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Quality Assurance Project Plan

Upper Columbia River
Phase 2 Sediment Study
Split Sample Metals Analysis

Upper Columbia River, Washington

Prepared for

U.S. Environmental Protection Agency
Region 10

September 2013

Prepared by
CH2MHILL

AES10
Architect and Engineering Services Contract
Contract No. 68-S7-04-01

Quality Assurance Project Plan

Upper Columbia River

Phase 2 Sediment Study
Split Sample Metals Analysis

Plan approvals:

Marilyn Gauthier
CH2M HILL Project Manager

Laura Buelow and Matt Wilkening
EPA Task Order Project Officers

Artemis Antipas

Artemis Antipas, Ph.D.
CH2M HILL Quality Assurance Officer

Ginna Grepo-grove

Digitally signed by Ginna Grepo-grove
DN: cn=Ginna Grepo-grove, o=USEPA, ou=OEA, email=grepo-grove.gina@epa.gov, c=US
Date: 2013.09.19 12:36:45 -07'00'

Ginna Grepo-Grove
EPA Quality Assurance Manager

NA

Other Agency Approval, Agency *(if required)*

Distribution List

Name/Organization	Address/Phone/Email	Document Distribution
Laura Buelow EPA Task Order Project Officer	U.S. EPA, Hanford Project Office 309 Bradley Blvd, Suite 115 Richland, WA 99352 Phone: 509 376-5466 Fax: 509 376-2396 E-mail: buelow.laura@epa.gov	QAPP, FSP
Matt Wilkening EPA Task Order Project Officer	U.S. EPA, Idaho Office 950 W. Bannock St Boise, ID 83702 Phone: 208/378-5760, Fax: 208/378-5744 email: wilkening.matt@epa.gov	QAPP, FSP
Gina Grepo-Grove EPA Quality Assurance Manager/ CLP Project Officer	EPA Region 10 1200 Sixth Avenue Seattle, WA 98101 (206) 553-1632 Grepo-Grove.Gina@epamail.epa.gov	QAPP
Jennifer Crawford EPA QAO EPA Regional RSCC	EPA Region 10 1200 Sixth Avenue Seattle, WA 98101 (206) 553-6261 Crawford.Jennifer@epa.gov	QAPP (e-copy only)
Marilyn Gauthier CH2M HILL Project Manager	2020 4th Ave SW, Suite 300 Portland, OR 97201 (503) 872 4800 Marilyn.Gauthier@ch2m.com	QAPP, FSP
Artemis Antipas CH2M HILL Quality Assurance Officer	1100 112th Ave NE, Suite 400 Bellevue, WA 98004-4504 (425) 233-3051 Artemis.Antipas@CH2M.com	QAPP (e-copy only)
Cameron Irvine CH2M HILL Field Team Leader	2485 Natomas Park Drive Suite 600 Sacramento, CA 95833 Cameron.Irvine@CH2M.com	QAPP (e-copy only)
Tina Rice CH2M HILL Data Base Manager	2020 South West 4th Avenue 3rd Floor Portland, OR 97201-4958 (503) 872-4513 Tina.Rice@Critigen.com	QAPP (e-copy only)

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Acronyms and Abbreviations

AES	Architect and Engineering Services
BLM	Bureau of Land Management
CLP	Contract Laboratory Program
DQO	Data Quality Objective
FSP	Field Sampling Plan
FTL	Field Team Leader
HSP	Health and Safety Plan
MDL	Method Detection Limit
MEL	Manchester Environmental Laboratory
PM	Project Manager
PO	Project Officer
QA	Quality Assurance
QAO	Quality Assurance Officer
QAPP	Quality Assurance Project Plan
QC	Quality Control
RI	Remedial Investigation
RPD	relative percent difference
RSCC	Regional Sample Control Coordinator
RSD	relative standard deviation
RTL	Review Team Leader
SOP	Standard Operating Procedure
SRM	standard reference material
TAI	Teck American Incorporated
TOPO	Task Order Project Officer
TSU	Technical Support Unit
UCR	Upper Columbia River
EPA	U.S. Environmental Protection Agency

USGS	U.S. Geological Survey

SECTION 1

1 Introduction

This Quality Assurance Project Plan (QAPP) presents the policies, organizations, objectives, and functional activities/procedures for the **Phase 2 Sediment Study Split Sample Metals Analysis** being conducted by the U.S. Environmental Protection Agency (EPA) in the Upper Columbia River, Washington in 2013. The QAPP and its supporting documents, found in Appendix A (Data Quality Objectives [DQOs]) have been developed to document the type and quality of data needed for environmental decisions. Note, the split samples described in this QAPP will be collected in the laboratory following homogenization of samples collected at the designated locations. Therefore, this QAPP does not contain an appendix describing the field procedures for split sample collection.

The QAPP follows EPA guidelines contained in *EPA Guidance for Quality Assurance Project Plans* (EPA, 2002a), and *EPA Requirements for Quality Assurance Project Plans* (EPA, 2001, reissued 2006). The contents of the QAPP also meet the *Uniform Federal Policy for Quality Assurance Project Plans* (EPA, 2005). The development, review, approval, and implementation of the QAPP is part of EPA's mandatory quality system, which requires all organizations to develop and operate management structures and processes in order to ensure that data used in agency decisions are of the type and quality needed for their intended use. This document structure correlates with the subtitles found in the EPA guidelines (EPA, 2001, 2006), consistent with *Uniform Federal Policy for Quality Assurance Project Plans* (EPA, 2005.)

This document is organized as follows:

- **Section 1—Introduction.** Provides the purpose and organization of this report.
- **Section 2—Project Management (EPA Group A).** Provides a summary-level description of the project and task organization; background and problem definition; work tasks and project schedule; quality and objectives criteria; special training and certifications; and documents and records.
- **Section 3—Data Generation and Acquisition (EPA Group B).** Describes the sampling design; sampling methods; sample handling and custody; analytical methods; quality control; instrument, equipment testing, inspection and maintenance; instrument/equipment calibration and frequency, inspection/acceptance of supplies and consumables; nondirect measurements; and data management.
- **Section 4—Assessment and Oversight (EPA Group C).** Describes assessment, oversight, and reports to management.
- **Section 5—Data Validation and Usability (EPA Group D).** Introduces the concepts of data review, verification, and validation; describes verification and validation methods; and explains reconciliation with user requirements.
- **Section 6—References.** Provides a list of references used in this document.

In addition to the sections summarized above, this QAPP contains the following appended materials:

- **Appendix A—Systematic Planning/Data Quality Objectives**
- **Appendix B – Field Oversight Plan**
- **Appendix C - Health and Safety Plan**

SECTION 2

2 Project Management (EPA Group A)

2.1 Project/Task Organization (A4)

The task order for this project was issued pursuant to EPA Architect and Engineering Services (AES) Contract No. 68-S7-04-01. The task order is managed by CH2M HILL's Project Manager (PM), who works directly with the EPA Task Order Project Officer (TOPO) to accomplish the task order. The PM manages the financial, scheduling, and technical aspects of the task order. The key people involved in interfacing with the PM are the EPA TOPO and the CH2M HILL Quality Assurance Officer (QAO), Review Team Leader (RTL), Task Leader, and Field Team Leader (FTL). Note that all of the sample collection activities at the Site will be conducted by Teck American Incorporated, (TAI); split samples will be created by TAI's laboratory following homogenization of the field samples. Therefore, the FTL for this project will only be responsible for field oversight of sample collection activities. Field oversight procedures are documented in the Field Oversight Plan, included as Appendix B.

The project organization and lines of authority for CH2M HILL staff are illustrated on Figure 2-1. The data flow is shown on Figure 2-2. The data for this task order are limited to laboratory analyses. Figure 2-1 shows the EPA and CH2M HILL technical and quality assurance personnel. The organizational functions shown are consistent with the overall AES 10 Program Plan (*EPA Management Plans and Standard Operating Procedures for Region 10 Architect Engineering Services*, *Contract Solicitation No. PR-R7-02-10217* [EPA, 2003a and updates]). The AES 10 Program Plan provides additional details for these organizational functions.

The following additional organizational guidelines apply:

- The review team (led by the RTL) and the QAO will review project planning documents, data evaluation, and deliverables. The primary responsibility for project quality rests with the PM, and independent quality control is provided by the RTL and QAO.
- The field team will implement the Field Oversight Plan and Health and Safety Plan (HSP). The site safety coordinator, who is also the FTL, is responsible for adherence to the HSP procedures. The entire field effort is directed by the FTL. Field team responsibilities are further described in the Field Oversight Plan and HSP.
- The subcontract administrator will procure subcontracts for EPA's AES projects under Federal Acquisition Regulations and provides the interface with subcontractors. Subcontractors may be used on this task order for laboratory analyses depending on EPA regional laboratory availability.
- Where quality assurance problems or deficiencies requiring special action are uncovered, the PM, RTL, and QAO will identify the appropriate corrective action to be initiated by the FTL.
- EPA Region 10 (R10) adheres to a national EPA Field and Analytical Services Teaming Advisory Committee (FASTAC) strategy for procurement of all Superfund analytical services. FASTAC consists of EPA Headquarters, Regional Superfund Program staff, and Research, Science and Technology (RS&T) managers. The Field and Analytical Services Teaming Advisory Committee (FASTAC) developed a 'Decision Tree' analytical strategy in 1998 which has been implemented in every EPA Region. According to the Region 10 (R10) *Quality Management Plan* (EPA, 2009a), analytical services requests are funneled through the Regional Sample Control Center (RSCC) Coordinator who selects the analytical vehicle according to the following order:
  - Tier 1—EPA Regional Laboratory and Environmental Services Assistance Team (ESAT) Contract
  - Tier 2—National Analytical Services Contracts (Contract Laboratory Program [CLP])[1]

[1] Information about the EPA Contract Laboratory Program may be found on the CLP Web site: http://www.epa.gov/superfund/programs/clp.

- Tier 3—Region Specific Analytical Services Contracts
- Tier 4—Analytical Services Interagency Agreements (IAGs) and Field Contracts/Subcontracts

A QAPP and R10 Analytical Services Request Form are required for the RSCC to begin laboratory coordination. The R10 laboratory is offered first right of refusal before proceeding to Tier 2. RSCC lab coordination occurs after QAPP development. Therefore, laboratory and analytical specifics throughout the QAPP must be applicable to either the EPA R10 Manchester Environmental Laboratory (MEL) or a laboratory within the EPA CLP, as laboratory assignment is unknown during the planning process. Laboratories are required to meet the analytical requirements set forth in this QAPP for methodology, reporting limits, quality control, and data management. The laboratory data flow is presented in Figure 2-2.

- The EPA RSCC is responsible for both CLP and EPA MEL coordination. The RSCC works with the EPA Regional Quality Assurance Manager, the region's CLP Project Officer (PO), and the project's PMs in resolving laboratory and field quality assurance (QA) issues and laboratory scheduling. The RSCC provides the regional sample tracking numbers, sample tags, custody seals, and other CLP-required chain-of-custody documentation.

FIGURE 2-1
Project Organization and Lines of Authority

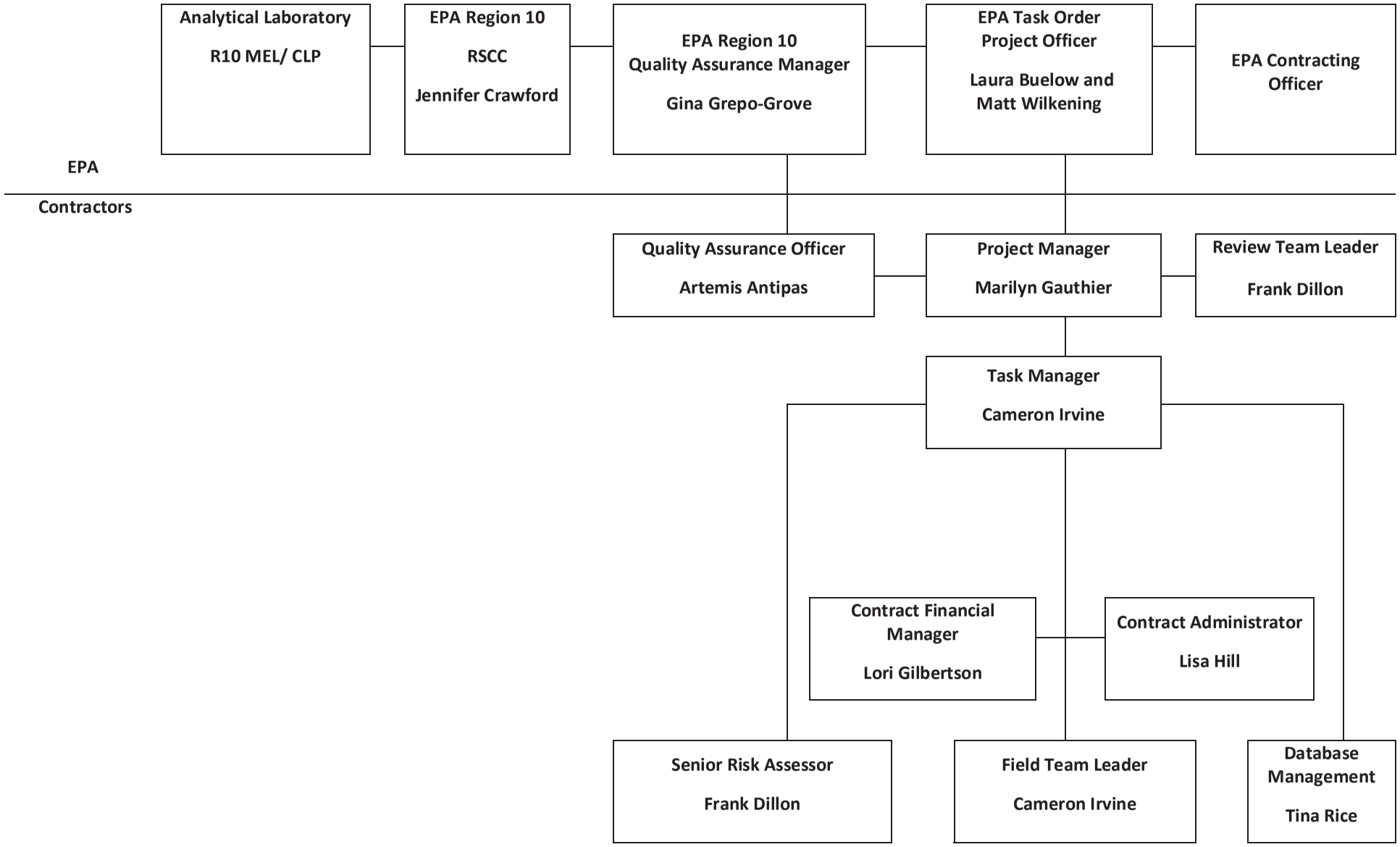
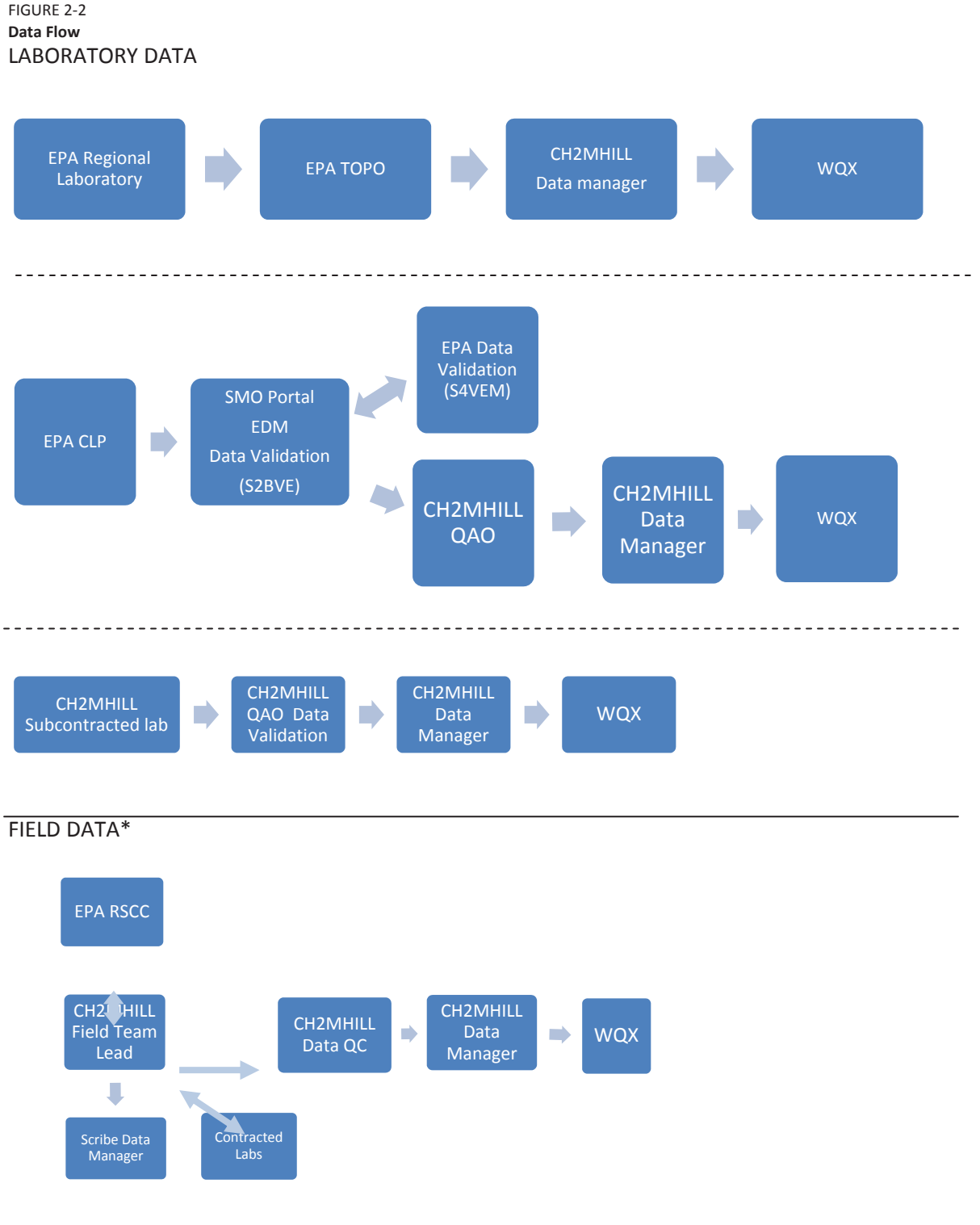


FIGURE 2-2
Data Flow



*Field data will be limited to oversight notes; the split samples will be created and submitted for analysis following homogenization at TAI's laboratory.

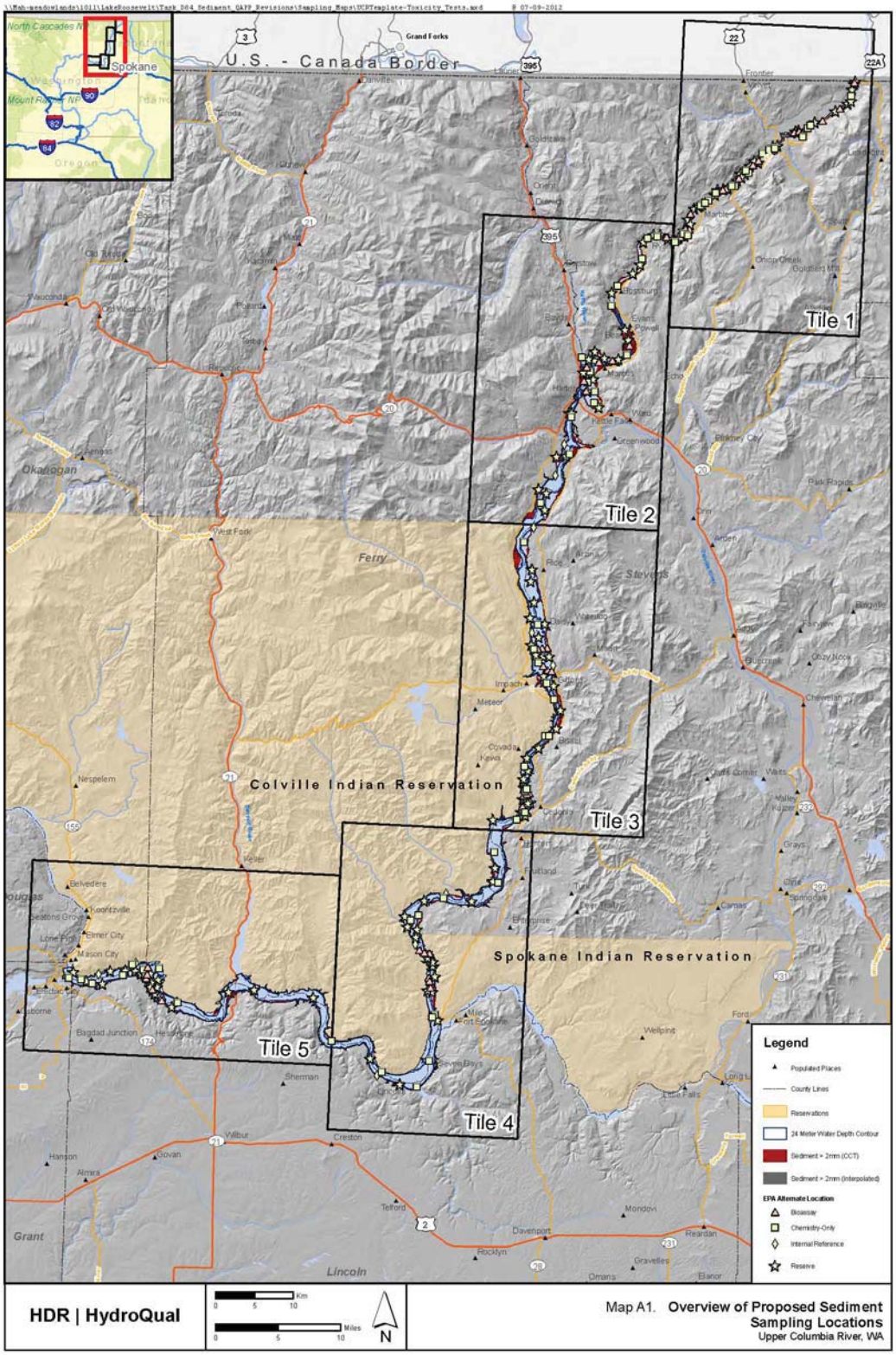

U.S. - Canada Border
Grand Forks
Spokane
Tile 1
Tile 2
Tile 3
Tile 4
Tile 5
Colville Indian Reservation
Spokane Indian Reservation
Okanogan
Ferry
Stevens
Lincoln
Grant
Legend
Populated Places
County Lines
Reservations
24 Meter Water Depth Contour
Sediment > 2mm (CCT)
Sediment > 2mm (Interpolated)
EPA Alternate Location
Bioassay
Chemistry-Only
Internal Reference
Reserve
HDR | HydroQual
Km
Miles
N
Map A1. Overview of Proposed Sediment Sampling Locations
Upper Columbia River, WA

Figure 2-3

2.2 Problem Definition/Background (A5)

2.2.1 Background

One hundred and forty (140) sediment locations have been identified for study as part of the Baseline Ecological Risk Assessment (BERA) that is part of the Remedial Investigation/Feasibility Study (RI/FS) being conducted by TAI under EPA oversight at the UCR site in northeastern Washington. TAI is responsible for collection, processing, and analysis of the sediment samples, as detailed in the *Upper Columbia River Quality Assurance Project Plan for the Phase 2 Sediment Study (*Phase 2 Sediment QAPP) prepared by TAI.

Independent studies conducted to date at the UCR site have identified a number of chemicals of potential concern (COPCs) in sediment that may adversely affect benthic organisms. These studies do not, however, sufficiently establish potential concentration-response relationships, nor do they fully integrate measures of bioavailability. As a result, the primary purpose of the overall Phase 2 sediment study being conducted by TAI is to evaluate if there are unacceptable risks to benthic organisms associated with exposure to sediment/porewater COPCs. To do this, additional sediment/porewater chemistry data and synoptic benthic toxicity tests are needed.TAI data collection efforts will focus on obtaining information that will inform our understanding of potential relationships between sediment chemistry and toxicity.

This QAPP is focused on analysis of split samples from the Phase 2 sediment sampling effort. Phase 2 sample locations are shown in Figure 2-3. The split samples will be obtained at a subset of these locations following homogenization at TAI's laboratory. The split sediment samples obtained under this QAPP will be analyzed for total chemistry only, no biotoxicity tests will be performed using these splits. In addition, no split samples will be collected from the pore water samples obtained in the field or in the laboratory.

A split sample is a sample that has been homogenized and equally divided into two or more subsamples. The purpose of the split sample analysis is to evaluate the analytical data provided by TAI's subcontracted laboratories for: (1) comparability of results - precision (2) sample homogeneity and splitting efficiency and (3) laboratory performance.

2.2.2 Purpose

This QAPP presents the policies, organizations, objectives, and functional activities/ procedures for the **Phase 2 Sediment Study Split Sample Metals Analysis.** The QAPP was developed to document the type and quality of data needed for environmental decisions and to describe the methods for collecting and assessing those data during the implementation of this study.

2.2.3 Problem Definition

The primary objective of the **Phase 2 Sediment Study Split Sample Metals Analysis** is to collect additional sediment data that will insure the reliable characterization of COPC concentrations for use in developing an understanding of potential relationships between sediment chemistry and toxicity. The sediment sample results may also be used to inform the nature and extent evaluations for the RI/FS. Data quality objectives (DQOs) for these uses are detailed in the Phase 2 Sediment Study QAPP.

The following problem statement was identified during the process of identifying DQOs for the split samples for metals analysis:

- Samples collected during the Phase 2 Sediment study will be analyzed by a laboratory subcontracted to TAI. As part of the oversight activities, the EPA will obtain splits of approximately 15 percent of the sediment samples (approximately 21 samples) designated for whole chemistry analysis to assess comparability of results – precision, sample homogeneity and splitting efficiency, and laboratory performance.

2.3 Project Description (A6)

2.3.1 Description of Work Tasks

The work activities covered under this QAPP include the following:

- Analysis of split sediment samples following processing at TAI laboratory
- Report results

2.3.2 Project Schedule

The Phase 2 sediment sampling effort is scheduled to begin in September 2013 and continue for five to seven weeks. Proposed sediment sample locations are shown in Figure 2-3. Samples will be shipped from the field to the laboratory by TAI. The laboratory will homogenize the samples and create splits from designated sample locations on a weekly basis.

2.4 Quality Objectives and Criteria (A7)

2.4.1 Project Quality Objectives

Project-specific technical systematic planning has been carried out through the DQO process planning tool (EPA, 2006) to meet decision maker and data user needs for each activity. Appendix A presents the DQO decision-making process findings for the split samples.

The data needs as determined through the DQO process are presented in Table 2-1 (located at the end of this section). This table lists the specific analytes, data uses, data users, and needed detection levels. Measurement performance criteria for the split samples are listed in Table 2-2. The selected analytical methodology and associated laboratory and field analytical reporting limits are shown in Table 2-3.

The needed detection limits or Ecological Screening Values for Phase 2 Sediment Samples and the analytical reporting limits (Table 2-3) are compared in Step 5 of the DQOs (Appendix A). The target analytical reporting limits (i.e., method detection limits [MDLs] and method reporting limits [MRLs]) are consistent with the needed limits. The selected methods are state-of-the-art and what are appropriate for this study. For most analytes, laboratory-specific MDLs are expected to be below needed detection levels listed in Table 2-3. Where sample-specific reporting limits are higher than needed limits, the project team will use MDLs, as needed and available, for project decisions.

As the split sample data will be used to compare the two sets, equivalent analytical methodologies and detection limit requirements identified for the laboratory in the Phase 2 Sediment QAPP will be applied to the split sampling program. These analytical methodologies are listed in Table 2-2, the estimated laboratory MDLs and MRLs for TAI data and potential ecological screening values for each analyte are shown in Table 2-3. Table 2-4 summarizes the split samples to be collected for metals

metals analysis during the Phase 2 sediment sample collection event. Table 2-5 lists the proposed locations for each of the sample splits.

2.4.2 Measurement Performance Criteria

The QA objective of this plan is to identify procedures and criteria that will provide data of known and appropriate quality for the needs identified in Section 2.4.1. Data quality is assessed by representativeness, comparability, accuracy, precision, and completeness. These parameters, the applicable procedures, and level-of-effort are described in the following paragraphs.

The applicable quality control (QC) procedures, quantitative target limits, and level-of-effort for assessing data quality are dictated by the intended use of the data and nature of the analytical methods. Analytical parameters, analytical methods, applicable detection levels, analytical precision, accuracy, and completeness in alignment with needs identified in Section 2.4.1 are presented in Table 2-2. Analytical methods and quality control procedures are further detailed in Section 3.

Reporting detection levels/target detection limits listed in Table 2-2 are laboratory MRLs, equivalent to MEL Reporting Limits or EPA CLP contract-required levels. “Target” implies that final sample detection levels might be higher because of sample matrix effects. Sample reporting limits will be elevated as a function of sample moisture since concentrations are reported on a dry weight basis. Detection levels for the individual samples will be reported in the final data. As described in Section 2.4.1, some of the reporting levels might be higher than needed limits because of matrix effect, dilutions, preparation/digestion weight (solids) or because no practicable methodology for lower detection is available. Laboratory-specific MDLs are significantly below reporting levels. Where reporting limits are higher than regulatory limits, the project team will use MDLs, as needed, for project decisions. Values below the reporting are an estimate and will be qualified for proper use.

Following are definitions and levels of effort for the data assessment parameters.

Representativeness is a measure of how closely the results reflect the actual concentration or distribution of the chemical compounds in the matrix samples. Sampling plan design, sampling techniques, and sample-handing protocols (e.g., for storage, preservation, and transportation) have been developed and are discussed in Appendix A. The proposed documentation will establish that protocols have been followed and sample identification and integrity ensured.

Comparability expresses the confidence with which one data set can be compared to another. Data comparability will be maintained using defined procedures and the use of consistent methods and consistent units. Actual detection limits will depend on the sample matrix and will be reported as defined for the specific samples.

Accuracy is an assessment of the closeness of the measured value to the true value. For samples, accuracy of chemical test results is assessed by spiking samples and blanks with known standards and establishing the average recovery. For a matrix spike, known amounts of a standard compound identical to the compounds being measured are added to the sample. A quantitative definition of average recovery accuracy is given in Section 5.3. Accuracy is a combination of random error (precision) and systematic error (bias), introduced during sampling and analytical operations. Bias is the systematic distortion of a measurement process that causes errors in one direction, so that the expected sample measurement is always greater or lesser to the same degree than the sample’s true value. The accuracy of measurement data will be determined by calculating the recoveries from the analysis of standard reference materials and laboratory and laboratory fortified samples (matrix

spikes).Accuracy measurements will be carried out with a minimum frequency of 1 in 20 samples analyzed.

Precision of the data is a measure of the data spread, when more than one measurement has been taken on the same sample. Precision can be expressed as the relative percent difference; a quantitative definition is given in Section 5.3. The level of effort for precision measurements will be a minimum of 1 in 20 samples.

Completeness is a measure of the amount of valid data obtained from the analytical measurement system and the complete implementation of defined field procedures. The quantitative definition of completeness is given in Section 5.3. The target completeness objective will be 90 percent; the actual completeness might vary depending on the intrinsic nature of the samples and the ability to assess sample locations and collect field samples. The completeness of the data will be assessed during QC reviews.

2.5 Special Training/Certification (A8)

All project staff working on the site will be trained in health and safety and follow requirements specified in the project's HSP. The HSP describes the specialized training required for personnel on this project and the documentation and tracking of this training is also included in the HSP.

2.6 Documents and Records (A9)

Project systematic planning through the DQO is documented in Appendix A of this QAPP.

Required field documentation and records for field oversight are described in Appendix B.

Laboratory documentation will be provided in accordance with methods and QA protocols listed in Sections 3.4 and 3.5 of this QAPP and with EPA Regional Laboratory-specific standard operating procedure (SOPs).

Overall project documentation will be prepared in accordance with the EPA Region 10 AES Program Plan (EPA, 2003a and b and updates).

TABLE 2-1
Data Needs and Uses

Matrix	Analytical Suites	Data Use	Data User	Needed detection levels (Lowest Project Criteria/Technical Criterion)[a]
Sediment	TAL Metals	Compare EPA split sample data results with TAI results.	Chemists, Regulators	Defined by Phase 2 Sediment QAPP (see Table 2-3)

TABLE 2-2
Measurement Performance Criteria – Analytical Measurements for Sediment Split Samples[(a)]

Analytical Suite	Analytes	Method [(b)]	Accuracy (percent)	Precision (RPD)	Completeness (percent)
TAL Metals	Aluminum, antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, copper, lead, manganese, nickel, selenium, silver, thallium, vanadium, zinc	CLP or EPA 6020A [(b)]	75 - 125	± 20	90
	Calcium, iron, magnesium, potassium, sodium	CLP or EPA 6010C [(b)]	75 - 125	± 20	90
	Mercury	CLP or EPA 7471B [(b)]	75 - 125	± 20	90

[(a)] Measurement performance criteria in this table are the same as for TAI data shown in Table B5-1. Measurement Quality Objectives, Phase 2 Sediment Study QAPP (TAI 2013)
[(b)] Methodology and QA/QC per EPA Regional laboratory (MEL) or EPA CLP standard operating procedures.

TABLE 2-3
Analytes, MDLs, MRLs, and Ecological Screening Values for Phase 2 Sediment Samples

Method	Analyte	Toxicity Benchmark Values[a] (mg/kg-dw)	CRQL ICP-AES	CRQL ICP MS
6020A	Aluminum	NA	20	-
6020A	Antimony	0.4	5	1
6020A	Arsenic	9.79	1	0.5
6020A	Barium	NA	20	5
6020A	Beryllium	NA	0.5	0.5
6020A	Cadmium	0.99	0.5	0.5
6020A	Chromium	NA	1	1
6020A	Cobalt	NA	5	0.5
6020A	Copper	NA	2.5	1
6020A	Lead	NA	1	0.5
6020A	Manganese	25.8	1.5	0.5
6020A	Nickel	22.7	4	0.5
6020A	Selenium	NA	3.5	2.5
6020A	Silver	NA	1	0.5
6020A	Thallium	NA	2.5	0.5
6020A	Vanadium	NA	5	2.5
6020A	Zinc	121	6	1
6010C	Calcium	NA	500	-
6010C	Iron	31.6	10	-
6010C	Magnesium	NA	500	-
6010C	Potassium	80	500	-
6010C	Sodium	40	500	-
7471B	Mercury	NA	0.1	0.1

[a] Based on chronic TECs - Source: MacDonald et al. (2000)
[b] Non-detects will be reported to the MDL. Values between the MDL and the MRL will be estimated (i.e., "J" qualified).
CRQL = Contract required quantitation limit
ICP–AES = Inductively coupled plasma atomic emission spectroscopy
ICP-MS = Inductively coupled plasma mass spectrometry
mg/kg = milligrams per kilogram
dw = dry weight
NA = not applicable
TEC = threshold exposure concentrations

TABLE 2-4
Phase 2 Sediment Split Sample Metals Quantities and Analytical Methods

Analytes	Quantity	Sample Preparation		Quantitative Analysis	
		Protocol	Procedure	Protocol	Procedure
Total Metals (aluminum, antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, copper, lead, manganese, nickel, selenium, silver, thallium, vanadium, zinc)	21	EPA 3050B or CLP	Acid Digestion	EPA 6020A or CLP	ICP/MS
Total Metals (calcium, iron, magnesium, potassium, sodium)	21	EPA 3050B or CLP	Acid Digestion	EPA 6010C or CLP	ICP/AES
Mercury (total)	21	EPA 7471B or CLP	Acid Digestion	EPA 7471B or CLP	Cold Vapor/AA

Notes:
AA = atomic absorption
AES = atomic emission spectrometry
EPA = US Environmental Protection Agency
ICP = inductively coupled plasma
MDL = method detection limit
MRL = method reporting limit
MS = mass spectrometry

Table 2-5

Proposed Phase 2 Sediment Split Locations for Metals Analysis

Sample Location ID*	Location Priority	Proposed Analysis	Split Group Based on mPECQ	Scheduled sampling week	Projected sample shipping (from field)
8-C4	Primary	TAL Metals	>1<4 Pri	12-Sep	17-Sep
Ref-4	Primary	TAL Metals	<1 Ref	12-Sep	17-Sep
Ref-8	Primary	TAL Metals	<1 Ref	12-Sep	17-Sep
6-B3	Primary	TAL Metals	>1<4 Pri	16-Sep	23-Sep
6B-C2	Primary	TAL Metals	<1 Pri	16-Sep	23-Sep
7-B5	Primary	TAL Metals	>1<4 Pri	16-Sep	23-Sep
5-B2	Primary	TAL Metals	>1<4 Pri	23-Sep	30-Sep
5-B5	Primary	TAL Metals	>1<4 Pri	23-Sep	30-Sep
5-B6	Primary	TAL Metals	<1 Pri	23-Sep	30-Sep
5B-C3	Primary	TAL Metals	<1 Pri	23-Sep	30-Sep
5-C3	Primary	TAL Metals	>1<4 Pri	23-Sep	30-Sep
4-B3	Primary	TAL Metals	>4<8 Pri	30-Sep	7-Oct
4-C6	Primary	TAL Metals	<1 Pri	30-Sep	7-Oct
3-B3	Primary	TAL Metals	>8 Pri	6-Oct	14-Oct
3-C4	Primary	TAL Metals	>1<4 Pri	6-Oct	14-Oct
Trib-3	Primary	TAL Metals	<1 Ref	7-Oct	14-Oct
2-B2	Primary	TAL Metals	>1<4 Pri	14-Oct	21-Oct
1-B2	Primary	TAL Metals	>4<8 Pri	20-Oct	28-Oct
1-B3	Primary	TAL Metals	>1<4 Pri	20-Oct	28-Oct
1-C1	Primary	TAL Metals	>8 Pri	20-Oct	28-Oct
1-C3	Primary	TAL Metals	>4<8 Pri	20-Oct	28-Oct

* If sampling is not feasible at proposed location, split will be taken at one of the reserve locations assigned to this location

SECTION 3

3 Data Generation and Acquisition (EPA Group B)

This section describes the sampling design; sampling methods; sampling handling and custody; analytical methods; quality control; instrument/equipment testing, inspection and maintenance; instrument/equipment calibration and frequency, inspection/acceptance of supplies and consumables; nondirect measurements; and data management.

3.1 Sampling Design (Experimental Design) (B1)

The rationale for and the design is described in step seven of the DQO process shown in Appendix A, Data Quality Objectives.

3.2 Sampling Methods (B2)

TAI will collect and process (for example, homogenize and press-sieve to 2 mm) the sediment samples in the laboratory using the methods detailed in the EPA-approved Phase 2 Sediment Study QAPP. Approximately 200 grams of the processed sediment will be made available to the EPA for each split sample. CH2MHILL and EPA will be responsible for confirming which sample locations require splits and for picking up and shipping the split samples from TAI's laboratory to MEL or to a CLP laboratory. The following sections apply to the sample documentation and handling procedures that will follow processing at TAI's laboratory.

3.3 Sample Handling and Custody (B3)

A sample is physical evidence collected from a potential hazardous waste site, the immediate environment, or another source. Because of the potential evidentiary nature of samples, the possession of samples must be traceable from the time the samples are collected until they are introduced as evidence. In addition to field notebooks, a number of documents are available for tracking sample custody.

Documents including sample custody seals and chain-of-custody records will be obtained from the RSCC in EPA's Region 10 Quality Assurance Office. Chain-of-custody procedures will be used to maintain and document sample collection and possession. After sample packaging, the appropriate chain-of-custody form will be completed. Scribe software will be used for project data management and completing chain-of-custody documentation.

Copies of the TR-COC, Scribe XML (*.xml) and Excel (*.xls) are submitted to CLP and the RSCC in accordance with the instructions for sample shipping and documentation per CLP/RSCC requirements. The laboratory copy is to be sent to the CLP and subcontracted labs, while the regional copy is to be sent to MEL. All Scribe project information, sample information, and documentation (labels/TR-COCs) must be completed according to the Region 10 RSCC sampling guidelines. A separate unique Traffic Report (TR)/chain-of-custody will be created for each cooler shipped, documenting the specific contents and location of the associated cooler.

The following subsections summarize each element of sample handling and custody, as applicable to splits generated by TAI's laboratory following homogenization and processing of samples.

3.3.1 Chain-of-Custody

Because samples collected during any investigation could be used as evidence, their possession must be traceable from the time the samples are collected until they are introduced as evidence in legal proceedings. Chain-of-custody procedures are followed to document sample possession.

3.3.1.1 Definition of Custody

A sample is under custody if one or more of the following criteria are met:

- The sample is in a person's physical possession.
- The sample is in a person's view after being in his or her physical possession.
- The sample was in a person's physical possession and was then locked up or sealed to prevent tampering.
- The sample is kept in a designated secured area.

3.3.1.2 Field Custody

Does not apply – TAI will retain custody of the samples in the field.

3.3.1.3 Transfer of Custody and Shipment

Samples are accompanied by a chain-of-custody record. When transferring samples, the individuals relinquishing and receiving the samples sign, date, and note the time on the record. This record documents custody transfer from the sampler, often through another person, to the analyst at the laboratory.

Samples are packaged properly for shipment and dispatched to the appropriate laboratory for analysis, with a separate chain-of-custody record accompanying each shipping container (one for each field laboratory if being used and one for samples driven to the laboratory). Shipping containers will be sealed with custody seals for shipment to the laboratory. Courier names and other pertinent information are entered in the "Received by" section of the chain-of-custody record. The RSCC will be notified of shipment and the Scribe .xml file will be uploaded to the CLP Sample Management Office (SMO) Portal Web site on the day of shipment.

All shipments are accompanied by the chain-of-custody record identifying its contents. The original record and one copy accompany the shipment to the laboratory, and a second copy is retained by the PM. The Scribe .xml file is also emailed to the RSCC along with the R10 template custom view .xls file export.

A separate unique TR/COC and Airbill will be created for each cooler shipped, documenting the specific contents and location of the associated cooler. Freight bills, postal service receipts, and bills of lading are retained as part of the permanent documentation.

3.3.1.4 Laboratory Custody Procedures

A designated sample custodian accepts custody of the shipped samples and verifies that the sample numbers match those on the chain-of-custody records. Pertinent information about shipment, pickup, and courier is entered in the "Remarks" section. The custodian then enters the sample numbers into a bound notebook. The laboratory custodian uses the sample identification number or assigns a unique laboratory number to each sample, and is responsible for ensuring that all samples are transferred to the proper analyst or stored in the appropriate secure area.

The custodian distributes samples to the appropriate analysts. Laboratory personnel are responsible for the care and custody of samples from the time they are received until the sample is exhausted or returned to the custodian. The data from sample analyses are recorded on the laboratory report form.

When sample analyses and necessary QC checks have been completed in the laboratory, the unused portion of the sample will be retained until specific written permission for disposal is received from EPA. The unused portion of the sample will then be disposed of properly. All identifying sample tie tags, data sheets, and laboratory records are retained as part of the documentation. Sample containers and remaining samples are disposed of by the laboratory in compliance with all federal, state, and local regulatory requirements.

3.3.2 Custody Seals

Custody seals will be placed on coolers during transport of samples to the laboratory. The seals will be placed on two sides of the lid (one in front, and one on the side) and covered with tape to prevent inadvertent breaking of the seals. To prevent the opening of coolers during shipment and to ensure that the samples remain sealed under custody until arrival at the lab additional large liner bag (drum liner type) inside around entire contents of cooler (ice and samples), tied tightly closed and secured with additional custody seal will also be used.

3.3.3 Field Notebooks

As part of field oversight (see Appendix B), field notebooks and forms will be used to record observations made during Phase 2 sediment sampling activities. Field notebooks will also be used by personnel picking up and shipping the split samples from TAI's laboratory. The notebook will be retained by each agency as a permanent record, and copies of field notes from each sampling event will be submitted to EPA.

These notebooks are intended to provide sufficient data and observations to enable participants to reconstruct events that occurred during the project, and to refresh the memory of the personnel, if required.

3.3.4 Corrections to Documentation

All original data recorded in field notebooks and field data forms will be written in waterproof ink, unless prohibited by weather conditions. None of these accountable serialized documents is to be destroyed or thrown away, even if they are illegible or contain inaccuracies that require a replacement document.

If an error is made on an accountable document, personnel may make corrections simply by drawing a single line through the error and entering the correct information. The erroneous information should not be obliterated. Any subsequent error discovered on an accountable document should be corrected by the person who made the entry. All subsequent corrections must be initialed and dated.

3.4 Analytical Methods (B4)

Project analytes, methods and target laboratory detection limits are listed in Table 2-2 and 2-3.

Where applicable, samples will be analyzed through EPA Contract Laboratory Program (CLP) and the associated statements of work along with CLP QA/QC requirements. Depending on availability, these analyses may also be carried out through the EPA regional laboratory, MEL, per MEL SOPs and

QA/QC procedures. Where CLP is not applicable samples will be analyzed by the EPA regional laboratory (MEL) per MEL SOPs and QA/QC procedures.

3.5 Quality Control (B5)

3.5.1 Field Quality Control Procedures

Since the samples will be collected at the laboratory following homogenization and processing, no field QC samples will be collected.

3.5.2 Laboratory Procedures

Laboratory QC procedures will include the following:

- Analytical methodology and QC according to methods listed in Table 2-2
- Instrument calibration and standards as defined in the methods listed in Table 2-2 and laboratory (MEL) SOPs
- Laboratory blank measurements at a minimum 5 percent or 1-per-batch frequency
- Accuracy and precision measurements at a minimum of 1 in 20, 1 per set
- Data reduction and reporting according to the methods listed in Table 2-2
- Laboratory documentation per MEL standard operating procedure equivalent to EPA Contract Laboratory (CLP) documentation.

3.6 Instrument/Equipment Testing, Inspection, and Maintenance (B6)

Not applicable - TAI will be collecting the samples that will be split following processing at the laboratory.

3.7 Instrument/Equipment Calibration and Frequency (B7)

3.7.1 Field Calibration Procedures

Not applicable

3.7.2 Laboratory Calibration Procedures

Laboratory calibration procedures are specified in the methods referenced in Table 2-2 and in the laboratory's SOP.

3.8 Inspection/Acceptance of Supplies and Consumables (B8)

Supplies and consumables will be acquired and inspected in accordance with acquisition specifications upon receipt.

3.9 Non-direct Measurements (B9)

Not applicable; analytical results for the split samples will be compared directly to analytical results for parent samples collected under the EPA-approved Phase 2 Sediment QAPP.

3.10 Data Management (B10)

Split sample analytical data will undergo laboratory data review and verification. Split sample data management is discussed further in Section 5 (EPA Group D) of this QAPP. Following receipt of reviewed and validated data, the data will be uploaded to EPA's electronic data warehouse (WQX) to facilitate data access, queries, and report preparation. Data management practices are detailed in the Project Data Management Plan (CH2MHILL, 2011d). Scribe software will be used to document and manage split sample custody, location information, and other data associated with any samples submitted for chemical analysis.

SECTION 4

4 Assessment and Oversight (EPA Group C)

This section describes assessment, oversight, and reports to management.

4.1 Assessments and Response Actions (C1)

The QAO, RTL, and PM will monitor the performance of the QA procedures. If problems arise or the EPA TOPO directs the PM accordingly, the QAO will conduct audits of split sample collection and documentation procedures. Field audits may be scheduled to evaluate the following:

- Execution of field measurements
- Whether field information gathering procedures were properly implemented
- Execution of sample identification, chain-of-custody procedures, field notebooks, sampling procedures, and field measurements
- Whether trained personnel staffed the sample event
- Whether equipment was in proper working order
- Availability of proper sampling equipment
- Whether appropriate sample containers, sample preservatives, and techniques were used
- Whether sample packaging and shipment were appropriate
- Whether QC samples were properly collected

Chemical analyses will be carried out at EPA MEL or an EPA CLP laboratory. Analyses, if needed, may also be carried out at subcontract labs as directed by RSCC. The distribution of analyses to the laboratories will be determined according to laboratory capability and capacity and the sampling schedule. The distribution of analyses may change at the time of analysis depending on capacity and implementation of specific procedures at the Regional Laboratory. The RSCC, residing at EPA's Environmental Services Unit (ESU), will be responsible for coordinating and scheduling analytical services from the CLPs and MEL. The data quality and laboratory performance of CLP laboratories are monitored by the Analytical Services Branch in EPA Headquarters and the region's Quality Staff, including the CLP PO and RSCC. For MEL, QA oversight is provided by the laboratory's QA Coordinator. In addition, onsite audits or performance evaluation samples will be administered by the CH2M HILL QAO and EPA Regional QAO, as necessary. Audits will be followed up with an audit report prepared by the reviewer. The auditor will also debrief the laboratory or the field team at the end of the audit and request that the laboratory or field team comply with the corrective action request.

If QC audits result in detection of unacceptable conditions or data, the PM will be responsible for developing and initiating corrective action. The TOPO will be notified if non-conformance is of program significance or requires special expertise not normally available to the project team. In such cases, the PM will decide whether any corrective action should be pursued. Corrective action could include the following:

- Recollecting field data if practicable
- Evaluating and amending field data collection procedures
- Reanalyzing samples if holding time criteria permit
- Resampling and analyzing
- Evaluating and amending sampling and analytical procedures
- Accepting data acknowledging a level of uncertainty

All corrective actions will be documented in a field logbook.

4.2 Reports to Management (C2)

The PM or TOPO may request that a QA report be made to the TOPO on the performance of sample collection and data quality. The report will include the following:

- Assessment of measurement data accuracy, precision, and completeness
- Results of performance audits
- Results of systems audits
- Significant QA problems and recommended solutions

SECTION 5

5 Data Validation and Usability (EPA Group D)

This section introduces the concepts of data review, verification, and validation; describes verification and validation methods; and explains reconciliation with user requirements.

5.1 Data Review, Verification, and Validation (D1)

Data for all parameters (except MEL data) will undergo two levels of review and validation: (1) at the laboratory data review and verification, and (2) outside the laboratory by third-party independent data verification and validation. CLP-generated data will be verified and validated by the Quality Staff in EPA's ESU prior to authorization of payment to the laboratory. The data generated by the regional EPA laboratory (MEL) is reviewed and verified internally at MEL and is not considered 'validation' although validation qualifiers are applied as needed. If needed, the EPA R10 QA unit may validate MEL data for unique circumstances where it is requested. All validated CLP laboratory data are downloaded directly by CH2M HILL in the SMO Portal and as needed emailed by EPA QA to CH2M HILL. The stage of validation assigned to each Sample Delivery Group (SDG) will determine when the data are final and appropriate for download and project use (see Section 5.2). The data generated by the subcontracted commercial laboratories will be validated by CH2M HILL or an independent third-party data reviewer. Stage of data validation as explained below will be included in the data validation report.

5.2 Verification and Validation Methods (D2)

Initial laboratory analytical data reduction, validation, and reporting at the laboratory will be performed as described in the laboratory-specific SOPs. Independent data validation by EPA or their designee and subcontracted laboratory data validation by CH2M HILL will follow EPA *Contract Laboratory Program National Functional Guidelines for Inorganic/Organic Data Review* (EPA, 2002b and 2010), as described above. CH2M HILL validation of subcontracted data for methods other than CLP or CLP equivalent (e.g., Method 6010) will follow EPA guidance as applicable to method QC parameters (e.g., ASTM methods). An equivalent level of effort as prescribed in the guidance will be implemented. The minimum level of effort for subcontracted data validation will be at 10% S2BVE and 90% S4VEM.

EPA validation of CLP data is labeled with a level-of-effort "Stage" identification in accordance with *Guidance for Labeling Externally Validated Laboratory* Analytical *Data for Superfund Use* (EPA, 2009b). Standardized terminology for identification of data validation is designed to help increase national consistency and improve communication and understanding about the nature of verification and validation conducted on laboratory analytical data for Superfund use. An in-depth definition of each data validation stage label can be found in Appendix A of the cited EPA guidance document.

Inorganic data is electronically validated at S2BVE; however organic data is automatically validated at S3VE through validation software prior to delivery at the SMO Portal. For this project, a full Stage 4 electronic and manual data validation (100 percent S4VEM) will be performed on all samples if QA resources and time are available (EPA, 2009b).

All EDDs will be downloaded by the project staff/designated contractors from the CLP SMO Portal. EPA QA chemists will notify the project data managers with SMO Portal access when SDGs are designated for validation (30 percent). Those designated SDGs are not final until the EPA QA Data Validation Report has been sent out and the data reflect the "S4VEM" DV label. All other S2BVE (70 percent) of the project data may be downloaded after site upload has occurred. Validation report memorandums and qualified results will be prepared by the validator (EPA S4VEM or CLP SMO S2BVE) and submitted to the EPA PM and the contractor's PMs.

5.3 Reconciliation with User Requirements (D3)

Laboratory analytical data obtained will be reconciled with the requirements specified in Table 2-2. Assessment of data for precision, accuracy and completeness will be performed in accordance with the quantitative definitions in the following sections.

Split sample data will be evaluated as described in step 5 of the DQO, Appendix A.

5.3.1 Precision

If calculated from duplicate measurements, use the following equation:

$$RPD = \frac{(C_1 - C_2) \times 100\%}{(C_1 + C_2) / 2} \quad (1)$$

Where:

RPD	=	relative percent difference
C_1	=	larger of the two observed values
C_2	=	smaller of the two observed values

If calculated from three or more replicates, use relative standard deviation (RSD) rather than the RPD, as follows:

$$RSD = (s / \bar{y}) \times 100\ \% \quad (2)$$

Where:

RSD	=	relative standard deviation
s	=	standard deviation
$\bar{y}$	=	mean of replicate analyses

Standard deviation, s, is defined as follows:

$$S = \sqrt{\sum_{i=1}^{n} \frac{(y_i / \bar{y})^2}{n-1}} \quad (3)$$

Where:

s	=	standard deviation
y_i	=	measured value of the i^{th} replicate
$\bar{y}$	=	mean of replicate analyses
n	=	number of replicates

5.3.2 Accuracy

For measurements where matrix spikes are used, use the following:

$$\%R = 100\% \; x\left[\frac{S-U}{C_{sa}}\right] \tag{4}$$

Where:

%R	=	percent recovery
S	=	measured concentration in spiked aliquot
U	=	measured concentration in unspiked aliquot
C_{sa}	=	actual concentration of spike added

For situations where a standard reference material (SRM) is used instead of or in addition to matrix spikes, use the following:

$$\%R = 100\% \; x\left[\frac{C_m}{C_{sm}}\right] \tag{5}$$

Where:

%R	=	percent recovery
C_m	=	measured concentration of SRM
C_{sm}	=	actual concentration of SRM

5.3.3 Completeness (Statistical)

Defined as follows for all measurements:

$$\%C = 100\% \; x\left[\frac{V}{T}\right] \tag{6}$$

Where:

%C	=	percent completeness
V	=	number of measurements judged valid
T	=	total number of measurements

SECTION 6

6 References

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Appendix A
Data Quality Objectives

APPENDIX A

Data Quality Objectives for UCR Phase 2 Sediment Study Split Sample Metals Analysis

Step	DQO Guidance of Purpose and Outputs of Step	Sediment Study Split Sample Metals Analysis Program
1. Problem Statement	**Purpose:** Clearly define the problem that requires new environmental data so that the focus of the study will be clear and unambiguous. **Outputs From This Step:** A concise description of the problem. A list of the planning team members and identification of the decision-maker. A summary of available resources and relevant deadlines for the study.	**Background** Samples collected during the UCR Phase 2 Sediment Study will be analyzed by a laboratory subcontracted to TAI. Under such circumstances, there is a potential for bias in the analyses and reporting of results. The EPA will obtain splits of designated sediment samples and analyze them using the same preparation and analytical methods as the TAI laboratory in order to identify possible bias and, if found, evaluate its significance. **Problem Statement** Samples collected during the UCR Phase 2 Sediment Study will be analyzed by a laboratory subcontracted to TAI. As part of the oversight activities there is a need for the EPA to obtain split samples towards assessing (1) comparability of results - precision (2) sample homogeneity and splitting efficiency and (3) laboratory performance. **Planning Team Members** Laura Buelow and Matt Wilkening - EPA TOPOs Gina Greppo-Grove/EPA Quality Assurance Manager Marilyn Gauthier - CH2M HILL Project Manager Artemis Antipas - CH2M HILL Quality Assurance Officer **Limitations on Available Resources** Collection of split samples will follow field sampling activities and laboratory processing (sieving and splitting) conducted by others. Split samples must be obtained and analyzed within appropriate holding times for designated analyses. **Relevant Deadlines** CH2M HILL needs to submit all relevant planning documents for approval prior to the start of the sampling event, currently scheduled for September 3 through October 31, 2013.

Step	DQO Guidance of Purpose and Outputs of Step	Sediment Study Split Sample Metals Analysis Program
2. Decision Statements	**Purpose:** Define the decision(s) that will be resolved using data to address the problem. **Approach:** Identify the key question that the study attempts to address and alternative actions that may be taken, depending on the answer to the key study question. **Outputs From This Step:** A statement of the decision that must be resolved using data to address or solve the problem. A list of possible actions or outcomes that would result from each resolution of the decision statement. *Note from EPA guidance on DQO: If the principal study question is not obvious and specific alternative actions cannot be identified, then the study may fall in the category of exploratory research, in which case, this particular step of the DQO Process may not be needed.*	**Key Questions** Are the analytical results reported by TAI's laboratory in agreement with those reported by EPA to include: (1) comparability of results – precision; (2) sample homogeneity and splitting efficiency; and (3) laboratory performance (both EPA's and TAI's). **Possible Outcomes** TAI's laboratory results are significantly different than EPA's laboratory TAI's laboratory results are not significantly differently than EPA's laboratory

Step	DQO Guidance of Purpose and Outputs of Step	Sediment Study Split Sample Metals Analysis Program
3. Inputs to the Decision	**Purpose:** The purpose of this step is to identify the data inputs that will be required to resolve the decision, and to determine which inputs require environmental measurements. **Activities:** Identify the information that will be required to resolve the decision. Determine the sources for each item of information identified. Identify the information that is needed to establish the action level for the study. Confirm that appropriate field sampling techniques and analytical methods exist to provide the necessary data. **Outputs From This Step:** A list of informational inputs (including sources and potential action levels) needed to resolve the decision. The list of environmental variables or characteristics that will be measured.	**Informational Needs** Split sample data analyzed by the EPA and TAI independently for the same analytes and methods as those identified in TAI's QAPP (UCR Phase 2 Sediment Study QAPP, TAI 2013). **Sources of Information** EPA split sample analyses TAI split sample analyses **Action Levels** Detection levels need to be the same for TAI and EPA samples; thus the detection limits identified in TAI's QAPP will be targeted. The ecological screening values that define the target analytical detection limits for TAI are listed in Table 2-3 of the Split Sample Metals Analysis QAPP **Field and Analytical Methods** Sample preparation protocols and analytical methods are listed in Table 2-2 of the QAPP.

Step	DQO Guidance of Purpose and Outputs of Step	Sediment Study Split Sample Metals Analysis Program
4. Study Boundaries	**Purpose:** Specify the spatial and temporal circumstances that are covered by the decision. **Activities:** Define the domain or geographic area within which all decisions must apply. Specify the characteristics that define the population of interest. When appropriate, divide the population into strata that have relatively homogeneous characteristics. Define the scale of decision-making. Determine when to collect data. Determine the timeframe to which the study data apply. Identify any practical constraints on data collection. **Outputs From This Step:** Characteristics that define the domain of the study. A detailed description of the spatial and temporal boundaries of the decision. A list of any practical constraints that may interfere with the study.	**Spatial** The spatial boundary of the study is shown in Figure 2-3. Split samples will be obtained within this boundary and the findings will be applied to the full study within this boundary. i.e. While comparisons of the laboratory data will be on a sample by sample basis, the decisions about the quality of laboratory data may apply to the entire study-area, to certain analytical methods, or to other possible stratifying elements. **Temporal** Decision will apply until the data are evaluated and the next round of sampling is planned. **Practical Constraints on Data Collection** Some sediment sample locations may not have sufficient volume to allow for splitting, thus constraining the number of samples that might be randomly selected for duplicate analysis.

<table>
<tr><th>Step</th><th>DQO Guidance of Purpose and Outputs of Step</th><th>Sediment Study Split Sample Metals Analysis Program</th></tr>
<tr><td>5. Decision Rules</td><td>Purpose: The purpose of this step is to integrate the outputs from previous steps into a single statement that describes the logical basis for choosing among alternative actions.
Activities:
Specify the parameter that characterizes the population of interest.
Specify the action level for the study.
Combine the outputs of the previous DQO steps into an ‘if…then…’ decision rule that defines the conditions that would cause the decision-maker to choose among alternative actions.
Outputs From This Step:
An ‘if…then…’ statement that defines the conditions that would cause the decision-maker to choose among alternative courses of action.</td><td>Specify the parameter that characterizes the population of interest
Individual sample/analyte concentrations
Specify the action level for the study
same as Step 3
Develop a decision rule:
Split sample data for EPA and TAI data will be obtained for assessing (1) comparability of results - precision (2) sample homogeneity and splitting efficiency and (3) laboratory performance (both EPA's and TAI's).
The following processes will be used, as needed, to compare and evaluate split sample data:
1- Both EPA and TAI data will be validated and flagged per EPA data validation guidelines.
2-Split sample data will be tabulated to include for both TAI and EPA data, sample collection dates and locations, sample IDs, sample results, detection limits, laboratory and validation flags.
3-For initial comparison of split sample data, two factors will be calculated and entered into the split sample data table described above:
3a- Relative percent deviation (RPD), which is calculated by taking the difference of the two split sample results divided by the average and multiplied by one hundred. The RPD results will be screened to an advisory limit of 50% and the data flagged for RPDs exceeding 50%.
3b-Agreement factor, which is obtained by dividing the detected results for each sample by each other. Depending on the situation and agreement factor (see table below), the split sample results will be categorized in the split sample data tables as being in agreement, disagreement; or major disagreement.
<table>
<tr><th>Situation</th><th>Agreement</th><th>Disagreement</th><th>Major Disagreement</th></tr>
<tr><td>Analyte detected above RL in both TAI and EPA samples</td><td>≤ 2X difference</td><td>>2X ≤ 3X difference</td><td>>3X difference</td></tr>
<tr><td>One result is less than RL</td><td>≤ 3X difference</td><td>>3X≤ 5X difference</td><td>>5X difference</td></tr>
<tr><td>One result is less than MDL</td><td>≤ 5X difference</td><td>>5X ≤ 10X difference</td><td>>10X difference</td></tr>
<tr><td colspan="4">RL- reporting limit, MDL- method detection limit
Derived from Reference: CRREL Special Report No. 96-9, “Comparison Criteria for Environmental Chemical Analyses of Split Samples Sent to Different Laboratories - Corps of Engineers Archived Data”, Grant, C.G., Jenkins, T.F., and Mudambi, A.R., USACE Cold Regions & Environmental Research Laboratory, Hanover NH, May1996.</td></tr>
</table>
The number of agreement, disagreement and major disagreement observations can be further evaluated for the following:
• Numbers of sample pairs compared</td></tr>
</table>

Step	DQO Guidance of Purpose and Outputs of Step	Sediment Study Split Sample Metals Analysis Program
		• Number of sample pairs with one detect and one non-detect (then percentages of each) • Number of sample pairs with both non-detects (then percentages of each). • Number of sample records with two detections (and percentages) • Number of pairs and the percentage of those pairs that fall into the following categories: ▪ major disagreement ▪ disagreement ▪ acceptable The findings for the above analyses can be summarized to assess potential biases. 4- Further statistical evaluations as needed following the above evaluations may be carried out to assess potential biases in the data sets.. 5-Comparisons to project action levels (regulatory or risk criteria) for reporting limits and detects – both sets of data can also be compared to project action levels for potential indication of bias for either set. The above framework provides for an overall view of the agreement between the EPA and TAI results.

Step	DQO Guidance of Purpose and Outputs of Step	Sediment Study Split Sample Metals Analysis Program
6. Tolerable Limits on Decision Rules	**Purpose:** Specify the decision-maker's acceptable limits on decision errors, which are used to establish appropriate performance goals for limiting uncertainty in the data. **Activities:** Determine the possible range of the parameter of interest. Define both types of decision errors and identify the potential consequences of each. Specify a range of possible parameter values where the consequences of decision errors are relatively minor (gray region). Assign probability values to points above and below the action level that reflect the acceptable possibility for the occurrence of decision errors. Check the limits on decision errors to ensure that they accurately reflect the decision-maker's concern about the relative consequences for each type of decision error. **Outputs From This Step:** The decision-maker's acceptable decision error rates based on a consideration of the consequences of making an incorrect decision.	This step is not applicable as locations of split samples will be per systematic judgment as described in the next step.

Step	DQO Guidance of Purpose and Outputs of Step	Sediment Study Split Sample Metals Analysis Program
7. Optimization of the Sampling Design	**Purpose:** Identify the most resource-effective sampling and analysis design for generating data that are expected to satisfy the DQOs. **Activities:** Review the DQO outputs and existing environmental data. Translate the information from the DQOs into a statistical hypothesis. Develop general sampling and analysis design alternatives. For each design alternative, formulate the mathematical expressions needed to solve the design problems. For each design alternative, select the optimal sample size that satisfies the DQOs. Select the most resource-effective design that satisfies all of the DQOs. Document the operational details and theoretical assumptions of the selected design in the Sampling and Analysis Plan. **Outputs From This Step:** The most resource-effective design for the study that is expected to achieve the DQOs, selected from a group of alternative designs generated during this step.	The intent of the split sample analysis program is to duplicate the sample preparation and analyses being conducted by TAI's laboratory on a randomly selected group of sediment samples from the study area. Samples will be collected at 15 percent of the Phase 2 sample locations One hundred and forty (140) locations along the UCR will be sampled for chemical analysis during the course of the Phase 2 Sediment Study. The split samples will be obtained from the homogenized sediment at 15 percent of the sediment sample locations (approximately 21 locations). The samples to be split will be following homogenization of samples from the sediment sampling locations listed in Table 2-5 of the QAPP. If a listed primary sample location cannot be sampled, the split will be obtained at the successful alternate for that location. If there are no successful alternates for the location, a replacement split sample location will be randomly selected from remaining pool of primary sampling locations. The selection process will be repeated until splits are collected at 15% of the total number of successful sample locations (21 locations).

Appendix B
Field Oversight Plan

APPENDIX B

UCR Phase 2 Sediment Sampling (2013) - Field Oversight and Split Sample Collection Plan

This document provides the Field Oversight and Split Sample Collection Plan for observation and documentation of the Phase 2 sediment field sampling efforts being conducted by Teck American Incorporated (TAI) during 2013. TAI is a potentially responsible party (PRP) for the Upper Columbia River (UCR) site and will be responsible for collection, processing, and analysis of sediment samples during the scheduled sampling event. The sampling program being conducted by TAI is described in the Quality Assurance Project Plan for the Phase 2 Sediment Study (Phase 2 Sediment QAPP) (TAI, 2013) Subject to EPA approval, field sampling is expected to begin in early to mid-fall (September to October) 2013 and take approximately 6 to 8 weeks. CH2M HILL personnel will provide work with U.S. Environmental Protection Agency (EPA) staff to provide field oversight of sediment and pore-water sampling procedures. Details concerning collection and documentation of the split samples are presented in the Phase 2 Sediment Study Split Sample Metals Analysis Quality Assurance Project Plan (Split Sample Metals QAPP; CH2M HILL, 2013). EPA split samples will not be collected in the field and CH2M HILL personnel are not expected to take possession of any split samples in the field. The U.S. Department of Interior (DOI) will collect split samples within their jurisdiction as required in TAIs sampling permit.

Summary of 2013 Sampling Event

This section provides a general summary of the planned 2013 sediment sampling event. Field oversight personnel will be responsible for reviewing the Phase 2 Sediment QAPP and the Split Sample Metals and Bioassay QAPPs and will be familiar with the details of the sample collection, processing, and documentation programs detailed therein before going in the field (TAI, 2013; Appendix A).

The primary goal of the UCR Phase 2 sediment study is to evaluate if there are unacceptable risks to benthic invertebrates associated with exposure to metals and other chemicals, collectively called chemicals of potential concern (COPCs) in UCR sediments (TAI, 2013). Sediment sampling for Phase 2 toxicity testing as part of the UCR Remedial Investigation/Feasibility Study (RI/FS) is intended to target sediment with at least 25 percent of the sample grain size less than 2 millimeters (mm), representing depositional areas to assess risks to benthic organisms.

Consistent with input from the EPA, TAI will attempt to collect whole sediment and field porewater at 140 target sampling stations from the top 6 in. (15 cm) of the sediment for the analysis of analytical chemistry. These 140 target stations include 124 Site stations (includes 10 internal reference stations), 6 tributary reference stations (previously sampled in 2005), and 10 upstream reference stations in Canada (Table 1). In addition to chemical analysis, standard shorter‐term chronic sediment bioassays (with survival and growth endpoints) using *Hyalella azteca* and *Chironomus dilutus* will be performed on whole sediment samples from 74 of the 140 locations. Reproductive endpoints will be assessed using long‐term bioassays on archived sediment from 18 of the 74 bioassay locations.

During the course of sampling, field conditions or circumstances may adversely affect sampling success. Such conditions or circumstances may include, but are not necessarily limited to, the presence of cultural resources (refer to Cultural Resources Coordination Plan, Appendix D of the QAPP), the presence of coarse substrates (e.g., gravels, cobbles, boulders, bedrock), and/or above-average river flow conditions. To accommodate such circumstances, reserve sampling stations have been identified for the 124 primary stations, as listed in Table 2. In the event that samples cannot be collected from a primary sampling station, the field sampling crew will attempt to collect a sample from one of the reserve stations designated as applicable to the target station.

EPA oversight is to ensure that the sampling is done according to the QAPP. EPA will make key decisions on when there have been enough unsuccessful attempts at a primary station to move to a reserve station.

Table 1
Number of UCR Sediment Sample Locations

			Sampling Locations	
Sample Type		Analyses	Primary	Reserve
Site		Chemistry and Bioassay	48	114
		Chemistry Only	66	
Reference	Internal	Chemistry and Bioassay	10	10
	Tributary	Chemistry and Bioassay	6	--
	Upstream (Canada)	Chemistry and Bioassay	10	--
		Totals	***140***	***124***

Key Points:

- EPA and EPA representatives will be on the safety boat (downstream of Onion Creek) while NPS and CCT cultural resource observers will be on the sampling boat providing cultural oversight. The safety boat will maintain radio and visual contact with the research boat at all times.
- There is flexibility in the QAPP to determine how many attempts should be made at one location before moving to a reserve station. Generally, three grabs at three different anchor points (for a total of 9 grabs) should be attempted before considering moving. If the first grab refuses or is otherwise obviously not suitable, then TAI is not required to do 2 more grabs. They can move right away. If after the 9 grabs there is only a small amount of sediment to gather to get the required volume, then EPA should instruct TAI to stay on that location and continue to take more grabs. Use your best judgment in the field. Communicate with EPA in the other safely boat as needed.
- The NPS and CCT permit require TAI to collect an additional 3-5 gallons of split sample for each bioassay station. EPA and NPS need to work together in the field to determine when to move to a reserve station. Generally, EPA will determine when to move to another station if the initial 12 gallons cannot be collected. Once the 12 gallons is collected to satisfy the QAPP, NPS then determines how much effort should be made to get the additional 3-5 gallons for NPS. In the situation that TAI cannot get 15 gallons then they have to request a waiver from the Park Service, which can be given verbally by the NPS representative in the field.
- Generally, keep sediment from a primary site even if it is decided to move to a reserve site. TAI may ask if they have to dispose of the sample, and EPA is in support of keeping as much sample as they are able to get at all locations. Once the sampling is complete, we can decide which samples will be analyzed. This decision does not need to be made in the field.
- The samples can be taken anywhere in a 150’ radius from the center of the sampling point. The first sample does NOT have to be taken in the center. EPA should be in communication with the research boat and together determine where to attempt the first sample.
- Support the Cultural Monitors. On each research boat, there will be a cultural monitor from the NPS, Colville Tribe or Spokane Tribe. They have a protocol to follow if any artifact or suspect artifact is found. Follow their lead as to whether the sample location is moved to within the allowed 150’ radius or completely abandoned and a reserve station is selected. Also, NPS particularly has specific hours that they can work (not more than 12 h per day, including travel). If their hours are up, we need to follow their lead and not put pressure on anyone to continue to work.

Table 2
Sample Location Information By Focus Area and Location Priority

Location Priority	Proposed Analysis	Focus Area	Primary Sample ID	Reserve 1 (same Group and Focus Area as primary sample)	Reserve 2 (potentially different Group or different Focus Area)
Primary	Bioassay	1	1-B1	1-R1, 1-R5, 1-R2, 1-R10, 1-C1	1-R9, 2-R9, 2-R10
Primary	Bioassay	1	1-B2	1-R9, 1-C2, 1B-R1, 1B-R2, 1B-R3, 1B-R4	2-R1, 2B-R2, 1-R1, 1-R2, 1-R5, 1-R7, 1-R8, 1-R10
Primary	Bioassay	1	1-B3	-	3-R10, 1-R3, 1-R6, 2-R2, 2-R4, 2-R7
Primary	Bioassay	1	1-B4	1-R9, 1-C2, 1B-R1, 1B-R2, 1B-R3, 1B-R4	2-R1, 2B-R2, 1-R1, 1-R2, 1-R5, 1-R7, 1-R8, 1-R10
Primary	Bioassay	1	1-B5	1-R7, 1-R8, 1B-C1, 1-C3	3-R4, 1-R9
Primary	Bioassay	1	1-B6	1-R10, 1-R2, 1-R1, 1-R5, 1-C1	1-R9, 2-R9, 2-R10
Primary	Chemistry-Only	1	1-C1	1-R1, 1-R5, 1-R2, 1-R10	2-R9, 2-R10, 1-R9, 1B-R1, 1B-R2, 1B-R3, 1B-R4
Primary	Chemistry-Only	1	1-C2	1-R9, 1B-C2, 1B-C3, 1B-C4	2-R1, 2B-R2, 1B-R1, 1B-R2, 1B-R3, 1B-R4, 3-R10, 1-R1, 1-R2, 1-R5, 1-R7, 1-R8, 1-R10
Primary	Chemistry-Only	1	1-C3	1-R7, 1-R8, 1B-C1	3-R4, 1-R9
Primary	Chemistry-Only	1	1-C4	1-R3, 1-R4	3-R3, 1-R6, 2-R2, 2-R3, 2-R4, 2-R5, 2-R6, 2-R7
Reserve	bioassay or chem	1	1-R1	-	-
Reserve	bioassay or chem	1	1-R2	-	-
Reserve	bioassay or chem	1	1-R3	-	-
Reserve	bioassay or chem	1	1-R4	-	-
Reserve	bioassay or chem	1	1-R5	-	-
Reserve	bioassay or chem	1	1-R6	-	-
Reserve	bioassay or chem	1	1-R7	-	-
Reserve	bioassay or chem	1	1-R8	-	-
Reserve	bioassay or chem	1	1-R9	-	-
Reserve	bioassay or chem	1	1-R10	-	-
Primary	Chemistry-Only	1B	1B-C1	-	1-R7, 1-R8, 3-R4, 1B-R1, 1B-R2, 1B-R3, 1B-R4
Primary	Chemistry-Only	1B	1B-C2	1B-R1, 1B-R2, 1B-R3, 1B-R4	1-R9, 2-R1, 2B-R2, 3-R1, 3-R6, 1-R1, 1-R2, 1-R5, 1-R10, 1-R7, 1-R8
Primary	Chemistry-Only	1B	1B-C3	1B-R1, 1B-R2, 1B-R3, 1B-R4	1-R9, 2-R1, 2B-R2, 3-R1, 3-R6, 1-R1, 1-R2, 1-R5, 1-R10, 1-R7, 1-R8
Primary	Chemistry-Only	1B	1B-C4	1B-R1, 1B-R2, 1B-R3, 1B-R4	1-R9, 2-R1, 2B-R2, 3-R1, 3-R6, 1-R1, 1-R2, 1-R5, 1-R10, 1-R7, 1-R8
Reserve	bioassay or chem	1B	1B-R1	-	-
Reserve	bioassay or chem	1B	1B-R2	-	-

Table 2

Sample Location Information By Focus Area and Location Priority

Location Priority	Proposed Analysis	Focus Area	Primary Sample ID	Reserve 1 (same Group and Focus Area as primary sample)	Reserve 2 (potentially different Group or different Focus Area)
Reserve	bioassay or chem	1B	1B-R3	-	-
Reserve	bioassay or chem	1B	1B-R4	-	-
Primary	Bioassay	2	2-B1	2-R1, 2B-R2	1B-R1, 1B-R2, 1B-R3, 1B-R4, 3-R2, 3-R6, 4-R7, 2-R9, 2-R10
Primary	Bioassay	2	2-B2	2-R2, 2-R4, 2-R5, 2-R6, 2-R7, 2-R3 2-C1, 2-C3, 2-C2	1-R6, 3-R1, 3-R7, 3-R8, 3-R9
Primary	Bioassay	2	2-B3	2-R2, 2-R4, 2-R5, 2-R6, 2-R7, 2-R3 2-C1, 2-C3, 2-C2	1-R6, 3-R1, 3-R7, 3-R8, 3-R9
Primary	Bioassay	2	2-B4	2-R2, 2-R4, 2-R5, 2-R6, 2-R7, 2-R3 2-C1, 2-C3, 2-C2	1-R6, 3-R1, 3-R7, 3-R8, 3-R9
Primary	Bioassay	2	2-B5	2-R10, 2-R9	1-R10, 1-R5, 1-R1, 1-R2, 3-R5, 2-R1, 2B-R2
Primary	Bioassay	2	2-B6	2-R10, 2-R9	1-R10, 1-R5, 1-R1, 1-R2, 3-R5, 2-R1, 2B-R2
Primary	Chemistry-Only	2	2-C1	2-R2, 2-R4, 2-R5, 2-R6, 2-R7, 2-R3	2B-R1, 2B-R3, 2B-R4,1-R6
Primary	Chemistry-Only	2	2-C2	2-R3, 2-R2, 2-R4, 2-R5, 2-R6, 2-R7	2B-R1, 2B-R3, 2B-R4,1-R6
Primary	Chemistry-Only	2	2-C3	2-R2, 2-R4, 2-R5, 2-R6, 2-R7, 2-R3	2B-R1, 2B-R3, 2B-R4,1-R6
Primary	Chemistry-Only	2	2-C4	-	2B-R3, 2B-R4, 1-R3, 1-R4, 3-R3
Reserve	bioassay or chem	2	2-R1	-	-
Reserve	bioassay or chem	2	2-R2	-	-
Reserve	bioassay or chem	2	2-R3	-	-
Reserve	bioassay or chem	2	2-R4	-	-
Reserve	bioassay or chem	2	2-R5	-	-
Reserve	bioassay or chem	2	2-R6	-	-
Reserve	bioassay or chem	2	2-R7	-	-
Reserve	bioassay or chem	2	2-R8	-	-
Reserve	bioassay or chem	2	2-R9	-	-
Reserve	bioassay or chem	2	2-R10	-	-
Primary	Chemistry-Only	2B	2B-C1	2B-R1	2-R2, 2-R4, 2-R5, 2-R6, 2-R7
Primary	Chemistry-Only	2B	2B-C2	2B-R1	2-R2, 2-R4, 2-R5, 2-R6, 2-R7
Primary	Chemistry-Only	2B	2B-C3	2B-R3, 2B-R4	1-R3, 1-R4, 3-R3
Primary	Chemistry-Only	2B	2B-C4	2B-R1	2-R2, 2-R4, 2-R5, 2-R6, 2-R7

Table 2

Sample Location Information By Focus Area and Location Priority

Location Priority	Proposed Analysis	Focus Area	Primary Sample ID	Reserve 1 (same Group and Focus Area as primary sample)	Reserve 2 (potentially different Group or different Focus Area)
Reserve	bioassay or chem	2B	2B-R1	-	-
Reserve	bioassay or chem	2B	2B-R2	-	-
Reserve	bioassay or chem	2B	2B-R3	-	-
Reserve	bioassay or chem	2B	2B-R4	-	-
Primary	Bioassay	3	3-B1	3-R1, 3-R7, 3-R8, 3-R9, 3-C1	2-R3, 2B-R1, 4-R2, 4-R6, 2-R2, 2-R4, 2-R5, 2-R6, 2-R7, 2-R8
Primary	Bioassay	3	3-B2	3-R5	2-R9, 2-R10, 3-R6, 3-R2, 3-R10
Primary	Bioassay	3	3-B3	3-R4	3-R2, 3-R6, 2-R1, 2B-R2, 1B-R1, 1B-R2, 1B-R3, 1B-R4, 4-R7
Primary	Bioassay	3	3-B4	3-R5	2-R9, 2-R10, 3-R6, 3-R2, 3-R10
Primary	Bioassay	3	3-B5	3-R2, 3-R6	2-R1, 2B-R2, 4-R7, 3-R4, 3-R5
Primary	Bioassay	3	3-B6	3-R7, 3-R8, 3-R9, 3-R1, 3-C1	2B-R1, 4-R2, 4-R6, 2-R2, 2-R4, 2-R5, 2-R6, 2-R7, 2-R3
Primary	Chemistry-Only	3	3-C1	3-R7, 3-R8, 3-R9, 3-R1	2B-R1, 4-R2, 4-R6, 2-R2, 2-R4, 2-R5, 2-R6, 2-R7, 2-R3
Primary	Chemistry-Only	3	3-C2	3-R3	2B-R3, 2B-R4, 4-R1
Primary	Chemistry-Only	3	3-C3	3-R3	2B-R3, 2B-R4, 4-R1
Primary	Chemistry-Only	3	3-C4	3-R3	2B-R3, 2B-R4, 4-R1
Reserve	bioassay or chem	3	3-R1	-	-
Reserve	bioassay or chem	3	3-R2	-	-
Reserve	bioassay or chem	3	3-R3	-	-
Reserve	bioassay or chem	3	3-R4	-	-
Reserve	bioassay or chem	3	3-R5	-	-
Reserve	bioassay or chem	3	3-R6	-	-
Reserve	bioassay or chem	3	3-R7	-	-
Reserve	bioassay or chem	3	3-R8	-	-
Reserve	bioassay or chem	3	3-R9	-	-
Reserve	bioassay or chem	3	3-R10	-	-
Primary	Chemistry-Only	3B	3B-C1	3B-R1, 3B-R2, 3B-R3, 3B-R4	3-R1
Primary	Chemistry-Only	3B	3B-C2	3B-R1, 3B-R2, 3B-R3, 3B-R4	3-R1
Primary	Chemistry-Only	3B	3B-C3	3B-R1, 3B-R2, 3B-R3, 3B-R4	3-R1

Table 2

Sample Location Information By Focus Area and Location Priority

Location Priority	Proposed Analysis	Focus Area	Primary Sample ID	Reserve 1 (same Group and Focus Area as primary sample)	Reserve 2 (potentially different Group or different Focus Area)
Primary	Chemistry-Only	3B	3B-C4	3B-R1, 3B-R2, 3B-R3, 3B-R4	3-R1
Reserve	bioassay or chem	3B	3B-R1	-	-
Reserve	bioassay or chem	3B	3B-R2	-	-
Reserve	bioassay or chem	3B	3B-R3	-	-
Reserve	bioassay or chem	3B	3B-R4	-	-
Primary	Bioassay	4	4-B1	-	3-R4, 4-R7, 4-C4, 2-R1, 2B-R2,3-R2, 3-R6
Primary	Bioassay	4	4-B2	4-R7, 4-C4	3-R2, 3-R6, 2-R1, 2B-R2, 1B-R1, 1B-R2, 1B-R3, 1B-R4
Primary	Bioassay	4	4-B3	4-R7, 4-C4	3-R2, 3-R6, 2-R1, 2B-R2, 1B-R1, 1B-R2, 1B-R3, 1B-R4
Primary	Bioassay	4	4-B4	4-R1, 4-R3, 4-R4, 4-R5, 4-R9, 4-R11, 4-R10, 4-R12	5-R5, 5-R6
Primary	Bioassay	4	4-B5	-	3-R5, 2-R9, 2-R10, 4-R7, 4-C4, 4-R1, 4-R11, 4-R3, 4-R4, 4-R5, 4-R9, 4-R10, 4-R12
Primary	Bioassay	4	4-B6	4-R2, 4-R6	3-R7, 3-R8, 3-R9
Primary	Chemistry-Only	4	4-C1	4-R5, 4-R9, 4-R11, 4-R3, 4-R4, 4-R10, 4-R12, 4-R1	5-R5, 5-R6
Primary	Chemistry-Only	4	4-C2	4-R12, 4-R10, 4-R5, 4-R9, 4-R11, 4-R4, 4-R3, 4-R1,	5-R1, 5-R7, 3-R10
Primary	Chemistry-Only	4	4-C3	4-R4, 4-R3, 4-R1, 4-R9, 4-R5, 4-R10, 4-R12, 4-R11	5-R5, 5-R6
Primary	Chemistry-Only	4	4-C4	4-R7	3-R2, 3-R6, 3-R4, 3-R5, 3-R10, 4-R1, 4-R3, 4-R4, 4R-5
Primary	Chemistry-Only	4	4-C5	4-R5, 4-R9, 4-R11, 4-R3, 4-R4, 4-R10, 4-R12, 4-R1	3-R10, 5-R9, 5-R5
Primary	Chemistry-Only	4	4-C6	4-R2, 4-R6	3-R1, 3-R7, 3-R8, 3-R9, 4-R1, 4-R3, 4-R4, 4-R5
Reserve	bioassay or chem	4	4-R1	-	-
Reserve	bioassay or chem	4	4-R2	-	-
Reserve	bioassay or chem	4	4-R3	-	-
Reserve	bioassay or chem	4	4-R4	-	-
Reserve	bioassay or chem	4	4-R5	-	-
Reserve	bioassay or chem	4	4-R6	-	-
Reserve	bioassay or chem	4	4-R7	-	-
Reserve	bioassay or chem	4	4-R9	-	-

Table 2

Sample Location Information By Focus Area and Location Priority

Location Priority	Proposed Analysis	Focus Area	Primary Sample ID	Reserve 1 (same Group and Focus Area as primary sample)	Reserve 2 (potentially different Group or different Focus Area)
Reserve	bioassay or chem	4	4-R10	-	-
Reserve	bioassay or chem	4	4-R11	-	-
Reserve	bioassay or chem	4	4-R12	-	-
Primary	Chemistry-Only	4B	4B-C1	4B-R1	5-R8, 3-R3
Primary	Chemistry-Only	4B	4B-C2	4B-R2, 4B-R3, 4B-R4	4R-11, 4R-5, 4R-9
Primary	Chemistry-Only	4B	4B-C3	4B-R2, 4B-R3, 4B-R4	4R-11, 4R-5, 4R-9
Primary	Chemistry-Only	4B	4B-C4	4B-R4, 4B-R2, 4B-R3	4R-5, 4R-9, 4R-11
Reserve	bioassay or chem	4B	4B-R1	-	-
Reserve	bioassay or chem	4B	4B-R2	-	-
Reserve	bioassay or chem	4B	4B-R3	-	-
Reserve	bioassay or chem	4B	4B-R4	-	-
Primary	Bioassay	5	5-B1	5-R8	4B-R1, 6-R4, 6-R5, 6-R9
Primary	Bioassay	5	5-B2	5-R5, 5-R6, 5-R7, 5-R9, 5-R1	4-R1, 4-R9
Primary	Bioassay	5	5-B3	5-R5, 5-R6, 5-R7, 5-R9, 5-R1	4-R1, 4-R9
Primary	Bioassay	5	5-B4	5-R5, 5-R6, 5-R7, 5-R9, 5-R1	4-R1, 4-R9
Primary	Bioassay	5	5-B5	5-R3, 5-R10, 5-C2	5B-R1, 5-R1, 5-R5, 5-R6, 5-R7, 5-R8, 5-R9
Primary	Bioassay	5	5-B6	5-R3, 5-R10, 5-C2	5B-R2, 5B-R3, 5B-R4, 4-R6, 5-R1, 5-R5, 5-R6, 5-R7, 5-R9, 5-R8
Primary	Chemistry-Only	5	5-C1	5-R5, 5-R6, 5-R7, 5-R9, 5-R1	4-R9, 4-R11
Primary	Chemistry-Only	5	5-C2	5-R3, 5-R10	5B-R2, 5B-R3, 5B-R4, 4-R6, 5-R1, 5-R5, 5-R6, 5-R7, 5-R9, 5-R8
Primary	Chemistry-Only	5	5-C3	5-R5, 5-R6, 5-R7, 5-R9, 5-R1	4-R9, 4-R11
Primary	Chemistry-Only	5	5-C4	5-R5, 5-R6, 5-R7, 5-R9, 5-R1	4-R9, 4-R11
Reserve	bioassay or chem	5	5-R1	-	-
Reserve	bioassay or chem	5	5-R2	-	-
Reserve	bioassay or chem	5	5-R3	-	-
Reserve	bioassay or chem	5	5-R4	-	-
Reserve	bioassay or chem	5	5-R5	-	-
Reserve	bioassay or chem	5	5-R6	-	-
Reserve	bioassay or chem	5	5-R7	-	-

Table 2

Sample Location Information By Focus Area and Location Priority

Location Priority	Proposed Analysis	Focus Area	Primary Sample ID	Reserve 1 (same Group and Focus Area as primary sample)	Reserve 2 (potentially different Group or different Focus Area)
Reserve	bioassay or chem	5	5-R8	-	-
Reserve	bioassay or chem	5	5-R9	-	-
Reserve	bioassay or chem	5	5-R10	-	-
Primary	Chemistry-Only	5B	5B-C1	5B-R2, 5B-R3, 5B-R4, 5B-R1	6-R1, 6-R3, 6-R6, 6-R7, 6-R10, 5-R3, 5-R10
Primary	Chemistry-Only	5B	5B-C2	5B-R2, 5B-R3, 5B-R4, 5B-R1	6-R1, 6-R3, 6-R6, 6-R7, 6-R10, 5-R3, 5-R10
Primary	Chemistry-Only	5B	5B-C3	-	5-R8, 6-R5, 6-R9, 6-C1, 6-C3, 3-R3
Primary	Chemistry-Only	5B	5B-C4	5B-R2, 5B-R3, 5B-R4, 5B-R1	6-R1, 6-R3, 6-R6, 6-R7, 6-R10, 5-R3, 5-R10
Reserve	bioassay or chem	5B	5B-R1	-	-
Reserve	bioassay or chem	5B	5B-R2	-	-
Reserve	bioassay or chem	5B	5B-R3	-	-
Reserve	bioassay or chem	5B	5B-R4	-	-
Primary	Bioassay	6	6-B1	6-R3, 6-R6, 6-R7, 6-R10, 6-R1	5B-R1, 7-R4, 7-R5, 7-R10, 5B-R2, 5B-R3, 5B-R4
Primary	Bioassay	6	6-B2	6-R8, 6-R2	5-R7, 7-R8
Primary	Bioassay	6	6-B3	6-R3, 6-R6, 6-R7, 6-R10, 6-R1	5B-R1, 7-R4, 7-R5, 7-R10, 5B-R2, 5B-R3, 5B-R4
Primary	Bioassay	6	6-B4	6-R4, 6-R5, 6-R9, 6-C1, 6-C3	6B-R1, 6B-R2, 6B-R3, 6B-R4
Primary	Bioassay	6	6-B5	6-R3, 6-R6, 6-R7, 6-R10, 6-R1	5B-R1, 7-R4, 7-R5, 7-R10, 5B-R2, 5B-R3, 5B-R4
Primary	Bioassay	6	6-B6	6-R3, 6-R6, 6-R7, 6-R10, 6-R1	5B-R1, 7-R4, 7-R5, 7-R10, 5B-R2, 5B-R3, 5B-R4
Primary	Chemistry-Only	6	6-C1	6-R4, 6-R5, 6-R9	6B-R1, 6B-R2, 6B-R3, 6B-R4
Primary	Chemistry-Only	6	6-C2	6-R8, 6-R2	5-R7, 7-R8
Primary	Chemistry-Only	6	6-C3	6-R4, 6-R5, 6-R9	6B-R1, 6B-R2, 6B-R3, 6B-R4
Primary	Chemistry-Only	6	6-C4	6-R8, 6-R2	5-R7, 7-R8
Reserve	bioassay or chem	6	6-R1	-	-
Reserve	bioassay or chem	6	6-R2	-	-
Reserve	bioassay or chem	6	6-R3	-	-
Reserve	bioassay or chem	6	6-R4	-	-
Reserve	bioassay or chem	6	6-R5	-	-
Reserve	bioassay or chem	6	6-R6	-	-
Reserve	bioassay or chem	6	6-R7	-	-
Reserve	bioassay or chem	6	6-R8	-	-

Table 2

Sample Location Information By Focus Area and Location Priority

Location Priority	Proposed Analysis	Focus Area	Primary Sample ID	Reserve 1 (same Group and Focus Area as primary sample)	Reserve 2 (potentially different Group or different Focus Area)
Reserve	bioassay or chem	6	6-R9	-	-
Reserve	bioassay or chem	6	6-R10	-	-
Primary	Chemistry-Only	6B	6B-C1	-	6-R3, 6-R6, 6-R7, 6-R10, 6-R1
Primary	Chemistry-Only	6B	6B-C2	6B-R1, 6B-R3, 6B-R4, 6B-R2	7-R1, 7-R2, 6-R4, 6-R5, 6-R9
Primary	Chemistry-Only	6B	6B-C3	6B-R1, 6B-R3, 6B-R4, 6B-R2	7-R1, 7-R2, 6-R4, 6-R5, 6-R9
Primary	Chemistry-Only	6B	6B-C4	-	6-R1, 6-R3, 6-R6, 6-R7, 6-R10
Reserve	bioassay or chem	6B	6B-R1	-	-
Reserve	bioassay or chem	6B	6B-R2	-	-
Reserve	bioassay or chem	6B	6B-R3	-	-
Reserve	bioassay or chem	6B	6B-R4	-	-
Primary	Bioassay	7	7-B1	7-R1, 7-R2, 7-R3, 7-R9, 7-C1	7B-R1, 7B-R2, 6B-R1, 6B-R3, 6B-R4
Primary	Bioassay	7	7-B2	7-R6, 7-R7, 7-R4, 7-R5, 7-R10	6-R1, 6-R3, 6-R6, 6-R7, 6-R10, 7B-R4
Primary	Bioassay	7	7-B3	7-R4, 7-R5, 7-R10, 7-R6, 7-R7	7B-R4, 6-R3, 6-R6, 6-R7, 6-R10
Primary	Bioassay	7	7-B4	7-R1, 7-R2, 7-R3, 7-R9, 7-C2	6B-R2, 7B-R1, 7B-R2
Primary	Bioassay	7	7-B5	7-R8	6-R8, 8-R1, 8-R3
Primary	Bioassay	7	7-B6	7-R4, 7-R5, 7-R10, 7-R6, 7-R7	7B-R4, 6-R3, 6-R6, 6-R7, 6-R10
Primary	Chemistry-Only	7	7-C1	7-R1, 7-R2, 7-R3, 7-R9	7B-R1, 7B-R2, 6-R4, 6-R5
Primary	Chemistry-Only	7	7-C2	7-R1, 7-R2, 7-R3, 7-R9	7B-R1, 7B-R2, 6-R4, 6-R5
Primary	Chemistry-Only	7	7-C3	7-R8	6-R2, 6;R8, 8-R3
Primary	Chemistry-Only	7	7-C4	7-R8	6-R2, 6;R8, 8-R3
Reserve	bioassay or chem	7	7-R1	-	-
Reserve	bioassay or chem	7	7-R2	-	-
Reserve	bioassay or chem	7	7-R3	-	-
Reserve	bioassay or chem	7	7-R4	-	-
Reserve	bioassay or chem	7	7-R5	-	-
Reserve	bioassay or chem	7	7-R6	-	-
Reserve	bioassay or chem	7	7-R7	-	-
Reserve	bioassay or chem	7	7-R8	-	-
Reserve	bioassay or chem	7	7-R9	-	-

Table 2

Sample Location Information By Focus Area and Location Priority

Location Priority	Proposed Analysis	Focus Area	Primary Sample ID	Reserve 1 (same Group and Focus Area as primary sample)	Reserve 2 (potentially different Group or different Focus Area)
Reserve	bioassay or chem	7	7-R10	-	-
Primary	Chemistry-Only	7B	7B-C1	7B-R4	7-R4, 7-R5, 7-R6, 7-R7, 7-R10
Primary	Chemistry-Only	7B	7B-C2	7B-R4	7-R4, 7-R5, 7-R6, 7-R7, 7-R10
Primary	Chemistry-Only	7B	7B-C3	7B-R3	8B-R1, 8R-2, 8R-3, 8R-4
Primary	Chemistry-Only	7B	7B-C4	7B-R3	8B-R1, 8R-2, 8R-3, 8R-4
Reserve	bioassay or chem	7B	7B-R1	-	-
Reserve	bioassay or chem	7B	7B-R2	-	-
Reserve	bioassay or chem	7B	7B-R3	-	-
Reserve	bioassay or chem	7B	7B-R4	-	-
Primary	Bioassay	8	8-B1	8-R2, 8-R10, 8-R6, 8-R9	8B-R1, 7-R4, 7-R5, 7-R6, 7-R7, 7-R10, 8-R1, 8R-3, 8-R4, 8-R5, 8-R7
Primary	Bioassay	8	8-B2	8-R6, 8-R9, 8-R10, 8-R2	8B-R1, 7-R4, 7-R5, 7-R6, 7-R7, 7-R10, 8-R1, 8R-3, 8-R4, 8-R5, 8-R7
Primary	Bioassay	8	8-B3	8-R8, 8-R1, 8-R5, 8-R3, 8-R4	8B-R3, 8B-R4, 7-R8, 8-R2, 8-R6, 8-R9, 8-R10
Primary	Bioassay	8	8-B4	8-R6, 8-R9, 8-R10, 8-R2	8B-R1, 7-R4, 7-R5, 7-R6, 7-R7, 7-R10, 8-R1, 8R-3, 8-R4, 8-R5, 8-R7
Primary	Bioassay	8	8-B5	8-R6, 8-R9, 8-R10, 8-R2	8B-R1, 7-R4, 7-R5, 7-R6, 7-R7, 7-R10, 8-R1, 8R-3, 8-R4, 8-R5, 8-R7
Primary	Bioassay	8	8-B6	8-R8, 8-R1, 8-R5, 8-R3, 8-R4	8B-R3, 8B-R4, 7-R8, 8-R2, 8-R6, 8-R9, 8-R10
Primary	Chemistry-Only	8	8-C1	8-R7	7B-R2, 7B-R1, 7-R1, 7-R2
Primary	Chemistry-Only	8	8-C2	8-R7	7B-R2, 7B-R1, 7-R1, 7-R2
Primary	Chemistry-Only	8	8-C3	5-R2, 5-R4, 8-R3	-
Primary	Chemistry-Only	8	8-C4	8-R8, 8-R1, 8-R5, 8-R3, 8-R4	7-R8, 7B-R3
Reserve	bioassay or chem	8	8-R1	-	-
Reserve	bioassay or chem	8	8-R2	-	-
Reserve	bioassay or chem	8	8-R3	-	-
Reserve	bioassay or chem	8	8-R4	-	-
Reserve	bioassay or chem	8	8-R5	-	-
Reserve	bioassay or chem	8	8-R6	-	-
Reserve	bioassay or chem	8	8-R7	-	-
Reserve	bioassay or chem	8	8-R8	-	-

Table 2

Sample Location Information By Focus Area and Location Priority

Location Priority	Proposed Analysis	Focus Area	Primary Sample ID	Reserve 1 (same Group and Focus Area as primary sample)	Reserve 2 (potentially different Group or different Focus Area)
Reserve	bioassay or chem	8	8-R9	-	-
Reserve	bioassay or chem	8	8-R10	-	-
Primary	Chemistry-Only	8B	8B-C1	8B-R1	8-R6, 8R-9, 8R-10
Primary	Chemistry-Only	8B	8B-C2	8B-R2	8-R7, 7B-R1, 7B-R2, 8-R2, 8-R6, 8-R9, 8-R10
Primary	Chemistry-Only	8B	8B-C3	8B-R3, 8B-R4	8-R1, 8-R3, 8-R4, 8-R5, 8-R8
Primary	Chemistry-Only	8B	8B-C4	8B-R2	8-R7, 7B-R1, 7B-R2, 8-R2, 8-R6, 8-R9, 8-R10
Reserve	bioassay or chem	8B	8B-R1	-	-
Reserve	bioassay or chem	8B	8B-R2	-	-
Reserve	bioassay or chem	8B	8B-R3	-	-
Reserve	bioassay or chem	8B	8B-R4	-	-
Primary	Internal Reference		Ref-1	Ref-1b	-
Primary	Internal Reference		Ref-2	Ref-2b	-
Primary	Internal Reference		Ref-3	Ref-3b	-
Primary	Internal Reference		Ref-4	Ref-4b	-
Primary	Internal Reference		Ref-5	Ref-5b	-
Primary	Internal Reference		Ref-6	Ref-6b	-
Primary	Internal Reference		Ref-7	Ref-7b	-
Primary	Internal Reference		Ref-8	Ref-8b	-
Primary	Internal Reference		Ref-9	Ref-9b	-
Primary	Internal Reference		Ref-10	Ref-10b	-
Reserve	Internal Reference		Ref-1b	-	-
Reserve	Internal Reference		Ref-2b	-	-
Reserve	Internal Reference		Ref-3b	-	-
Reserve	Internal Reference		Ref-4b	-	-
Reserve	Internal Reference		Ref-5b	-	-
Reserve	Internal Reference		Ref-6b	-	-
Reserve	Internal Reference		Ref-7b	-	-
Reserve	Internal Reference		Ref-8b	-	-
Reserve	Internal Reference		Ref-9b	-	-

Table 2

Sample Location Information By Focus Area and Location Priority

Location Priority	Proposed Analysis	Focus Area	Primary Sample ID	Reserve 1 (same Group and Focus Area as primary sample)	Reserve 2 (potentially different Group or different Focus Area)
Reserve	Internal Reference		Ref-10b	-	-
Primary	Tributary Reference		Trib-1	-	-
Primary	Tributary Reference		Trib-2	-	-
Primary	Tributary Reference		Trib-3	-	-
Primary	Tributary Reference		Trib-4	-	-
Primary	Tributary Reference		Trib-5	-	-
Primary	Tributary Reference		Trib-6	-	-

Summary of Sample Collection Procedures

Field sampling methods are detailed in the Field Sampling Plan (Appendix A of the Phase 2 Sediment Study QAPP) and summarized below:

On-boat Activities:

1. Deploy decontaminated grab sampler at sampling station. Record GPS location.
2. Retrieve grab sampler and check grab sampler for sample acceptability (e.g., closed sampler, not overfilled, minimal winnowing, Photograph sediment in the sampler.
3. If acceptance criteria are not met, classify this sediment as rejected. Rejected sediment should be processed as described below and temporarily stored during attempts to collect accepted sediment.
4. Siphon water from sampler.
5. Extract porewater from the grab sampler into a syringe using an airstone (label syringe as containing porewater from rejected or accepted sediments).
6. Deposit sediment into Lexan tub.
7. Examine sediment for the presence of cultural resources (performed by tribal or National Park Service cultural resource monitors). If the recovered sediment contains cultural resources, follow instructions from the cultural resource monitor regarding what to do with the recovered sediment and cultural artifacts, as well as whether to abandon the sampling station.
8. Samples rejected due to incorrect grabs as defined in Step 2 will not be processed for chemical analysis or toxicity testing.
9. Evaluate and document sediment particle size (As detailed in SOP-3, if there is sufficient volume to perform analyses per Table A2, sediment samples should be evaluated and homogenized as laid out in the steps below, and retained for future analyses. The collection of these rejected sediments will allow some evaluation of the area, in the event that similar sampling difficulties are encountered at reserve locations.)
    a. Remove large rocks and debris from sediments by hand containing mostly fine particles.
    b. Press sediment through a 5 mm sieve if sediments contain large fractions of particles >2 mm. Do not use river water to wash sediments through sieve.
    c. Assess the sediment grain size (at least 25 percent must be ≤2 mm).
10. Evaluate and document the presence of black silica particles in sediment.
11. Homogenize sediment sample using decontaminated equipment (e.g., hand-held power auger).
    a. Note that EPA has discussed how homogenization on the sampling boat may be challenging and the adequacy of this procedure will be addressed through oversight where TAI must produce a sample that is homogenized to the EPA observer's satisfaction. If they are unable to satisfy the observer then there will be more discussion about alternatives. Being on a separate boat will pose challenges, of course, but EPA/CH2M HILL will do the best we can and we will be on the boat during initial sampling where the procedure is demonstrated and upstream of Onion Creek where the samples with highest metal concentrations are likely to be collected. The chemistry data may also inform our determination of the adequacy of homogenization – but this is after the fact.
12. Photograph homogenized sediments
13. Fill all sediment sample containers in designated order. Add river water to bioassay sediment samples to create a thin water layer. This layer will minimize oxygenation during transit.

a. Fill the AVS/SEM container completely, leaving no headspace. Distribute the AVS/SEM preservative by storing the container inverted or by mixing.

b. Fill all remaining sediment containers for analytical chemistry, minimizing headspace

c. Fill appropriate decontaminated bioassay containers (e.g., 5-gallon buckets with lids) with sediment.

d. Add river water to bioassay sediment samples to create a thin water layer. This layer will minimize oxygenation during transit.

e. Fill porewater sample containers with filtered or unfiltered water as appropriate for the analytical method.

14. Store all analytical chemistry samples in a cooler with ice. Bioassay samples may be stored on the sampling vessel at ambient temperature [note that these will not be separated from the parent sample on the boat and will need to be maintained on ice].

15. Return any excess sediment and/or porewater to the river, decontaminate equipment (e.g., grab sampler, Lexan tub, mechanical stainless paddle wheel mixer), and move to next sample station.

16. Upon arriving at the dock, transfer all sample containers into a refrigerated area where they can be stored until shipped.

17. Decontaminate sample collection, homogenization, and transfer equipment before moving to the next sample station.

On-shore Activities (TAI)

1. Receive and log porewater and sediment samples.
2. Store all sample containers into a refrigerated area (before and after processing).
3. Prepare sample labels, chain of custody and shipping documents.
4. Pack samples in coolers and ship to laboratories.

Note that EPAs split chemistry sample and bioassay samples will be prepared by TAIs lab (Australian Laboratory Service [ALS] – formerly Columbia Analytical Services [CAS]) after receiving samples collected in the field. The life cycle of a sediment sample is currently planned to be as described in Figure 1.

Sample Analysis

The porewater and sediment samples will be analyzed as follows:

- **Porewater** - If sufficient volume is available, field porewater samples will be analyzed for TAL metals (the dissolved fraction) and other water quality parameters needed to assess metal bioavailability using the BLM. Therefore, the volume-dependent priority order of porewater analytes are described in the QAPP as: 1) aluminum, cadmium, calcium, copper, iron, lead, magnesium, manganese, nickel, potassium, sodium, and zinc; 2) pH, dissolved organic carbon [DOC], hardness (to be calculated), and alkalinity; and 3) chloride and sulfate. In addition to the aforementioned bioassays, no fewer than 35 sediment samples will be selected for backscatter electron microscopy. Preliminary results (e.g., chemistry data, field observations etc.) will be used to refine and identify which samples will undergo this evaluation.

- **Sediment** - Sediment samples from all locations will be analyzed for grain size, pH, acid volatile sulfide (AVS), simultaneously extracted metals (SEM), total organic carbon (TOC), and target analyte list (TAL) metals. Bioassays to be performed on 74 samples include:

  – 28-day whole-sediment toxicity tests with the amphipod, *H. azteca* (endpoints of survival, weight, and biomass [USEPA 2000; ASTM 2011])

- 10-day whole-sediment toxicity tests with the midge, *C. dilutus* (endpoint of survival, weight, and biomass [USEPA 2000; ASTM 2011])

In addition to the above-listed standard bioassays, reproductive endpoints will be also assessed on 18 split-samples. Consistent with EPA's direction, preference for these 18 split-samples will be given to those stations located within high and medium exposure gradient bins, but will be finalized following Round 1 activities. Results of the above-listed 10- and 28-day survival and growth tests, in conjunction with preliminary chemistry data will be used to refine and identify which samples will undergo further evaluation. Specific bioassays to be performed on these 18 samples include the following:

- 42-day whole-sediment toxicity tests with the amphipod, *H. azteca* (endpoints of survival, weight, biomass, and neonates/surviving female [USEPA 2000; ASTM 2011])
- 50- to 65-day whole-sediment toxicity tests with the midge, *C. dilutus* (endpoints of survival, weight, biomass, emergence, eggs/surviving female, egg hatching, and viability of young using the adopted method starting with 7-day old larvae [USEPA 2000; ASTM 2011])

Collection of Split Samples

Two separate split sample analysis programs will be conducted as part of the Phase 2 sediment sampling event; splits for TAL metals analysis by the EPA's Manchester Environmental Laboratory (MEL) in Port Orchard, Washington, and splits for bioassays to be conducted by the US Army Engineer Research and Development Center (ERDC) in Vickburg, Mississippi.

The splits for metals analysis will be obtained from no less than 15 percent of the sediment sample locations (that is, a total of 21 locations if sediment is successfully obtained from all 140 primary [or reserve] locations). The samples will be analyzed for TAL metals. Each split sample for metals analysis will contain not less than 200 grams and will be collected as splits of the homogenized sediments. Samples will be sent by TAI from the field to ALS, homogenized, and then split samples will be collected and sent to MEL for EPAs split sample analysis. CH2M HILL oversight personnel may be needed to provide oversight for the correct homogenization, sampling, labeling, and shipping using the EPA's Scribe application. Split sample locations for EPA chemical analyses are listed in Table 3.

Split samples for EPAs bioassay QA/QC analyses will be determined based on sample volume and initial sample chemistry after the sampling program is complete. Samples stored by TAI at ALS will be re-homogenized and shipped to ERDC once these samples have been identified. A total of 10 split sediment samples collected for ERDCs bioassay QA/QC testing. Up to 7 of these will be site samples collected between Onion Creek and the Canada-US border and up to 3 split samples will be collected from reference locations in Canada. As with EPAs split chemistry samples, bioassay split samples will be sent by TAI from the field to ALS, homogenized, and then split samples will be collected and sent to ERDC for EPAs split sample analysis. CH2M HILL oversight personnel may be needed to provide oversight for the correct homogenization, sampling, labeling, and shipping using the EPA's Scribe application.

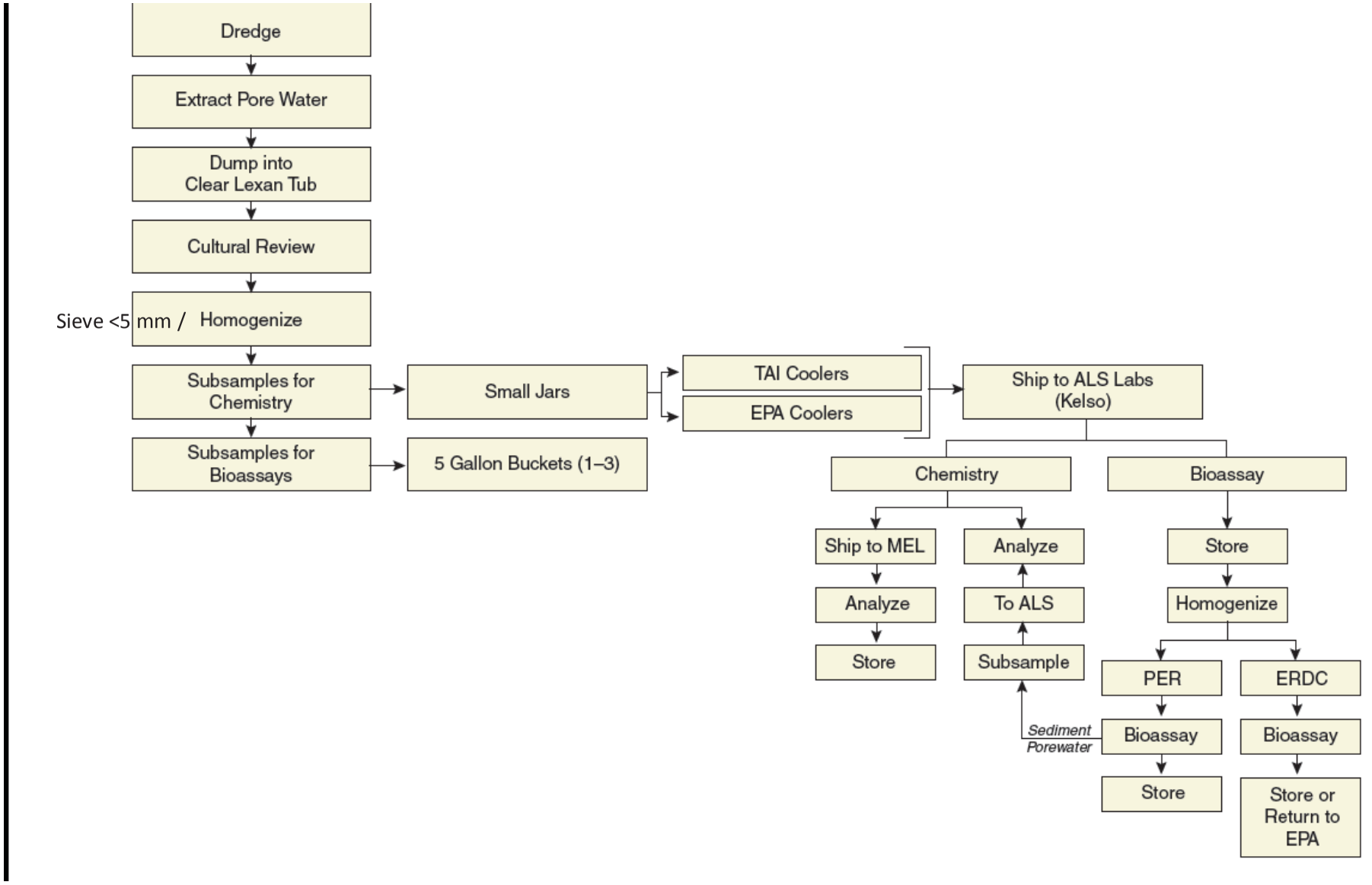

Figure 1. Life of a UCR Sediment Sample

Table 3
Split Sample Locations for TAL Metals Analysis

Sample Location ID	Location Priority	Proposed Analysis	Split Group based on mPECQ
4-C6	Primary	TAL Metals	<1 Pri
5-B6	Primary	TAL Metals	<1 Pri
5B-C3	Primary	TAL Metals	<1 Pri
6B-C2	Primary	TAL Metals	<1 Pri
Ref-4	Primary	TAL Metals	<1 Ref
Ref-8	Primary	TAL Metals	<1 Ref
Trib-3	Primary	TAL Metals	<1 Ref
1-B3	Primary	TAL Metals	>1<4 Pri
2-B2	Primary	TAL Metals	>1<4 Pri
3-C4	Primary	TAL Metals	>1<4 Pri
5-B2	Primary	TAL Metals	>1<4 Pri
5-B5	Primary	TAL Metals	>1<4 Pri
5-C3	Primary	TAL Metals	>1<4 Pri
6-B3	Primary	TAL Metals	>1<4 Pri
7-B5	Primary	TAL Metals	>1<4 Pri
8-C4	Primary	TAL Metals	>1<4 Pri
1-B2	Primary	TAL Metals	>4<8 Pri
1-C3	Primary	TAL Metals	>4<8 Pri
4-B3	Primary	TAL Metals	>4<8 Pri
1-C1	Primary	TAL Metals	>8 Pri
3-B3	Primary	TAL Metals	>8 Pri

Volume Basis for Prioritization of Split Samples (Bioassay Stations)

The approved sampling QAPP (TAI, 2013; Table B3-1) has identified the required sample volume to be 12 gallons (45 liters). This includes approximately 11.8 gallons for toxicity testing (and possible TIE testing[1]) and 337 g for chemical analyses (Table B3-1 of TAI, 2013). EPA requires and approximately 5 gallons (19 liters) for toxicity testing at ERDC and 300 g for chemical analyses. In addition, the National Parks Service (NPS) requires s 3-5 gallon (11.4-19 liters) sediment split sample from each of the stations sampled within the Lake Roosevelt Recreation area (i.e., downstream of Onion Creek). The sample volumes needed for successful sampling and testing are as follows.

- Chemistry-only station: The minimum sample volume for a successful collection at a chemistry-only station is less than 1 gallon (approximately 1 liter).
  - 337 g for TAI (chemistry)
  - 300 g for EPA (chemistry)
- Bioassay station located upstream of Onion Creek: The minimum sample volume for a successful collection at a bioassay station located upstream of Onion Creek (i.e., includes EPA split sample for potential bioassays) is 17 gallons (64 liters). to be split as follows:

[1] Most of this sample is to be held in the event that TIES are needed. EPA and TAI may be consulted to discuss not collecting this additional sediment (i.e., 21 liters for TAI) if target sample volumes are not achieved at primary and reserve sampling locations.

  - 44.6 liters for TAI (chemistry, short-term and long-term toxicity testing)
  - 19 liters for ERDC splits (if this is also an EPA chemistry split sample then a small volume of the ERDC sample volume (i.e., 300 g) can be used for the EPA chemistry split sample.
  - If this minimum volume is not achieved, then the sample will be set aside as a possible reserve station or, if needed, for a chemistry-only station in the event that a chemistry station must be used as a reserve bioassay station.

- Bioassay station located downstream of Onion Creek: The minimum sample volume for a successful collection at a bioassay station downstream of Onion Creek (i.e., includes NPS split sample) is 15 gallons (56 liters). to be split as follows:
  - 44.6 liters for TAI (chemistry, short-term and long-term toxicity testing)
  - 11.4 liters for DOI splits
  - 300 g for EPA if this is also an EPA chemistry split sample
  - If this minimum volume is not achieved, then the sample will be set aside as a possible reserve station or, if needed, for a chemistry-only station in the event that a chemistry station must be used as a reserve bioassay station.

Final selection of samples will be used for bioassays will be made in consultation with EPA and could potentially be made at the end of sampling based on the available sample volumes and chemical analyses data if primary and reserve station sediment volumes are insufficient.

Field Oversight Staffing

Trained personnel will observe the sample collection, processing, and documentation procedures during each sampling event. TAI plans to have two field teams collecting sediments at any given time and EPA is providing one observer at any given time during these activities. Therefore, CH2M HILL will provide 1 observer at all times for field oversight:

- **Sediment Sampling Observers** – Observers will be 40-hour HAZWOPER trained geologists, engineers, environmental scientists, or sampling technicians with experience collecting and documenting sediment samples for laboratory and toxicity analysis.
- **Split Sample Coordinator** – One part or full-time sample coordinator who will prepare sampling documentation and ship the split samples to the laboratories for analysis from ALS. The sample coordinator will be trained in use of current EPA sample documentation protocols and software (Scribe).

Field Oversight Activities

Field oversight personnel will monitor the performance of the sampling events relative to information provided in the relevant QAPPs and associated field sampling plans (FSPs) and standard operating procedures (SOPs). The oversight activities will include:

- whether trained personnel staffed the sample event;
- whether equipment was in proper working order (that is, calibration);
- availability of proper sampling equipment;
- observation and documentation (e.g., notes and photographs) of sampling techniques, sample collection, homogenization, and packaging (whether appropriate sample containers, sample preservatives, and techniques were used);
- whether QC samples were properly collected;

- observation and documentation (e.g., notes and photographs) of sampling location identification and sampling location reassignment decisions;
- communication and documentation of necessary changes to field techniques and procedures;
- whether sample identification, chain-of-custody procedures, field notebooks, sampling procedures, and field measurements are appropriately documented; and,
- whether sample packaging and shipment were appropriate.

Sampling activities will be photographed and, in some cases, may be video-recorded. Observations will be documented in field log books and on a sample event-specific observer checklist developed from detailed review of the relevant QAPPs, FSPs, and SOPs. A copy of the checklist to be used is provided in Attachment A.

Project Communications

Frequent and detailed communication between field personnel and management staff is essential to successful completion of the sampling events. The anticipated lines of communication for different elements of the field effort are as follows:

1. **Day to Day Operations**– Field observers will attend daily meetings conducted by TAI and coordinate logistics directly with the TAI field team leaders. Also on a daily basis, field oversight personnel will review samples collected and compare these to the targeted samples. Field observers will then coordinate with TAI's field personnel, EPA, and the CH2M HILL field team leader to plan the next day's activities to fill targeted sample deficiencies, if identified. Field observers will provide daily reports to the field team leader and project manager (by telephone or email), summarizing each day's activities and describing activities planned for the next day. Any issues regarding schedule, safety, or logistics that cannot be resolved in the field should also be reported immediately to the project manager who will bring the issue to the attention of TAI and/or EPA managers, as appropriate.

2. **Deviations from QAPPs, FSPs, and SOPs** – Any deviations to the sampling program or changes in procedures will be recorded in the field log book and on the observer checklists. The reason for the deviations and changes should also be noted, along with the names of people making and authorizing the changes. Note - field oversight personnel are not authorized to approve deviations or changes in procedures. It is TAIs responsibility to keep EPA informed immediately in the event of a deviation and, if possible, EPA should participate in determining the corrective action. CH2M HILL oversight staff will document and participate in this process by communicating this information to EPA and supporting EPA as requested.

   One anticipated deviation is the potential need for sample location reassignment. Decisions to reassign a sampling location will be made according to the following prioritization:

   - Location
   - Effort
   - Volume
   - Completeness

3. **Quality and Completeness Issues -** Changes to the sampling program that have the potential to affect quality and completeness should be communicated directly (telephone or email) to the CH2M HILL field team leader at the end of each day, or to the available EPA representatives that may be present on-site. The CH2M HILL field team leader or project manager will contact the EPA to determine an appropriate path forward if direct communication between field oversight personnel and EPA is not possible.

   The degree to which the samples collected meet these targets will be the measure of completeness for the sampling event. A target of 80 percent sampling completeness has been determined by EPA. Completeness will be evaluated on a daily basis through the review of samples collected each day to ensure that certain sediment category bins are filled at a variety of locations and for a variety of sediment types throughout the

UCR. Also note that a sample collection gap is not a data gap for the overall sediment toxicity study *per se*. Data gaps will be determined after data review.

References

CH2M HILL. 2013. Quality Assurance Project Plan - Phase 2 Sediment Study Split Sample Metals Analysis. July.

Teck American Inc. (TAI). 2013. Upper Columbia River Draft Final Quality Assurance Project Plan for the Phase 2 Sediment Study. Prepared for Teck American Inc. by Exponent, HDR-Hydroqual and Parametrix, Inc. March.

U.S. Army Engineer Research and Development Center (ERDC). 2013. Quality Assurance Project Plan (QAPP) for Assessment of Toxicity of Upper Columbia River Sediments to Benthic Invertebrates. Prepared for the USEPA by J.A. Steevens and J.A. Stanley. August.

U.S. Environmental Protection Agency (USEPA). 2012. Summary and Evaluation of Phase 1 (2005) Sediment Toxicity Tests Upper Columbia River Site. Prepared by CH2M HILL. August.

Additional Field Guidance

What to Wear:

- Close toes shoes (do not need to be steel toed)
- Long pants
- Layers. Temperatures can vary widely.
- Do NOT need hard hat or vest

Gear to Bring/Have:

- PFD
- Camera
- Reusable water bottle. There will be a 5 gallon jug for refills.
- Food. There may be the ability to call in our breakfast/lunch/dinner orders along with Exponent and URS.
- Sunscreen
- Sunglasses
- Rain gear
- Binoculars if you have them
- Radios (Cam will arrange for equipment)

Contact Information

Laura Buelow (w) 509-376-5466 (c) 509-420-0435	Marilyn Gauthier/CH2M HILL (w) (503) 872-4800 (c) (425) 894-6464	Dave Hose (Crew Leader for URS) (c) 206-218-7536 Verizon Says he will also get AT&T
Marc Stifelman W 206/553-6979 M 206/250-8675	Cameron Irvine/CH2M HILL (c) (916) 335-2369	Kris McCaig, TAI Project Manager 509-623-4501
Matt Wilkening (w) 208-378-5760	Nicole Badon (w) +1 (425) 233-3404 x25404 (c)	Marko Adzic, TAI 509-623-4585
Burt Shephard (w) (206) 553-6359 (c) 425-359-2268	Steve Demus (w) +1 (509) 464-7222 x27222 (c)	
Monica Tonel (w) (206) 553-0323 (c)		

Appendix C
Health and Safety Plan