SAMPLING AND ANALYSIS PLAN

Kalaloch Firing Range
Olympic National Park
Kalaloch, Washington

PART I – FIELD SAMPLING PLAN
PART II – QUALITY ASSURANCE PROJECT PLAN

Prepared for:

Olympic National Park
600 East Park Avenue
Port Angeles, WA 98362-9757

Prepared by:

Resource Environmental Management Consultants, Inc
8138 South State Street, Ste. 2A
Midvale, Utah 84047
801-255-2626

June 24, 2011

TABLE OF CONTENTS

List of Figures

List of Tables

List of Appendices

1.0 INTRODUCTION

This document serves as the Sampling and Analysis Plan (SAP) for an Engineering Evaluation/ Cost Analysis (EE/CA) at the Kalaloch Firing Range located in Olympic National Park (Site). This SAP is intended to apply to investigational activities taking place at the Site during an EE/CA conducted by the National Park Service (NPS).

This SAP has been prepared as a guide for sampling associated with Site characterization as required to complete the EE/CA. All sampling will be conducted following this SAP.

There has been one previous investigation conducted at the Site by Michael Baker Jr. Incorporated (Baker, 2007) for the NPS. A Technical Review Report (Baker, 2007) was prepared to summarize the results of a Site visit and the collection of seven composite soil samples.

Figure 1.0 shows the geographic location of the Site.

The SAP is comprised of the Field Sampling Plan (FSP) and the Quality Assurance Project Plan (QAPP) and includes the following sections:

Section 1 - Introduction
Section 2 - Site Background

Part I: Field Sampling Plan

Section 3 - Sampling Program, Rationale and Locations
Section 4 - Field Methods and Procedures

Part II: Quality Assurance Project Plan

Section 5 - Project Management
Section 6 - Quality Control Requirements
Section 7 - Assessment and Oversight
Section 8 - Data Validation and Usability
Section 9 - Measurement and Data Acquisition
Section 10 - References

Appendix A - Standard Operating Procedures
Appendix B - Laboratory QA/QC Documentation (available upon request)

1.1 Objectives

This SAP describes the collection and analysis of soil, surface and ground water samples, as well as several field data collection measurements to be performed in the field concurrently with investigational activities taking place at the Site during an EE/CA. The sampling effort will provide the following data to complete an EE/CA:

Site Investigation

- Near surface and at-depth soil samples will be collected to determine lead concentrations in soil.
- Samples will be collected in the area surrounding the firing range. Sample locations will be field-fit as required to determine the extents of lead impacts.
- Soil samples will be collected outside of the firing range area to determine background lead concentrations.
- Soil samples will be analyzed using two methodologies: 1) Laboratory analysis will be conducted by a laboratory certified by the State of Washington; and 2) samples will be field screened using Field X-Ray Fluorescence (XRF) screening to assess lead concentrations in "real time".
- If required by Site conditions, surface and shallow groundwater samples may be collected. Water samples will be analyzed by a laboratory certified by the State of Washington.

Section 3.1 further explains how data will be used.

1.2 Project Schedule

Data collection will occur during site characterization which is expected to be completed in one site visit. The data will be presented in the EE/CA Report.

2.0 SITE BACKGROUND

Site background information was presented in the Technical Review Report (Baker, 2007). The study area, Site history, previous Site investigations and environmental setting are summarized below.

2.1 Study Area and Environmental Setting

The former Kalaloch Firing Range is located approximately 0.25 miles east of Highway 101 in Jefferson County, Washington (Figure 1). The elevation of the Site is approximately fifty feet above mean sea level (Baker, 2007).

A site sketch and previous sample locations are presented in Figure 2.0 of the Technical Review Report (Baker, 2007).

2.2 Site History

The Site has been closed for approximately ten years. Various types of small arms were believed to have been used at the range. The range consisted of approximately eleven metal target stands, roughly seven to ten feet apart. There is no backstop or berm present. The area behind the stands is heavily vegetated, overgrown and wet in many places (Baker, 2007). No visible signs of spent bullets or lead were noted during the site visit documented in the Technical Review

Report (Baker, 2007)

2.3 Previous Site Investigations

One previous Site Investigation was conducted and is documented in the Technical Review Report (Baker, 2007).

PART I: FIELD SAMPLING PLAN

3.0 SAMPLING PROGRAM, RATIONALE AND LOCATIONS

The Field Sampling Plan (FSP) for this investigation has been developed to provide guidance for sampling during investigatory activities associated with the EE/CA.

3.1 Experimental Design and Sampling Rationale

The general objective of this sampling effort is collect sufficient data to conduct the EE/CA.

3.2 Sample Media and Parameters

All sampling described below is required to achieve the project objectives. The focus of sample collection activities proposed in this SAP is evaluation of the environmental Site media described in Section 3.3. Table 3.0 summarizes the sample media and parameters to be measured.

3.3 Sampling Locations

3.3.1 Soil Sample Locations

Sampling locations will be field-fit as required to characterize the Site. Samples will be collected in up and down-range areas of the Site. Background samples will be collected in the vicinity of the Site in areas outside of any potentially impacted areas.

3.3.2 Water Sample Locations

Surface and shallow groundwater samples will be collected if warranted by site conditions. Sample locations will be field-fit as necessary.

4.0 FIELD METHODS AND PROCEDURES

The following field methods and procedures will be used during this project (see Section 5.7 for laboratory analytical methods):

- Site Mobilization;
- Mobilization of Equipment, Supplies and Containers;
- Equipment Decontamination; and

- Field Sample Collection.
  - — Soil Sampling
  - — Surface and Shallow Groundwater Sampling

Referenced Standard Operating Procedures (SOPs) are included in Appendix A.

4.1 Site Mobilization

RMC will identify and provide all necessary personnel, equipment and materials for mobilization and demobilization to and from the Site to collect samples. Equipment mobilization includes ordering and purchasing equipment and supplies. A complete inventory of available equipment and supplies will be conducted prior to the start of sampling.

4.2 Equipment, Supplies and Containers

Equipment and supplies necessary for field sampling are summarized in Table 4.0. This table separates field items into the following categories: sampling, health and safety, equipment and personal decontamination and general field operations.

Sample containers and any required preservatives will be supplied by the laboratory or purchased from approved vendors. All sample containers will be pre-cleaned and traceable to the facility that performed the cleaning. Sample containers will not be cleaned in the field. Surface and shallow groundwater containers will be triple-rinsed in the field with sample media prior to filling.

4.3 Equipment Decontamination

All non-dedicated and non-disposable sampling equipment will be decontaminated prior to use at each station and between media types. Equipment decontamination procedures outlined in the SOP, *Standard Procedures for Sampling Equipment Decontamination* (RMC SOP 6, provided in Appendix A) will be used in this sampling program. Equipment will be decontaminated by placing the sampling equipment in a bucket filled with deionized (DI) water and non-phosphate soap and removing any visible residual material from the sampling equipment with a brush. Any residual soap or debris will be removed by pouring DI water over the equipment. Sampling equipment will then be double rinsed with DI water. Upon completion of this procedure, all equipment will be air dried and stored in a "clean" vessel or wrapped with foil until ready for use. Disposable "one-use" sampling equipment will be used whenever possible.

4.4 Field Sampling and Data Collection

Table 4.1 provides a summary of the analyses that will be conducted during the EE/CA. The sample volumes, containers and preservation requirements for these samples are specified in the QAPP (Part II). Samples for chemical analysis will be identified as follows:

- Soil samples will be designated with a SL identifier;
- Surface water samples will be designated with a SW identifier; and

- Shallow groundwater samples will be designated with a SHGW identifier.

The methods that will be used to collect the samples are discussed below.

4.4.1 Field X-Ray Fluorescence Screening

Field X-Ray Fluorescence (XRF) screening will be conducted to assess metals concentrations in "real time." XRF screening and data collection will be used during the EE/CA for the following purposes:

- In situ "ground shots" will be used to determine lead concentrations at specific locations throughout the Site. Multiple ground shots will be taken at each location. Locations will be determined in the field during the Site investigation. Due to the large amounts of XRF "shots" taken during this procedure (100s per day) it is impractical to collect Quality Control/Quality Assurance samples. One random Quality Control/Quality Assurance sample will be collected each day the XRF is used to collect ground shots.

Samples may be air- or oven-dried if required. XRF screening will be conducted according to *Standard Procedures for XRF Field Screening* (RMC SOP 8) which is based on EPA Method 6200 and is presented in Appendix A.

4.4.2 Soil Sampling

Soil sampling will be conducted to determine concentrations of lead as required. Composite samples will be collected. Composite samples will be used to confirm the results of XRF screening. Composite samples will consist of five (5) subsamples per area/volume to be sampled. Soil sampling includes confirmation sampling in removal areas. Samples will also be screened with the XRF according to procedures described in Section 4.4.1.

The samples will be collected according to the SOP, *Standard Procedures for Collection of Surface Soil Samples* (RMC SOP 2a), presented in Appendix A.

The samples will be placed in appropriate containers and kept in coolers on ice (4 degrees Celsius) until transferred to a refrigerator at the laboratory.

4.4.3 Surface Water Samples

Surface water samples will be collected upstream and downstream of the Site. The samples will be collected according to the SOP, *Standard Procedures for Collection of Surface Water Samples* (RMC SOP 1), presented in Appendix A. Field analytical parameters and procedures are shown on Table 4.1 of this SAP. Surface water samples for dissolved metals analyses will be filtered by the analytical laboratory prior to sample preservation (RMC SOP 1, Appendix A).

The samples will be placed in glass or polyethylene containers and kept in coolers on ice (4 degrees Celsius) until transferred to a refrigerator at the laboratory.

4.4.4 Shallow Groundwater Samples

One shallow groundwater sample will be collected adjacent to the Site. The sample will be collected according to the SOP, *Standard Procedures for Collection of Groundwater Samples* (RMC SOP 3c), presented in Appendix A. Field analytical parameters and procedures are shown on Table 4.1 of this SAP. Groundwater samples for dissolved metals analyses will be filtered by the analytical laboratory prior to sample preservation (RMC SOP 1, Appendix A).

Water samples will be placed in glass or polyethylene containers and kept in coolers on ice (4 degrees Celsius) until transferred to a refrigerator at the laboratory.

4.4.5 Investigation-Derived Waste

Investigation-derived waste (IDW) generated during this study will be handled in accordance with OSWER Directive 9345.3-02 *Management of Investigation-Derived Wastes During Site Inspections* (EPA, 1991). Collecting only the volume of material needed to satisfy laboratory analytical requirements will minimize the generation of IDW. Any excess material will be discarded at the sample collection point.

4.5 Sample Alteration Form

Changes to sample collection methodologies, procedures, equipment or parameters will be

documented on a Sample Alteration Form (Table 4.2). The Sample Alteration Form will be included when reporting applicable results.

PART II: QUALITY ASSURANCE PROJECT PLAN

5.0 PROJECT MANAGEMENT

The QAPP for the former Kalaloch Firing Range EE/CA has been developed in accordance with EPA QA/R-5 guidance for preparing QAPPs (EPA, 2001). This section covers the basic area of project management, including the project organization, background and purpose, project description, quality objectives and criteria, special training, documentation and records.

5.1 Project Organization

Organization and responsibilities specific to this investigation are discussed in this section. Laboratory services will be provided by a State of Washington-approved laboratory, which will analyze the soil and water samples for lead.

For this data collection effort, key management personnel are as follows:

Individual	Role/Responsibility
Jim Fricke	Project Manager

The management team is not yet determined.

The NPS Project Coordinator is Mike Sorenson.

The Project Manager will be responsible for the overall management and coordination of the following:

- Coordination with NPS regarding the status of the project;
- Providing oversight of the subcontractors;
- Preparing status reports;
- Supervising production and review of deliverables;
- Tracking work progress against planned budgets and schedules;
- Informing NPS of changes in the EE/CA and/or other project documents;
- Notifying NPS immediately of significant problems affecting the quality of data or the ability to meet project objectives;
- Procuring subcontractors to provide sampling and analytical support;
- Providing oversight of report preparation;
- Organizing and conducting a field planning meeting;
- Coordinating with the laboratory regarding the analytical, data validation and Quality Assurance/Quality Control (QA/QC) issues related to sample analysis;
- Reviewing analytical results and deliverables from subcontractors;
- Incorporating changes in the EE/CA and/or other project documents;
- Scheduling personnel and material resources;
- Implementing field aspects of the Removal Action, including this SAP and other project documents;
- Implementing the QC measures specified in the QAPP in this and other project documents;
- Implementing corrective actions resulting from staff observations, QA/QC surveillance and/ or QA audits;
- Providing oversight of data management;
- Coordinating and overseeing the efforts of the subcontractors providing sampling and analytical support;
- Scheduling and conducting field work;
- Notifying the analytical laboratory of scheduled sample shipments and coordinating work activities;
- Gathering sampling equipment and field logbooks and confirming required sample containers and preservatives;
- Maintaining proper chain-of-custody forms and shipping of samples to the analytical laboratory during sampling events;
- Ensuring that sampling is conducted in accordance with procedures detailed in this SAP and that the quantity and location of all samples meet the requirements of the SAP; and
- Identifying problems at the field team level, resolving difficulties in consultation with the

QA/QC staff, implementing and documenting corrective action procedures at the field team level and providing communication between the field team and NPS management.

The roles and responsibilities of other field team members will be to assist the Project Manager with sampling activities, sample handling and overall documentation.

5.2 Quality Assurance/Quality Control Organization

The Project Manager or designated representative, will be responsible for the Quality Assurance/Quality Control of the data that are generated during implementation of the SAP. The Project Manager will be responsible for the following:

- Reviewing and approving project specific plans;
- Directing the overall project QA/QC program;
- Maintaining QA/QC oversight of the project;
- Reviewing QA/QC sections in project reports, as applicable;
- Reviewing QA/QC procedures applicable to this SAP;
- Auditing selected activities of this project, as necessary;
- Initiating, reviewing and following up on response actions to address QA/QC problems, as necessary;
- Consulting with the Project Coordinator, as needed, on appropriate QA/QC measures and corrective actions;
- Arranging performance audits of measurement activities, as necessary; and
- Providing written reports on QA/QC activity to the Project Manager.

5.3 Background and Purpose

Site background information for the former Kalaloch Firing Range is provided in Section 2.0 of this SAP. The purpose and objectives of the work assignment are discussed in Section 1.1 of this SAP. The purpose of this QAPP is to provide guidance to ensure that all environmentally related data collection procedures and measurements are scientifically sound and of known, acceptable and documented quality conducted in accordance with the requirements of the project.

5.4 Project Description

The QAPP addresses field work, data collection and laboratory analyses performed for this work assignment. Detailed project descriptions are outlined in the FSP sections above.

5.5 Data Quality Objectives (DQOs) and Criteria for Measurement

This section provides internal means for control and review so that environmentally-related measurements and data collected in this study are of known quality. The subsections below describe the DQOs (Section 5.5.1) and data measurement objectives (Section 5.5.2).

5.5.1 Data Quality Objectives

The DQO process is a series of planning steps based on the scientific method that are designed to ensure that the type, quantity and quality of environmental data used in decision-making are appropriate for the intended purpose. The EPA has issued guidelines to help data users develop site-specific DQOs (EPA, 1994b). The DQO process is intended to:

- Clarify the study objective;
- Define the most appropriate type of data to collect;
- Determine the most appropriate conditions from which to collect the data; and
- Specify acceptable levels of decision errors that will be used as the basis for establishing the quantity and quality of data needed to support the design.

The goal of the DQO process is to help ensure that data of sufficient quality are obtained to support removal response decisions, reduce overall costs of data sampling and analysis activities and accelerate project planning and implementation. Data Quality Objectives are summarized in Table 5.0.

The DQO process specifies project decisions, the data quality required to support those decisions, specific data types needed, data collection requirements and analytical techniques necessary to generate the specified data quality. The process also ensures that the resources required to generate the data are justified. The DQO process consists of seven steps, of which the output from each step influences the choices that will be made later in the process. These steps include:

Step 1: State the problem;
Step 2: Identify the decision;
Step 3: Identify the inputs to the decision;
Step 4: Define the study boundaries;
Step 5: Develop a decision rule;
Step 6: Specify tolerable limits on decision errors; and
Step 7: Optimize the design.

During the first six steps of the process, the planning team develops decision performance criteria (DQOs) that will be used to develop the data collection design. The final step of the process involves developing the data collection design based on the DQOs. A brief discussion of these steps and their application to this project is provided below.

Step 1: State the Problem

The purpose of this step is to describe the problem to be studied so that the focus of the study will be unambiguous. The sampling specified in this SAP will be conducted to provide Site-specific data to confirm the completion of the Removal Action.

Step 2: Identify the Decision

This step identifies what questions the study will attempt to resolve and what actions may result.

Step 3: Identify the Inputs to the Decision

The purpose of this step is to identify the information that needs to be obtained and the measurements that need to be taken to resolve the decision statement. Based on the study questions, the following information is required:

- Lead concentrations in Site soils; and
- Lead concentrations in Site surface water and shallow groundwater.

Step 4: Define the Boundaries of the Project

This step defines the spatial boundaries of the project. The entire project will be field-fit and performed within the area of the former Kalaloch Firing Range.

Step 5: Develop a Decision Rule

The EE/CA decision process consists of the following steps:

1) Decide if the data collected is sufficient to complete the EE/CA;
2) Compare sample results with regulatory guidelines (e.g. screening levels).

Step 7: Optimize the Design for Obtaining Data

This step identifies a resource-effective data collection design for generating data that are expected to satisfy the DQOs. The data collection design (sampling program) is described in detail in the FSP (Part 1 of this SAP).

5.5.2 Data Measurement Objectives

Based on the information provided on the DQOs, all analytical samples will be analyzed using EPA methods and other standard analytical techniques. Every reasonable attempt will be made to obtain a complete set of usable analytical data. If a measurement cannot be obtained or is unusable for any reason, the effect of the missing data will be evaluated Project Manager. Table 4.1 summarizes the analytical methods and data measurement objectives for analyses that will be conducted in the field investigations.

5.5.3 Quality Assurance Guidance

The field QA program has been designed in accordance with EPA's *Guidance for the Data Quality Objectives Process* (EPA, 1994b) and the EPA's *Requirements for Quality Assurance Project Plans for Environmental Data Operations* (EPA, 1997).

5.5.4 Precision, Accuracy, Representativeness, Completeness and Comparability Criteria

Precision, Accuracy, Representativeness, Completeness and Comparability (PARCC) parameters are indicators of data quality. PARCC goals are established for the Site characterization to aid in assessing data quality, as discussed in the following paragraphs:

Precision. The precision of a measurement is an expression of mutual agreement among individual measurements of the same property taken under prescribed similar conditions. Precision is quantitative and most often expressed in terms of relative percent difference (RPD). Precision of reported results is a function of inherent field-related variability plus laboratory analytical variability. Various measures of precision exist, depending upon "prescribed similar conditions." Field duplicate samples (five-percent of sample load) will be collected to provide a measure of the contribution to overall variability of field-related sources. Contribution of laboratory-related sources to overall variability is measured through various laboratory QC samples. The acceptable RPD limits for field duplicates are less than 35% for soil, water and sediments. Chemical analytical data will be validated for precision using field duplicates, laboratory duplicates, matrix spike/matrix spike duplicates (MS/MSDs) and laboratory control sample/laboratory control sample duplicates (LCS/LCSDs), as applicable.

Accuracy. Accuracy is the degree of agreement of a measurement with an accepted reference or true value and is a measure of the bias in a system. Accuracy is quantitative and usually expressed as the percent recovery (%R) of a sample result. Ideally, it is desirable that the reported concentration equals the actual concentration present in the sample. Acceptable QC limits for %R are 75% to 125% for LCS/LCSDs, method-defined for surrogates and laboratory-defined for MS/MSDs. Chemical analytical data will be validated for accuracy using surrogates, MS/MSDs and LCS/LCSDs, as applicable.

Representativeness. Representativeness expresses the degree to which sample data accurately and precisely represent; (a) a characteristic of a population; (b) parameter variations at a sampling point; and/or (c) an environmental condition. Representativeness is a qualitative parameter that is most concerned with the proper design of the sampling plan and the absence of cross-contamination. Good Representativeness will be achieved through: (a) careful, informed selection of sampling sites; (b) selection of testing parameters and methods that adequately define and characterize the extent of possible contamination and meet the required parameter reporting limits; (c) proper gathering and handling of samples to avoid interference and prevent contamination and loss; and (d) collection of a sufficient number of samples to allow characterization. Representativeness is a consideration that will be employed during all sample location and collection efforts and will be assessed qualitatively by reviewing field procedures and reviewing actual sampling locations versus planned locations.

Completeness. Completeness is a measure of the amount of usable data obtained from a measurement system compared to the amount that was expected to be obtained under normal conditions. Evaluating the PARCC parameters will assess usability. Those data that are validated and need no qualification, or are qualified as estimated data, are considered usable. Rejected data are not considered usable. Completeness will be

calculated following data evaluation. For this work, a completeness goal of ninety-percent is projected for each analytical test. If this goal is not met, additional sampling may be necessary to adequately achieve project objectives.

Comparability. Consistency in the acquisition, handling and analysis of samples is necessary for comparing results. Where appropriate, the results of analyses obtained will be compared with the results obtained in previous studies. Standard EPA analytical methods and QC will be used to ensure comparability of results with other analyses performed in a similar manner. Comparability is a qualitative parameter and cannot be assessed using QC samples.

5.6 Field Measurements

Field measurements specified in Table 4.1 will be collected during the investigation. All procedures recommended by the manufacturer will be followed in calibrating and operating the instruments. Analytical methods, reporting limits, holding times and QC analyses are discussed below.

5.7 Laboratory Analytical Methods

Analytical methods with corresponding laboratory reporting limits (LRLs) are specified on Table 4.1. Laboratories with established protocols and quality assurance procedures that meet or exceed applicable EPA guidelines will analyze samples by following these methods. Samples will be analyzed using EPA-approved or recommended methods when available and will include all associated QA/QC procedures recommended in each method.

Samples will be submitted to a laboratory certified with the State of Washington. The laboratory will:

- Demonstrate ability to achieve the required detection limits,
- Be certified by the State of Washington; and
- Have an established internal QA/QC program.

If contradictions between the laboratory QA/QC manuals or other documents are identified, information in this SAP supersedes all other documents.

5.7.1 Soil

Soil will be analyzed for lead as specified in Table 4.1.

5.7.2 Surface and Shallow Groundwater

If required, samples of surface and shallow groundwater will be analyzed for total and dissolved lead and field analytical parameters noted in Table 4.1.

6.0 QUALITY CONTROL REQUIREMENTS

Quality control will include collecting field duplicates at a rate of five-percent of the sample load for each sample type and ensuring that the laboratory runs matrix spike/matrix spike duplicates at a rate of five-percent of the sample load for each sample type. The field duplicates will be submitted "blind" to the sample laboratory, i.e., they will be given a separate sample identification number from the environmental sample, unidentifiable to the laboratory, as described above. Field duplicates will be run for the same analytical suite as the environmental samples.

Samples for preparation of matrix spikes and laboratory duplicates will be selected at random by the laboratory. Separate samples do not need to be collected in the field. The laboratory will perform and report all analyses under QA/QC procedures that include the results of method blanks, laboratory control samples, matrix spikes and laboratory duplicates. Additional method-specific quality control procedures such as interference check samples, serial dilution and internal standards will be used as specified for each analytical method in SW-846 (U.S. EPA 2003).

Due to the nature of the contaminants at this Site, ambient, equipment and trip blanks will not be collected.

6.1 Instrument/Equipment Testing, Inspection and Maintenance Requirements

All instruments and equipment will be regularly tested, inspected and maintained according to manufacturers' instructions. Field equipment will be tested and inspected daily before use. Any equipment found to not be functioning properly will be repaired or replaced. Laboratory equipment will be tested, inspected and maintained in accordance with the laboratory QA/QC manual and manufacturers' recommendations.

6.2 Instrument Calibration & Frequency

6.2.1 Field Instruments

Site personnel will follow the manufacturer's specifications to calibrate any field equipment prior to each day. These manufacturers specifications are included in RMC's SOPs (Appendix A).

6.2.2 Laboratory Equipment

Procedures and schedules for the calibration of laboratory equipment are described in the appropriate SW-846 and EPA methods and in the laboratory's Quality Assurance Plan. These procedures and schedules will be followed for all laboratory work.

6.3 Data Management

Data will be submitted to the Project Manager in both hard copy and electronic form. To avoid transcription errors, report tables will be prepared directly from the electronic submittals.

7.0 ASSESSMENT / OVERSIGHT

This section describes the number, frequency and type of assessment activities needed for this project. Assessments coordinated by the Project QA Officer will include: (1) a readiness review prior to initiating each major portion of field work; and (2) a data quality assessment (DQA).

The readiness review will be conducted with both the field staff and analytical laboratories as a technical check to determine if the staff, subcontractors, equipment and record keeping system are in place to start work in accordance with this QAPP. At the review, the QA Officer will review the project objectives, methodologies, record keeping requirements and schedule with the field team and laboratories to make sure they are familiar with and prepared to meet project requirements. The QA Officer will make sure all systems are ready before field work is initiated.

The DQA will be conducted to determine whether the data meet the assumptions that the DQOs and data collection design were developed under and whether the total error in the data are tolerable. This assessment will include complete data verification and validation as described in Section 8.0. *Guidance for the Data Quality Assessment Process* (EPA QA/G-9) will be consulted.

The Project Manager will be responsible for implementing any necessary corrective actions. The occurrence and resolution of major quality issues identified during assessment activities will be documented in memorandum to the NPS Project Manager.

8.0 DATA VALIDATION AND USABILITY

8.1 Data Review, Validation & Verification Requirements

The data validation process evaluates whether the specific requirements for an intended use have been fulfilled and ensures that the results conform to the user's needs. The data validation process develops the QC acceptance criteria or performance criteria.

Data verification confirms that the requirements of the specified sampling and analytical methods were followed. This process involves reviewing the results of sampling and analysis to determine conformance with the QC requirements described for the project. The data verification process ensures the accuracy of data by using validated methods and protocols and is often based on comparison with reference standards.

Requirements and methods for data validation and verification are listed in Tables 8.0 and 8.1.

8.2 Validation & Verification Methods

Data will be reviewed to ensure that the requirements stated in Tables 4.1 and 8.0 were met. Data validation and verification will be conducted using the methods described in Table 8.1. Definitions for data verification and validation are as follows:

> Data Verification: A consistent, systematic process that determines whether the data have been collected in accordance with the stated requirements for each activity. The

verification process is independent of data validation and is conducted at various levels both internal and external to the data generator (laboratory). Data verification includes confirming that all sampling activities were conducted in accordance with the procedures described in this SAP.

Data Validation: An evaluation of the technical usability of the verified data with respect to planned objectives. Data validation is performed external to the data generator (laboratory), using a defined set of performance criteria to a body of data in the evaluation process. This may include checks on some or all of the calculations in the data set and reconstruction of some or all final reported data from initial laboratory data (e.g., chromatograms, instrument printouts). It is in the data validation process that data qualifiers for each verified data are evaluated. It extends beyond the analytical method to protocols or QAPPs to address the overall technical usability of the generated data.

One hundred-percent of the data will be validated according to Table 8.1 requirements by the Project QA Officer or a subcontractor experienced in conducting this type of data verification. Data will be reviewed as it is received throughout the project. If problems are uncovered as a result of the validation effort, the QA Officer and Project Manager will be immediately notified. The QA Officer or Project Manager will discuss possible corrective actions with the laboratory prior to implementation. The Project Manager will immediately notify NPS of any data verification or validation issues that may affect the success of the project.

Any deviations from the analytical control limits specified in Tables 4.1 and 8.1 will be evaluated in terms of their effect on the data usability. Data usability will be assessed using the National Functional Guidelines for Data Review (Inorganic & Organic, February 1994). The completeness goal for the project is ninety-percent valid data.

The results of the data validation and verification will be summarized in a Data Review Report, to be prepared as part of the EE/CA.

8.3 Reconciliation with Data Quality Objectives

The data validation and verification results will be compared to the DQOs stated in Table 5.0 and with the PARCC parameters described in Table 8.0. This evaluation will summarize the QA/QC performance by PARCC criteria including completeness calculations expressing the percent complete of valid data compared to the total number of samples collected. The result of the data validation and verification will be summarized in the Data Review Report described above.

8.4 Reporting Limits

The reporting limits provided in Table 4.1 are the minimum levels that the laboratory will report analytical results without a qualifier when an analyte is detected. The laboratory can typically detect analytes at concentrations of up to an order of magnitude lower than the reporting limits; in this case, when a positive detection is less than the reporting limit, the value may be reported and qualified as an estimated concentration.

8.5 Holding Times

Holding times are storage times allowed between sample collection and sample extraction or analysis (depending on whether the holding time is an extraction or analytical holding time) when the designated preservation and storage techniques are employed. Sample preservation and holding time requirements for samples collected in the field investigations are summarized in Table 4.1. Holding times for soil samples for analysis of lead is 180 days with no preservative. Holding times for water samples for analysis of lead is 180 days with nitric acid preservative (pH <2.0). Field parameter samples (pH, conductivity, temperature) should be analyzed as soon as possible following collection. All samples will be cooled and stored at 4 degrees Celsius (±2 degrees Celsius) until the requested analyses are performed.

8.6 Quality Control Analyses

To provide an external check of the quality of the field procedures and laboratory analyses, two types of QC samples will be collected and analyzed. Field duplicate samples will be collected in order to distinguish between variability in results introduced by the field and sample handling prior to receipt by the laboratory and variability introduced by the laboratory procedures. These samples will be analyzed for lead. If non-disposable sampling equipment is used, an equipment rinsate blank will be collected and analyzed for lead to assess potential contamination of sampling equipment for the analytes of interest. The collection and number of field QC samples that will be analyzed in this field program are discussed in Section 6.0 of this QAPP.

In addition to the external QA/QC controls, the laboratory maintains internal QA procedures. Internal QC samples will include laboratory blanks (i.e., method blanks, preparation blanks), laboratory duplicates, MS/MSDs and LCS/LCSDs, as discussed in Appendix B.

8.7 Special Training Requirements

The only special training required for this investigation is the health and safety training (29 CFR 1910.120) described in the Health and Safety Policy for the project (RMC, 2011).

9.0 MEASUREMENT AND DATA ACQUISITION

This section covers sample process design, sampling methods requirements, handling and custody, analytical methods, QC, equipment maintenance, instrument calibration, supply acceptance, non-direct measurements and data management.

9.1 Sample Process Design

The general goal of the field investigation is to collect sufficient data to complete the EE/CA. Sections 3.0 and 4.0 of this SAP describe the Field Sampling Plan.

9.2 Sampling Methods Requirements

Sampling equipment, containers and overall field management are described below.

9.2.1 Sampling Equipment and Preparation

Sampling equipment required for the field program for environmental sampling, health and safety monitoring, equipment and personal decontamination and general field operations are presented in Table 4.0 of this SAP.

Field preparatory activities include review of SOPs, procurement of field equipment, laboratory coordination, confirmation of Site access and a field planning meeting attended by field personnel and QA staff. Site mobilization is described in Section 4.1 of this SAP.

9.2.2 Sample Containers

Containers for the environmental samples that will be collected during the field program are specified in Table 4.1.

9.2.3 Sample Collection

Samples collected during this field program will consist of soil, surface water, shallow groundwater and QC samples. All sample collection procedures are outlined in Section 4.4 and SOPs in Appendix A. The following SOPs apply to all applicable sample collection activities:

RMC SOP 1, Standard Procedures for Collection of Surface Water Samples
RMC SOP 2, Standard Procedures for Collection of Surface Soil Samples
RMC SOP 3, Standard Procedures for Collection of Groundwater Samples
RMC SOP 4, Standard Procedures for Sample Handling, Documentation and Shipping
RMC SOP 5, Standard Procedures for Sampling Equipment Decontamination
RMC SOP 6, Standard Procedures for XRF Field Screening

9.3 Sample Handling and Custody Requirements

Custody and documentation for field and laboratory work are described below, followed by a discussion of corrections to documentation.

9.3.1 Field Sample Custody and Documentation

Samples analyzed through laboratories coordinated by RMC will be labeled using procedures established in the SOP, *Standard Procedures for Sample Handling, Documentation and Shipping* (RMC SOP 5). Sample labels will include the Site name, sample identification number, date and time of sample collection and required analyses. Sampler's initials will be recorded on the labels with permanent ink markers or pens at the time of sample collection.

9.3.2 Chain-of-Custody Requirements

A Chain-of-Custody Record will be completed at the time of sample collection. Field personnel will record the sample identification number, sampling date and time, sample matrix, sampler's initials and analytical requirements with permanent ink pens. Completed Chain-of-Custody

Records will be reviewed for completeness prior to sample submittal. Samples will be relinquished under the Chain-of-Custody Procedures identified in the SOP, *Standard Procedures for Sample Handling, Documentation and Shipping* (RMC SOP 5).

9.3.3 Sample Packaging and Shipping

Samples will be hand delivered to the laboratory when possible.

After the sample containers are sufficiently packaged, the plastic bag containing the samples will be sealed. Ice will be placed between the plastic bags and cooler.

9.3.4 Field Logbooks and Records

Documentation of field activities will be conducted in accordance with the SOP, *Standard Procedures for Sample Handling, Documentation and Shipping* (RMC SOP 5). The field sampling team will maintain a comprehensive field logbook that includes notes regarding instruments used, Site and weather conditions, GPS coordinates, vegetative community observations, sample time, sampler's name, analytical parameters, sample handling and chain of custody. The field activities will be recorded in bound, sequentially numbered, waterproof notebooks. All entries will be will be made in permanent ink and will be clear, objective and legible. Where required, representative photographs will also be taken of field activities and sample locations and a description will be recorded in the logbook. The Field Operations Manager is responsible for maintenance and document control of the field logbooks.

9.3.5 Laboratory Custody Procedures and Documentation

Laboratory custody procedures are provided in each laboratory's QA Manual. Upon receipt at the laboratory, each sample shipment will be inspected to assess the condition of the shipping cooler and the individual samples. This inspection will include measuring the temperature of the cooler (to document that the temperature of the samples is within the acceptable criteria if cooling is required) and verifying sample integrity. The enclosed chain-of-custody records will be cross-referenced with all of the samples in the shipment. Laboratory personnel will then sign these chain-of-custody records and copies will be provided to field personnel. The sample custodian may continue the chain-of-custody record process by assigning a unique laboratory number to each sample on receipt. This number, if assigned, will identify the sample through all further handling. It is the laboratory's responsibility to maintain internal logbooks and records throughout sample preparation, analysis, data reporting and disposal.

9.3.6 Corrections To and Deviations From Documentation

For the logbooks, a single strikeout initialed and dated is required for documentation changes. The correct information should be entered in close proximity to the erroneous entry. All deviations from the guiding documents will be recorded in the logbook(s).

9.4 Analytical Methods Requirements

Samples collected during this project will be analyzed in accordance with standard EPA and/or nationally-accepted analytical procedures. The selected EPA-approved laboratories will adhere to all applicable QC requirements established by the subcontract. The methods to be used for chemical analysis and the associated holding times are shown in Table 4.1.

9.5 Quality Control Requirements

Field, laboratory and internal office QC are discussed below.

9.5.1 Field Quality Control Samples

Quality control checks will be employed during field activities to ensure the quality and integrity of sample collection. Field duplicate QC samples will be collected in the field and submitted to the appropriate laboratory for analysis, as described in Section 6.0.

All field duplicates will be collected as close as possible to the same point in time and space as the primary field sample. Field duplicate samples will be prepared at a frequency of five-percent of all laboratory samples obtained during the study and will be handled and analyzed in the same manner as the environmental samples.

9.5.2 Laboratory Quality Control Samples

The approved EPA contract laboratory(ies) will follow all laboratory QC checks, as defined in the analytical methods listed in Section 5.7. Quality control data are necessary to determine precision and accuracy and to demonstrate the absence of interferences and/or contamination. Each type of laboratory-based QC will be analyzed at a rate of five-percent or one per batch (a batch is a group of up to 20 samples analyzed together), whichever is more frequent. Results of the QC will be included in the QC package and QC samples may consist of laboratory blanks, laboratory duplicates, MS/MSDs and/or LCS/LCSDs (whichever are applicable) and any other method-required QC samples.

Laboratory blank samples will be analyzed to assess possible contamination so that corrective measures may be taken, if necessary. Duplicate samples are aliquots of a single sample that are split on arrival at the laboratory or upon analysis. Results obtained for two replicates that are split in a controlled laboratory environment may be used to assess laboratory precision of the analysis. MS/MSD and LCS/LCSD analyses may be used to determine both precision and accuracy.

Both normal and QC samples will be spiked with surrogate compounds, when applicable, and a percent recovery will be calculated for each surrogate.

9.5.3 Internal Quality Control Checks

Internal QC checks will be conducted throughout the project to evaluate the performance of the project team during data generation. All internal QC will be conducted in accordance with EPA CLP methods and requirements.

9.6 Equipment Maintenance Procedures

All laboratory equipment will be maintained in accordance with each laboratory's SOPs.

9.7 Instrument Calibration Procedures and Frequency

Calibration of field and laboratory instruments is addressed in the following subsections.

9.7.1 Field Equipment

Field instruments used in the field investigation consist of a field portable XRF, GPS units used to measure sample station coordinates and conductivity and pH meters used to measure water samples (if required). The GPS receivers require no special calibration procedure and all measurements will be conducted according to the manufacturer's suggested procedures.

Calibration of the XRF will be performed prior to use in the field on a daily basis. In all cases, the XRF will be calibrated and operated according to instructions supplied with the instrument and calibration information will be recorded in the field log or instrument log.

If water samples are required, calibration of the pH meter will be performed prior to use in the field on a daily basis. In all cases, the pH meter will be calibrated and operated according to instructions supplied with the instrument and calibration information will be recorded in the field log or instrument log. Solutions used for the calibration of pH meters will be within the expiration date supplied on the bottle label.

9.7.2 Laboratory Equipment

Calibration of laboratory equipment will be based on written procedures approved by laboratory management. Instruments and equipment will be initially calibrated and subsequently continuously calibrated at approved intervals, as specified by either the manufacturer or more updated requirements (e.g., methodology requirements). Calibration standards used as reference standards will be traceable to the EPA, National Institute of Standards and Technology or another nationally-recognized reference standard source.

Records of initial calibration, continuing calibration and verification, repair and replacement will be filed and maintained by the laboratory. Calibration records will be filed and maintained at the laboratory location where the work is performed and may be required to be included in data reporting packages.

9.8 Acceptance Requirements for Supplies

Prior to acceptance, all supplies and consumables will be inspected to ensure that they are in satisfactory condition and free of defects.

9.9 Non-Direct Measurement Data Acquisition Requirements

Non-direct measurement data include information from Site reconnaissance, literature searches and interviews. The acceptance criteria for such data include a review by someone other than the author. Any measurement data included in information obtained from the above-referenced sources will determine further action at the Site only to the extent that those data can be verified.

9.10 Data Reporting

Sample results and QC data will be delivered to the NPS project Manager as an electronic data deliverable (EDD) in addition to a hard-copy data package. Electronic copies of all project deliverables (including graphics) are maintained by project number. Electronic files are routinely backed up and archived.

10.0 REFERENCES

Michel Baker Jr. Inc, (Baker), 2007, Final Technical Report, Kalaloch Firing Range, ECL Site No. 1475, Olympic National Park, Port Angeles, Washington

Resource Management Consultants, Inc. (RMC), 2011, Health and Safety Policy for the , Kalaloch Firing Range.

United States Environmental Protection Agency (EPA). 1991. Management of Investigation-Derived Wastes During Site Inspections, Office of Emergency and Remedial Response, Washington, DC, OERR Directive 9345.3-02.

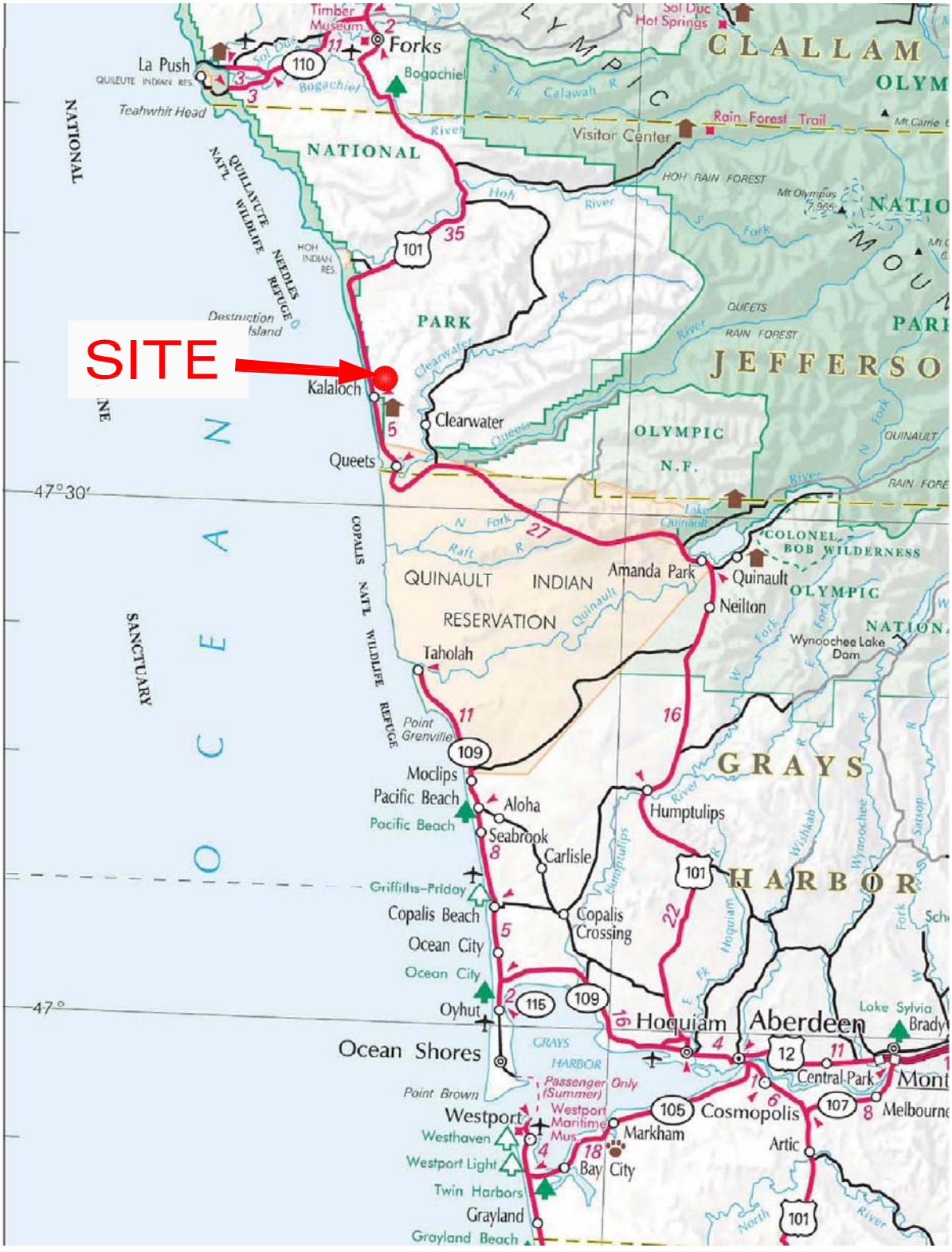
United States Environmental Protection Agency (EPA). 1994a. The National Functional Guidelines for Inorganic Data Review. February, with current revisions (Inorganic Guidelines).

United States Environmental Protection Agency (EPA). 1994b. Guidance for the Data Quality Objectives Process, EPA QA/G-4. September.

United States Environmental Protection Agency (EPA). 1997. EPA Requirements for Quality Assurance Project Plans for Environmental Data Operations, QA/R-5. Draft Final, October.

United States Environmental Protection Agency, Environmental Response Team (EPA/ERT). 1999. Standard Operating Procedures (SOPs).

U.S. EPA 2003. SW-846 On-Line (http://www.epa.gov/epaoswer/hazwaste/test/main.htm)



Notes:
1. Map Source - State of Washington Department of Transportation.

NOT TO SCALE

KALALOCH FIRING RANGE SAP

FIGURE 1.0
SITE LOCATION MAP

RESOURCE MANAGEMENT CONSULTANTS
8138 SOUTH STATE ST.
SUITE 2A
MIDVALE, UT 84047
801-255-2626

MAY 2011

oly np sap fig 1.dwg

Table 3.0
Sampling Objectives
Kalloch Firing Range
Sampling and Analysis Plan

Media/Parameters	Sampling and Analysis Objectives	Data Use
Site Soils: Lead concentrations and distribution.	Determine lead concentrations.	Determine lead impacts and extents.
Site Soils: Disposal characterization.	Determine lead leachibility.	Determine soil characteristics for disposal options.
Optional Surface Water: Total and Dissolved Pb and water quality parameters.	Determine if site soils have impacted site surface water and if surface water emanating from the Site meet applicable regulatory standards.	Compare metals concentrations with Washington State and Federal Water Quality Standards.
Optional Shallow Groundwater: Total and Dissolved Pb and water quality parameters.	Determine if site soils have impacted site groundwater.	Compare metals concentrations with Washington State and Federal Water Quality Standards.

Table 4.0
Recommended Field Equipment and Supplies
Kalaloch Firing Range
Sampling and Analysis Plan

Sampling	**Health & Safety**	**Decontamination**	**General**
Stainless steel spoons (2)	Latex gloves (or equivalent)		GPS
Soil core tool or soil pick	Sunscreen	Plastic trash bags (1 box)	Wooden stakes or pin flags
Steel shovel	Rubber boots	Deionized water (3 gallons)	Flagging (2 rolls)
Stainless steel bowls (2)	Copy of HASP	Alconox	Coolers
XRF		Plastic buckets (2 5-gal)	Copy of SAP/HASP
Self-sealing plastic bags (qt.& gal. size)		Scrub brushes (1)	Tape measure
Field logbook		Sprayer (1-liter)	Ice
Survey lathe, trimmed to 6"			
Plastic trash bags (1 box of large - 30 count)			
Polyethylene bottles (liter & 0.5 liter)			

Table 4.1

Sample Collection Guide - Target Analytes and Collection Requirements

Kalaloch Firing Range

Sampling and Analysis Plan

SOIL

Parameters	Method	PRL[1]	Container	Volume[2]	Temperature[3]	Preservative	Technical Holding Times (Days)	Precision and Accuracy
Pb (Total)	SW-846 6010C	1	LDPE bag or wide mouth glass container with Teflon-lined lid	8 oz.	4°C +/- 2°	N/A	180	+/- 35% 75%-125%
Pb (TCLP)	SW-846 6010C/1311	0.1	LDPE bag or wide mouth glass container with Teflon-lined lid	8 oz.	4°C +/- 2°	N/A	180	+/- 35% 75%-125%

OPTIONAL SURFACE AND SHALLOW GROUNDWATER

Parameters	Method	PRL[4]	Container	Volume[2]	Temperature[3]	Preservative[5]	Technical Holding Times (Days)	Precision and Accuracy
pH, Temperature	EPA 150.1, 170.1	NA	HDPE Bottle with Teflon-lined lid	1 Liter	N/A	None	1	+/- 20% 75%-125%
Conductivity	EPA 120.1	NA	HDPE Bottle with Teflon-lined lid	1 Liter	4°C +/- 2°	None	28	+/- 20% 75%-125%
Pb (Total and Dissolved)	SW-846 6010C or 6020A	0.01	HDPE Bottle with Teflon-lined lid	1 Liter	4°C +/- 2°	2 ml HNO3 (pH<2)	180	+/- 20% 75%-125%

N/A - Not Applicable

PRL - Practical Reporting Limit

1 - All units are mg/kg based upon dry weight unless otherwise noted. Soil samples with greater than 10% moisture may require an LRL adjusted upward. Reporting limits are goals. These goals are at or near method detection limits and may be impacted by sample volume and/or sample matrix.

2 - Laboratory analysis for the above parameters will require collection of the following sample volumes at each sample station.

3 - Laboratory will measure the temperature of each cooler upon receipt to ensure proper temperature was maintained (4°C +/- 2°).

4 - All units mg/l except as noted.

5 - If field preservation is conducted.

Table 4.2
Sample Alteration Form
Kalaloch Firing Range
Sampling and Analysis Plan

Project Name and Number: _____

Material to be Sampled: _____

Measurement Parameter: _____

Standard Procedure for Field Collection and 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: _____

Table 5.0
Sample Information Summary, Data Quality Objectives, Data Uses, Data Type, and QC Levels
Kalaloch Firing Range
Sampling and Analysis Plan

Data Quality Objectives	Existing Data Summary	Design Rational, Data Needs and Parameters [1]	Scheduling and Sample Selection Procedures[2]	Data Use	Analysis Type	Measurement Classification and QC Level
Determine lead concentrations in Site soils.	Seven samples collected in 2007.	Screen soils with XRF for lead.	Samples will be collected during characterization activities.	Determine extents of lead impacts	XRF field screening, soil metals analysis (Pb, dry weight).	Screening (XRF)
Determine lead concentrations in Site soils.	Seven samples collected in 2007.	Sample soils for lead.	Samples will be collected during characterization activities.	Determine extents of lead impacts	Analytical Laboratory soil metals analysis (Pb, dry weight).	Definitive (Laboratory)
Determine if surface and shallow groundwater discharging from the Site meets applicable water quality standards.	None	Determine total and dissolved lead concentrations.	One set of samples per media.	Confirm that Site is not discharging Pb.	Water quality analysis, field parameters, total and dissolved Pb.	Definitive

1 - Detection limits and Methods are specified on Table 4.1.

2 - Locations will be determined in the field.

Table 8.0
Precision, Accuracy, Representativeness, Comparability and Completeness (PARCC)
Kalaloch Firing Range
Sampling and Analysis Plan

Parameter	QC Program	Evaluation Criteria	Acceptance Criteria	Recommended Corrective Actions
Precision	Field Duplicate	Relative Percent Difference (RPD)	RPDs: soil, sediment and water samples +/- 35 percent if > 5 times LRL, or, +/- LRL if < 5 times LRL	Verify the RPD calculation. If correct, determine if matrix interference or heterogeneous samples are factors in poor RPD. If matrix effects or heterogeneous samples are not observed, reanalyze the associated investigative samples and MS/MSD. If appropriate, reextract or redigest and reanalyze the associated investigative samples and MS/MSD.
	Matrix Spike/Matrix Spike Duplicate (MS/MSD)	Relative Percent Difference (RPD)	See method-specific control limits[1]	Verify the RPD calculation. If this is correct, determine if matrix interference or heterogeneous samples are factors in poor RPD. If matrix effects or heterogeneous samples are not observed, reanalyze the method duplicate and associated investigative samples.
Accuracy	Matrix Spike (MS)	Percent Recovery	See method-specific control limits[1]	Verify the matrix spike percent recovery calculations and evaluate the LCS percent recovies. If the calculations are correct and the LCS recoveries are acceptable, determine if matrix interference is a factor in the poor recoveries. If matrix effects not observed, reanalyze the MS and associated samples. If appropriate, reextract or redigest and reanalyze the MS and associated investigative samples.
	Matrix Spike Duplicate (MSD)	Percent Recovery	See method-specific control limits[1]	Same as above.
	Laboratory Control Samples (LCS)	Percent Recovery	See method-specific control limits[1]	Verify the percent recovery calculations. Evaluate the standard to determine if it is faulty. If it is, prepare a new standard and reanalyze the LCS and associated investigative samples. If necessary, recalibrate the instrument. Do not continue analysis until problem solved.
Representativeness	Holding Times	Representative of Environmental Conditions	Holding times met 100 percent	Evaluate whether data is critical to decision making. If so, resample and reanalyze for parameter exceeding holding time.
	Method Blanks	Qualitative Degree of Confidence	See method specific requirements[1]	Evaluate instrument, locate source of contamination, perform system blanks to confirm that system blanks meet performance criteria. Re-analyze method blank and associated samples. If method blank still above acceptance criteria, reextract or redigest the method blank and all associated samples.
	Equipment/Rinsate Blanks	Qualitative Degree of Confidence	Target analytes <1 X LRL; 5-10 X LRL for laboratory-inducted contaminants.	Suggests field sampling-induced contamination may have occurred. Evaluate all associated QC samples. If all other QC samples are within prescribed acceptance limits, but equipment blank is not (e.g., positive identification of target analytes observed), contact USEPA immediately to determine if resampling and/or reanalysis required.
	Field Duplicates	Qualitative Degree of Confidence	90 Percent of Field Duplicates Meet RPD Goals	If acceptance criteria not met, evaluate reasons for not meeting criteria (I.e., matrix interferences or heterogeneous samples) and make recommendations on whether resampling and/or reanalysis is necessary to improve degree of confidence.
Comparability	Standard Units of Measure	Qualitative Degree of Confidence	Laboratory Methods Followed	Revise analytical reports with correct units.
	Standard Analytical Methods		SOPs Followed	If SOPs not followed, evaluate whether reanalysis is necessary to obtain reliable data.
Completeness	Complete Sampling	100 Percent Valid[2] Samples	90 Percent Valid[2] Data	If not enough samples were collected for project needs, collect and analyze additional samples for parameters needed for key decisions.

[1] Laboratory Control limits are specific to individual analytical/digestion methods and any deviation outside control limits are reported (see method-specific SOPs in Appendix A).
[2] Valid means that samples meet all evaluation criteria (I.e., are not rejected for any reason).

Precision is a measure of how repeatable data are and is often measured by sample duplicates.
Accuracy is a measure of how close the data are to the actual, or real value, measured by certified reference materials and matrix spikes.
Representativeness is a measure of how representative a sample is of the sample population and is achieved by accurate sampling procedures and appropriate sample homogenization.
Comparability looks at ongoing projects and how variable one set of data is relative to another. Comparability helps to measure the scientific consistency of the system to past work.
Completeness is a measure of how many data points collected are usable; 90% usable data is considered to be an acceptable value for completeness.

Table 8.1
Data Validation and Verificaiton Requirements
Kalaloch Firing Range
Sampling and Analysis Plan

Data Validation and Verification Steps		Data Validation and Verification Methods
Samples were collected according to established locations and frequencies.	→	Comparison with Sampling Plan
Sample collection and handling followed established procedures.	→	Review of field notes, field procedures and COCs
Appropriate analytical methods were used; internal laboratory calibration checks were performed according to the method-specified protocol.	→	Review of analytical methods and case narratives provided with laboratory reports. Documentation of any communications with laboratory concerning problems or corrective actions.
Required holding times and laboratory reporting limits were met.	→	Comparison with established holding times and LRLs.
Field Duplicates for QA/AC	→	Field duplicates met acceptance criteria tabulation of RPDs and comparison with PARCC parameters
Acceptance criteria (see Table 8.0) for field and laboratory QC samples (field blanks, field dups, equipment/rinsate blanks, method blanks, LCS) were met.	→	Tabulation of RPDs and spike recoveries, and direct comparison with method-specific acceptance criteria (see SOPs in Appendix A). Comparison with PARCC parameters.
Appropriate steps were taken to ensure the accuracy of data reduction, including reducing data transfer errors in the preparation of summary data tables and maps.	→	Maintain permanent file for laboratory hardcopies of analysis reports. Minimize retyping of data and error check data entered into database, tables, maps, etc.

RPD - Relative Percent Difference
LRL - Laboratory Reporting Limit

APPENDIX A

STANDARD OPERATING PROCEDURES

RMC SOP 1
STANDARD PROCEDURES FOR COLLECTION OF SURFACE WATER SAMPLES

1.0 Purpose

This SOP describes the procedures that will be used for collection of surface water samples. The procedures will ensure that samples are collected and handled properly and that appropriate documentation is completed.

1.0 Sampling Equipment:

- Log forms / Field notebook / Chain of Custody Forms (COC) – Documentation of sample activities, field notes and sample custody.
- Sample containers – Containers provided by laboratory for the collection, storage and transportation of samples.
- Direct reading instruments – field instruments to measure pH, conductivity and temperature.
- Disposable sampling gloves – to prevent exposure to water and the prevention of cross-contamination.
- Custody seals – seals to be placed on sample containers to maintain sample integrity.
- 0.45 um filter apparatus with inert filters – for filtering samples in preparation for the analysis of dissolved metals.
- Nitric acid (HNO_3, supplied by the analytical laboratory) – for sample preservation.
- Water velocity meter and tape measure – to measure stream flow (where applicable).
- Distilled water – for rinsing direct reading instruments.
- Custody seals – seals to be placed on sample containers to maintain sample integrity.

2.0 Procedure

Sample bottles will remain sealed until the water sample is collected. At that time, the bottle lid will be removed and placed, top down, in an appropriate place. The sample bottle will be placed under the flow of water. If wading is required for sample collection, the sample must be collected upstream of wading personnel to avoid the sampling of suspended sediments. The container will be rinsed three times. After rinsing the container will be completely filled; any overflow of the sample container will be kept to a minimum. Sediment disturbance shall be kept to an absolute minimum. The sample cap will then be replaced on the sample bottle. All surface water samples will be collected in accordance with containers, volumes, preservatives, temperatures and holding times as outlined in Table 4-1 of the Sampling and Analysis Plan.

3.0 Dissolved Metals Analysis

Surface water samples collected for analysis of Dissolved (D) Metals will be a minimum volume of 500 ml, collected in a poly or glass container. The samples will be field filtered. The field filtering methodology will include the following steps:

1: Sample shall be collected in a 1000 ml bottle.

2: Sample is poured into the top of the disposable plastic filter.

3: Vacuum pump is attached to the filter and pumped.

4: When the bottom compartment of the filter is full, the water is to be transferred into a 500 ml sample container which shall be rinsed three times, the sample will be preserved with 2 ml of nitric acid (HNO_3), sufficient to bring the sample to pH <2.

5: The pH level in samples will be verified using pH paper before bottles are sealed if field preservation occurs.

4.0 Total Metals Analysis

Surface water samples collected for analysis of Total (T) Metals will be a minimum volume of 500 ml, collected in a poly or glass container, and preserved with 2 ml of nitric acid (HNO_3), sufficient to bring the sample to pH <2. The pH level in samples will be verified using pH paper before bottles are sealed.

5.0 Cations/Anions and Total Suspended Solids

Cations/Anions and Total Suspended Solids samples shall be collected in accordance with the methodologies outlined in the Procedure section of this SOP. Samples will not be preserved.

6.0 Stream flow Measurement

Stream flow volumes shall be measured during surface water sampling activities. To minimize sediment disturbance during sampling, the stream flow measurements should be conducted either downstream from the sampling point or after the completion of sample collection. RMC uses an electronic flow meter. The procedure for measuring stream flows is as follows:

1: Measure the width of the stream and divide the width into 0.5 foot increments.

2: At the midpoint of each 0.5 foot increment record the total depth of the stream. The water velocity shall be measured at 0.6 of the total height of the water (e.g. if the water is one foot deep the velocity is measured at a depth of 0.4 foot from the surface or 0.6 feet from the streambed).

3: Turn the electronic stream meter gauge on. Set the meter to record the average velocity. Insert the stream flow gauge into the water at the midpoint of each segment with the arrow pointing in the direction of flow. Measure the velocity for approximately one minute and record the average.

4: Calculate the stream flow by calculating the area of each 0.5 foot wide segment by multiplying the width times depth. To obtain the flow volume for each 0.5 wide segment multiply the area of the segment by the average flow velocity for the segment. The obtain the total stream flow add the total stream flow for each segment. An Excel spreadsheet is typically used for the calculations.

Calculations:

Segment flow volume = depth of 0.5 foot segment x width x flow velocity (feet/sec.) = cubic feet/ second
Total flow volume = sum of segment flow volumes.

7.0 Labeling

Each sample will be labeled with the following information:

- Sample identification;
- Project number/name;
- Analyses requested;
- Preservatives (if required);
- Date/time collected; and
- Samplers initials.

8.0 Documentation

Field activities shall be recorded in a hard bound field notebook. Field notes shall include all pertinent information including but not limited to:

- Date and time samples were collected;
- Physical description of sample area;
- Identification of samples collected;
- Total number of samples collected;
- Total number of samples collected from each sample location;
- Physical description of samples;
- Preservatives used for samples;
- Sample container types;
- Filtered vs. Unfiltered samples (water);
- Analysis to be performed;
- Weather conditions;
- Hand sketches of subject area(s); and
- Description and date of any photograph(s) taken.

Sample handling and Chain of Custody documentation shall be in accordance with RMC SOP 5 found in this document.

9.0 Demobilization

After Decontamination, sample equipment will be stored in the appropriate, clean containers. Any equipment that suffers damage or excessive wear while conducting sampling will be labeled and reported to the equipment manager for the necessary maintenance, repair and/or replacement.

SOP 2
STANDARD PROCEDURES FOR COLLECTION OF SOIL SAMPLES

1.0 Purpose

This SOP describes the procedures that will be used for sampling surface soils from ground surface to a maximum of 18 inches below surface. Samples will be collected with a Decontamination shovel or hand auger/probe. Specific soil sampling locations will be determined from the project work plan.

2.0 Sampling Equipment:

- Hand Auger/Probe and/or Shovels – For the collection of soil samples below the ground surface.
- Log forms / Field notebook / Chain of Custody (COC) - Documentation of sample activities, field notes and sample custody.
- Sample containers - Containers provided by laboratory for the collection, storage and transportation of samples.
- Stainless steel sample spoons – For the collection of surface soil samples and composite sample mixing.
- Sample location staking – For the marking and identification of sample locations. Staking should be easily visible for surveying.
- Disposable sampling gloves – to prevent exposure to soils and the prevention of cross-contamination.
- Custody seals – seals to be placed on sample containers to maintain sample integrity.

3.0 Decontamination Equipment:

- 5 gallon buckets – For washing and the collection of rinsate.
- Alconox - Soap
- Scrub brushes – For cleaning sampling equipment.
- Distilled water – For final equipment rinse.
- Culinary tap water – for equipment rinse.
- Garbage bags – for clean equipment storage.

4.0 PROCEDURE:

All samples shall be collected using Decontaminated equipment. Decontamination procedures are detailed in RMC SOP 6.

4.1 Discrete Samples

If significant vegetation, rocks, or debris prevent collecting the surface samples then the upper 2-3 inches of soil will be scraped away from the sample location with a shovel or stainless steel spoon. The underlying soil will then be collected and placed into sample containers with a stainless steel spoon or gloved hand. Composite samples will be homogenized as described below. Coarse grained soils, gravel and rock fragments will be removed wherever possible.

4.2 Composite Samples

Composite samples will be collected (as described above) by placing sub samples into a stainless steel mixing bowl or a clean plastic bag, or by hand with new, clean sampling gloves. The sample will be homogenized with a stainless steel spoon or gloved hand. The homogenized soil will be packaged in a laboratory-supplied sample container, labeled and placed in a cooler to maintain temperature.

4.3 Sediment Samples

Sediment samples will be collected from depths of up to 10 cm using a procedure similar to that used for discrete surface soil samples.

5.0 Sample Preparation

Soil Samples collected for human health risk assessment shall be sieved to <250 microns. The <250 micron fraction is then analyzed for metals. For ecological screening/risk assessment purposes, sieving should not occur. Sieving shall be performed by the laboratory.

6.0 Labeling

Each soil sample will be labeled with the following information:

- Sample identification;
- Project number/name;
- Analyses requested;
- Date/time collected; and
- Samplers initials.

7.0 Documentation

Field activities shall be recorded in a hard bound field notebook. Field notes shall include all pertinent information including but not limited to:

- Date and time samples were collected;
- Physical description of sample area;
- Identification of samples collected;
- Total number of samples collected per sampling event;
- Total number of samples collected from each sample location;
- Physical description of samples;
- Preservatives used for samples;
- Sample container types;
- Filtered vs. Unfiltered samples (water);
- Analysis to be performed;
- Weather conditions;
- Hand sketches of subject area(s); and
- Description and date of any photograph(s) taken.

Sample handling and Chain of Custody documentation shall be in accordance with RMC SOP 5 found in this document.

8.0 Demobilization

After Decontamination, sample equipment will be stored in the appropriate, clean containers. Any equipment that suffers damage or excessive wear while conducting sampling will be labeled and reported to the equipment manager for the necessary maintenance, repair and/or replacement.

SOP 3
STANDARD PROCEDURES FOR GROUNDWATER SAMPLING

1.0 Purpose

This SOP describes the procedures that will be used for collecting groundwater samples. Samples will be collected with a new disposable bailer and/or a Decontaminated downhole pump. Specific monitoring well locations will be determined from the project work plan.

2.0 Sampling Equipment:

- Log forms / Field notebook / Chain of Custody Forms – Documentation of sample activities, field notes and sample custody.
- Sample containers – Containers provided by laboratory for the collection, storage and transportation of samples.
- Micro piezometer, tubing and syringes (for shallow groundwater sampling)
- Direct reading instruments – field instruments to measure pH, conductivity and temperature.
- Disposable sampling gloves – to prevent exposure to water and the prevention of cross-contamination.
- Custody seals – seals to be placed on sample containers to maintain sample integrity.
- 0.45 um filter apparatus with inert filters – for filtering samples in preparation for the analysis of dissolved metals.
- Nitric acid (HNO_3, supplied by the analytical laboratory) – for sample preservation.
- Distilled water – for rinsing direct reading instruments.
- Water level probe – to measure water level (if required for monitoring wells)
- Disposable bailers – to extract water from monitoring wells
- Clean new twine – to lift bailers out of wells.
- Downhole pump – if required for deep wells.
- Water level probe – to measure water level.
- Field notebook – for recording field data.

3.0 Decontamination Equipment

- 5 gallon buckets – For washing and the collection of rinsate.
- Alconox - Soap
- Scrub brushes – For cleaning sampling equipment.
- Distilled water – For final equipment rinse.
- Culinary tap water – for equipment rinse.
- Garbage bags – for clean equipment storage.

4.0 Procedure

Micropiezometers

Place Micropiezometer to desired depth. Extract water using tubing and syringe. Use the syringe to fill he sample bottle

Monitoring Wells

Unlock and open the well, obtain a water level by inserting a Decontaminated water level probe into the well and measuring the standing water surface to the established datum point on the top of the well head. The established datum point can be installed by using a file to insert a notch in the PVC casing.

Purge the well with appropriate water removal device (Decontaminated bailer/pump or disposable bailer). A total of three well bore volumes of water are normally removed.

Determine the well volume (V) by the following formula:

V in gallons $=\pi r^2 h \times 7.48$

Where $\pi = 3.14$
r = radius of well casing converted to feet
and h = Water level – total depth of well (determined from drillers log or previous well sounding)

Pump or bailer discharge during purging is directed to a bucket or container to determine purge rate.

Samples are collected after a sufficient purge volume is withdrawn. Bottles are filled directly from discharge from the well or from another clean container.

After the bottles are filled, the appropriate preservatives are added, if required. The pH level in samples will be verified using pH paper before bottles are sealed.

If dissolved metals analysis is required, filtration is required and the samples will be field filtered. The field filtering methodology will include the following steps:

1: Sample shall be collected in a 1000 ml bottle.

2: Sample is poured into the top of the disposable plastic filter.

3: Vacuum pump is attached to the filter and pumped.

4: When the bottom compartment of the filter is full, the water is to be transferred into a 500 ml sample container which shall be rinsed three times, the sample will be preserved with 2 ml of nitric acid (HNO_3), sufficient to bring the sample to pH <2.

5: The pH level in samples will be verified using pH paper before bottles are sealed. The pH level in samples will be verified using pH paper before bottles are sealed.

5.0 Labeling

Each soil sample will be labeled with the following information:

- Sample identification;
- Project number/name;
- Analyses requested;
- Preservatives;
- Date/time collected; and
- Samplers initials

6.0 Documentation

Field activities shall be recorded in a hard bound field notebook. Field notes shall include all pertinent information including but not limited to:

- Date and time samples were collected;
- Physical description of sample area;
- Lithologic descriptions of soils encountered;
- Identification of samples collected;

- Total number of samples collected per sampling event;
- Total number of samples collected from each sample location;
- Physical description of samples;
- Preservatives used for samples;
- Sample container types;
- Analysis to be performed;
- Well construction details;
- Weather conditions;
- Hand sketches of subject area(s); and
- Description and date of any photograph(s) taken.

7.0 Decontamination

If cross contamination of sampled wells is a potential problem, the following procedure should be followed:

1. Decontamination equipment according to RMC SOP 6.
2. Design sampling to proceed from best quality water to the poorest quality water.
3. If a pump is used rinse the pumping apparatus if well yields are too low to allow sufficient water to purge the pump.
4. Use one disposable bailer for both purging and sampling per well.

8.0 Demobilization

After Decontamination, sample equipment will be stored in the appropriate, clean containers. Any equipment that suffers damage or excessive wear while conducting sampling will be labeled and reported to the equipment manager for the necessary maintenance, repair and/or replacement.

SOP 4
STANDARD PROCEDURES FOR SAMPLE HANDLING, DOCUMENTATION, AND SHIPPING

1.0 Purpose

This section describes the handling and documentation procedures that will be used once soil and water samples are collected. The procedures will ensure that samples are handled properly and that appropriate documentation is completed.

2.0 Sample Handling

All samples will be promptly placed into a cooler to maintain a temperature of 4°C. Typically, samples selected for chemical analysis will be delivered at the end of each day to the analytical laboratory. If they are not submitted to the laboratory on the same day, they will be stored in a refrigerator in a locked storage room until they can be delivered to the laboratory.

3.0 Sample Identification and Labeling

Soil samples will be labeled in such a way as to identify the area and depth from which they were taken. Water samples will be labeled as to identify when and where they were collected from. Duplicate samples will always be labeled in the same manner such that the laboratory cannot tell they are duplicate (i.e., as a "blind duplicate"). Each sample container will be immediately labeled with the following information:

- Project name
- Project number
- Sample identification
- Date and time collected
- Analysis requested
- Filtered or unfiltered (water)
- Samplers initials
- Preservative used (water)

This information will also be recorded in the field logbook.

5.0 Custody Seals

Custody seals shall be used to prevent tampering and to maintain sample integrity. A seal shall be placed across the top of sample jars or across the seals of plastic sample bags. The seal shall be signed and dated by the sampler who collected the sampler.

6.0 Chain-of-Custody (COC)

COC documentation will begin in the field for each sample submitted to the laboratory and will also be maintained by laboratory personnel. Samples that are submitted to AEC will use the COC provided by AEC. A COC for each sampling event will be completed and will accompany each sample batch to the analytical laboratory. Sample custody means that all samples will remain in the possession or observation of the sampler at all times, or in a locked facility until delivery to the analytical laboratory. A sample COC form is provided in Appendix D. Copies of the COC forms shall be stored in a three ring binder for sample tracking.

7.0 Field Book

RMC field personnel will maintain a field logbook to record all field activities. The field logbook will be a weather-resistant bound field book. All data generated during the project and any accompanying comments will be entered directly into the logbook in indelible ink; any corrections will be made with single line-out deletions. At no time will any pages be removed from the field logbook.

Each day's field activities will be documented, including the following minimum information:

- Date of field activity;
- Time of field activity;
- RMC field personnel's initials;
- Project name;
- Project number;
- Date and time samples were collected;
- Physical description of sample area;
- Identification of samples collected;
- Total number of samples collected per sampling event;
- Total number of samples collected from each sample location;
- Physical description of samples;
- Preservatives used for samples;
- Sample container types;
- Filtered vs. Unfiltered samples (water);
- Analysis to be performed;
- Weather conditions;
- Hand sketches of subject area(s); and
- Description and date of any photograph(s) taken.

8.0 RMC Sample Logbook

RMC will maintain a sample logbook, which will track all samples collected and/or accepted by RMC. The logbook will provide a unique, six digit alphanumeric identifier that will be assigned to each sample collected. All samples collected will be assigned an identifier number, regardless of that samples' submission to a laboratory. The next available chronological number in the sample logbook will determine the identifier, and this number will be cross-referenced with a sample description number, assigned in the field.

The RMC Sample logbook will be a covered, bound journal with non-removable pages. At no time will any pages be removed from the sample logbook.
All entries into the sample logbook will be made in indelible ink; and all corrections shall consist of initialed, line-out deletion. Data contained therein will include:

- Unique identifier number;
- Date;
- Project number;
- Sample description number;
- Sampler initials; and Lab acceptance initials.

SOP 5
STANDARD PROCEDURES FOR SAMPLING EQUIPMENT DECONTAMINATION

1.0 Purpose

This SOP details the Decontamination protocols for sampling equipment. In order to reduce the risk of transferring materials from one sample site to another, and to assure that there is no cross-contamination of samples, the following procedures will be used.

2.0 Decontamination Equipment:

- 5 gallon buckets – For washing and the collection of rinsate.
- Alconox - Soap
- Scrub brushes – For cleaning sampling equipment.
- Distilled water – For final equipment rinse.
- Culinary tap water – for equipment rinse.
- Garbage bags – for clean equipment storage.

3.0 DECONTAMINATION PROCEDURES:

RMC uses the following Decontamination procedure for equipment:

3.1 Gross contaminant removal

This step involves scrubbing the equipment using an Alconox and water solution and a stiff scrub brush. The scrubbing will continue until all visible contaminants are removed from the equipment. This water will be changed as necessary. The Alconox and water solution is typically prepared and stored in a clean 5-gallon bucket.

3.2 Clean detergent wash

This step involves using a clean volume of Alconox and water solution. Equipment will be washed in this solution once all gross contaminants have been removed during Step 1. This solution will also be changed as necessary. The Alconox and water solution is typically prepared and stored in a clean 5-gallon bucket.

3.3 Clear water rinse

This step involves rinsing the equipment in clear, culinary tap water. This water will be changed as necessary to maintain its purity. The water solution is typically collected and stored in a clean 5-gallon bucket.

3.4 Distilled water rinse

Distilled water will be used as a final rinse for all Decontamination procedures. The water will be poured from a new container, or sprayed from a suitable container or the equipment will be submerged in a suitable container. Decontamination (equipment) blanks will be collected as required in the Sampling and Analysis Plan. The water solution is typically collected and stored in a clean 5-gallon bucket.

3.5 Decontamination fluid disposal

Decontamination fluids shall be disposed of on-site in the tailings impoundment area.

SOP 6
STANDARD PROCEDURES FOR XRF FIELD SCREENING

1.0 Purpose

This SOP describes the procedures that will be used for the collection of X-Ray Fluorescence Spectrometry (XRF) field screening data. This procedure outlines the use of a hand held portable XRF to collect in real time, in situ "ground shots". The methodologies outlined in this SOP are based on EPA method 6200 "Field portable X-Ray Fluorescence Spectrometry for the Determination of elemental Concentrations in Soil and Sediment".

2.0 Sampling Equipment

- Field data sheets / Field notebook / Chain of Custody Forms (COC) – Documentation of sample activities and field notes.
- Field portable XRF
- Known standard samples.

3.0 Procedure

The XRF will be operated by trained personnel in accordance with the manufacture's operating manual. Prior to use the XRF will be calibrated against known standards. The first standard to be used will be an instrument blank consisting of silicon dioxide. The instrument blank is used to verify that no contamination exists in the XRF. The second set of standards will be precision measurement standards. The precision measurement standards will consist of samples with low, medium and high known concentrations of target analytes. A minimum of two precision measurements will be conducted daily. Each precision measurement will be conducted three times in replicate to measure consistency in sample readings. The results of calibration will be noted in the field notebook.

Field screening ground shots will be collected by placing the XRF unit on a smoothed, level section of the exposed soil to be tested. If required, a disposable piece of survey lathe will be used to provide a consistent level, smooth surface for analysis. The soil will be screened for approximately one minute in each location. Five replicate measurements will be taken in each location. The XRF will be moved approximately one inch for each replicate. If required on a project specific basis, the target analyte concentration for each replicate measurement will be noted and recorded. If required on a project specific basis a pin flag with the screening results may be placed in each screening location.

This procedure will not be conducted on soils with excessive moisture contents (e.g. soils that appear wet or saturated).

4.0 Documentation

Field activities shall be recorded in a hard bound field notebook according to project specifications. Due to the large amounts of data collected only selected final screening data may be recorded. Field notes shall include all pertinent information including but not limited to:

- Date and time screening was conducted;
- Physical description of sample area;
- Soil moisture conditions;
- Analysis to be performed;
- Weather conditions;
- Hand sketches of subject area(s); and
- Description and date of any photograph(s) taken.

7.0 Demobilization

After completion of sampling, sample equipment will be stored in the appropriate, clean containers. Any equipment that suffers damage or excessive wear while conducting sampling will be labeled and reported to the equipment manager for the necessary maintenance, repair and/or replacement.