field sample duplicates (in contrast to laboratory sample duplicates), field blanks, equipment blanks, and trip blanks are used to assess field precision and accuracy. Since these QC elements are related to field activities, they are mentioned in this laboratory SQAP only in the context of routine sample analyses. Further discussion on the application and interpretation of these field elements is contained in Section D1.

Quality Control Definitions

This section defines the quality control elements OnSite will use for the project.

Batch

Many analytical laboratory processes approach batch processes and therefore the batch is a basic unit for the frequency of some quality control elements. Two types of lab process batches can be identified: the preparation and instrument batch. A preparation batch is defined as a group of

twenty or less samples that are prepared (e.g., extracted or digested) within the same time period or in limited continuous sequential time periods. Samples in each batch should be of similar matrix (e.g., soil, sludge, liquid waste, water), be treated in a similar manner, and use the same reagents. The instrument batch is a group of samples that are analyzed together within the same analytical run sequence or in continuous sequential time periods. The instrument batch may contain more than one preparation batch. In general, if an instrument is not used for periods of time (e.g., overnight) or shut down then a new instrument batch must be started.

The "quality control batch" (QC batch) is the fundamental quality control unit for this project and is a set of up to twenty field samples that behave similarly and are processed using the same procedures, reagents, and standards within the same time period. Included in the QC batch are a method blank, laboratory control sample, and matrix spike/matrix spike duplicate (or sample duplicate and a single matrix spike). Field quality control samples are included as discrete samples in the batch sample count but laboratory quality control samples (stated above) are not included in the count of field samples. For methods that require independent preparation prior to analysis, the QC batch is defined by preparation batch, and for methods that do not require independent preparation, the QC batch is defined by the instrument batch. Volatile organics analyses (VOA) by GC or GC/MS is an example of the latter since the sample preparation (purge and trap) is performed as part of the instrumental analysis. In addition, for VOA GC and GC/MS analyses the sample preparation is more of a sequential, rather than batch, process. For the purpose of QC frequency, VOA GC and GC/MS batches are defined as twenty or less samples analyzed within a calibration (and for GCMS, tune) time period, or within sequential continuous calibration time periods. For VOA GC and GC/MS analyses, a batch may extend over a calibration and tune.

In general, preparation batch samples and QC should be analyzed in same instrument batch. In some instances (e.g., sample dilutions, reanalysis to verify results, expedited TAT) the QC samples may not be run with all samples from the preparation batch. Samples not run with the preparation QC must meet the following conditions:

- All samples from the preparation batch must be clearly associated with their corresponding preparation QC, and appropriate corrective is performed on all from the preparation batch.
- All instrument QC are met.
- Instrument cleanliness be proven with the preparation method blank, an instrument blank, or a clean method blank from another batch.

In summary, the basic unit for quality control is the QC batch, and it may be initiated at the preparation or instrument stage of the sample analysis process.

Method Blank

The method blank is a quality control sample that consists of all reagents specific to the method and is carried through every aspect of the procedure including preparation, clean up, and analysis. The method blank is used to identify any interference or contamination of the analytical system that may lead to the reporting of elevated analyte concentrations or false positive data. Some inorganics methods do not have a distinct preparation, and for these tests, the instrument blank, which contains all reagents used with samples and is equivalent to the method blank, is considered the method blank. A method blank is included in each QC batch.

Instrument Blank

An instrument blank is used to monitor the cleanliness of the instrument portion of a sample analysis process. Instrument blanks are usually just the solvent or acid solution of the standard used to calibrate the instrument. With an exception for metals analyses, instrument blanks are analyzed each instrument batch whenever a method blank is not analyzed in that instrument batch. Routine metals analyses receive an instrument blank every ten samples. Instrument blanks are also analyzed on an as-needed basis for troubleshooting.

Laboratory Control Samples (LCS)

A laboratory control sample is a well-characterized, laboratory-generated sample used to monitor the laboratory analytical process independent of matrix effects. It is spiked with a known quantity of analytes of interest, is prepared with each batch of samples, and is taken through the entire sample preparation and analysis process. The LCS measures the accuracy of the process by the recovery of spiked target analytes in a controlled matrix or matrix-free sample. LCS results, together with matrix spike results, can establish the presence of matrix effects. For methods where there is no distinct preparation, a continuing calibration standard may be used as the LCS, if it meets all LCS criteria.

Duplicate Control Sample (DCS)

Duplicate control samples are two LCS prepared and analyzed together. Accuracy (recovery) and within-batch precision may be determined when DCS are used. DCS are evaluated according to LCS criteria for accuracy and MS/MSD criteria (if available) for precision. DCS may be used when matrix spikes are not amenable to the sample or method, when insufficient sample volume is received for matrix spikes or sample duplicates, or client specific requirements. For methods that have no distinct preparation, two consecutive calibration standards may be used as a DCS, if all other DCS criteria are met.

Matrix Spikes and Matrix Spike Duplicates (MS/MSD)

To measure matrix specific method performance, a field sample is spiked with a known quantity of target analytes before preparation and analysis. The target analytes spiked are listed in the laboratory SOP and are the same as those spiked into the LCS. The spiked sample is called a matrix spike (MS) and, if another aliquot of the sample is also spiked, the second sample is called a matrix spike duplicate (MSD). The accuracy of the matrix specific method performance

may be determined by the recovery of the spiked analytes after native concentrations of the spike analytes are subtracted. If a matrix spike duplicate (MSD) is analyzed, the matrix specific precision of the method may be calculated. In general for organics and inorganic analyses, an MS/MSD pair are prepared and analyzed with each QC batch of up to 20 field samples.

Sample Duplicates (SD)
A sample duplicate (SD) is a second aliquot of an environmental sample (taken from the same container if possible) that is processed with the first aliquot of that sample. The results are compared to the first aliquot analysis to determine the matrix specific method precision of the analysis. The matrix specific method precision may be calculated by dividing the difference in the results by the average. Sample duplicates are prepared and analyzed for some inorganic analyses that are not amenable to matrix spiking.

Surrogate Compounds
GC, GC/MS, and HPLC analyses include the addition, subsequent quantitation, and ultimate recovery calculation of surrogate compounds. Surrogate compounds are:

- Compounds not requested for analysis.
- Compounds that do not interfere with the determination of required analytes of interest.
- Compounds that are not naturally occurring, yet are chemically similar to the required analytes.
- Compounds exhibiting similar response to analytes under determination.

When used by a method, surrogate compounds are added to every sample, LCS, MS/MSD, and method blank at the beginning of the sample preparation, and the surrogate recovery is used to monitor matrix effects and sample preparation. Surrogate control criteria are applied to all field samples and QC samples and re-analysis and re-extraction may be performed if surrogate criteria are not met. Surrogate compounds are given in the site SOP.

Internal Standards
Internal standards are compounds not found in the sample, are added at the time of instrumental analysis, are used to quantitate results, and are used to correct for injection variability. Although GC and ICP methods may use internal standards, mass spectrometer methods require them.

Laboratory Batch Quality Control Logic

Frequency of batch quality control
For organics and inorganics analyses each QC batch will contain a method blank, an LCS, and an MS/MSD pair. There are a few exceptions to the QC frequency stated above due to the nature of the analyses or method specific requirements. Some methods, usually wet chemistry methods, are not amenable to matrix spikes (e.g., pH). For these methods, laboratory sample duplicates are usually substituted for the matrix spikes. When there are exceptions to the general QC frequency stated above, these exceptions will be clearly stated in the site SOP, and the basic concepts of batch control and matrix and laboratory performance assessment and control will remain intact.

Batch Quality Control Logic

This section provides a general description of the QC batch control logic and the corrective actions that will be used. For the method-specific application of this general description, please refer site-specific SOPs. Batches are controlled by method blanks and LCS. Matrix spike recoveries and relative percent difference (whether from matrix spikes or sample duplicate analyses) will be reviewed for systematic trends and errors, as well as the effect of the matrix on method performance. Surrogate recoveries will be reviewed for matrix effects as well as individual sample errors.

Batch Quality Control Logic - Method Blanks

The method blank is included in each QC batch and measures laboratory introduced contamination for the batch. An acceptable method blank has no target analytes greater than the PSRL (see section 7.4 for definition) and must have acceptable surrogate recoveries. If target analytes are present in the method blank above the PSRL, then they must be less than the higher of 5% of the sample concentration, or 5% of the regulatory limit. Any method blank with target analyte concentration greater than the PSRL must be documented as a nonconformance, and addressed in the project or case narrative.

If the above criteria are not met, corrective action is implemented. The first step of corrective action is to assess the effect on the samples. For example, if an analyte is found only in the blank but not in any batch samples, re-extraction and re-analysis of the batch may not be necessary. Investigating and eliminating the source of the contamination and documenting the evaluation may be the appropriate action in such a scenario. In general, corrective action will be executed in the following order: reanalysis of the method blank, re-analysis of the samples, re-preparation and reanalysis of all effected QC batch samples and QC.

It is a goal to have no detected target analytes in the method blanks but analytes may be periodically detected in blanks due to the nature of the analysis or the PSRL of the analyte. For example, in organic volatile analyses, methylene chloride, acetone, and 2-butanone (MEK) may sometimes be found in the method blank, and in organic semi-volatiles analyses, the phthalate esters may sometimes be found in the method blank. For ICP or GFAA metals analyses, copper, zinc, iron, and lead (GFAA and Trace ICP only) may sometimes be found in method blanks. For these common laboratory contaminants, data may be reported with qualifiers if the concentration of the analyte is less than five times the *RL* for organic methods, and less than two times the RL for inorganic methods. Any lab contaminants found in the method blank are discussed in the report narrative.

Blank subtraction is not performed (unless required by the method).

CDM will be contacted if batch re-preparations do not lead to method blanks that meet the above criteria.

Batch Quality Control Logic - LCS

LCS are evaluated by comparing the recovery of spiked target analytes to the laboratory generated acceptance criteria. For organic analyses, the LCS are spiked with a set of compounds representative of the target analyte list and for inorganic analyses LCS are spiked with all target analytes. The analytes spiked into the LCS are listed in the method-specific tables. When a limited spike list is used, all spiked compounds must be within the recovery windows for the batch to be considered acceptable, and when a full spike list is used a batch may be considered acceptable for those analytes which had acceptable recoveries in the LCS. If analytes are outside of the acceptance windows, corrective action must be initiated.

The first step of the corrective action process is to evaluate the effect on the samples; for example, if an analyte in the LCS has a recovery above the upper acceptance window, and other QC elements of the batch and sample analysis indicate that other samples in the batch were not affected, re-analysis or re-preparation of the batch may not be necessary. Corrective action consists of an attempt to locate the cause of the non-conformance and the documentation of the evaluation in the laboratory report narrative. For example, if an LCS spiked analyte does not have an acceptable recovery, but the MS/MSD pair does for the same analyte (and there is no matrix interference in the MS/MSD pair for that analyte), then the batch may be accepted, with an explanation of the evaluation in the report narrative. In general, for LCS with limited spike lists, if a compound or element spiked into the LCS has an unacceptable recovery, the LCS, method blank, and all batch samples must be re-extracted and re-analyzed. For LCS with full target analyte spike lists, the batch samples, method blank, and LCS must be re-prepared and re-analyzed for the failed analytes. Intermediate corrective action may include re-analysis of the LCS, but the re-analysis must be performed in real time, to properly determine that the instrument excursion was isolated to the LCS analysis only.

Matrix Spike Evaluation

For organic and inorganic methods amenable to matrix spikes, an MS/MSD pair is analyzed with each QC batch of samples. Both organic and inorganic batches are evaluated for matrix precision and accuracy. Accuracy is evaluated by calculating the recovery of spiked analytes and precision is evaluated by calculating the relative percent difference (RPD) of the recoveries (see section 12 for equations). The recovery and RPD are compared to the laboratory generated acceptance limits. If a matrix spike analyte fails precision or accuracy criteria, corrective action must be initiated.

Matrix spike data evaluation is more complex than blank or LCS data evaluation since matrix spikes measure matrix effects in addition to sample preparation and analysis effects. The heterogeneity of soil, grab sampling, and sequential collection of water samples further complicates the evaluation since matrix spike accuracy and precision assumes that the *native* concentration in the three analyses (the original sample, the spiked sample, and the duplicate spiked sample) is constant. However, appropriately trained personnel aware of the data's end use may improve data quality by an evaluation of matrix spike data. In consideration of these

limitations, the laboratory will not qualify data based on matrix spike performance but will perform corrective actions as outlined below, and note MS failures in the narrative.

When an MS/MSD pair fails in accuracy or precision for any spiked analyte, the cause of the failure will be investigated. If there is significant evidence to indicate that the sample matrix interfered with the precision and accuracy assessment (e.g., significant chromatographic peaks interfere with target analyte identification in a GC analysis, or poor post-spike recovery occurs for a metals analysis) this evidence will be clearly documented in the laboratory report case narrative and no further corrective action may be necessary. If the native concentration of target analytes in the unspiked sample is high relative to the spiking concentration, the differences in the native concentration between the unspiked sample and the spiked sample may contribute a significant error to the precision and accuracy calculations making the accuracy and precision measures unrepresentative of the true method and matrix performance. For this reason, if the native concentration is four or more times the spiked concentration, the matrix spike recoveries will not be calculated, the matrix spikes will not be re-analyzed or re-prepared, and no further corrective action may be necessary. Finally if, in the judgment of the analyst, an analytical process error has occurred appropriate re-analysis or re-preparation steps are implemented. In all situations, the evaluation and corrective actions performed will be clearly and completely documented in the laboratory report case narrative.

For analyses using a MS and sample duplicate, the single matrix spike sample is evaluated for accuracy and the sample and DU are assessed for precision. The assessment follows the same logic and reporting convention as described above.

For those analyses that do not allow matrix spikes, an LCS and sample duplicate will be analyzed with each batch of samples. Batch control will be the same as that described for LCS. The within-batch precision is measured by calculating the relative percent difference (RPD) of any target analytes found in the primary and duplicate analysis of the sample if the found amount is greater than five times the RL. The acceptance windows for LCS accuracy, and the associated corrective actions for failed QC, are based on laboratory generated acceptance criteria.

Laboratory Batch Quality Control for Field, Equipment, and Trip Blanks

The section below outlines the quality control applied to trip blanks, field blanks, and equipment blanks from sampling equipment.

Trip blank vials are sent with empty sample containers to the field and are shipped back to the laboratory with field samples to measure potential contamination from storage, collection, and shipment in the field and laboratory. Field blanks are created in the field and are intended to measure background contamination in the field. Regardless of the matrix of the project samples, trip and field blanks are reagent water and are usually only analyzed for volatile contamination. Trip and field blanks may be processed without *site-specific* matrix spike samples: they may be processed with matrix spikes or sample duplicates from another site, if the matrix adequately

matches the matrix of the field or trip blank. If matrix spikes or sample duplicates from another project are not available, these field or trip blanks may be analyzed with a DCS.

Equipment blanks assess the decontamination procedures of the field sampling equipment, and consist of reagent water, or water known to be free of target analytes. Equipment blanks are usually analyzed for all the parameters, which are to be performed on the associated samples. The batch QC requirements for equipment blanks from *soil* sampling equipment are the same as those described for trip and field blanks described above. Equipment blanks from *water* sampling equipment are processed in the same manner as the associated field samples, since their matrices are compatible.

Other Quality Control Elements

Reagents

Laboratory reagent water that meets the resistivity requirements of Type II water, as described in Standard Methods, is checked daily. The resistivity of the water is measured and recorded in a logbook. Method blanks are routinely analyzed for purity and accompany each batch tested.

High-purity reagents are purchased as required by each test method and the date received, batch or lot, lot number, supplier, and date opened is documented.

Establishment and Use of Control Limits

OnSite monitors the spike percent recovery in laboratory control samples (LCS), matrix spikes (MS) and matrix spike duplicates (MSD), and the surrogate recovery in all samples, blanks, and LCS where surrogates are used. The relative percent differences of matrix spike/matrix spike duplicates, or sample/duplicates depending on the method, are also monitored.

Control limits are derived from SW846 requirements and method performance limits. The historically based limits may be updated periodically but will be updated only after CDM and regulators have approved the new limits.

If, at any time during the analysis, the process is out of control as indicated by unacceptable QC sample accuracy or precision, corrective action must be taken and documented. The following three steps must be addressed:

1. What actions were taken to bring the process back into control.
2. What actions were taken to prevent reoccurrence of the out-of-control situation.
3. What was done with the data collected while the process was out of control.

Results of performance evaluation samples can also be used as an indicator of laboratory data quality, and help in evaluating the impact of out-of-control situations.

B6. INSTRUMENT/ EQUIPMENT TESTING, INSPECTION, AND MAINTENANCE REQUIREMENTS

The primary objective of a instrument / equipment testing, inspection, and maintenance (preventive) maintenance program is to help ensure the timely and effective completion of a measurement effort by minimizing the down time of crucial sampling and/or analytical equipment due to expected or unexpected component failure. In implementing this program, efforts are focused in three primary areas: maintenance responsibilities, maintenance schedules, and adequate inventory of critical spare parts and equipment.

FIELD INSTRUMENT PREVENTATIVE MAINTENANCE

The field equipment for this project includes a PID. Specific preventative maintenance procedures to be followed for field equipment are those recommended by the manufacturer. Field instruments will be checked and calibrated daily before use. Calibration checks will be documented on the Field Meter/Calibration Log sheets. All equipment will be checked by an experienced equipment maintenance technician before it is shipped to the site. Critical spare parts such as batteries will be kept onsite to reduce downtime. Backup instruments and equipment will be available onsite or within 1-day shipment to avoid delays in the field schedule.

LABORATORY INSTRUMENT PREVENTATIVE MAINTENANCE

Maintenance Responsibilities

Maintenance responsibilities for laboratory equipment are assigned to the respective group leaders. The group leaders oversee the maintenance procedures and schedules for each major equipment item. These are contained in the maintenance logbooks assigned to each instrument.

Maintenance Schedules

The effectiveness of any maintenance program depends to a large extent on adherence to specific routine maintenance for each major equipment item. Other maintenance activities may also be identified as requiring attention on an as-needed basis. Manufacturers' recommendations and sample throughput provide the basis for the established maintenance schedules, and manufacturers' service contracts provide primary maintenance for many major instruments (e.g., GC/MS instruments, atomic absorption spectrometers, analytical balances, etc.). Maintenance activities for each instrument are documented in a maintenance log. Maintenance schedules are given in the OnSite quality assurance management plan (OnSite, latest version).

Spare Parts

Along with a schedule for maintenance activities, an adequate inventory of spare parts is required to minimize equipment down time. This inventory emphasizes those parts (and supplies) which are subject to frequent failure, have limited useful lifetimes, or cannot be obtained in a timely manner should failure occur. The respective laboratory managers are responsible for maintaining an adequate inventory of spare part and backup instrumentation.

B7. INSTRUMENT CALIBRATION AND FREQUENCY

This section describes the calibration procedures and the frequency at which these procedures will be performed for both field and laboratory instruments.

FIELD INSTRUMENT CALIBRATION

Field instruments include PID and will be calibrated per CDM's equipment SOP.

LABORATORY INSTRUMENT CALIBRATION

This section discusses general requirements for instrument calibration and standards preparation and traceability. Test specific calibration details for the methods used at the site are given in the latest version of the site SOPs.

Instrumentation calibration is necessary for accurate sample quantitation. Calibrations establish the dynamic range of an instrument, establish response factors to be used for quantitation, and demonstrate instrument sensitivity. Criteria for calibration are method specific, are taken from the published analytical methods, and are executed as described in each method's site SOP. Accurate sample quantitation also relies on accurate standards. Standards accuracy may be established by tracing the quantitation standard to a source of known and documented quality or by comparing standards from different sources. Instrument calibrations and standards are unambiguously documented so that the process of calibration can be re-created.

Standards

The accuracy of sample target analyte quantitation is directly related to the accuracy of the standards used for instrument calibration. To ensure the highest quality standard, primary reference standards used by OnSite are obtained from the National Institute of Standards and Technology (NIST), EPA CRADA vendors, or other reliable commercial sources. When standards are received at the laboratory, the date received, supplier, lot number, purity and concentration, and expiration date are recorded in a standards log book. Vendor certifications sent with the standards are also filed.

Standards purchased by OnSite may be in a pure form, in a stock, or working standard solution. Often dilutions are made from vendor standards. All standards made are given a unique standard identification number and have the following information recorded in a standards logbook: source of standard used to prepare dilution; preparer's initials; initial concentration; final concentration; solvent; source and lot number of solvent; volume of final solution; and volume of standard diluted. After preparation and before routine use, standards are validated. Validation procedures range from a check for chromatographic purity to verification of the concentration of the standard using a standard prepared at a different time or obtained from a different source. Reagents are also examined for purity by subjecting an aliquot or subsample to the analytical method in which it will be used; for example, every lot of dichloromethane (for organic

extractables) is analyzed for undesirable contaminants prior to use in the laboratory. Standards are routinely checked for signs of deterioration (e.g., discoloration, formation of precipitates, and changes in concentration) and are discarded if deterioration is suspected or their expiration date has passed. Expiration dates may be taken from the vendor recommendation, the analytical methods, or from internal research.

Organic Methods Calibration

The field of chromatography involves a variety of instrumentation and detection systems. While calibration requirements vary depending on the type of analytical system and methodology, the following principles of calibration generally apply: calibration occurs before any sample quantitation; initial multipoint calibrations are performed periodically; daily standards are analyzed prior to sample analysis; and continuing calibration standards are analyzed at a specific frequency throughout the sample analysis. Sample quantitation may be based on either initial, daily, or continuing calibration. Sample quantitation may be with an external calibration technique or with an internal standard calibration technique. Internal standard techniques require internal standards to be spiked in all samples and standards and then quantitate target analytes relative to the internal standard response. Internal standard techniques are always used for gas chromatography/mass spectrometry (GC/MS) methods and may be used for GC methods.

Gas Chromatography

This section discusses general calibration techniques for non-GC/MS methods such as SW8080A, SW8020A and SW8010B. External or internal standard calibration techniques may be used for calibrating the gas chromatograph.

Initial calibrations are performed upon initial instrument set up, failure of the daily or continuing standard, and upon any major change in the system. However, before initial calibrations are performed, the instrument operating conditions are verified, any routine preventative maintenance is performed, and an instrument blank is analyzed to test for, or show the absence of, interferences. The initial multipoint calibration consists of a standard containing each analyte of interest at least five concentration levels for SW846-8000A series methods. One of these standards should be approximately at the RL. The other standards should bracket the concentration range expected in real samples, but not exceed the working linear range of the detector being used. From the initial calibration, calibration factors are calculated for each analyte of interest to evaluate the system performance. The calibration factors, for analyses not using internal standards, are calculated as follows:

$$CF = \frac{A}{M}$$

Where:

CF = calibration factor
A = area of the analyte peak
M = mass of target analyte injected

The CF is used to evaluate instrument response linearity for each analyte of interest across the calibrated range. Linearity is determined by the correlation coefficient, r, of the best fit linear or non-linear line, or the percent relative standard deviation (%RSD). For example, the linear correlation coefficient is calculated as follows:

$$r = \frac{n\Sigma(xy) - (\Sigma x)(\Sigma y)}{\sqrt{[n(\Sigma x^2) - (\Sigma x)^2][n(\Sigma y^2) - (\Sigma y)^2]}}$$

Where:

x = calibration concentration
y = instrument response (peak area)
n = number of calibration points (x,y data pairs).

The %RSD is calculated as follows:

$$\%RSD = \frac{s}{\bar{X}}(100\%)$$

Where:

x = mean of the five CF for a particular compound
s = standard deviation of the CF for that compound.

For SW846 methods, the %RSD generally must be less than or equal to 20%, or the correlation coefficient, r, must be greater than or equal to 0.995. The use of r or %RSD must be uniformly applied to a calibration sequence and instrument.

The initial calibration is checked at least daily by injecting a daily calibration standard. This standard is usually the mid-range standard of the initial calibration and is injected before any samples or method blanks are analyzed. The percent difference (%D) is calculated and should be within 15 percent of the average response factor of the initial calibration curve or the quantitated value should be within 15% of the expected value. Generally, a continuing calibration standard is analyzed every ten samples and at the end of an analytical run to further evaluate system performance. The %D of the continuing calibration standards must, depending on the method, either meet the same criteria as the daily standard or be within 15% of the daily standard CF.

Percent Difference is calculated as:

$$\%D = \frac{R_1 - R_2}{R_1}(100\%)$$

Where:

%D = percent difference
R_1 = average CF from initial calibration
R_2 = CF from continuing calibration.

Gas Chromatography/Mass Spectrometry (GC/MS)

Every 12 hours, prior to calibration or sample analysis the mass spectrometer must be tuned. Generally, for volatiles methods, bromofluorobenzene (BFB) is used and for semi-volatile methods, decafluorotriphenylphosphine (DFTPP) is used. Tuning criteria are generally given in the methods and are stated in the method specific site SOPs.

Initial calibrations are performed upon instrument setup, failure of the continuing standard, or upon any major change in the system. Initial calibrations for SW846 methods use at least five calibration concentrations with the lowest standard at approximately the RL. Initial calibrations must contain all analytes of interest and contain internal standards. The initial calibration is evaluated on certain key compounds referred to as System Performance Calibration Compounds (SPCC) and Calibration Check Compounds (CCC). The SPCC evaluate system sensitivity and the CCC evaluate system linearity. A relative response factor (RF) is calculated for the analyte of interest relative to the internal standard whose retention time is closest to that compound. The RF is calculated as follows:

$$RF = (A_x C_{is}) / (A_{is} C_x)$$

Where:

A_x = area of quantitation ion for the compound being measured
A_{is} = area of quantitation ion for the specific internal standard
C_{is} = concentration of the specific internal standard
C_x = concentration of the compound being measured

From the RF at each concentration an average RF is calculated. The SPCC are checked for a minimum average RF and the CCC are checked for maximum percent relative standard deviation (%RSD) of their RF across calibration concentrations. %RSD is calculated as follows:

$$\%RSD = \frac{s}{\bar{x}}(100)$$

Where:

RSD = Relative standard deviation
x = Mean of 5 initial RFs for a compound
s = Standard deviation of the RFs for a compound.

After the initial calibration has been found acceptable, and before sample analysis, and every 12-hours during sample analysis, a tuning standard and calibration standard must be analyzed. The acceptance criteria for continuing standards (usually the midlevel standard of the initial calibration) is based on SPCC and CCC criteria, retention time criteria, and internal standard area criteria. SPCCs are checked for instrument sensitivity and CCC compounds are checked for daily drift from the average RF of the initial calibration. A percent difference criteria must be met in the RFs of CCCs. Percent difference is calculated as follows:

$$\%D = \frac{RF_i - RF_c}{RF_i} (100\%)$$

Where:

%D = percent difference
RF_i = average relative response factor from initial calibration
RF_c = Relative response factor from current calibration check standard

The internal standard retention times in the continuing calibration standard must be within 30 seconds of the previous continuing calibration standard and the internal standard areas must be within a factor of two from the last continuing calibration standard.

If any criteria are failed during initial, continuing, or tuning calibration, corrective action must be taken before sample analyses may proceed.

Metals Methods Calibration

Environmental metals analyses commonly use either atomic absorption (AA) or inductively coupled plasma (ICP) emission spectroscopy. For both of these techniques, after the initial instrument calibration, the calibration is monitored through the analysis of initial and continuing calibration verification standards (ICV, CCV) and initial and continuing calibration blanks (ICB, CCB).

Inductively Coupled Plasma (ICP)

The ICP or Trace ICP is calibrated daily prior to any sample analyses using criteria prescribed in the analytical method. The calibration is then verified using a standard from an independent source (ICV). The working range of the instrument is established each quarter year with a linear range verification check standard. Sample quantitation may not be performed outside the linear range.

An initial instrument calibration is established daily by analyzing a minimum of two standards, one of which is a calibration blank. The calibration is monitored throughout the day by analyzing CCB and a CCV after every 10 samples. The CCV is a standard at the mid-range of the calibration. If the verification standard and blank do not meet established criteria, corrective action must be performed. The corrective action procedures include examination of instrument performance and analysis information, consultation with the group leader, and a decision path to determine if recalibration and reanalysis of samples back to the previously acceptable calibration check is warranted.

An inter-element check standard is analyzed at the beginning and end (or after 8 hours) of each analytical run on the ICP to verify that inter-element and background correction factors have remained constant. Results outside of the established criteria trigger reanalysis of samples.

Wet Chemistry and Other Methods Calibration

The field of conventional, non-metals analysis (wet chemistry) involves a variety of instrumental and wet chemical techniques. While calibration and standardization procedures vary depending on the type of system and analytical methodology required for a specific analysis, the general principles of calibration apply universally. Each system is calibrated prior to analyses being conducted. Calibration consists of defining the working range by use of a series of standard solutions and identifying potential interferences. The calibration is checked on an ongoing basis to ensure that the system remains within specifications. If the ongoing calibration check does not meet established criteria, corrective action must be performed. The corrective action procedures include examination of instrument performance and analysis information, consultation with the group leader, and a decision path to determine if recalibration and reanalysis of samples back to the previous acceptable calibration check is warranted.

B8. INSPECTION/ ACCEPTANCE REQUIREMENTS FOR SUPPLIES AND CONSUMABLES

Pre-cleaned 4-ounce glass sample containers will be provided by OnSite Environmental and will be inspected by the field team leader. The containers will be kept closed and in their shipping boxes until used. After sampling, the containers will be labeled, secured with chain-of-custody seals, placed in coolers, chilled to 4°C, and shipped to the laboratory.

B9. DATA ACQUISITION REQUIREMENTS (NON-DIRECT MEASUREMENTS)

No data is to be required by non-direct methods or measurements for this project.

B10. DATA MANAGEMENT

All field and laboratory data will be reviewed by the QA manager who will then provide guidance and a report to the project manager about the quality and acceptability of the data. This report will be included as a summary in the final report.

PART C - ASSESSMENT/ OVERSIGHT

C1. ASSESSMENTS AND RESPONSE ACTIONS

Corrective action is the process of identifying, recommending, approving, and implementing measures to counter unacceptable procedures or out of quality control performance that can affect data quality. Corrective action can occur during field activities, laboratory analyses, data validation, and data assessment. All corrective action proposed and implemented should be documented in the regular quality assurance reports to management. Corrective action should only be implemented after approval by the project manager, or his designee, the field team leader. If immediate corrective action is required, approvals secured by telephone from the project manager should be documented in an additional memorandum.

For noncompliance problems, a formal corrective action program will be determined and implemented at the time the problem is identified. The person who identifies the problem is responsible for notifying the project manager, who in turn will notify the King County project manager. If the problem is analytical in nature, information on these problems will be promptly communicated to EPA's Quality Assurance Section. Implementation of corrective action will be confirmed in writing through the same channels.

Any nonconformance with the established quality control procedures in the SQAP will be identified and corrected in accordance with the SQAP. The project manager, or his designee, will issue a nonconformance report for each nonconformance condition.

FIELD CORRECTIVE ACTION

Technical staff and project personnel will be responsible for reporting all suspected technical or QA nonconformances or suspected deficiencies of any activity or issued document by reporting the situation to the project manager. This manager will be responsible for assessing the suspected problems in consultation with the QA officer and making a decision based on the situation's potential to impact the quality of the data. If it is determined that the situation warrants a reportable nonconformance requiring corrective action, then a nonconformance report will be initiated by the project manager.

The project manager will be responsible for ensuring corrective action for nonconformance is initiated by:

- Evaluating all reported nonconformances.
- Controlling additional work on nonconforming items.
- Determining disposition or action to be taken.
- Maintaining a log of nonconformances.
- Reviewing nonconformance reports and corrective actions taken.
- Ensuring nonconformance reports are included in the final site documentation in project files.

If appropriate, the field team leader will ensure that no additional work dependent on the nonconforming activity is performed until corrective actions are completed.

Corrective action for field measurements may include:

- Repeat the measurement to check the error.
- Check for proper adjustments for ambient conditions such as temperature.
- Check power supplies.
- Check the calibration.
- Replace the instrument or measurement devices.
- Stop work (if necessary).

The project manager is responsible for all project activities and at times is required to adjust the site programs to accommodate specific needs. When it becomes necessary to modify a program, the project manager will notify the field team leader of the anticipated change. The field team leader will then implement the new procedure. The field change request (FCR) will be signed by the initiators and field team leader. The FCR for each document will be numbered serially as required, and will be attached to the file copy of the affected document. The project manager must approve the change in writing or verbally prior to field implementation, if feasible. If unacceptable, the action taken during the period of deviation will be evaluated to determine the significance of any departure from established program practices and action taken.

The field team leader is responsible for controlling, tracking, and implementing the identified changes. Reports on all changes will be distributed to all affected parties, including King County's project manager.

LABORATORY CORRECTIVE ACTION

When errors, deficiencies, or out-of-control situations exist, the QA program provides systematic procedures, called corrective actions, to resolve problems and restore proper functioning to the analytical system.

Laboratory personnel are alerted that corrective actions may be necessary if:

- QC data are outside the acceptable limits for precision and accuracy.
- Blanks or LCS contain contaminants above acceptable levels.
- There are unusual changes in detection limits.
- Deficiencies are detected during internal or external audits or from the results of performance evaluation samples.
- Inquiries concerning data quality are received from clients.

Corrective action procedures are often handled at the bench level by the analyst, who reviews the preparation or extraction procedure for possible errors, checks the instrument calibration, spike and calibration mixes, instrument sensitivity, and so on. If the problem persists or cannot be identified, the matter is referred to the laboratory technical personnel or group leader, manager and/or QA department for further investigation. Once resolved, full documentation of the corrective action procedure is filed with the QA department by means of a laboratory nonconformance memo. Once resolved, this form is kept in a project folder and filed in the QA department.

Corrective action is dictated by the type and extent of the nonconformance. Corrective action may be initiated and carried out by non-supervisory staff, but final approval and data review by management is necessary before reporting any information. All potentially affected data must be thoroughly reviewed for acceptance or rejection.

Samples are monitored closely so that they can be analyzed within the recommended holding time. However, should a sample be analyzed outside of holding time a nonconformance memo is completed and the laboratory project manager is informed immediately. It is his/her responsibility to inform the CDM project manager and QA officer so that a decision can be made regarding resampling.

The laboratory project manager and QA manager share the responsibility of reviewing all laboratory analytical activities to ensure compliance with the QC requirements outlined in this SQAP. This review serves as a control function in that it should be conducted frequently so deviations from method requirements will be immediately identified and corrected.

CORRECTIVE ACTION DURING DATA VALIDATION AND DATA ASSESSMENT

The site may identify the need for corrective action during either the data validation or data assessment. Potential types of corrective action may include resampling by the field team or reinjection/reanalysis of samples by the laboratory.

These actions are dependent upon the ability to mobilize the field team, whether the data to be collected is necessary to meet the required quality assurance objectives (e.g. the holding time for samples is not exceeded, etc.) When a corrective action situation is identified, it is the CDM project manager who will be responsible for approving the implementation of corrective action, including resampling, during data assessment. All corrective actions of this type will be documented by the CDM QA officer.

C2. REPORTS TO MANAGEMENT

CONTENTS AND FREQUENCY OF PROJECT QC REPORTS

Project QC reports are communicated to project management in formal written reports, informal reports, and meetings. OnSite submits formal QC reports to CDM within each laboratory report: the laboratory reports state QC sample results and contain a narrative, which summarizes any atypical analytical occurrences. In addition, both CDM and OnSite are obligated to document the following elements in either a QC report or other written project document:

- Changes in the SQAP.
- Results of project-specific systems or performance audits.
- Limitations on data use.
- Significant quality program corrective actions.

Individuals receiving/reviewing QC reports

QC reports, or equivalent written or oral presentations, are performed when significant project changes occur and to maintain close coordination between King County, CDM, and OnSite. The laboratory QC reports are the responsibility of laboratory QA manager. An CDM project QA officer will review every OnSite laboratory report and will prepare a quality assurance report to accompany the laboratory data. The laboratory QC reports and CDM's data quality assurance reports will accompany the final report to be approved by EPA.

PART D - DATA VALIDATION AND USABILITY

D1. DATA REVIEW, VALIDATION, AND VERIFICATION REQUIREMENTS

CALCULATION OF DATA QUALITY INDICATORS

This section discusses precision, accuracy, completeness, and representativeness and lists relevant equations.

1) Percent Recovery:

$$R\% = \frac{(C_1 - C_2)(100\%)}{C_3}$$

Where:

$R\%$ = *Spike amount recovered*
C_1 = *Concentration of analyte in spiked sample*
C_2 = *Concentration of analyte in unspiked sample*
C_3 = *Concentration of spike added*

2) Relative Percent Difference:

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

Where:

RPD = *relative percent different*
X_1, X_2 = *value of sample 1 and sample 2*

3) Valid data percentage:

$$C\% = \frac{S}{R}(100\%)$$

Where:

C = *completeness*
S = *number of successful analysis*
R = *number of requested analysis*

4) Calibration factors are calculated as:

$$CF = \frac{A}{M}$$

Where:

CF = calibration factor
A = area of the analyte peak
M = mass of target analyte injected

5) Correlation coefficient is calculated as:

$$r = \frac{n\Sigma(xy) - (\Sigma x)(\Sigma y)}{\sqrt{[n(\Sigma x^2) - (\Sigma x)^2][n(\Sigma y^2) - (\Sigma y)^2]}}$$

Where:

x = calibration concentration
y = instrument response (peak area)
n = number of calibration points (x,y data pairs).

6) Relative Standard Deviation:

The %RSD is calculated as follows:

$$\%RSD = \frac{s}{\bar{X}}(100\%)$$

Where:

x = mean of the five CF for a particular compound
s = standard deviation of the CF for that compound.

7) Percent Difference is calculated as:

$$\%D = \frac{R_1 - R_2}{R_1}(100\%)$$

Where:

%D = percent difference
R_1 = average CF from initial calibration
R_2 = CF from continuing calibration.

8) Response Factor is calculated as:

$$RF = (A_x C_{is}) / (A_{is} C_x)$$

Where:

A_x = area of characteristic ion for the compound being measured
A_{is} = area of characteristic ion for the specific internal standard
C_{is} = concentration of the specific internal standard
C_x = concentration of the compound being measured

9) Relative Standard Deviation is calculated as:

$$\%RSD = \frac{s}{\bar{x}} (100)$$

Where:

RSD = Relative standard deviation
x = Mean of 5 initial RFs for a compound
s = Standard deviation of the RFs for a compound.

10) Percent Difference is calculated as follows:

$$\%D = \frac{RF_i - RF_c}{RF_i} (100\%)$$

Where:

%D = Percent difference
RF_i = average relative response factor from initial calibration
RF_c = Relative response factor from current calibration check standard.

D2. VALIDATION AND VERIFICATION METHODS

All data generated through in field activities or by the laboratory operation shall be reduced and validated prior to reporting. No data shall be disseminated by the laboratory until it has been subjected to the procedures summarized in the following sections.

DATA REDUCTION

Field Data Reduction Procedures

Field data reduction procedures will be minimal in scope compared to those implemented in the laboratory setting. Only direct read instrumentation will be employed in the field. The use of an OVM-PID, thermometer, and pH, dissolved oxygen, conductivity, and turbidity meters will generate directly read measurements. Such data will be written into field records immediately after measurements are taken. If errors are made, results will be legibly crossed out, initialed, and dated by the field member and corrected in a space adjacent to the original (erroneous) entry.

Laboratory Data Reduction Procedures

In most cases, calculations from raw data are included in discussions of analytical procedures presented in the EPA methods. These data reduction and review procedures will not be repeated here. Details of data reduction, calibration, and reporting not addressed elsewhere are discussed in this section.

Data reduction calculations used for this project are typically included on the standard reporting forms developed by the laboratories and associated with each individual method or groups of methods. Calculations not present on standard reporting forms include computer-based data reduction programs. The laboratory is responsible for maintaining a list of these data reduction programs and for being able to demonstrate their validity. The complete calculation procedures used in computer-based data reduction programs (e.g., GC/MS and GC analyses) are based on the calculation procedures specified in each method and will not be covered here.

Some instruments are configured to operate without computers. For these, the signal is recorded as a strip chart trace, numerical output on a printer strip, or direct reading from a digital or analog dial. In such cases, additional work is required by the analyst to reduce the data to a reportable format. The original signal must be multiplied by a calibration factor or compared with a standard curve. The aliquot result must be divided by the mass or volume of sample to produce a concentration-based final result. Most calculations are carried out on hand-held scientific calculators; simple programs are used for some. All of these data are recorded in a dedicated lab notebook or bench sheet for the particular determination in question.

Some laboratory tests, such as titrations or sensory evaluations, do not have instrumental raw data. For these, the quantitative result or observation is recorded directly on a bench sheet by the

assigned analyst. Calculations like those described above may be needed; these are recorded in the same lab notebook.

Data storage and documentation will be maintained using logbooks and data sheets that will be kept on file. Computer acquired data are stored on magnetic tape, floppy disks, or other media. Paper hard copies of raw data are kept on file for seven years, or as described in the OnSite Record Retention Policy.

DATA VALIDATION

Procedures Used to Validate Field Data

Procedures to evaluate field data for this project primarily include checking for transcription errors and review of the field sampling forms and the project log books on the part of field crew members. This task will be the responsibility of the CDM project QA officer, who will otherwise not participate in making any of the field measurements.

Procedures used to Validate Laboratory Data

The laboratory system for ensuring valid data includes several levels of review. Each level demands specific action to prevent the unqualified release of erroneous data and to correct any problems discovered during the review process. All analytical data generated at OnSite are extensively checked for accuracy and completeness. The data validation process consists of data generation, reduction, and three levels of review, as described below.

Level 1 review

The analyst who generates the analytical data has the prime responsibility for the correctness and completeness of the data. Each analyst reviews the quality of his or her work based on an established set of guidelines. The analyst reviews the data package to ensure that:

- Sample preparation information is correct and complete.
- Analysis information is correct and complete.
- The appropriate SOPs have been followed.
- Analytical results are correct and complete.
- QC samples are within established control limits; blanks are acceptable.
- Special sample preparation and analytical requirements have been met.
- Documentation is complete (e.g., all anomalies in the preparation and analysis have been documented, out of control forms, if required, are complete, holding times are documented, etc.).

This initial review step, performed by the analyst is designated Level 1 review. Level 1 data review is documented and the signature of the reviewer and the date or review is recorded. The analyst then passes the data package to an independent reviewer who performs a Level 2 review.

Level 2 review

Level 2 review is performed by a group leader or senior analyst whose function is to provide an independent review of the data package. This review is structured to ensure that:

- Calibration data are scientifically sound, appropriate to the method, and completely documented.
- QC samples are within established guidelines.
- Qualitative identification of sample components is correct.
- Quantitative results are correct.
- Documentation is complete and correct (e.g., anomalies in the preparation and analysis have been documented, out-of-control forms, if required, are complete, holding times are documented, etc.).
- The data are ready for incorporation into the final report.
- The data package is complete and ready for data archive.

Level 2 review is structured so that all calibration data and QC sample results are reviewed, and all of the analytical results from 10 percent of the samples are checked back to the bench sheet. If no problems are found with the data package, the review is considered complete. If any problems are found with the data package, an additional 10 percent of the samples are checked to the bench sheet. The process continues until no errors are found or until the data package has been reviewed in its entirety. Level 2 data review is documented and the signature of the reviewer and the date of review recorded. The reviewed data are then approved for release and a final report is prepared.

Level 3 review

Before the report is released to the client, the laboratory project manager reviews the report to ensure:

- The data meets the overall objectives of the project
- Overall completeness
- Client requests completed
- Comparative data check
- Non-conformances are properly documented and narrated.

This review is the Level 3 review. The Level 3 review is documented and the signature of the reviewer and date of review are recorded.

Each step of this review process involves evaluation of data quality based on both the results of the QC data and the professional judgment of those conducting the review. This application of technical knowledge and experience to the evaluation of the data is essential in ensuring that data are consistently of high quality.

Independent Data Validation

Laboratory data will be independently validated by CDM. The independent data validation process quantifies technical data quality, verifies that adequate documentation was provided, and determines whether the analytical data is usable and meets project DQOs. The remaining laboratory data will be evaluated for compliance with DQOs and procedural requirements contained in this plan, and with guidelines for data validation as described in the following references:

- Contract Laboratory Program, National Functional Guidelines for Organic Data Review (U.S. Environmental Protection Agency, 1994a).
- Contract Laboratory Program, National Functional Guidelines for Inorganic Data Review (U.S. Environmental Protection Agency, 1994b).
- Data Qualifiers for Data Users (U.S. Environmental Protection Agency, 1988).

Technical Validity

Technical validation requires comparison of QC and instrument performance standard results to required control limits. The following QC elements will be independently reviewed for this project:

- Analytical holding times
- Blank contamination
- Analytical accuracy (matrix spike compound recoveries, blank spike compound recoveries, surrogate compound recoveries)
- Analytical precision (comparison of replicate sample results and replicate spike results, expressed as relative percent differences)
- Reported detection limits

Data Usability and Data Quality Objectives

The independent validator will determine whether the analytical data meets the data quality objectives. Qualifier flags will be applied to data points that may have limited usability or that have been rejected.

Procedures for Handling Unacceptable Data

All Quality Control information will be recorded in laboratory benchsheets, logbooks, or printouts. It is the analyst's responsibility to check the QC information against limits for the analysis. When an analysis of a QC sample (blank, spike, check standard, replicate, or similar sample) shows that the analysis of that batch of samples is not in control, the analyst will perform corrective action or bring the matter to the attention of the group leader. The group leader will, if necessary, consult with the laboratory QA manager or the laboratory project manager to determine whether the analysis can proceed, if selected samples should be rerun, or if specific corrective action needs to be taken before analyzing additional samples. Out-of-control analyses must be documented. The analyst or group leader will file a nonconformance memorandum with the laboratory QA manager for lab analysis out of control events that require documentation.

DATA REPORTING

Data reporting procedures shall be carried our for field and laboratory operations as indicated below:

Field Data Reporting

Field data reporting shall be conducted principally through the transmission of report sheets containing tabulated results of all measurements made in the field, and documentation of all field calibration activities.

Laboratory Data Reporting

It is OnSite's intent to provide paper and electronic deliverables that meet the requirements of our clients and regulators. OnSite has designed a standard RCRA deliverables format that incorporates required QA/QC elements for definitive data. For samples requiring rigorous data validation, an extended data validation deliverables format has been developed.

For the project, OnSite will provide a standard deliverable unless an extended data validation deliverable is requested at the time of project set-up. Laboratory reports will contain acceptance limits for surrogates, LCS, and matrix spikes and will report method blanks whenever they are used. The laboratory report will unambiguously link batch quality control with samples of that batch.

Each laboratory report will have a narrative section that summarizes comments pertinent to the batch of samples reported. The narrative section will be used to document corrective actions.

REFERENCES CITED

AGI Technologies (now CDM). 1999. *Limited Phase II Environmental Site Assessment, Ellisport Creek Acquisition Site, Vashon Island, Washington,* Prepared for Vashon Park District, Vashon, Washington. September 17, 1999

USEPA. 1998. *Quality Assurance Guidance for Conducting Brownfields Site Assessments*, U.S. Environmental Protection Agency, EPA 540-R-98-038, September 1998.

USEPA. 2002. *Guidance for Quality Assurance Project Plans*, U.S. Environmental Protection Agency QA/G-5, EPA 240-R-02-009, December 2002.

Tables

Table 1
Summary of Total Petroleum Hydrocarbon Detections in Soil and Groundwater (CDM 1999)
King County/Site Assessment - Ellisport Creek Greenspace Project
Vashon Island, Washington

Soil Samples

Sample No.	Date Sampled	Washington State Test Method WTPH-D (extended) Diesel	Oil
		mg/kg	
S1	07/13/99	ND	52
S3	07/13/99	ND	110
S4	07/13/99	380	4,400
S6	07/13/99	120	420
S7/TP6	07/13/99	64,000	90,000
S8	07/13/99	ND	370
S11	07/13/99	32	310
Laboratory Detection Limit		25	50
Cleanup Level [a]		1,000	1,000

Groundwater Sample

Sample No.	Date Sampled	WTPH-D (extended) Diesel	Oil
		µg/L	
W1	07/14/99	57,000	100,000
Cleanup Level [b]		500	500

Notes:

Shaded value indicates that concentration exceeds cleanup level.
a) Washington Administrative Code Chapter 173-340 Model Toxics Control Act Cleanup Regulation Method A suggested cleanup level for residual soil.
b) Washington Administrative Code Chapter 173-340 Model Toxics Control Act Cleanup Regulation Method A suggested cleanup level for groundwater.
WTPH-D (extended) – total petroleum hydrocarbons quantified as diesel and oil.
ND – not detected at or above laboratory detection limit.
mg/kg – milligram per kilogram.
µg/L - microgram per liter.

Table 2
Summary of PAH Detections in Soil and Groundwater (CDM 1999)
King County/Site Assessment - Ellisport Creek Greenspace Project
Vashon Island, Washington

Analyte	Laboratory Detection Limit Soil	Sample I.D. S7	Laboratory Detection Limit Groundwater	Sample I.D. W1
Polyaromatic Hydrocarbons (PAHs)				
EPA Test Method 8270	µg/kg	µg/kg	µg/L	µg/L
Naphthalene	1,000	ND	0.5	34
Acenaphthylene	1,000	ND	0.5	0.5
Acenaphthene	1,000	1,700	0.5	8.2
Fluorine	1,000	ND	0.5	10
Phenanthrene	1,000	2,100	0.5	37
Anthracene	1,000	ND	0.5	8.1
Fluoranthene	1,000	1,300	0.5	9.4
Pyrene	1,000	6,800	0.5	14
Benzo [a] Fluoranthene	1,000	1,000	0.5	3.6
Chrysene	1,000	3,900	0.5	7.2
Benzo (b) Fluoranthene	1,000	ND	0.5	5.3
Benzo (k) Fluoranthene	1,000	ND	0.5	5.3
Benzo (a) Pyrene	1,000	1,400	0.5	2.7
Benzo (g,h,i) Perylene	1,000	1,300	0.5	1.3

Notes:
There were no detections for BTEX and PCB compounds for the two samples.
µg/kg - microgram per kilogram.
ug/L - micrograms per liter
NA - not analyzed.
ND – not detected

Table 3
Matrix Accuracy, Precision, and Completeness Goals
King County/Site Assessment - Ellisport Creek Greenspace Project
Vashon Island, Washington

Analyte	Method	Accuracy		Precision
		LCL (MS/MSD)	UCL (MS/MSD)	RPT (precision) Dup or MS/MSD
TPH-Diesel and Oil	NWTPH-Dx	64	121	n/a
Polyaromatic Hydrocarbons (PAHs)				
EPA Test Method 8270				
Naphthalene	8270-SIM PAHs	30	115	25
Acenaphthylene	8270-SIM PAHs	46	125	25
Acenaphthene	8270-SIM PAHs	40	119	25
Fluorene	8270-SIM PAHs	50	133	25
Phenanthrene	8270-SIM PAHs	48	128	25
Anthracene	8270-SIM PAHs	53	134	25
Fluoranthene	8270-SIM PAHs	50	143	25
Pyrene	8270-SIM PAHs	44	139	25
Benzo [a] Anthracene	8270-SIM PAHs	62	129	25
Chrysene	8270-SIM PAHs	42	127	25
Benzo (b) Fluoranthene	8270-SIM PAHs	57	132	25
Benzo (k) Fluoranthene	8270-SIM PAHs	57	131	25
Benzo (a) Pyrene	8270-SIM PAHs	59	132	25
Indeno (1,2,3-c,d) Pyrene	8270-SIM PAHs	55	135	25
Dibenz (a,h) Anthracene	8270-SIM PAHs	36	146	25
Benzo (g,h,i) Perylene	8270-SIM PAHs	42	140	25

Table 4
Analytes and Reporting Limits
King County/Site Assessment - Ellisport Creek Greenspace Project
Vashon Island, Washington

Analyte	Method Detection Limit (mg/kg)	Reporting Limit (mg/kg)
TPH-Diesel	2.16	25
TPH-Oil	7.89	50
Polyaromatic Hydrocarbons (PAHs)		
EPA Test Method 8270		
Naphthalene	0.00157	0.0067
Acenaphthylene	0.000880	0.0067
Acenaphthene	0.000824	0.0067
Fluorene	0.000909	0.0067
Phenanthrene	0.000788	0.0067
Anthracene	0.000754	0.0067
Fluoranthene	0.00115	0.0067
Pyrene	0.00131	0.0067
Benzo(a)anthracene	0.00120	0.0067
Chrysene	0.00110	0.0067
Benzo(b)fluoranthene	0.00121	0.0067
Benzo(k)fluoranthene	0.00137	0.0067
Benzo(a)pyrene	0.000847	0.0067
Indeno(1,2,3-c,d)pyrene	0.00127	0.0067
Dibenz(a,h)anthracene	0.000915	0.0067
Benzo(g,h,i)perylene	0.00107	0.0067

Note:
mg/kg - milligrams per kilogram.

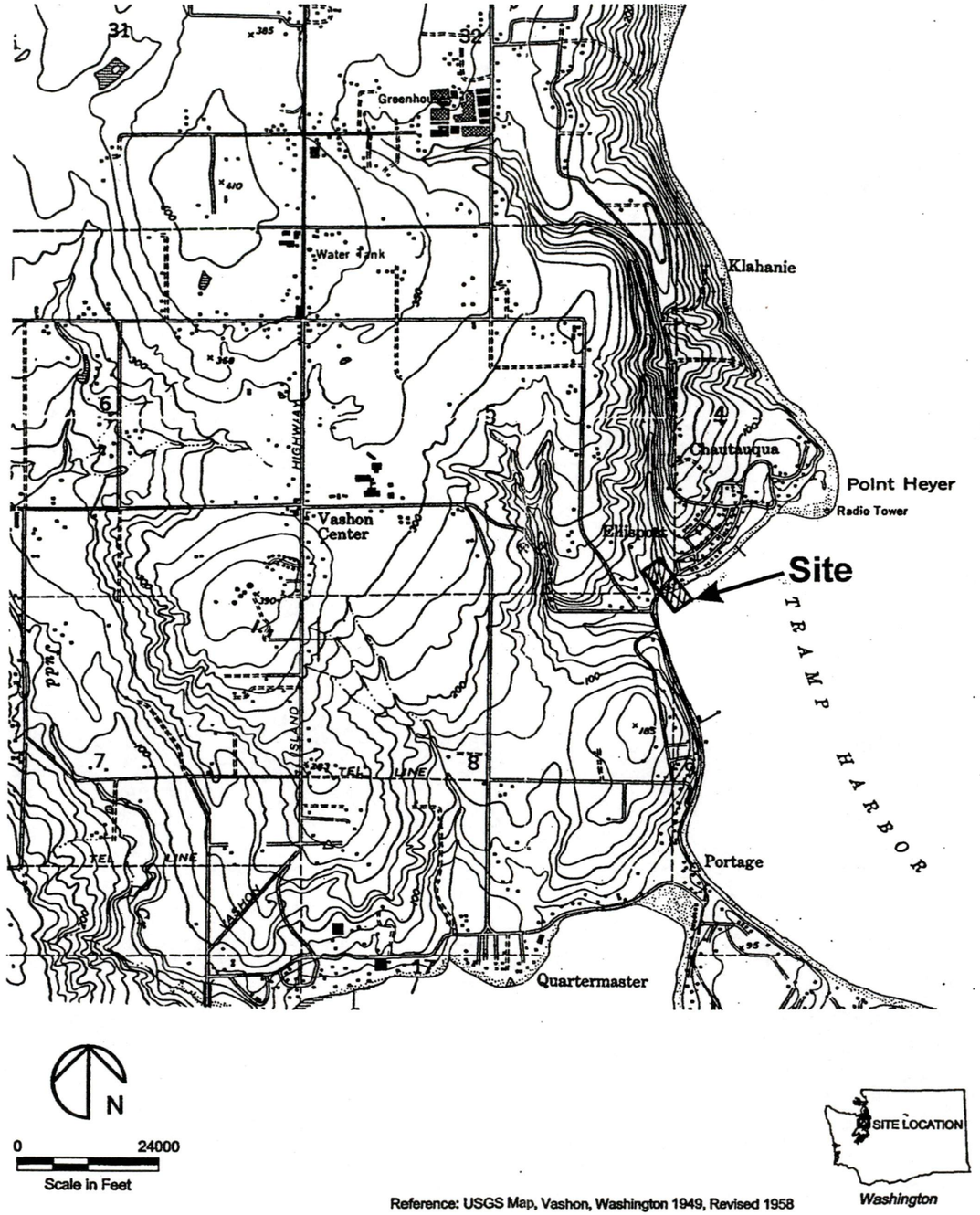
Table 5
Sample Network Summary
King County/Site Assessment – Ellisport Creek Greenspace Project
Vashon Island, Washington

General Area	Location	Number of Sample Locations	Total Number of Samples	Analyses (with minimum number of samples)	Sample Collection Rationale
Site	Between S6 and S10	1	1	NWTPH-Dx (1)	Horizontal Contamination Delineation
Site	East of S11	2	2	NWTPH-Dx (2)	Horizontal Contamination Delineation
Site	South of S3 and S4	2	2	NWTPH-Dx (2)	Horizontal Contamination Delineation
Site	Over Entire 50 ft by 50 ft Square Grid Pattern	20	20	NWTPH-Dx (20) PAHs (5)	Vertical Contamination Delineation

Table 6
Analytical Methods, Sample Containers, and Holding Times
King County/Site Assessment – Ellisport Creek Greenspace Project
Vashon Island, Washington

Analyte	Method	Container/Preservative	Maximum Holding Time
TPH- Diesel and Oil	NWTPH-Dx	4 oz glass jar (4 degrees Celsius)	14 Days
PAHs	8270-SIM Full analysis w/TICs	4 oz glass jar (4 degrees Celsius)	14 Days

Figures

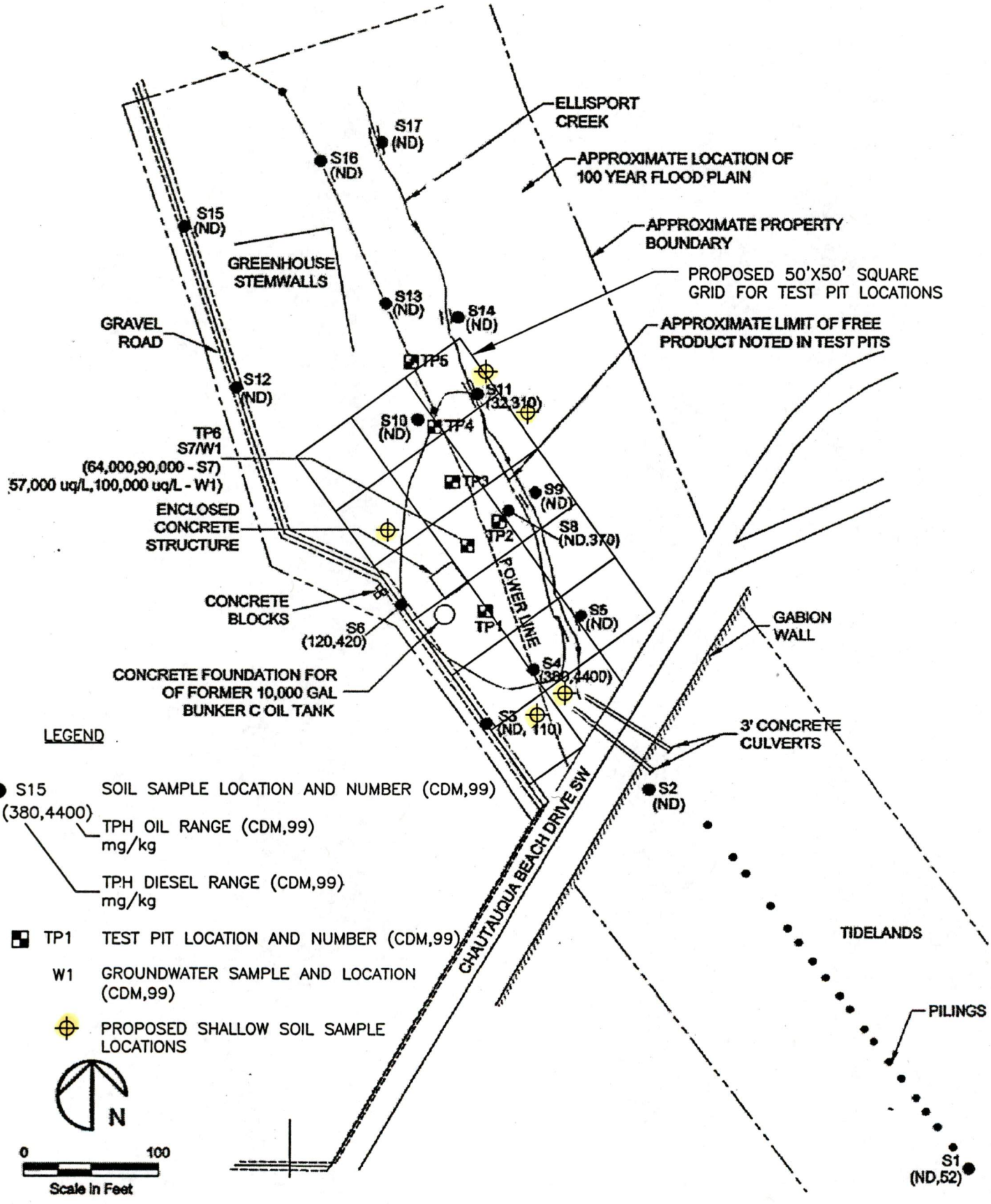


Reference: USGS Map, Vashon, Washington 1949, Revised 1958

KING COUNTY/ELLISPORT CREEK GREENSPACE
PROPERTY ASSESSMENT
VASHON ISLAND, WA

CDM

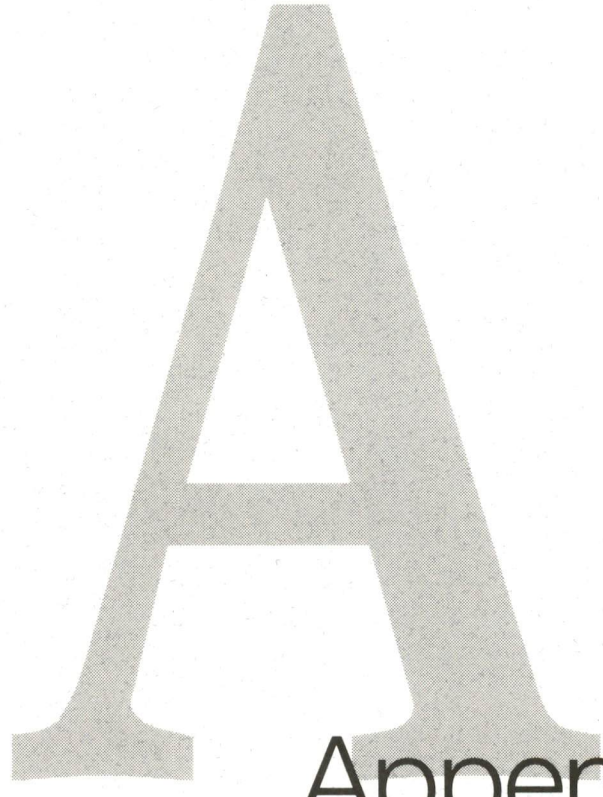
Figure No. 1
Vicinity Map



KING COUNTY/ELLISPORT CREEK GREENSPACE
PROPERTY ASSESSMENT
VASHON ISLAND, WA

Figure No. 2
Site Plan

CDM



Appendix A

APPENDIX A

SAMPLE DEVIATION AND CORRECTIVE ACTION FORMS

Sample Deviation Form

Project Name and Number: _____

Material to be Sampled: _____

_____

Measurement Parameter: _____

_____

Standard Procedure for Field Collection & Laboratory Analysis (cite reference):

_____

_____

_____

_____

Reason for Change in Field Procedure or Analysis Variation:

_____

_____

_____

_____

_____

Variation from Field or Analytical Procedure:

_____

_____

_____

_____

Special Equipment, Materials or Personnel Required:

_____

_____

_____

Initiators Name: _____ Date: _____

Project Officer: _____ Date: _____

QA Officer: _____ Date: _____

Corrective Action Form

Project Name and Number: _____

Sample Dates Involved: _____

Measurement Parameter: _____

_____

Acceptable Data Range: _____

_____

Problem Areas Requiring Corrective Action:

_____

_____

_____

_____

_____

Measures Required to Correct Problem:

_____

_____

_____

_____

_____

_____

Means of Detecting Problems and Verifying Correction:

_____

_____

_____

_____

_____

Initiators Name: _____ Date: _____

Project Officer: _____ Date: _____

QA Officer: _____ Date: _____

Appendix B

APPENDIX B

FIELD FORMS

CDM

FIELD INVESTIGATION DAILY REPORT

Sheet _____ of _____

Project _____ Project No. _____

Location _____ Date _____

Equipment Rental _____ Company _____ To _____

Equipment Hours _____ F.E. Time from: _____ to: _____ By _____

Visitors:

Attachments ☐ Continued

Distribution Initial

CDM Camp Dresser & McKee Inc.

SOIL SAMPLING RECORD

Sheet _____ of _____

Project _____ Date _____

Project No. _____ Sampled By _____

Weather _____ Reviewed By _____

ID	Sample ID							
	Time Collected							
LOCATION	Location							
	Depth							
	Surface Elevation (feet)							
SAMPLING	Sampling Method							
	Container							
	Composited	☐ Yes	☐ No	☐ Yes	☐ No	☐ Yes	☐ No	
	Cooled By							
SAMPLE DESCRIPTION	Soil Description/ Classification							
	Odor							
	Head Space Analysis	Instrument						
		Background						
		Reading						
DISPOSITION	Split	Name						
		Organization						
	Duplicate No.							
	Archive	☐ Yes	☐ No	☐ Yes	☐ No	☐ Yes	☐ No	
	CDM Lab	☐ Yes	☐ No	☐ Yes	☐ No	☐ Yes	☐ No	
	Other (Describe)							
	Name of Analytical Lab							
	Date Sent							
	Delivery Method							
	Chain-of-Custody No.							
	Comments							

CDM

FIELD LOG OF EXPLORATION

BORING/TEST PIT NO. ____

SHEET ____ OF ____ TOTAL DEPTH: ____

LOCATION

SURFACE ELEVATION: ____

DATUM: ____

PROJECT:	
PROJ. MGR:	
PROJECT NO:	LOGGED BY:
	EDITED BY:
DRILLING CONTRACTOR:	
DRILL RIG TYPE:	
DRILLERS NAME:	
SAMPLING METHODS:	
HAMMER WT.:	DROP:
STARTED, TIME: -	DATE:
COMPLETED, TIME:	DATE:
BACKFILLED, TIME:	DATE:

DATE:			
TIME:			
BORING DEPTH (ft)			
CASING DEPTH (ft)			
WATER DEPTH (ft)			

SAMPLE DEPTH	SAMPLER TYPE	BLOWS/0.5 FOOT	FEET DRIVEN	FEET RECOVERED	SAMPLE CONDITION	DRILLING RATE (min/ft)			DEPTH IN FEET	GRAPHIC LOG
									1	
									2	
									3	
									4	
									5	
									6	
									7	
									8	
									9	
									10	

SURFACE CONDITIONS:

CDM Camp Dresser & McKee Inc.

FIELD CALIBRATION LOG

Date	Time	Equipment/Desc./Model	Calibration Results

Chain of Custody

Page _____ of _____

OnSite Environmental Inc.
14648 NE 95th Street • Redmond, WA 98052
Phone: (425) 883-3881 • Fax: (425) 885-4603

Company:

Project Number:

Project Name:

Project Manager:

Sampled by:

Turnaround Request (in working days)

(Check One)

☐ Same Day ☐ 1 Day

☐ 2 Day ☐ 3 Day

☐ Standard (7 working days)

☐ _____ (other)

Laboratory Number:

Requested Analysis

Lab ID	Sample Identification	Date Sampled	Time Sampled	Matrix	# of Cont.	NWTPH-HCID	NWTPH-Gx/BTEX	NWTPH-Dx	Volatiles by 8260B	Halogenated Volatiles by 8260B	Semivolatiles by 8270C	PAHs by 8270C / SIM	PCBs by 8082	Pesticides by 8081A	Herbicides by 8151A	Total RCRA Metals (8)	TCLP Metals	HEM by 1664	VPH	EPH					% Moisture

	Signature	Company	Date	Time
Relinquished by				
Received by				
Relinquished by				
Received by				
Relinquished by				
Received by				

Comments/Special Instructions:

Reviewed by/Date

Reviewed by/Date

Chromatograms with final report ☐

DISTRIBUTION LEGEND: White - OnSite Copy Yellow - Report Copy Pink - Client Copy

Appendix C

APPENDIX C

ONSITE ENVIRONMENTAL, INC. – LABORATORY QUALITY ASSURANCE MANUAL

QUALITY ASSURANCE MANUAL

Revision No. 9.1
January 28, 2004

OnSite Environmental Inc.
14648 NE 95th Street
Redmond, Washington 98052
(425) 883-3881

Approved By: Kelley Wilt — Kelley Wilt, Laboratory QA/QC Officer — 1/28/04 Date

Approved By: Karl Hornyik, Laboratory Manager — 1/28/04 Date

Approved By: Robert Wallace, President/Technical Director — 1/28/04 Date

Copy No.: _____

Issued To: _____

Date Issued: _____

Revision History

Origination Date: **Unknown**

Revisions 1.0 through 8.0
The status of the electronic files and originals of these versions is unknown.

Revision 8.1 (February 26, 2002)
A copy of this revision is filed in the QA/QC files. The electronic copy is on the server and has been backed up.

Revision 9.0 (August 28, 2003)
The Quality Assurance Manual underwent significant major upgrade in response to an EPA review, which noted many deficiencies in the document. The NELAC Manual was used to insure the Quality Assurance Manual more fully addressed the issues that regulators and clients would be looking for in our Quality Assurance Manual and to anticipate possibly getting accredited under NELAC in the near future.

Revision 9.1 (January 28, 2004)
The Quality Assurance Manual underwent the annual review. The organization chart, instrument list, and SOP list were updated to reflect changes since the last revision.

Table of Contents

Appendices

1.0 Quality Assurance Policy and Objectives

1.1 Mission Statement

OnSite Environmental Inc. provides high quality and timely chemical analyses to primarily environmental, engineering and industrial clients.

1.2 Core Values

At OnSite Environmental Inc. we hold the following principles and values to be the most important, and we consider these values in making decisions in our business:

- Honesty
- Safety of our employees and community
- Good science
- Fairness, and
- Quality

1.3 Ethics Policy

Ethics is a set of moral principles, a code of right and wrong, or behavior that conforms to accepted professional practices.

Fraud is an intentional act of deceit that may result in legal prosecution. Unethical actions become fraudulent when a law is violated. For example, it is unethical to change the acquisition date of a file for a chromatogram to meet holding times. It becomes fraud when the results are mailed or faxed to the client (wire fraud or mail fraud).

All employees at all times shall conduct themselves in an honest and ethical manner. Compliance with this policy will be strictly enforced. Unethical behavior is grounds for immediate termination.

Examples of unethical behavior include, but are not limited to the following:

- Artificially fabricating results
- Misrepresenting data such as peak integration, calibration, tuning, or system suitability
- Improper clock settings to meet holding times
- Intentional deletion of non-compliant data
- Improper manipulation of data or software
- Improper handling of data errors, non-compliant data, or QC outliers
- Lack of reporting unethical behavior by others

An employee must report any suspected unethical behavior or fraudulent activities to one of the following management representatives: Robert Wallace, Technical Director; Karl Hornyik, Laboratory Manager; or Kelley Wilt, Laboratory QA/QC Officer. If an employee wishes to remain anonymous, they may choose to describe the situation in an unsigned note to one of the above representatives. If the facts of the case are not clear after an investigation, a committee of senior employees may be asked to investigate the situation further and offer an opinion to the owners of the corporation.

1.4 Standards of Conduct

Our standards are those generally expected of employees in any professional business organization. Employees engaged in any of the following activities, or others deemed equally serious, will forfeit all benefits of employment:

- Theft or embezzlement
- Willful violation of safety or security regulations
- Conviction of a felony
- Working for a competitor
- Establishing a competing business
- Being intoxicated or under the influence of drugs or alcohol while at work
- Possession of drugs on the job
- Falsification of records
- Abuse, destruction, waste or unauthorized use of equipment, facilities or materials
- Gambling while on premises
- Chronic tardiness or absenteeism
- Breech of company or client confidentiality

This list of offenses is to highlight general company expectations and standards and does not include all possible offenses or types of conduct that will result in discipline or discharge. Management reserves the absolute right to determine the appropriate degree of discipline, including discharge, warranted in individual cases.

There may be no alcoholic beverages on the company premises, other than at times designated as company functions. At such times, non-alcoholic beverages will be provided as well.

Company policy requires employees to have no relationships or engage in any activities that might impair their independence or judgement. Employees must not accept gifts, benefits or hospitality that might tend to influence them in the performance of their duties. It is expected that there will be no employment by any competing company, nor any employment by any outside interest or engaging in any outside activity that might impair an employee's ability to render full time service to OnSite Environmental Inc.

1.5 Confidentiality

During the course of business, employees are privy to data or information considered confidential or proprietary by our clients. This information includes, but is not limited to, test results, origin of samples, business relationship with client, any procedures and processes that they conduct or investigate, information about their business, our own laboratory procedures, and clients. All such information is kept strictly confidential and discussed only with corporate officers for the client's company. **The information will not be discussed with anyone**, even those within the client's company not designated as a contact, without prior permission from the client.

We are often contacted by government agencies or consultants hired by our clients. Without express permission, we only discuss the test methods or QC limits, and then solely if it is obvious from the conversation that the caller has a copy of the original report. Any discussion of the information listed in the above paragraph requires written permission from the designated contact. Permission by the designated contact may be granted by phone and should be followed in writing.

1.6 Complaint Resolution

Anytime a serious complaint is received, it is recorded in a permanent record so it can be tracked to insure resolution and brought to the attention of management.

A serious complaint is one that questions the validity of our results. Standard Operating Procedure 1.13 addresses the steps taken to document and resolve the complaint. In general, the nature of the complaint is documented and then given to the President or Technical Director. Someone is assigned to resolve the issues. The progress of the complaint is tracked during weekly staff meetings. Finally, after resolution, the complaint is fully documented and kept in the Laboratory QA/QC Officer's files for future reference.

1.7 Objectives

The overall objective of the quality assurance program for OnSite Environmental Inc. is to provide legally defensible analytical data that meet or exceed customer and regulatory requirements. To accomplish this, the following are done.

- Maintain appropriate chain of custody of samples submitted to the laboratory.
- Maintain an effective, on-going quality control program to measure and verify laboratory performance.
- Monitor daily operational performance of the laboratory and provide timely corrective action for out of control events.
- Track corrective actions for resolution and appropriateness.
- Meet data requirements for accuracy, precision and completeness.
- Maintain traceability of measurements.
- Maintain complete records of data and reports generated by the laboratory.
- Provide sufficient flexibility to allow controlled changes in routine methods and Standard Operating Procedures to meet specific client data quality objectives.
- Maintain a data review process.
- Train employees in good analytical technique and in requirements of Standard Operating Procedures they are responsible to perform.

In order to facilitate these objectives, OnSite Environmental Inc. uses four controlled types of documents to establish the steps necessary to achieve these objectives.

Quality Assurance Manual (QAM) -- The primary Quality Control/Quality Assurance document for the laboratory is the Quality Assurance Manual. This manual provides an overview of the entire quality assurance program for OnSite Environmental Inc. The President/Technical Director, Laboratory Manager and Laboratory QA/QC Officer must approve the Quality Assurance Manual. The Quality Assurance Manual will be reviewed and revised, if necessary, at least annually.

Standard Operating Procedures (SOP) – Standard Operating Procedures document in sufficient detail the steps necessary to reproduce specific tasks within the laboratory. They are written to insure consistency from employee to employee and from day to day. They also serve as excellent training and reference documents for new employees. The author of the SOP, the Laboratory Manager and the Laboratory QA/QC Officer must approve Standard Operating Procedures. Each SOP will be reviewed and revised, if necessary, at least annually.

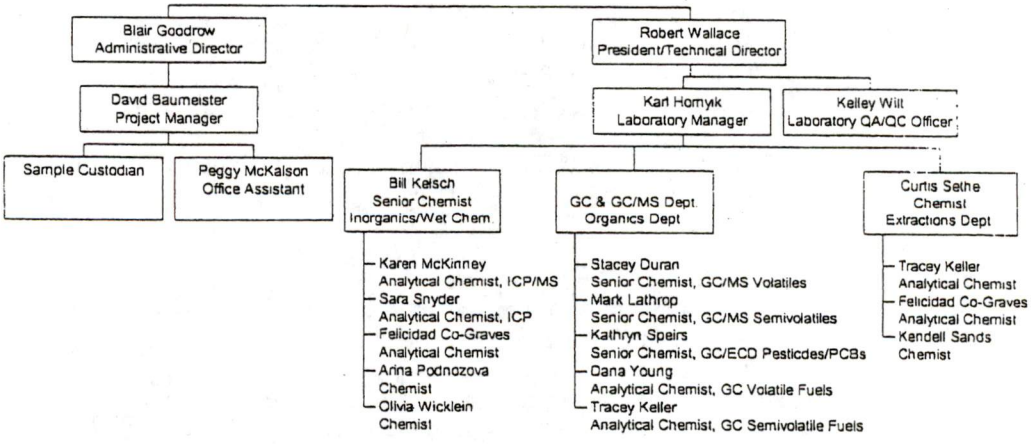
Laboratory Notebooks – Laboratory notebooks are used to document critical measurements and information such as sample weights, sample volumes, extract final volumes, dilutions, standard preparations, instrument maintenance, refrigerator, pipette and balance calibration and verification activities etc. These bound notebooks are controlled documents that are tracked by the Laboratory QA/QC Officer. The procedure for controlling, maintaining and reviewing Laboratory Notebooks can be found in Standard Operating Procedure 1.01.

Quality Assurance Project Plans (QAPP) – These documents are typically created and provided by our clients. These documents may detail specific data quality objectives that are to be met for a specific client project. Since these data quality objectives may differ from what is internally defined by OnSite Environmental's QA/QC program, it is absolutely required that the QAPP be submitted to OnSite Environmental Inc. for approval before work is started at the laboratory so that we can determine if the data quality objectives can be met and what, if any, changes need to be made in our Standard Operating Procedures, QA/QC program or reporting process to achieve these data quality objectives. OnSite Environmental Inc. will not be responsible for external data quality objectives that are not achieved unless we have approved a written QAPP prior to the beginning of the project. **Clients that submit work to us without an approved written QAPP specifically agree to the data quality objectives specified by OnSite Environmental's internal QA/QC program.**

2.0 Organization and Personnel

2.1 Organization

The organization of the laboratory personnel is organized in the following manner:



2.2 Job Descriptions and Quality Assurance Responsibilities

The following positions are presently defined at OnSite Environmental Inc. Resumes of the key management positions can be found in Appendix A. Although the minimum requirements are desirable, equivalent education, experience or demonstrated transferable skills may be substituted for the requirements at the discretion of the Technical Director.

<u>President/Technical Director</u>

Requires a minimum of a BA or BS in chemistry or related scientific field and at least eight years of laboratory experience. Management experience is highly desirable.

The Technical Director is ultimately responsible for the entire laboratory and the implementation of the quality assurance program.

The Technical Director shall certify that personnel with appropriate educational and/or technical background perform all tests for which the laboratory is accredited. Such information shall be documented.

Administrative Director

Requires a minimum of a BA or BS, preferably in chemistry or other scientific field, and at least three years of management experience.

The Administrative Director is responsible for the front office activities, which include:

- Client services
- Payroll
- Personnel
- Purchasing
- Accounts payable
- Accounts receivable
- Contract administration.

Laboratory Manager

Requires a minimum of a BA or BS in chemistry or related scientific field and at least five years of laboratory experience at the analyst level. Management experience is highly desirable. The Laboratory Manager reports directly to the President/Technical Director.

The Laboratory Manager is responsible for:

- Manage and help laboratory staff with production issues such as work schedules, workloads, instrument troubleshooting, and reporting of data.
- Implement and supervise the quality assurance program.
- Supervise and maintain the data review processes.
- Perform Tier II data reviews.
- Train staff.

Laboratory QA/QC Officer

Requires a minimum of a BA or BS in chemistry or related scientific field and at least four years of laboratory experience at the analyst level. Experience in data validation, statistics or previous QA/QC experience is highly desirable. The Laboratory QA/QC Officer reports directly to the President/Technical Director.

The Laboratory QA/QC Officer shall:

- Serve as the focal point for QA/QC and be responsible for the oversight and review of quality control data.

- Have functions independent from laboratory operations for which one has quality assurance oversight.
- Be able to evaluate data objectively and perform assessments without outside (e.g., managerial) influence.
- Have documented training and experience in QA/QC procedures.
- Have a general knowledge of the analytical test methods for which data review is performed.
- Arrange internal laboratory audits at least annually.
- Arrange for performance evaluations and maintaining accreditations.
- Notify laboratory management of deficiencies in the quality assurance program and monitor corrective action.
- Maintain QA/QC documents and reports.
- Monitor complaints and corrective actions for resolution.
- Assist Laboratory Manager with Tier II data reviews.

Project Manager

Requires a minimum of a BA or BS, preferably in chemistry or other scientific field, and at least one year of laboratory experience at the analyst level. The Project Manager reports directly to the Administrative Director except for technical issues, which should be directed to the Technical Director, Laboratory Manager and/or Laboratory QA/QC Officer as appropriate.

Typical duties of the Project Manager include:

- Work with clients on establishing the analytical scope of each client project.
- Review client data quality objectives to make sure we can meet them.
- Initiate specialized work plans for projects under QAPP guidance.
- Supervise the purchasing, preservation and shipment of bottles and containers for client projects.
- Supervise the Sample Custodian in receiving and maintaining proper chain of custody procedures of incoming samples.
- Coordinate sample testing within holding time and turn around time restrictions within the laboratory.
- Coordinate subcontracting of analytical work to other laboratories.
- Perform Tier III data reviews.
- Coordinate preparation of preliminary and final reports and electronic data deliverables.

Senior Chemist

Requires a minimum of a BA or BS, preferably in chemistry or other scientific field, and at least three years of laboratory experience at the analyst level. Experience and training may be substituted for educational requirements. Senior Chemists report directly to the department supervisor or the Laboratory Manager.

Senior Chemists duties include:

- Help extract or digest samples.
- Maintain and calibrate instruments.
- Prepare and analyze samples.
- Process and report data.
- Document non-conformances.
- Perform Tier I and Tier II data reviews.

- Troubleshoot and repair analytical equipment.
- Develop new methods.

Analytical Chemist

Requires a minimum of a BA or BS, preferably in chemistry or other scientific field, and at least one year of laboratory experience. Experience and training may be substituted for educational requirements. Analytical Chemists report to their department supervisor or to the Laboratory Manager in the absence of a department supervisor.

Analytical Chemists duties include:

- Help extract or digest samples.
- Maintain and calibrate instruments.
- Prepare and analyze samples.
- Process and report data.
- Perform Tier I data reviews.
- Document non-conformances.

Chemist

Requires a minimum of a high school diploma and preferably at least one year of college chemistry. Chemists report to the department supervisor or to the Laboratory Manager in absence of a department supervisor.

Chemist duties typically include:

- Extract or digest samples.
- Maintain and calibrate instruments.
- Prepare and analyze samples.
- Process and report data.
- Perform Tier I data reviews.
- Document non-conformances.

Sample Custodian

Requires a minimum of a high school diploma. The Project Manager supervises the Sample Custodian.

Sample Custodian duties include:

- Log in samples maintaining proper chain of custody protocols.
- Document non-conformances.
- Maintain sample storage facilities.
- Coordinate sample disposal.
- Pack and ship sample containers to clients.
- Assist Project Manager and Administrative Director in their duties.

Office Assistant

Requires a minimum of a high school diploma. The Project Manager supervises the Office Assistant.

Office Assistant duties include:

- Create reports from submitted sample data.
- Assist Project Manager and Administrative Director in their duties.

2.3 Personnel Training

OnSite Environmental Inc. has a formal training program covered in Standard Operating Procedure 1.06. In general, employees are familiarized with the Quality Assurance Manual, the Health and Safety Manual, the Employee Manual, and the Standard Operating Procedures they are expected to perform. A tour of the laboratory is given with attention given to the safety features of the laboratory such as fire extinguishers, first aid kits, eye wash stations, spill kits, fire escapes, etc.

Training in first aid and CPR is offered to the employees occasionally to make sure most employees have current certifications.

A training record is kept for each employee documenting when and what training has been received by the employee and by whom the training was given.

Each chemist must also pass a Demonstration of Capability procedure to document that they can achieve acceptable precision and accuracy from their technique with each of the technical Standard Operating Procedures they perform.

Employees are encouraged to attend external training courses to further their knowledge of analytical chemistry. Employees should contact the Technical Director for what steps they need to take to coordinate time off and reimbursement if the suggestion is approved.

2.4 Quality Assurance Document Control, Distribution and Revision

The Quality Assurance Manual, Standard Operating Procedures and Laboratory Notebooks are controlled documents. The revision history and distribution of these documents must be recorded using the Standard Operating Procedure 1.07 used to control documents. The Laboratory QA/QC Officer is responsible for document control.

Uncontrolled versions of these documents are acceptable but the distribution and revision distributed must also be documented as discussed in SOP 1.07. Only the Technical Director, Laboratory Manager and Laboratory QA/QC Officer may authorize the release of controlled documents.

Standard Operating Procedure 1.00 details the process required to create, review, revise, promulgate, retire and archive Standard Operating Procedures.

Standard Operating Procedure 1.01 details the process required to create, promulgate and archive Laboratory Notebooks and to do a QA/QC review of their contents.

The Quality Assurance Manual and appropriate Standard Operating Procedures are distributed by the Laboratory QA/QC Officer to each department for access by all employees.

2.5 Quality Assurance Assessments

2.5.1 Internal Audits

The Laboratory QA/QC Officer manages internal audits at two levels. A monthly audit is performed using Standard Operating Procedure 1.14 and an annual audit is performed using Standard Operating Procedure 1.15.

In general, the monthly audit consists of a random 10% QA/QC review of the reports generated from the previous month. Spot checks on these reports generally focus on issues related to the normal production procedures associated with the processing of samples within the laboratory such as:

- Check in and acceptance of sample into laboratory
- Storage temperature and location of client samples
- Sample extraction SOPs followed correctly
- Samples analyzed using correct SOP procedures
- Initial Calibration, Initial Calibration Verification and Continuing Calibration Verifications performed properly
- Quality Control limits met for precision and accuracy
- Non-conformances documented properly
- Corrective actions on non-conformances appropriate
- Data review process followed
- Raw and electronic data properly documented, gathered and archived
- Report generated correctly and without transcription errors
- Case narrative included and adequately addresses any issues with data

A report of any deficiencies and issues found during the audits will be submitted to the Technical Director, Administrative Director, Laboratory Manager and Project Manager. A copy of the report will be maintained in the Laboratory QA/QC Officer's files. The Laboratory Manager is required to address any deficiencies and document their resolution.

The annual audit is a more thorough look at all QA/QC operations for the laboratory. This audit is to occur in January of each year following Standard Operating Procedure 1.15. Following the audit, the Laboratory QA/QC Officer shall prepare a report summarizing the results of the annual audit and the monthly audits from the previous year. The report will be presented to management for the management review process.

2.5.2 Managerial Review

In February of each year, the Technical Director, Administrative Director, Laboratory Manager, Laboratory QA/QC Officer and Project Manager will hold a meeting to conduct a review of its quality system and its testing and calibration activities to ensure its continuing suitability and effectiveness and to introduce any necessary changes or improvements in the quality system and laboratory operations. The review shall take account the outcome of recent internal audits, performance audits, any changes in the volume and type of work undertaken, feedback from clients, corrective actions and other relevant factors. This procedure is covered in more detail in Standard Operating Procedure 1.16. The results from this meeting shall be documented and a copy of the report shall be kept in the Laboratory QA/QC Officer's files. The Laboratory Manager is required to address and document the resolution of any deficiencies.

2.5.3 Performance Audit

Performance audits are typically performed as part of the accreditation process. The audit can include three different activities including performance evaluation samples, reviews of QA/QC documents such as the Quality Assurance Manual and Standard Operating Procedures and onsite audits by the accrediting authority. The Technical Director, Laboratory Manager or Laboratory QA/QC Officer may also order a single blind or double blind performance evaluation if they feel it would be helpful in identifying QA/QC problems within the laboratory. The performance audit process is covered in Standard Operating Procedure 1.17. The report of any performance audits shall be kept in the QA/QC Officer's files and the Laboratory Manager is required to address and document the resolution of any deficiencies.

2.5.4 Audit Review/Corrective Actions

The review and corrective action process is included as part of the Internal Audit, Management Review and Performance Audit Standard Operating Procedures 1.15, 1.16 and 1.17. Standard Operating Procedure 1.18 details the process for documenting non-conformances and the associated corrective action.

3.0 Facilities and Equipment

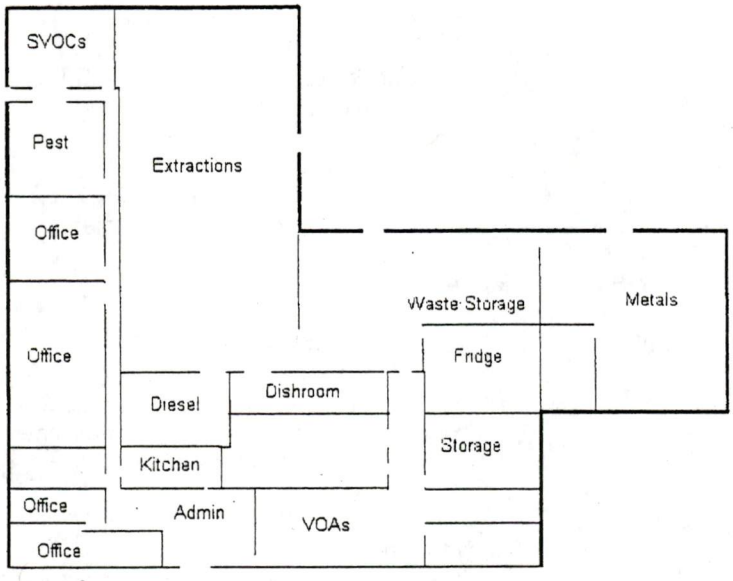
3.1 Facility Description

OnSite Environmental Inc. is located at 14648 NE 95th Street, Redmond, Washington 98052. This facility supports all normal laboratory operations.

The volatiles department has its own HVAC system that is independent from the extractions lab, semivolatiles labs and inorganic lab.

Zoned heating and air-conditioning maintain temperature within the laboratory. Temperature is generally set for employee comfort at normal room temperature of 68-72 °F. If a specific test method requires a controlled temperature, humidity or other environmental control, such controls can be found in the individual test Standard Operating Procedure.

Floorplan



3.2 Instrumentation and backup alternatives

All GC and GC/MS departments have back-up instrumentation. The metals department uses the ICP/MS to backup all functions of the ICP. The ICP can partially backup the ICP/MS; however, it cannot achieve the ultra low detection limits of this instrument.

GC Volatiles

Daryl:
GC Serial #3235A46317
Hewlett Packard 5890 Series II GC/PID/FID
Tekmar/Hewlett Packard 2032 Automatic Liquid Sampler
Tekmar Liquid Sample Concentrator 2000

Hope:
GC Serial #3203A40474
Hewlett Packard 5890A Series II GC/PID/FID
Varian Archon Autosampler
Tekmar Liquid Sample Concentrator 2000

GC/MS Volatiles

Albert:
GC Serial #3336A57367
MS Serial #3440A02022
Hewlett Packard 5890 Series II plus Gas Chromatograph
Hewlett Packard 5972A Mass Spectrometer
Varian Archon Autosampler
Hewlett Packard Liquid Sample Concentrator

Jessie:
GC Serial #US00033566
MS Serial #US94260049
Hewlett Packard 6890A Gas Chromatograph
Hewlett Packard 5973N Mass Spectrometer

Varian Archon Autosampler
Tekmar/Dohrmann Liquid Sample Concentrator 3100

GC Semivolatiles

Lucy: GC Serial #3235A45841
Hewlett Packard 5890 Series II GC/FID/FID
Dual Hewlett Packard Autosamplers

Isaac: GC Serial #2728A13937
Hewlett Packard 5890 GC/FID/FID
Dual Hewlett Packard Autosamplers

GC/MS Semivolatiles

Ralph: GC Serial #3336A55281
MS Serial #3434A01677
Hewlett Packard 5890 Series II plus Gas Chromatograph
Hewlett Packard 5972 Mass Spectrometer
Hewlett Packard Autosampler

Corey: GC Serial #US00007773
MS Serial #US82321650
Hewlett Packard 6890 Gas Chromatograph
Hewlett Packard 5973 Mass Spectrometer
Hewlett Packard Autosampler

GC/ECD

George: GC Serial #3140A39359
Hewlett Packard 5890 Series II Gas GC/ECD/ECD
Hewlett Packard Autosampler

Frank: GC Serial #US92305459
Hewlett Packard 6890 plus GC/ECD/ECD
Hewlett Packard Autosampler

Inorganics/Wet Chemistry

Phoenix (ICP) ICP Serial #ELO3068480
Varian Vista-MPX
Varian SPS-5 Autosampler

Elan (ICP/MS): ICP/MS Serial #0779906
Perkin Elmer Elan 6100 ICP/MS
Perkin Elmer AS90/91 Autosampler

Grandma (CVAA): AA Serial #128132
Perkin Elmer 2380 Atomic Absorption Spectrophotometer

Aquamate UV/VIS Spectrophotometer Serial #AQA 113606
Thermo Spectronic Helios Aquamate

3.3 Maintenance Activities

Preventative maintenance is an important part of a Quality Assurance Program. Maintenance activities are all described in their respective Standard Operating

Procedures for the following equipment:

Refrigerator Maintenance	8.01
Pipette Calibration	8.03
Thermometer Calibration	8.04
Balance Calibration	8.05
Sonicator Calibration	8.08
Microwave Calibration	8.09
DI Water System Maintenance	8.10
Laboratory Maintenance	8.13
Glassware Cleaning and Washing	8.14
Oven Maintenance	8.15

4.0 Sample Processing

4.1 Sample Receiving and Storage

When samples arrive in the laboratory, the Sample Custodian logs the samples into the laboratory using Standard Operating Procedure 1.02. The Sample Custodian works closely with the Project Manager to make sure the analysis plan meets the customer requirements and that any special requirements detailed in a client quality assurance project plan are met and conveyed to the rest of the laboratory. This procedure includes the following steps:

- Verify samples for damage and proper preservation and temperature
- Verify samples arrived within acceptable holding time
- Verify the sample labels match the chain of custody
- Verify that the samples meet the acceptance policy of the laboratory
- Assign a project number to the sample group
- Assign a sample identification number to each sample and labels each sample
- Log the required information into a sample notebook for record keeping
- Complete and sign the chain of custody and creates a project file
- Document any non-conformances found
- Store samples in the proper refrigerators
- Complete and distribute the paperwork required for each testing protocol
- Prepare documents and shipments of samples to be subcontracted

Evidence of collection, shipment, receipt and laboratory custody until disposal must be documented. Documentation is accomplished by means of a chain of custody record that records each sample and the individuals responsible for sample collection, shipment and receipt. A sample is considered to be in custody if it is:

- In a person's actual possession
- In view after being in a person's actual possession
- Locked or sealed to prevent tampering
- In a secured area accessible only to authorized personnel

OnSite Environmental Inc. refrigerators and laboratory space are considered a secured area thus chain of custody is considered to be maintained the entire time they are stored and processed while at our facility. This procedure is adequate and acceptable for the vast majority of our clients.

Some quality assurance project plans require a much stricter custody procedure. In such cases, the samples will be stored in locked refrigerators maintained by assigned sample custodians. Employees will have to obtain the samples from the sample custodian and sign for the samples. The employee will return the sample to the sample custodian immediately after using the sample unless it is to be consumed in analysis. Sample extracts will also be kept in locked refrigerators and the sample custodian will release them to the chemist when they are ready to analyze the sample extract. This procedure is detailed in Standard Operating Procedure 1.03.

4.2 Sample Preparation

The actual sample preparation steps are provided in the Standard Operating Procedure for each analytical method. The extraction and digestion departments also are careful to document proper chain of custody and non-conformances as the samples are being processed. The organic extraction and inorganic digestion departments maintain the following Standard Operating Procedures to maintain consistency in the actual practices they use to prepare samples:

Organic Extraction Department

♦ Separatory Funnel Water Extractions	Method 3510C	SOP 3.08
♦ Ultrasonic Soil Extractions	Method 3550B	SOP 3.07
♦ Waste Dilution	Method 3580A	SOP 3.06
♦ Acid Cleanup	Method 3665A	SOP 3.00
♦ Silica Gel Cleanup	Method 3630C	SOP 3.03
♦ Florisil Cleanup	Method 3620B	SOP 3.01
♦ Alumina Cleanup	Method 3611B	SOP 3.02
♦ Sulfur Cleanup		SOP 3.04
♦ Sonicator Calibration		SOP 8.08
♦ Diazomethane Generation		SOP 3.09
♦ Glassware Washing and Cleaning		SOP 8.14

Inorganic Digestion Department

♦ Dissolved Metals Water Preparation	Method 3005A	SOP 6.02
♦ Hotplate Water Digestion	Method 3010A	SOP 6.03
♦ Hotplate Soil Digestion	Method 3050B	SOP 6.06
♦ Microwave Assisted Water Digestion	Method 3015	SOP 6.04
♦ Microwave Assisted Soil Digestion	Method 3051	SOP 6.07
♦ Calibration of Microwave		SOP 8.09
♦ TCLP Preparation	Method 1311	SOP 6.00
♦ SPLP Preparation	Method 1312	SOP 6.01
♦ Glassware Washing and Cleaning		SOP 8.14

4.3 Sample Analysis & Data Generation

The sample analysis and data generation procedures for sample holding time, sample preparation, instrument tuning and calibration, quality control requirements and data reduction e.g. are detailed in the Standard Operating Procedure for each method. See Appendix B for a list of tests and the associated Standard Operating Procedure number for which OnSite Environmental Inc. currently maintains accreditation.

4.3.1 Manual Integrations

The initials of the analyst and the date of any manual integrations are required on all raw data. Standard Operating Procedure 1.12 gives examples of proper and

improper integrations for different situations and how to document any manual integrations that are done to correct for improper auto-integration.

4.3.2 Traceability of Standards and Calibrations

It is important to be able to trace and document the standards we purchase, prepare and use to calibrate and verify the calibration of our instruments. Standards and neat chemicals used to make analytical standards and spiking solutions internally are tracked by lot number and are assigned internal identification numbers as they are recorded in laboratory notebooks upon receipt from the vendor. Calibration standards and spiking solutions prepared from these materials are also tracked in laboratory notebooks and assigned identification numbers so they can be tracked during sample preparation and sample analysis. Standard Operating Procedure 1.11 details this procedure.

4.3.3 Initial Calibration Verification

It is OnSite Environmental Inc. policy that all initial calibrations for SW-846 methods must be verified with an initial calibration verification (ICV) standard. This standard should be near the midpoint of the calibration curve and is typically the same concentration as the continuing calibration verification standard. The ICV should be from a different manufacturer unless this is not feasible. In this case, a standard with a different lot number may be selected from the same manufacturer.

The ICV requirement can be useful to identify the following issues:

- Manufacturer incorrectly made the standard
- Standard has degraded and needs to be replaced
- Errors in standard preparation by the analyst
- Identifying poor (non-linear) calibration curves.

4.4 Data Review

OnSite Environmental Inc. employs a three-tiered data review process. Checklists are used to document each level of review. In general, the chemist performs the Tier I review. The chemist then submits the data to a senior chemist, the Laboratory Manager, the Laboratory QA/QC Officer, or the Technical Director for a Tier II review. If corrections need to be made after the Tier II review, then the data is given back to the chemist to correct and resubmit to the Tier II process. Otherwise, the data is submitted to the Project Manager who coordinates the generation of the report and performs the final Tier III review before signing off on the data and submitting it to the client. Any changes in the data found during a Tier III review need technical agreement by the Technical Director, Laboratory Manager or Laboratory QA/QC Officer. Preliminary data submitted to the client must pass through the Tier II level and be clearly marked as preliminary data. The data can then be reviewed again at a later time before the final report is submitted to the client. This review procedure is detailed in Standard Operating Procedure 1.04.

In addition to this three-tiered data review process, a random 10% of all final reports generated each month undergo an audit by the Laboratory QA/QC Officer as outlined in Standard Operating Procedure 1.14.

4.5 Data Reporting and Electronic Data Deliverables

The Administrative Director and Project Manager coordinate report generation with assistance from the Office Assistant. The reporting requirements and the

process to generate reports are described in Standard Operating Procedure 1.19. OnSite Environmental Inc. makes a concerted effort, whenever possible, to reduce the amount of hand entering of data to avoid transcription errors. Results from the instruments are electronically processed into a report using software or macros (typically Microsoft Excel). The results are then cut and pasted into the final report (Microsoft Word) with the help of macros so that data that is entered by hand is minimized.

The Laboratory Manager coordinates electronic Data Deliverables (EDDs). Since each client requires their own format, Standard Operating Procedure 1.19 only addresses how to verify the EDD to insure its accuracy and agreement with the final report.

4.6 Back up of Electronic Data and Archiving of Data

The file server is backed up once a month. The data backed up includes all analytical data files, final reports and any other documents generated by the front office. A redundant back up copy is also made and stored at an off-site location.

The hardcopy of all the raw data and reports are kept on file for several months so staff has easy access to the data or reports. When the files begin to get full, the excess data is archived into file boxes, labeled and sent to a secure, third party, off-site archival company where the data can be accessed upon request. Data is maintained for a minimum of five years.

The back up and archival procedures are detailed in Standard Operating Procedure 1.05.

4.7 Sample and Waste Disposal

It is OnSite Environmental Inc. policy to store samples for 30 days following analysis for follow-up analyses and to give the client time to request that the samples be archived, returned or disposed. Clients are typically not charged for sample disposal unless the material is extremely hazardous and could not be disposed of in our normal waste streams. If the client wishes us to return the samples, the client can either pick them up at the laboratory or pay for us to ship them back under chain of custody. If the client selects to archive the samples, a small fee per sample per month is assessed. The procedures for sample return, archival and disposal are addressed in Standard Operating Procedure 1.08.

Organic sample extracts are kept, at a minimum, until the holding time specified by the method expires (typically 45 days or less). Inorganic sample digests are kept, at a minimum, for 30 days.

When samples are scheduled for disposal, employees follow Standard Operating Procedure 1.08, which specifies that the samples be segregated into the following waste streams:

- Solid wastes (predominately hydrocarbon contaminated soils)
- Acidified aqueous wastes (predominately hydrochloric, nitric & sulfuric acid)
- Solvent wastes (predominately hexane, methylene chloride and acetone)
- PCB contaminated oils

Samples that do not fit these waste streams are set aside and handled on a case by case basis.

5.0 Quality Control

5.1 Definition of a Batch

Samples from different projects and clients may be batched together for quality control purposes unless a quality assurance project plan specifies that the quality control samples must be selected from that particular project. A batch can consist of up to twenty client samples in addition to any quality control samples that are required. The samples must be extracted, digested or otherwise prepared for analysis within a twelve-hour window. If more than twenty samples are to be extracted, a second batch of quality control samples must be generated. The types of quality control samples can differ depending on the method. Accuracy is assessed with any surrogates that are used and the spike blank and any matrix spike samples that are required by the method. Precision is assessed by any sample duplicates or matrix spike duplicates that are required by the method.

5.2 Method Blanks

Method blanks are used to make sure that the extraction and analysis procedures did not contribute contamination to the analysis.

5.3 Spike Blanks

Spike blanks are used to make sure that the analytes of interest can be accurately recovered from a blank matrix.

5.4 Matrix Spike/Matrix Spike Duplicate Samples

Matrix spike samples are used to make sure the analytes of interest can be accurately recovered from the sample matrix. The matrix spike duplicate is also used to make sure the analytes can be repeatedly recovered in an accurate and precise manner.

5.5 Duplicate Samples

Duplicate samples are used to make sure that sample results can be reproduced in a precise manner.

5.6 Surrogates

Surrogate compounds are compounds similar to the analytes of interest that are added to the sample at known concentration in order to track the accuracy of the sample extraction and analysis.

5.7 Standard Reference Materials

Standard Reference Materials are typically soil or sediment samples obtained from third party sources that have been extensively tested and have certified concentrations or concentration ranges of analytes of interest. Some quality assurance project plans require us to process a standard reference material while processing their samples as an accuracy check on our extraction and analysis procedures. OnSite Environmental Inc. currently analyzes standard reference material only if required by a client's quality assurance project plan.

Clients are responsible for the cost of purchasing or providing standard reference materials if required by their project.

5.8 Trip and Storage Blanks

Trip and storage blanks are useful in tracking potential contamination issues with sample shipping and storage. These types of blanks are analyzed only if

specified or submitted by the client or quality assurance project plan. Clients are typically charged for these samples.

5.9 Method Detection Limit Studies

Method detection limit studies are conducted annually for all accredited test methods. Standard Operating Procedure 1.20 specifies how this procedure is to be handled.

5.10 Demonstration of Capability

New methods must undergo a Demonstration of Capability (initial precision and accuracy study) to verify that the method is performing adequately. Standard Operating Procedure 1.21 specifies how this test is to be done. Each sample preparation technician and chemist as part of our training program also conducts these studies.

5.11 Solvent and Chemical Lot Checks

Each new lot of solvents, acids and bulk chemicals used to extract or digest samples is checked for interferences and contamination before it is used in the laboratory. Standard Operating Procedure 1.10 details how this is done.

6.0 Quality Assurance

6.1 Accuracy

Accuracy is generally expressed as percent recovery, which is calculated as:

$$\text{Percent Recovery (\%R)} = \frac{X_s}{C_t} * 100$$

Where: X_s is the observed concentration of the analyte.
C_t is the true concentration of the analyte.

The acceptable range for accuracy is determined by the method or by control charting of actual laboratory samples. The analyst is responsible for verifying that the surrogate, spike blank and MS/MSD percent recoveries meet the quality control limits. A non-conformance memo and corrective action must be initiated if the analyte does not fall within the appropriate quality control limits.

6.2 Precision

Precision is generally expressed as relative percent difference, which is calculated as:

$$\text{Relative Percent Difference (RPD)} = \frac{|X_1 - X_2|}{\left[\frac{X_1 + X_2}{2}\right]} * 100$$

Where: X_1 is the concentration from the first replicate sample.
X_2 is the concentration from the second replicate sample.

The acceptable range for precision is determined by the method or by control charting of actual laboratory samples. The analyst is responsible for verifying that the duplicate or MS/MSD recoveries meet the quality control limits. A non-

conformance memo and corrective action must be initiated if the analyte does not fall within the appropriate quality control limits.

6.3 Completeness

Completeness is expressed as the percentage of data quality objectives that are expected to be met by OnSite Environmental Inc. This requirement is generally specified as part of a quality assurance project plan. Although OnSite does not track this information routinely or have a specific limit that we internally specify must be met, we strive to achieve 100% at all times.

6.4 Representativeness

In order that the reported results are representative of the sample received, OnSite Environmental Inc. makes a reasonable effort to assure that the samples are adequately homogenized prior to sampling for analysis. OnSite Environmental Inc. cannot control factors in the field affecting sample representativeness; thus, it is ultimately the client's responsibility to insure that the sample submitted is well homogenized prior to submitting it to the laboratory.

6.5 Control Charting & Control Limits

OnSite Environmental Inc. routinely tracks and control charts surrogate percent recoveries, spike blank percent recoveries, MS/MSD percent recoveries and the relative percent difference of MS/MSD samples for all methods that require these quality control samples. The chemist is responsible for recording this information.

Control limits are derived from the control charts and are updated at least once a year. The control limit is established as three standard deviations from the mean of the data set. Standard Operating Procedure 1.22 provides additional guidance on generating and maintaining control charts and quality control limits.

6.6 Non-conformances & Corrective Action

Non-conformances are generated throughout the laboratory by sample receiving, the extractions/digestion departments, the different analytical groups, the Tier I/II/III review process, the front office, and from monthly and yearly audits. In order to make sure that each non-conformance is documented and that a resolution was implemented, the non-conformance procedure is governed under Standard Operating Procedure 1.18.

The non-conformances and corrective actions that are generated during 3rd party audits, internal audits, monthly and yearly audits, management reviews and through non-conformance forms are summarized each month in the monthly audit as part of SOP 1.14. The progress for each item is tracked in the following monthly audits until the item is finally resolved.

Appendix A

Resumes

President/Technical Director
Robert Wallace

Education:

Southwest Texas State University
San Marcos, Texas
Master of Science in Chemistry, 1982

Midwestern State University,
Wichita Falls, Texas
Bachelor of Science in Chemistry, 1981

Key Qualifications:

- Over eighteen years experience in environmental chemistry.
- Experienced in analytical support of projects involving UST management services, remediation of contaminated sites, site assessments, groundwater monitoring, and waste characterization.

Employment:

OnSite Environmental, Inc., Redmond, Washington
President/Technical Director, 1992 - present
Technical Director of environmental analytical laboratory. Responsible for client relations and overall laboratory operations.

Analytical Services, Inc., Kirkland, Washington
Laboratory Manager, 1989 - 1992
Helped start and then managed a twelve person environmental analytical laboratory. Responsible for quality control, review of data, and client contact.

Farr, Friedman & Bruya, Seattle, Washington
Chemist, 1986 - 1989
Performed analytical testing of soil, water and air matrices using gas chromatographic and infrared techniques of analyses. Worked as an on-site chemist at various locations in the Western United States.

National Marine Fisheries Services (NOAA), Seattle, Washington
Chemist, 1983 -1986
Performed various gas chromatographic and HPLC analyses in the study of pollution in the Puget Sound Region.

Project Experience:

Port of Seattle: Provided analytical chemistry support for the Lockheed Environmental Cleanup Project. Mr. Wallace assumed responsibility for the analytical support of this project, when the original laboratory could not keep up with the quick turnaround of analyses. The project involved the cleanup of PAHs and metals contamination.

Port of Seattle: Managed the environmental chemistry support for the Southwest Harbor Island Cleanup and Redevelopment Project. Project involved a remedial investigation of a site with contaminated soil and groundwater. Contaminates of concern were metals, pesticides and PCBs, volatile and semi-volatile organics, and petroleum hydrocarbons.

U.S. Army Corps of Engineers: Lead chemist for the laboratory support of the UST Management Services Contract for Eastern Washington. This involved the removal of underground storage tanks and the cleanup of contaminated soil and groundwater at over 20 sites in eastern Washington. Responsibilities included the development of a QA/QC plan, which was submitted and approved by the Army Corps of Engineers, and final review of all analytical data.

U.S. Army Corps of Engineers, Fort Lewis: Managed the analytical support of a project that involved the hazardous waste characterization of soil and sludge from over 60 oil/water separators at the army base. Worked with the Army Corps of Engineers and the Department of Ecology to coordinate and help better define the analytical methodologies to be used.

Administrative Director
Blair Goodrow

Education:

Certified Public Accountant, 1986

San Jose State University
San Jose, California
Post Graduate Studies in Accounting, 1982

University of California
Santa Barbara, California
Bachelor of Arts in Business-Economics, 1980

Employment:

OnSite Environmental, Inc., Redmond, Washington
Administrative Director, 1992 - present
Responsible for the marketing, financial and administrative functions of the company.

Analytical Services, Inc., Kirkland, Washington
Controller, 1989 - 1992
Responsible for all financial, banking, and administrative functions of the company. Set-up and maintained a computerized accounting system. Prepared monthly financial statements and all required tax reports.

Clothier & Head, PS
Senior Accountant, 1983 -1989
Reviewed and compiled financial statements and projections. Prepared and reviewed corporate, partnership and individual tax returns. Supervised and trained staff accountants.

Laboratory Manager
Karl Hornyik

Education:

University of Oregon
Eugene, Oregon
Bachelor of Science in Pre-Medicine, 1990

Key Qualifications:

- Over ten years experience in environmental chemistry.
- Experienced in analytical support of projects involving UST management services, remediation of contaminated sites, site assessments, groundwater monitoring, and waste characterization.

Employment:

OnSite Environmental, Inc., Redmond, Washington
Laboratory Manager, 1993 - present
Supervise all areas of laboratory operations, including extractions and analyses. Coordinate staffing and scheduling of employees of the laboratory. Responsible for the implementation of the quality assurance program of the laboratory.

Laucks Testing Laboratories, Inc., Seattle, Washington
GC Chemist, 1991-1993
Extracted and analyzed soil, water and waste samples for volatiles and semi-volatiles constituents.

Project Experience:

Tulalip Landfill Superfund Site, Washington
Project involved analytical testing of pre-construction fill prior to the principal remedial action. Contaminants of concern were volatile organics, semivolatile organics, PCBs, pesticides, herbicides, and metals.

EPA Superfund Technical Assessment and Response Team (START), Washington
Projects typically involve analytical testing of hazardous materials for characterization prior to determining remedial actions. Contaminants that are typically analyzed for are volatile organics, semivolatile organics, PCBs, pesticides, herbicides, and metals.

Port of Seattle, Environmental Services Group, Seattle, Washington
Environmental Analytical Laboratory Services Contract. Project involves analytical testing in support of Phase II Environmental Assessments. Contaminants of concern are total petroleum hydrocarbons (TPH), volatile organics, semivolatile organics, PCBs, pesticides, herbicides, and metals.

Laboratory QA/QC Officer
Kelley Wilt

Education:

Whitman College
Walla Walla, Washington
Bachelor of Arts in Chemistry, 1991

Key Qualifications:

- Over ten years experience in environmental chemistry.
- Experienced in analytical support of projects involving UST management services, remediation of contaminated sites, site assessments, groundwater monitoring, and waste characterization.

Employment:

OnSite Environmental, Inc., Redmond, Washington
Laboratory Quality Assurance/Quality Control Officer, 2001 – present
Responsible for the implementation and improvement of the laboratory's quality assurance/quality control program.

EcoChem, Inc., Seattle, Washington
Quality Assurance/Quality Control Chemist, 1998 – 2000
Validated GC, GC/MS, HPLC, AA, ICP and ICP/MS data from environmental laboratories using CLP, EPA Regional, USACE, and AFCEE guidelines. Authored technical reports summarizing validation findings.

Laucks Testing Laboratories, Inc., Seattle, Washington
GC/MS Chemist, 1997 – 1998
Analyzed environmental samples by CLP and EPA SW-846 methodologies using GC, GC/MS and HPLC instrumentation. Prepared data packages for validation. Assisted in sample extraction and cleanup of water, soil, air, and tissue matrices.

Friedman & Bruya, Inc., Seattle, Washington
Project Manager/Chemistry Consultant, 1993 – 1997
Planned and implemented clients' projects to provide analytical services to meet or exceed the data quality objectives. Analyzed environmental samples by GC and GC/MS. Provided litigation support (deposition and expert witness testimony) on chemistry issues. Provided age dating and identification services for petroleum hydrocarbons.

Alden Analytical Laboratories, Inc., Seattle, Washington
Extractions Supervisor 1991
GC/MS Chemist 1992 – 1993
Scheduled samples for extraction. Extracted air, water, soil, and tissue samples by SW-846 and other methodologies. Analyzed environmental samples by GC and GC/MS protocols (Methods 8010, 8020, 8240, 8260, and 8270).

Project Manager
David Baumeister

Education:

Emory University
Atlanta, Georgia
Bachelor of Arts in Biology, 1990

Key Qualifications:

- Over ten years experience in environmental chemistry and environmental regulations.
- Experienced in project management of projects involving UST management services, remediation of contaminated sites, site assessments, groundwater monitoring, and waste characterization.

Employment:

OnSite Environmental, Inc., Redmond, Washington
Project Manager, 1999 – present
Coordinate and manage analytical projects from inception to completion. Serve as a liaison between the laboratory and clients.

Analytical Chemist-Extractions Supervisor, 1994 – 1998
Analyzed environmental samples by GC methods. Supervised extraction of all organic laboratory samples.

Alden Analytical Laboratories, Inc., Seattle, Washington
Extractions Supervisor, 1993 – 1994
Supervised staff of chemists performing extractions of all laboratory samples. Coordinated daily operations of group. Developed methods as needed.

Analytical Technologies, Inc., Renton, Washington
Extractions Technician 1992 – 1993
Performed extractions of laboratory samples. Responsible for chemical inventory.

Weyerhaeuser
Physical Chemist, 1991 -- 1992
Analyzed paper products for quality control. Established QA/QC guidelines for various products.

Relevant Experience:

King County Department of Health. Soils investigation involving the support and development of a database of environmental information regarding the extent of contamination from the Tacoma metal smelter.

Appendix B

Table of Standard Operating Procedures

1.00	Standard Operating Procedures
1.01	Format and Control of Laboratory Notebooks
1.02	Sample Receipt & COC Procedures
1.03	Sample and Extract Internal Custody
1.04	Data Review Procedure
1.05	Data Back-up
1.06	Laboratory Training & Documentation
1.07	Document Control
1.08	Waste Management
1.09	Chemical Receipt
1.10	Bulk Chemical Lot Checks
1.11	Traceability of Standards
1.12	Manual Integrations
1.13	Complaints
1.14	Monthly Audit
1.15	Yearly Audit
1.16	Management Review
1.17	Performance Evaluations
1.18	Nonconformances and Corrective Actions
1.19	Report Generation
1.20	Method Detection Limit Studies
1.21	Demonstration of Capability
1.22	Establishing Method Control Limits
2.00	Turbidity - Method 180.1
2.01	Total Solids - Method 160.3
2.02	Flashpoint - Method 1010
2.03	Never issued
2.04	pH Soils (9045C)
2.05	Retired
2.06	Paint Filter Test
2.07	pH Waters (9040)
2.08	Sulfate (Turbidimetric) – Method 375.4
2.09	Nitrogen, Nitrate+Nitrite – Method 353.3
2.10	Phosphorous – Method 365.3
2.11	Alkalinity – Method 310.1
2.12	Total Suspended Solids – Method 160.2
2.13	Total Dissolved Solids – Method 160.1
2.14	Nitrogen, Ammonia – Method 350.3
2.15	Settleable Solids – Method 160.5
3.00	Acid Clean-up of Semivolatile Extracts
3.01	Florisil Clean-up of Pesticide Extracts – Method 3620B
3.02	Alumina Clean-up for PAHs – Method 3611B
3.03	Silica Gel Clean-up – Method 3630
3.04	Never issued
3.05	Sulfur Clean-up Procedure for Organic Extracts
3.06	Waste Dilution - Method 3580A
3.07	Ultrasonic Extraction – Method 3550
3.08	Separatory Funnel Extraction – Method 3510
3.09	Diazomethane Generation
4.00	Herbicides by GC/ECD – Method 8151
4.01	Organochlorine Pesticides by GC/ECD – Method 8081

4.02	Polychlorinated Biphenyls (PCBs) by GC/ECD – Method 8082
4.03	Semivolatile Organic Compounds by GC/MS – Method 8270
4.04	Retired
4.05	Retired
4.06	Semivolatile Petroleum Products by GC/FID – Method NWTPH-Dx
4.07	Hydrocarbon Identification by GC/FID – Method NWTPH-HCID
4.08	Washington EPH
4.09	Diesel Range Organics by GC/FID – Method AK102
4.10	Never issued
4.11	PAHs in Water by Selective Ion Monitoring (GC/MS-SIM) – Method 8270-SIM
4.12	Residual Range Organics by GC/FID – Method AK103
4.13	EDB and DBCP by GC/ECD – Method 8011
4.14	Retired
4.15	Hexane Extractable Material – Method 1664
5.00	Gasoline by GC/FID – Method NWTPH-Gx
5.01	Volatile Organics by GC/MS – Method 8260
5.02	Gasoline Range Organics – Method AK101
5.03	Washington VPH
5.04	BTEX by GC/PID – Method 8021B
5.05	Retired
6.00	TCLP – Method 1311
6.01	SPLP – Method 1312
6.02	Dissolved Metals in Water – Method 3005
6.03	Hotplate Digestion for Water – Method 3010A
6.04	Microwave Digestion for Water – Method 3015
6.05	Retired
6.06	Hotplate Digestion for Soils – Method 3050B
6.07	Microwave Digestion for Soils – Method 3051
6.08	Water Extraction for Hexavalent Chrome
6.09	Alkaline Digestion for Hexavalent Chrome
7.00	Retired
7.01	Retired
7.02	Metals by ICP – Method 6010
7.03	Metals by ICP/MS – Method 200.8
7.04	Mercury in Soil – Method 7471A
7.05	Mercury in Water – Method 7470A
7.06	Hexavalent Chrome – Method 7196
7.07	Metals by ICP/MS – Method 6020
8.00	Method Detection Limits and Instrument Detection Limits
8.01	QA/QC & Maintenance for Refrigerators & Freezers
8.02	Never issued
8.03	Calibration of Volumetric Pipettes
8.04	Thermometer Calibration
8.05	Balance Calibration
8.06	Never issued
8.07	Never issued
8.08	Sonicator Calibration
8.09	Microwave Calibration
8.10	Maintenance and Use of High Purity Water System
8.11	Never issued
8.12	Never issued
8.13	Instrument Maintenance
8.14	Glassware Cleaning & Washing
8.15	Oven Maintenance

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