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JUL 25 2012

OFFICE OF
ENVIRONMENTAL CLEANUP

July 25, 2012

EPA01-773180-000

Ms. Helen Bottcher
Project Coordinator, Office of Environmental Cleanup
U.S. Environmental Protection Agency, Region 10
1200 6th Avenue, Suite 900 (ECL-111)
Seattle, WA 98101-3140

Subject: Upper Columbia River Remedial Investigation Feasibility Study (UCR RI/FS) Draft Final Quality Assurance Project Plan for the *Phase 2 Sediment Study* (July 2012)

Dear Ms. Bottcher:

On behalf of Teck American Incorporated, I am pleased to submit for your review and approval the above-referenced draft final quality assurance project plan. I wish to confirm the enclosed document is accessible to registered users via the secure domain of the project website as well.

We look forward to receiving your approval on this matter in the near future look forward and to a successful 2012 field sampling season. Should you have any questions or require any additional information at this time, please do not hesitate to contact me at (509) 623-4585.

Sincerely,
Teck American Incorporated

Marko E. Adzic, P.E.
Manager, Environmental Engineering

USEPA SF
1398476

Attachments (1) Comments and Associated Responses on the Upper Columbia River Draft Quality Assurance Project Plan for the Phase 2 Sediment Study
Enclosures (1) Draft Final Quality Assurance Project Plan for the *Phase 2 Sediment Study* (July 2012)

cc: Monica Tonel, U.S. Environmental Protection Agency, Seattle, WA, Enclosures (8)
John Roland, Washington Department of Ecology; Spokane, WA; Enclosures (2)
Dan Audet, U.S. Department of Interior, National Parks Service; Spokane, WA; Enclosure (1)
Randy Connolly, Spokane Tribe of Indians; Wellpinit, WA; Enclosure (1)
Patti Bailey, Confederated Tribes of the Colville Reservation; Nespelem, WA; Enclosure (1)
Dr. Anne Fairbrother – Exponent, Inc.; Bellevue, WA; w/o enclosure
Dr. Mark Velleux - HDR | HydroQual Inc.; Mahwah, NJ; w/o enclosure
Dave Enos – URS Corporation; Spokane, WA; w/o enclosure

Comments and Associated Responses on the Upper Columbia River Draft Quality Assurance Project Plan for the Phase 2 Sediment Study

General Comments

1) **DQOs** – The revised sediment QAPP must expand section A7.2 to include a more comprehensive description of the Data Quality Objectives and the testable risk questions the study will address. The section must explain how this QAPP fits into the BERA workplan and the Problem Formulation Plan. It must also make clear which receptors/pathways are covered by the proposed investigations by referring to the CSM. For example, the draft QAPP is narrowly focused on the assessment of risk to benthic organisms, but the resulting sediment data may also be used in the evaluation of risk to aquatic plants, sediment-probing birds, and other receptors. Additional DQOs are indicated in several of the following general comments including:

   - Information inputs must include estimates of the approximate number of samples expected to meet DQOs (see General Comment 3);
   - The purpose of field collected pore water and lab pore water collections must be described more completely (see General Comment 5);
   - The purpose of collecting chemistry-only samples must be clearly described (see Specific comment 6); and,
   - Slag characterization must be described as an information input to support an understanding of the concentration-response (see General Comment 8).

TAI Response

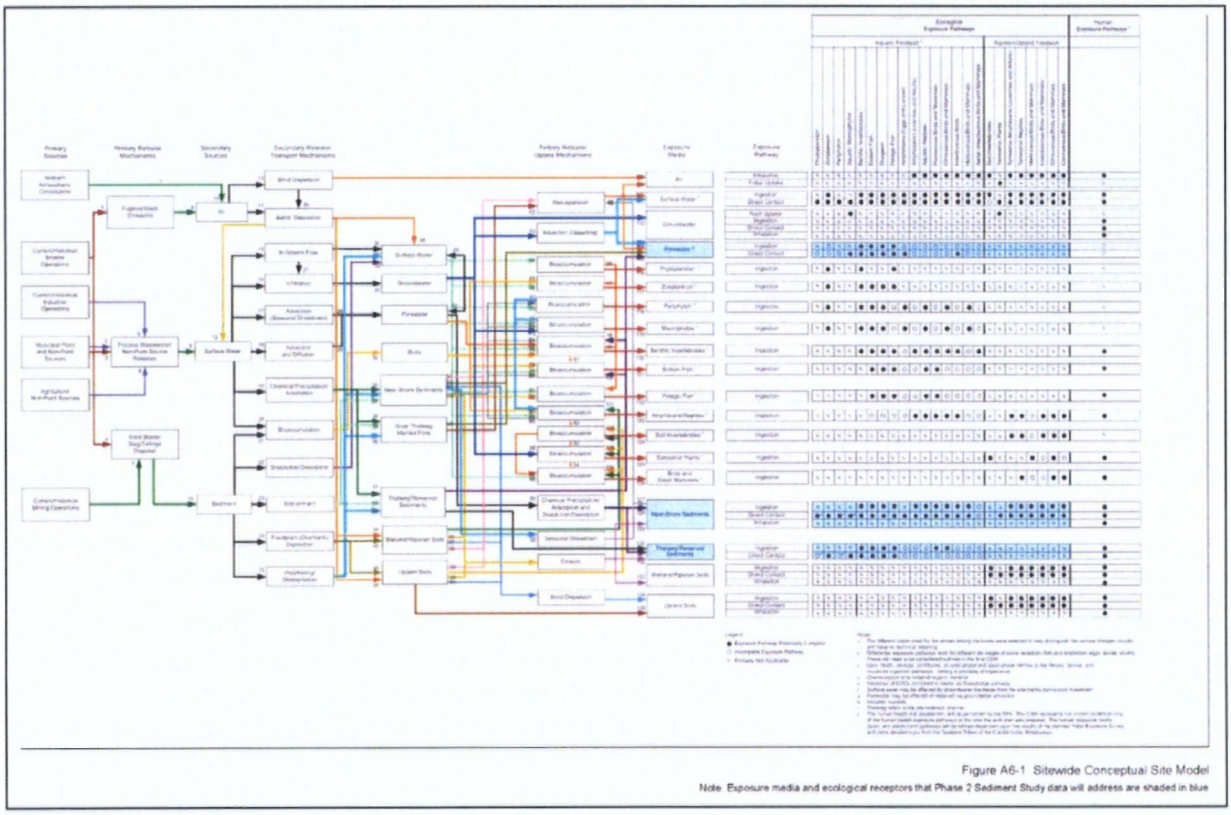
Comment acknowledged. As stated within the U.S. Environmental Protection Agency's February 2010 Level-of-Effort, *"the goal of this sediment sampling component of the baseline ecological risk assessment is to evaluate risks to benthic invertebrates associated with exposure to metals and other chemicals in the UCR..."* As such, the primary goal of this study remains consistent and is to evaluate risks to benthos associated with exposure to chemicals of potential concern in upper Columbia River sediments. However, the comment correctly identifies that the data can be used in the assessment of unacceptable risks to other ecological receptors. As a result and in response to comment, we wish to confirm that the document has been revised stating that data collected during this study will also be used to inform other components of the ecological risk assessment such as the evaluation of risk to aquatic plants, sediment-probing birds, and other receptors. This has been reflected in Section A7.2 as requested, as well as in other portions of the document, to illustrate how this study fits into the baseline ecological risk assessment. These include Sections A4.1, A5, A6, and A7.2 (see below).

Section A4.1 - The following text has been added to the 3rd paragraph of this section: "In addition, data collected during this study will be used to inform other components of the ecological risk assessment (e.g., evaluation of risk to aquatic plants, sediment-probing birds, and other receptors)."

Section A5 - The following text has been added to the 1st paragraph of this section: "The Baseline Ecological Risk Assessment (BERA) work plan (TAI 2011) identified several

historical studies that collected and evaluated sediment chemistry and toxicity data from the Site. Detailed summaries and an integration of these data are presented within Appendices D (sediment chemistry) and E (sediment toxicity) of the BERA work plan. Similarly, the Screening Level Ecological Risk Assessment…"

Section A6 - The following text has been added to this section: "In addition, sediment and porewater data collected during this study can and will be used to inform other components of the BERA. For example, these data can and will be used, as appropriate and applicable, in the evaluation of unacceptable risks to other ecological receptors such as aquatic plants and sediment-probing birds, see Figure A6-1." A copy of Figure A6-1 referenced herein is provided below.



Conceptual site model incorporated in the draft final version of the quality assurance project plan for the Phase 2 Sediment Study. Data to be collected for exposure media and associated ecological receptors have been highlighted for this Phase 2 sediment study.

Section A7.2 - The following text has been added to this section: "In addition to the above-mentioned primary goal and associated DQOs, other questions to be addressed by this study include:

- Are sediment COPCs bioavailable at levels indicative of potential unacceptable risks to other ecological receptors (e.g., aquatic plants, sediment-probing birds)?

- Can the nature and extent of unacceptable risk at the Site via spatial gradients and sediment bed properties such as slag content (e.g., Zn/V ratio[1]), TOC, mPECQ, and sediment texture be further refined?[2]

The above-mentioned abbreviations/acronyms are defined as follows: COPCs (chemicals of potential concern), Zn (zinc), V (vanadium), TOC (total organic carbon), and mPECQ (mean probable effects concentration quotient).

Please note responses to the bullets listed within this General Comment have been respectively addressed within the General- or Specific-comment referenced; please see responses to General comment Nos. 3, 5, and 8; and Specific Comment No. 6.

2) **Sampling Locations** – The draft QAPP uses GIS-based sediment bed property groupings to map the sediment bed layers using existing data and then randomly placing samples within bins covering the range of expected toxicity. The EPA has some concerns with the approach's predictive abilities and it differs in a few important ways from suggestions in the Sediment LOE. First, the draft QAPP uses an mPECQ of 2 to describe high metal concentrations in the sample location selection (Appendix B). The Sediment LOE proposed using an mPECQ of >5 to identify samples with a high probability of toxicity. The use of a different list of metals between EPA and Teck for the mPECQ calculations is inconsistent. EPA is concerned that Teck's approach will not capture enough samples at the high end of the toxicity range. Second, Teck's sample placement did not make adequate use of knowledge of the bottom types (or areas identified in the dry) and the likelihood of successfully collecting a sample with a VanVeen grab. The EPA is seeking a more refined approach in which samples will be shifted toward more focused areas and in which previous sampling success or local knowledge is used to achieve a higher chance of successfully obtaining a sample. Third, the number of samples proposed by Teck does not seem designed to ensure adequate coverage of the range of expected toxicity. The number of samples proposed by Teck also does not seem designed to achieve an optimum dose response curve with the first round of samples. Therefore, the EPA is recommending specific modifications and additional samples to the locations recommended by Teck in the draft QAPP. The EPA provided the location and a description of these alternative sample locations to Teck in a separate letter dated April 27, 2012.

TAI Response

Comment acknowledged and as documented on July 3, 2012, on the basis that sampling may proceed as planned during the 2012 field season, Teck American Incorporated while reserving its right to raise technical concerns associated with the U.S. Environmental Protection Agency's alternate locations (refer to June 11, 2012 correspondence), will undertake sediment sampling activities and analyses at U.S. Environmental Protection Agency's alternate locations (April 27, 2012 letter). Teck American Incorporated, also under protest, has incorporated the site reconnaissance recommendations outlined by the U.S. Environmental Protection Agency's contractor (CH2M Hill, Inc.; June 27, 2012 technical memorandum). We wish to confirm that the document has been revised to reflect Teck American Incorporated's commitment outlined in the July 3rd correspondence.

[1] The basis and rationale of using a Zn:V ratio was detailed within Appendix D of the BERA work plan (TAI 2011). Other chemical ratios and/or methods (i.e., backscatter electron microscopy) may also be used to refine sediment bed properties and facilitate data interpretation.

[2] The sampling design is not intended to provide an assessment of spatial distribution of contaminants in the Site.

3) **Number of Bioassay Samples/Phasing**: A DQO describing the purpose of sediment samples and toxicity testing must be included in the revised QAPP, including the approximate total number of samples expected to meet the DQOs, while recognizing that the final determination will be data driven. The EPA expects that 100-130 paired bioassay/chemistry samples representing a range of concentrations and conditions may be needed to develop concentration-response relationships. Teck must consider the paired sediment chemistry and bioassay data from the 2005 sampling program in the development of the dose response curve and use the 2005 data unless the lack of BLM parameters, porewater data or other critical parameters prevent the 2005 data from informing dose-response relationships. How well the 2005 data correlates with the newly collected data will be a factor in determining the need for Round 2 sampling. The revised QAPP must describe this, along with the other factors (i.e., inputs to the decision) and decision guidelines that will be considered in determining whether Round 2 samples need to be collected and if so, where. See specific comment 4 for additional detail.

TAI Response

Comment acknowledged and as documented on July 3, 2012, on the basis that sampling may proceed as planned during the 2012 field season, Teck American Incorporated while reserving its right to raise technical concerns associated with the U.S. Environmental Protection Agency's alternate locations (refer to June 11, 2012 correspondence), will undertake sediment sampling activities and analyses at U.S. Environmental Protection Agency's alternate locations (April 27, 2012 letter). Teck American Incorporated, also under protest, has incorporated the site reconnaissance recommendations outlined by the U.S. Environmental Protection Agency's contractor (CH2M Hill, Inc.; June 27, 2012 technical memorandum). We wish to confirm that the document has been revised to reflect Teck American Incorporated's commitment outlined in the July 3rd correspondence.

Furthermore, consistent with the U.S. Environmental Protection Agency's Guidance[3] and sampling events completed to date for the Remedial Investigation/Feasibility Study, Teck American Incorporated will continue to consider and evaluate high quality data (e.g., the above-referenced 2005 data). Following Phase 2 sediment/toxicity data collection, analyses, and evaluation, if the U.S. Environmental Protection Agency determines that there is insufficient information to support an informed risk-based management decision using existing site data; additional sediment/toxicity sample collection may be needed. Furthermore and per the terms and conditions of the June 2, 2006 Settlement Agreement, should Teck American Incorporated identify the need for additional data, this would be documented in a technical memorandum at that time.

We would like to take this opportunity to confirm for the U.S. Environmental Protection Agency that a data quality objective describing the purpose of sediment samples and toxicity testing was included in the draft quality assurance project plan and that consistent with response to General Comment No. 1 (see above) additional data quality objectives have been included to demonstrate how data from this study can and will be used in the assessment of unacceptable risks to other ecological receptors. Furthermore, we wish to confirm that Section A7.6.1 of the quality assurance project plan states "It is expected that at least 80

[3] USEPA. 1997. Ecological risk assessment guidance for Superfund: process for designing and conducting ecological risk assessments. EPA-540-R-97-006. U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response, Washington, DC.

percent of the required number of sediment samples will be successfully collected. As demonstrated by previous sampling events (e.g., USEPA 2005), successful collection of sediments cannot be determined a priori because some areas within the Site may experience sample refusal due to bedrock and/or large cobbles (i.e., sediments generally having particle diameters greater than 2 mm). If sample refusal occurs, a reserve location (refer to Maps A7-1 through A7-6) may be substituted." Copies of the aforementioned referenced maps have not been included in this response but are available in the draft final version of the document.

4) **Sieving**: The Sediment LOE recommended that all samples be press sieved through a 2 mm sieve. However, the EPA is revising this expectation based on a better understanding of the expected grain sizes that will be encountered. There are certainly sediments in the UCR with particle sizes >2 mm. However, there are areas where the sediment is fine grained and few if any particles > 2 mm are expected. Teck must specify the sediment particle size range that will be considered acceptable for sediment samples in the revised QAPP, and describe how sediments will be handled to ensure the samples are appropriate for both analytical chemistry and sediment bioassay tests (i.e., <2 mm). The EPA expects Teck to obtain sediments <2 mm and will ensure this is achieved through close field oversight of Teck's sampling. A qualified person should visually estimate and record the percentage of material <2 mm as samples are retrieved, and to select/retain sediment that contains at least 25% of the <2 mm size fraction. Additional field processing will depend on the sample and may vary across the site. The procedures for further processing must be specified in the QAPP using the following or similar rules: Samples of fine grained material with no particles >2 mm may be retained with no additional sorting. Samples that are mostly fine grained materials with some larger pieces of gravel or debris may have the larger pieces of gravel or debris removed by hand. Samples that have a large amount of materials >2 mm should be coarsely sieved in the field with a 5 mm sieve. Samples where more than 75% of the sample is material >2mm should be rejected.

<u>TAI Response</u>

Comment acknowledged. The field sampling plan (Appendix A of the quality assurance project plan) and its associated standard operating procedures have been accordingly updated. Firstly, acceptance criteria for sediment samples previously identified within the draft quality assurance project plan (e.g., presence of overlying water, adequate penetration depth, etc.) has been expanded to include that the "sample contains >25 percent fines (i.e., ≤ 2 millimeters [mm])." In addition, the following language has been added in Section 2.2.4 of the field sampling plan and is also reflected in standard operating procedure No. 3:

"Sediments that are composed entirely of fine grained material (≤2 mm) will be retained with no additional processing. Sediments that are composed mostly of fine grained materials but also include some larger pieces of gravel or debris will have the larger pieces of gravel or debris removed by hand. Samples with large proportions of materials that are >2 mm will be coarsely sieved using a number 4 or 3 sieve (5.6 to 6.35 mm). Sieving will be performed by shaking or pressing (e.g., using gloved hands to break apart clumps) the sediment through the sieve. Unacceptable sieving techniques include drying the sediment or washing it through the sieve using water."

5) **Pore Water Sampling**: DQOs describing the goals of field collected pore water and lab pore water collections must be included in a revised QAPP. The EPA is willing to consider pore water data collected using the air stone method proposed in the draft QAPP. However, this is a non-standard method and it has shown some potential for bias over other methods

(i.e., concentrations of lead were lower than from peepers, DGTs, and known concentrations in spiked water; White Sturgeon Methods Development Data Summary and Evaluation [Teck 2010]). Therefore, concentration-response relationships in laboratory exposures will be assessed using pore water collected from peepers in chemistry-only bioassay test beakers for each sediment sample. Analytes not determined from peepers in laboratory bioassays will be measured in pore water extracted via centrifuge from splits of homogenized sediments prepared for bioassays. The revised QAPP must describe in more detail how Teck intends to collect field porewater from sample locations requiring multiple sediment grabs, how Teck intends to compare field-collected and laboratory derived porewater, and how the field collected porewater could inform the risk assessment.

TAI Response

Comment acknowledged. We wish to confirm that the draft final quality assurance project plan has been updated to clearly distinguish between field- and laboratory-collected (i.e., bioassay) porewater. We believe that this distinction will clarify how these data will help inform study data quality objectives.

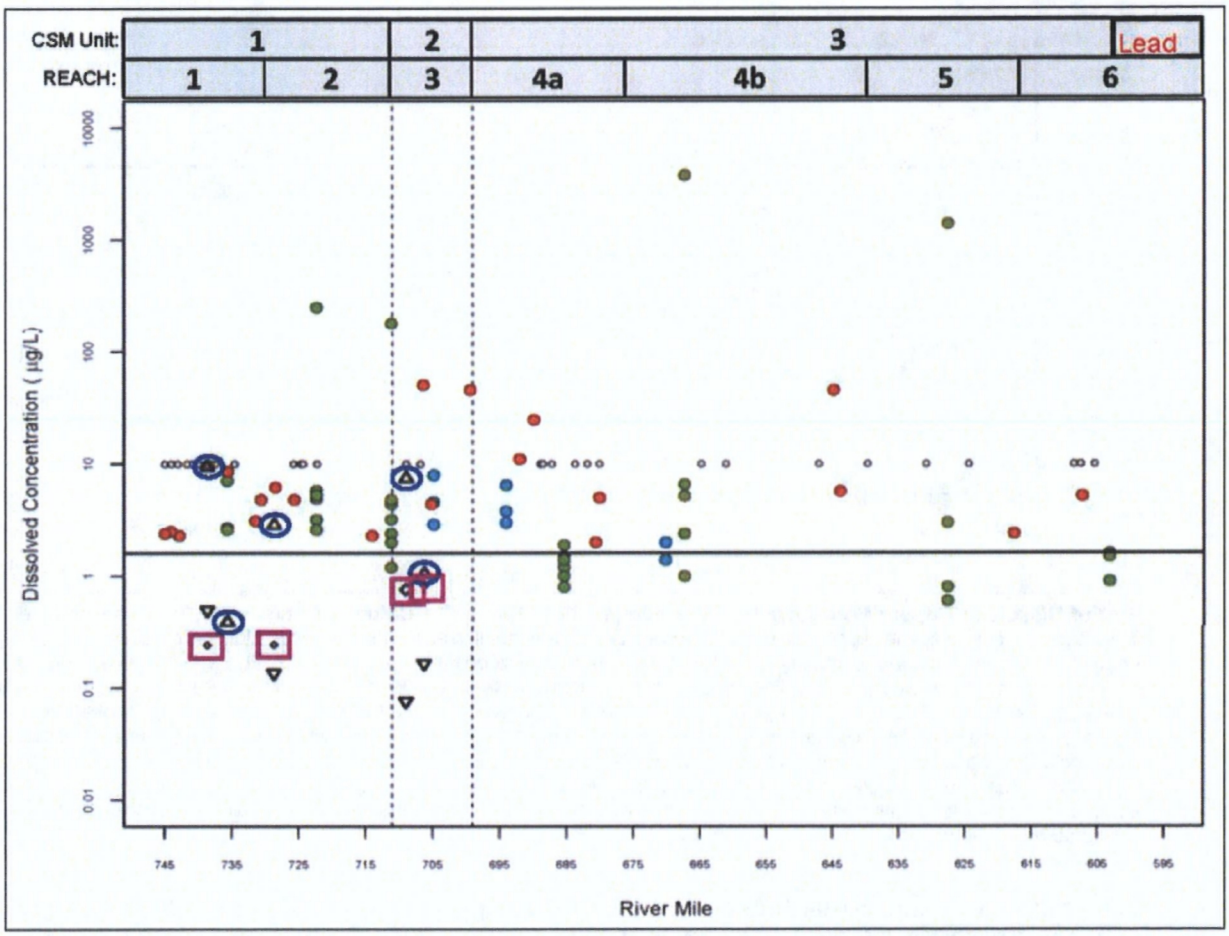
Laboratory-collected (bioassay) porewater will address the data quality objective of: "Are there significant differences in survival, growth, or reproduction of benthos (i.e., amphipods and midge) exposed to Site and reference sediments?" and if so "are these effects due to COPCs as measured in sediments and/or porewater?" Furthermore, laboratory porewater data will be used to help evaluate if a "concentration-response relationships can be established between measured COPC concentrations and observed effects?"

Similarly, field-collected porewater will address the following data quality objectives: a) "Are sediment COPCs bioavailable at levels indicative of potential unacceptable risks to benthos?"; and b) "Are sediment COPCs bioavailable at levels indicative of potential unacceptable risks to other ecological receptors (e.g., aquatic plants, sediment-probing birds)?" As detailed within the draft final quality assurance project plan (refer to Section A7.5.1), porewater chemistry will provide an important line of evidence in addressing and evaluating the above-listed data quality objectives.

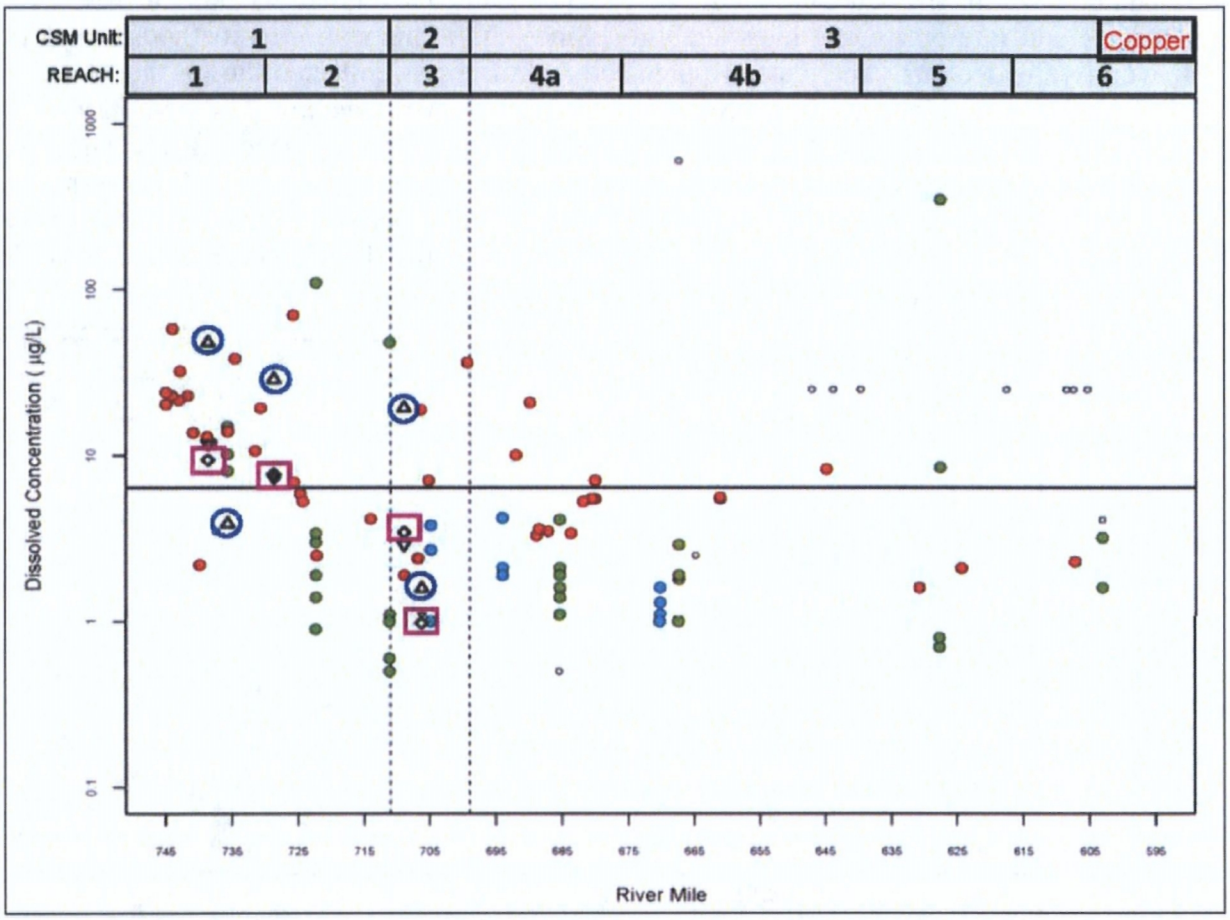
Both field- and laboratory-collected porewater data are needed to directly address study data quality objectives as outlined above. Furthermore, information from both field- and laboratory chemistry (sediment/porewater) and bioassay endpoints will be used to identify areas of unacceptable risk to benthos and evaluate concentration-response relationships. In other words, field-collected porewater data will help 'translate and relate' laboratory based observations to the field. As outlined in Section A7.5.1 the preparation of samples for laboratory bioassays necessarily results in changes to sediment characteristics that affect bioavailability which need to be considered and accounted for.

We appreciate the U.S. Environmental Protection Agency's willingness to consider porewater data collected using the ceramic airstone and wish to confirm that the draft final quality assurance project plan clearly identifies that peepers (see Section B4.2.1) will be used to collect laboratory-porewater for dissolved metal analyses. To maintain consistency between field- and laboratory-based porewater measurements and reduce uncertainties in the aforementioned field/laboratory 'translation' factor, it is important that the airstone also be used to extract laboratory-based porewater for analytes not determined from peepers. As detailed within the draft final quality assurance project plan, porewater collected via the

airstone within the laboratory will be analyzed for water quality parameters essential to assess and interpret metal bioavailability. Since the aforementioned methods development work, validated analytical data are publically available as collected during the "Assessment of Sediment Toxicity to White Sturgeon (*Acipenser transmontanus*)" study. Based on this data set, in which over 200 porewater measurements were made using the airstone, the aforementioned bias in dissolved lead concentrations does not appear to be present. Rather and as illustrated within the figures below, dissolved porewater concentrations recorded using the airstone appear consistent with other high-quality data studies conducted within the upper Columbia River.



Plot of Dissolved Lead Porewater Concentrations within the upper Columbia River as a Function of River Mile. This base plot appears in Appendix B, Attachment B3 of the quality assurance project plan (excluding the 2010 white sturgeon data) and as requested by the U.S. Environmental Protection Agency will be updated following the Phase 2 Sediment Study. In addition to including data from the Phase 2 Sediment Study, porewater data collected as part of the remedial investigation/feasibility study (e.g., the 2010 white sturgeon sediment toxicity assessment as above) will also be included. Average porewater concentrations collected during the 2010 white sturgeon sediment toxicity assessment have been included above to illustrate the effectiveness of ceramic airstones. Dissolved lead concentrations recorded during the 2010 white sturgeon sediment toxicity assessment from airstones and peepers appear as triangles (highlighted with a blue oval) and diamonds (highlighted with a pink square), respectively. Note that average dissolved lead concentrations extracted using the ceramic airstones are consistent with other site data.



Plot of Dissolved Copper Porewater Concentrations within the upper Columbia River as a Function of River Mile. This base plot appears in Appendix B, Attachment B3 of the quality assurance project plan (excluding the 2010 white sturgeon data) and as requested by the U.S. Environmental Protection Agency will be updated following the Phase 2 Sediment Study. In addition to including data from the Phase 2 Sediment Study, porewater data collected as part of the remedial investigation/feasibility study (e.g., the 2010 white sturgeon sediment toxicity assessment as above) will also be included. Average porewater concentrations as collected during the 2010 white sturgeon sediment toxicity assessment have been included above to illustrate the effectiveness of ceramic airstones. Dissolved copper concentrations recorded during the 2010 white sturgeon sediment toxicity assessment from airstones and peepers appear as triangles (highlighted with a blue oval) and diamonds (highlighted with a pink square), respectively. Note that average dissolved copper concentrations extracted using the ceramic airstones are consistent with other site data.

As a result, we believe that these additional data support the use of airstones not only in the field, but also in the laboratory and will help reduce uncertainties in decision-making that would be increased by introducing a third porewater extraction method (i.e., centrifugation). It should be noted that based on site data collected to date, centrifugation methods may have the potential to bias porewater concentrations on the high-side (multiple examples of this can be observed in Appendix B, Attachment B3 of the quality assurance project plan [e.g., barium, zinc etc.]). Therefore, maintaining consistency in porewater sampling methods to the maximum extent possible (i.e., the use of the ceramic airstone) will create data of the highest quality and reduce uncertainty.

The draft final quality assurance project plan (i.e., the field sampling plan and its associated standard operating procedures) fully describes how, if required, field-collected porewater would be handled should multiple grab sediment samples be needed.

6) ***H. azteca* test duration** - The rationale *for 10-day* test with *Hyalella azteca* is not clear and is inconsistent with the Sediment LOE. The EPA is requiring the use of the 28-day test on all bioassay stations and the QAPP must be revised accordingly.

TAI Response

The QAPP has been revised to use 28-day Hyalella tests in place of the standard 10-day tests.

7) **Bioaccumulation**: The Problem Formulation Expansion document states "*H. azteca tissue at the end of the 28-day tests will be archived and may be analyzed, at EPA's direction, to provide a supplemental line of evidence.*" The EPA has determined that tissues should NOT be archived from the 28-day *Hyalella* toxicity test. The 28-day *Hyalella* test tissues are needed to generate high quality dry weight measurements of surviving amphipods and those measurements could be compromised if the tissues are archived for chemistry (i.e., if wet weights are used as a toxicity test endpoint). Teck has agreed to consider invertebrate tissue residue concentrations as a secondary line of evidence if required by the EPA, using field collected invertebrate tissue and/or *Hyalella azteca* tissue concentrations analyzed as part of a Toxicity Identification Evaluation investigation. The tissue residue values would be compared to literature-derived toxicity reference values. The QAPP must be updated where appropriate to include this potential line of evidence.

TAI Response

Comment acknowledged and the draft final quality assurance project plan has been updated accordingly, please see Sections A6, A7.3.2, and B4.2.2.

8) **Slag characterization**: The EPA's evaluation of the 2005 toxicity data indicated the explanatory utility of a measure of the presence and/or amount of slag in each sample. Therefore, the revised Phase II sediment QAPP must include a DQO and methods for characterizing slag in sediment samples. Slag estimates will be used, as needed, as explanatory variables in the evaluation of lab-based toxicity data. Field documentation of sediment samples must include an estimate of the presence/ absence and percent of visible slag in each sample. Chemicals that may be used to characterize slag (e.g., Al, Ca, Cu, Fe, V, and Zn) must be included in sediment analyses, even if they would otherwise be eliminated in the COPC refinement process. Teck must evaluate multiple metal ratio methods for describing slag following the collection of Round 1 data, and must archive sediment from all Round 1 samples for additional slag characterization in case the ratios do not appear to provide sufficient distinction between the slag content of various samples. In addition, at least 25 percent of the total number of Round 1 samples (i.e., no fewer than 35) must also undergo electron back scatter scanning electron microscopy to provide direct measurements of the quantity and size of slag particles. Samples will be selected for microscopy following a review of the initial chemical characterization in consultation with EPA, and will represent a range of predicted slag content determined by the metal ratios. The DQO for this analysis is to calibrate/validate the metal ratio approach for characterizing slag and samples. The method for this more precise empirical evaluation must be described in the QAPP and may follow the method described in a report prepared by Dr. Bruce K. Nelson on behalf of Environment International for the *Pakootas et al.* litigation entitled "Pb Isotope Compositions and Backscatter Electron Image Analyses." The EPA would be happy to provide a copy of this report to you if you do not already have it. The EPA will determine the need for additional slag characterization of archived sediment samples following the initial dose-response evaluation by Teck and/or any TIE evaluations.

TAI Response

Comment acknowledged. As documented on July 3, 2012, following the collection, analysis, and evaluation of Phase 2 sediment/toxicity data, Teck American Incorporated (in consultation with the U.S. Environmental Protection Agency) will identify and analyze requested samples using back scatter electron microcopy. Consistent with our July 3rd correspondence, we wish to confirm that the draft final quality assurance project plan has been modified to communicate our commitment to the performance of this specialized work. In addition to revising the "Sediment Collection Field Forms" within Appendix A of the document, we have also added text to several sections of the quality assurance project plan on this subject matter; see Sections A7.1.2, A7.2, A7.3, A7.3.2, A7.4.3, and A7.5.3.

9) **Toxicity Identification Evaluation (TIE) Triggers**: The draft QAPP calls for TIE analyses on every sediment sample where significant toxic responses are observed, but the EPA does not think this is necessary. It is not possible to determine *a priori* if or which samples might need to undergo TIE testing. There is a reasonable expectation that observed toxicity will be clearly attributable to elevated metals. The planned toxicity tests, in conjunction with sediment and porewater chemistry, slag measurements, AVS/SEM and BLM parameters, may support a sufficiently robust dose response curve. However, if the dose response curve is not robust, it may be informative to run TIE tests to confirm that contaminants suspected of causing effects are in fact the causes. If unexplained toxicity (not reasonably correlated to contaminants or other factors) is observed, EPA may require that it be further explored using TIE testing to investigate the cause of toxicity. In addition to the "puzzling" samples, it will probably be desirable to re-run a few toxic and non-toxic samples where the toxicity results correlate well with contaminant concentrations to ensure the TIE tests are performing as expected. The revised QAPP must acknowledge that TIE testing may be needed and include language explaining that Teck will develop a technical memorandum, if required by the EPA, detailing which samples will be tested, why those samples were selected, and the TIE test procedures to be used if TIE testing is needed. The language on TIE testing in the revised QAPP must list the factors that Teck will consider in determining whether to run TIE tests. TIEs could include evaluation of grain structure or other possible toxicants. Less toxicity will mean it is less likely a TIE will be successful in identifying the toxicant, so EPA will not require Teck to investigate samples with marginal toxicity. Consistent with the outcome of the dispute between Teck and EPA on the Problem Formulation Expansion document, extra tissues from the 28-day *Hyalella* toxicity tests run as part of an initial TIE evaluation (before the samples are manipulated to sequester specific contaminant groups) must be analyzed for contaminants. Additional suggestions on the use of TIE tests from Dave Mount of EPA's ORD program are enclosed.

TAI Response

Comment acknowledged. The draft final quality assurance project plan has been revised to reflect the comment such that only samples that have equivocal or unexplained bioassay results will be subject to Toxicity Identification Evaluation. The text was also amended to include decision rules for selecting samples, and confirms that a Technical Memorandum will be prepared for the U.S. Environmental Protection Agency's approval to document sample selection for such testing. Several sections of the draft final quality assurance project plan have been updated to reflect this change; see Sections A7.3.2, A7.4.3, B1.4, and B4.2.2.

10) **Split Samples**: The EPA will require that two types of split samples be collected as part of the sediment program. A split of 15 percent of the samples, containing not less than 200

grams, must be provided to the EPA for chemical analysis as part of the EPA's QA/QC program. In addition, a split containing not less than 2.7 gallons from the 72 toxicity test samples must be provided to the U.S. Department of the Interior. The Department of the Interior will run confirmatory comparative analyses on these samples.

TAI Response

Comment acknowledged and as documented on July 3, 2012, consistent with the terms and conditions of the Settlement Agreement and field sampling programs completed to date for the Remedial Investigation/Feasibility Study, Teck American Incorporated will continue as part of the U.S. Environmental Protection Agency's Quality Assurance/Quality Control program to allow the U.S. Environmental Protection Agency or its authorized representatives to take split and/or duplicate samples. Therefore, to ensure that this commitment is clearly identified within the revised document the following text was added to Section B2 of the quality assurance project plan: "The FSP also describes the collection of field split samples that will be provided to EPA for chemical analysis as part of their QA/QC program. These will contain not less than 200 grams of sediment and will comprise approximately 15 percent of the samples collected." As identified within the above-cited text, additional discussion associated with the requested mass (i.e., ≥ 200 grams) has been accounted for and addressed within Appendix A (i.e., the field sampling plan – FSP).

At this time however, no changes to the document regarding the requested 2.7 gallons of sediment to be provided to the U.S. Department of the Interior have been made. Teck American Incorporated reserves its right to evaluate and assess how this information is intended to help inform the Remedial Investigation/Feasibility Study and ensure that it is consistent with Guidance and the Settlement Agreement.

Specific Comments

ID	Section	Page	Comment to Teck	Teck American Incorporated (TAI) Response
1	A5	A-5, 3rd paragraph	The Problem Definition and Background section must be revised to include references to studies that provide background information and justification for Phase II investigations. Include a reference to the study summaries in the BERA Work Plan to link the reader to this source of information.	The first paragraph within Section A5 has been modified to reflect that the Baseline Ecological Risk Assessment (BERA) work plan has been approved since the initial submittal of the Phase 2 Sediment Study Quality Assurance Project Plan. In addition to referencing the BERA work plan, appropriate appendices as they relate to sediments were also referenced. Section A5 now reads as follows: "*The Baseline Ecological Risk Assessment (BERA) work plan (TAI 2011) identified several historical studies that collected and evaluated sediment chemistry and toxicity data from the Site. Detailed summaries and an integration of these data are presented within Appendices D (sediment chemistry) and E (sediment toxicity) of the BERA work plan. Similarly, the Screening Level Ecological Risk Assessment (SLERA; TAI 2010) identified* ....etc."
2	A6	A-6	Revise the statement to: "~~Is there a~~ What concentration-response relationships can be established between measured COPC concentrations and observed effects?"	The original text from Section A7.2 (not Section A6 as identified within the comment), has been modified as requested, please see page A-8 of the draft final.
3	A6	A-7	A DQO is needed to describe the need for sediment data collected as part of Phase II investigations to inform risk analyses for receptors other than benthic invertebrates (e.g., sturgeon, aquatic plants). See GC-1.	Comment acknowledged. Please refer to response to General Comment No. 1 (GC-1) for details on how the document has been modified.
4	A7.1.2	A-6	The text here suggests that a second round of sampling may be performed but provides no indication of how a decision to implement Round 2 sampling would be reached. Either here or in another appropriate section, the revised QAPP must discuss the factors that would be considered in triggering and designing a Round 2 sampling event. The QAPP must openly acknowledge that Round 2 samples may be required and that Round 2 sampling would not begin without EPA approval of a Round 2 Field Sampling Plan. Factors to be included in considering and planning Round 2 sampling must include, but are not limited to: o Whether a gradient in responses for one or more toxicity test endpoints is observed that is significantly related to COPC concentrations or	Comment acknowledged. Text in Section A7.1.2 has been updated to reflect the direction provided in General Comment No. 3 (GC-3) - Number of Bioassay Samples/Phasing; GC-8 (Slag characterization); and GC-9 (Toxicity Identification Evaluation (TIE) Triggers). Therefore, Section A7.1.2 has been modified as follows: "*It is anticipated that this work will be completed in two distinct rounds. The first round is scheduled for early to mid-fall (September to October) of 2012 and includes sediment collection and short-term bioassays. For planning purposes, it is anticipated that preliminary results from Round 1 will be available by late winter (December) 2012. These preliminary data will be used to help guide, inform, and refine which samples will undergo additional long-term toxicity tests and specialized analyses such as backscatter electron microscopy. It is acknowledged that prior to initiating Round 2, technical memoranda, or amendment(s) to this QAPP will be required. As a result, the above-mentioned schedule is for planning purposes only and is subject to change.*"

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			other factors; o Number of sediment samples that were collected relative to the targeted number of samples (e.g., 90% completion); o Number of sediment samples that fall within the selected categories / bins of samples; o Number of samples collected that meet reference criteria and how well those samples represent the range of conventional parameters measured across the site; o Whether the control sediment sample(s) for each batch of sediments tested meet USEPA and/or ASTM toxicity testing acceptability criteria; o Adequacy of the sediment chemical analyses to provide the data needed to document the levels of all COPCs, with appropriate detection limits; and, o Whether the long- and short-term toxicity tests provide a basis for understanding the relationships between the results from these two tests. o If Round 2 samples are needed, the sediment bed maps must be updated with Round 1 data. If appropriate, the maps may be refined at that time to better predict contaminant concentrations and/or toxicity. The updated maps would then be used to inform Round 2 sample location selection.	Further to TAI's July 3rd correspondence and response to GC-3, we wish to confirm that consistent with EPA Guidance and sampling events completed to date for the Remedial Investigation/Feasibility Study, Teck American Incorporated will continue to consider and evaluate high quality data (e.g., the above-referenced 2005 data). Following Phase 2 sediment/toxicity data collection, analyses, and evaluation, if the U.S. Environmental Protection Agency determines that there is insufficient information to support an informed risk-based management decision using existing site data; additional sediment/toxicity sample collection may be needed. Furthermore and per the terms and conditions of the June 2, 2006 Settlement Agreement, should Teck American Incorporated identify the need for additional data, this would be documented in a technical memorandum at that time. We also wish to confirm that methods presented within Appendices B and C of the draft and draft final quality assurance project plan (e.g., sediment bed maps) will be updated with results from the Phase 2 sediment study, and other studies completed to date for the Remedial Investigation/Feasibility Study (e.g., beach sediments, white sturgeon sediment toxicity testing). The document has been updated to reflect this work, refer to Section A5, footnote number 2 which states "*...In addition and as requested by EPA, materials presented within Appendices B and C, will be updated following data collection and the analyses outlined herein.*"
5	A7.3 and A7.5.2	-	Change the text to indicate that a reference envelope will be one approach used in the analysis of the bioassay data.	Section A7.3.2 has been updated to incorporate the comment, specifically as follows: "*Bioassay results will be used to evaluate if the survival, growth, or reproduction of benthos in Site sediments differ significantly from those in reference sediments. One approach that will be used to conduct this analysis is application of the "reference envelope" approach which examines whether responses from Site samples lie below the range of results from reference samples (Hunt et al. 2001).*" Section 7.5.2 already discussed the use of a reference envelope approach; the language was clarified to state that this approach will be used, and the citation to Hunt et al. 2001 was added. Specifically, the text now reads as follows: "*Bioassay data will... A reference envelope approach (Hunt et al. 2001) will*

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				also be applied to the data, where reference site responses will be used to develop a response distribution and select a lower tolerance limit (generally the 5th percentile) to evaluate Site responses. Site samples..."
6	A7.3.2	A-9, Line 11	A DQO for chemistry-only samples needs to be clearly described. Clarify the target number of sediment samples that will be analyzed for chemistry-only (not for toxicity testing) and describe the purpose of these chemistry-only samples.	Further to response to General Comment No. 1 (GC-1), data quality objectives have been updated to reflect how chemistry-only samples will help inform the Baseline Ecological Risk Assessment. Specifically the following data quality objectives are listed within Section A7.2 of the draft final: • *"Are sediment COPCs bioavailable at levels indicative of potential unacceptable risks to benthos?* • *Are sediment COPCs bioavailable at levels indicative of potential unacceptable risks to other ecological receptors (e.g., aquatic plants, sediment-probing birds)?* • *Can the nature and extent of unacceptable risk at the Site via spatial gradients and sediment bed properties such as slag content (e.g., Zn/V ratio), TOC, mPECQ, and sediment texture be further refined?"* (This data quality objective includes reference to footnotes within the draft final version). Further to TAI's July 3rd correspondence and commitment to employ the U.S. Environmental Protection Agency's alternate sediment sampling locations, clarification regarding the number of samples to be analyzed to address the above-mentioned data quality objectives is no longer applicable.
7	A7.3.2	A-9, Line 11	Edit the QAPP for consistency and clarify the purpose of samples when referencing the total number of samples being collected. The draft QAPP is confusing and seemingly inconsistent when referring to samples to be collected in the field and those to be tested in the lab, and which samples are for bioassays or chemistry-only.	Comment acknowledged. The document has been reviewed and accordingly updated to ensure consistency and clarity in sample collection nomenclature (e.g., field-collected versus laboratory-collected porewater; see response to General Comment No. 5 too). Furthermore and consistent with our July 3rd correspondence, we wish to confirm that the numbers and analyses to be performed are consistent with EPA's alternate sediment sampling locations. In addition to clarifying this throughout the document, including appendices as necessary (e.g., Appendix A – *Field Sampling Plan*, and Appendix D – *Cultural Resources Coordination Plan*), a new table (i.e., Table A7-1) has been added to reflect EPA's alternate locations detailed in Appendix G (*EPA Phase 2 Sediment Sampling Alternative Locations, Rationale, and Site Reconnaissance*) of the draft final document. It should be noted that mathematical errors presented within Table 1 of the technical memorandum prepared for the EPA entitled "UCR Phase II Sediment Sampling – Alternative Sampling and Testing" (see Appendix G) have been corrected within Table A7-1.
8	A7.3.2	A-9, Line 17	The most recent ASTM (2011) guidance must be cited, not 2009.	Comment acknowledged. The citation for the ASTM guidance has been updated from 2009 to 2011. The citation has been updated to:

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				"ASTM (American Society for Testing and Materials). 2011. Standard test method for measuring the toxicity of sediment-associated contaminants with freshwater invertebrates (E1706-05). In ASTM Annual Book of Standards, Vol. 11.06, West Conshohocken, Pennsylvania." In addition, references within the body of the document have been accordingly updated to "*(ASTM 2011)*."
9	A7.4.1	A-10, Line 21	Edit this section as needed to reflect EPA's direction to use the 28 day *H. azteca* test instead of the 10 day *H. azteca* test.	Comment acknowledged. The text within this section has been updated to specify the use of the 28-day *Hyalella azteca* bioassay test, rather than the standard 10-day *H. azteca* bioassay test. Similarly any and all text, tables, and figures have also been updated to specify a short-term bioassay test duration period of 28-days.
10	A7.4.1	A-10, Line 21	Comment provided for Teck's information, no response needed: A key conclusion from the Milani *et al.* (2003) study is that "growth and reproductive impairment occurs with increasing metal concentration, and in general, growth and reproduction endpoints are more sensitive than survival." Hence, the Milani *et al.* (2003) study provides evidence for 28-d chronic *H. azteca* exposures, not 10-d acute *H. azteca* exposures proposed in the QAPP.	Comment acknowledged.
11	A7.4.1	A-10, Line 21	Comment provided for Teck's information, no response needed: The QAPP fails to cite and discuss key historic data for sediment toxicity testing with UCR sediments (e.g., USEPA 2005 database, Besser *et al.* 2008 with about 65 sediment samples evaluating 28-d *H. azteca* exposures and 10-d *C. dilutus* exposures. The USEPA (2005) database and the Besser *et al.* (2008) study are key reasons why 28-d *H. azteca* testing is required for future testing of UCR sediments in the sediment LOE.	Comment acknowledged.
12	A7.4.1	A-10, Lines 26 and 31	Although the Sediment LOE included freshwater mussels as part of the sediment toxicity testing program, EPA is not requiring the use of a mussel toxicity test at this time. The revised QAPP must acknowledge that EPA may require mussel toxicity tests in the future. Appendix D must be removed from the QAPP, and all references to Appendix D or mussel toxicity testing (i.e., Section A7.4.1) must be removed	Comment acknowledged. References to mussel sediment toxicity tests and formerly Appendix D - "*Draft Technical Memorandum Influence of Sieving on Sediment Characteristics and a Comparison of Amphipod and Mussel Sensitivity in Whole Sediment Toxicity Tests*" have been removed. Furthermore, the following text has been added to Section A7.4.1: *"Consistent with Guidance (USEPA 1997), should EPA determine that there is insufficient information to support an informed risk-based management*

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			from the text. Because EPA determined that mussel toxicity tests would not be included in the program at this time, EPA did not review Appendix D thoroughly. EPA did not rely on Appendix D to reach the determination that mussel toxicity tests were not needed at this time.	*decision using existing site data (includes data from this study), additional sediment/toxicity data may be needed. Such studies may include the use of other test organisms (e.g., freshwater mussels) should information within the scientific community indicate they are better suited to evaluate sediment contamination, and if standard test methods approved by American Society for Testing and Materials (ASTM) or EPA are available."*
13	A7.4.1	A-10, Line 28	A statement is made that mussel testing should not be conducted because there is no standard sediment toxicity test described for freshwater mussels. Remove this text.	Comment acknowledged. Please refer to response to Specific Comment No. 12, above.
14	A7.5.2	A-12, Line 36	Reference sediment should not be established relative to a statistical comparison to a control. See ASTM E1706 and USEPA (2000) for how reference sediments are established and used to evaluate data and revise the text accordingly.	Comment acknowledged. We concur that criteria used to establish reference sediment should be consistent with those listed in Section B1.1 of the document (i.e., *USEPA. 1994a. Selecting and using reference information in Superfund ecological risk assessments. EPA-540-F-94-050. U.S. Environmental Protection Agency, Office of Emergency and Remedial Response, Washington, DC.*). This section of the document (Section A7.5.2) is intended to describe how bioassay data will be analyzed and is consistent with EPA guidance (USEPA 2000). In other words, laboratory controls will provide a measure of test acceptability, evidence of test organism health, and a basis for interpreting data obtained from the test sediments. Upon confirming test acceptability, the initial analyses relative to laboratory controls is intended to ensure that variability simply associated with conducting the test has been considered. Comparisons of site sediments to reference sediments as described within Section A7.5.2 will provide a site-specific basis for evaluating toxicity and address study data quality objectives. We wish to confirm that language was added to this section referring the reader to other sections (i.e., Sections B1.1 and B1.3.1) of the document, in which reference selection is further discussed and detailed.
15	A7.5.2	A-13, Lines 1-11	Describe how potential internal reference sites will be evaluated and selected. For example, the reference envelope approach considers chemistry (mPECQ<0.2) and biological responses (> 75% of control survival) among other criteria for identifying acceptable internal reference samples.	Further to TAI's July 3rd correspondence and commitment to employ EPA's alternate sediment sampling locations, TAI cannot speak to how "internal reference sites" were selected. Please refer to Appendix G of the draft final document for EPA's rationale. We wish to confirm that discussions associated acceptable reference locations (external and/or internal) are detailed within Section B1.1 of the document. Therefore, to ensure that readers are aware of such discussions the following sentence was added to Section A7.5.2: *"Additional detail regarding the consideration and selection of reference sites is discussed in Section B1.1 of this document."* Following data collection activities, evaluation and identification of potential internal references will be gauged against the criterion listed in Section B1.1

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				and as noted within Section B1.3.1 will consider "*Sediments with a low $mPECQ_{metals}$ (e.g., <0.2), may be re-assigned a posteriori as "internal" reference sites, in consultation with EPA.*"
16	A7.6.2	A-15, Line 15	The reported test acceptability criteria for midge of >80% control survival is not consistent with requirements for 10-d or chronic midge testing (ASTM E1706, USEPA 2000). Check these values and update as necessary to conform with the EPA guidance cited and explain any intentional deviations from the guidance.	Comment acknowledged. The document has been updated to read as follows: "*Test organism survival should be high prior to the start of the bioassays (e.g., ≥80 percent for 48 hours before the start of a test [USEPA 2000]) and survival should remain high in test controls.*"
17	A7.6.2	-	Add that all water quality parameters will be maintained within the limits of the guidance and not just vary by less than 50%.	USEPA (2000), *Methods for measuring the toxicity and bioaccumulation of sediment-associated contaminants with freshwater invertebrates (second edition). EPA/600/R-99/064. U.S. Environmental Protection Agency, Office of Research and Development, Washington, DC*; requires that hardness, alkalinity, and ammonia measurements vary no more than 50 percent during the test, and dissolved oxygen be maintained above 2.5 mg/L (see, for example, Table 11.3 in EPA 2000). Therefore, text within the document has been modified to read as follows: "*Also, hardness, alkalinity, and ammonia measurements should vary by less than 50 percent over the duration of the exposure, and overlying water-dissolved oxygen concentrations should be maintained at greater than 2.5 mg/L (USEPA 2000).*"
18	A7.3	30-32	Add Mean PECQ to the list of sediment metrics that will be used to evaluate COPC bioavailability.	Comment acknowledged. The text has been modified and now reads: "*The degree of COPC bioavailability will be measured and evaluated using a range of methods. These include, but are not limited to, mPECQ, excess simultaneously extracted metals (SEMx) (simultaneously extracted metals minus acid volatile sulfide [SEM – AVS]), carbon-normalized excess SEM (SEMx,oc = SEMx/fraction organic carbon), pH, and the biotic ligand model (BLM).*" It should be noted that the determination of mPECQ ("mean PECQ") is based on the total metal concentration in sediments, and as such is not necessarily a measure of the bioavailable fraction. Nevertheless, this calculation can and will be used to identify and screen/refine sediments that do not likely represent an unacceptable risk.
19	A8	A-16	EPA has approved the firms that Teck proposes to use to complete the 2012 field sample collection, but the QAPP and/or Field Sampling Plan must specify the names of key field personnel and Teck must provide documentation to EPA for any personnel new	Comment acknowledged. The document has been updated to identify Dave Enos of URS Corporation (URS) as the "*Field Supervisor*" within the appropriate portions of the document (e.g., Section A3 and Table A4-1). In addition to updating the document in the necessary and appropriate Sections, we wish to confirm that consistent with other sampling programs completed to

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			to the team to ensure they have the necessary training and experience.	date for the Remedial Investigation / Feasibility Study a detailed schedule and associated field contact list will be generated and provided to EPA such that all field activities can be appropriately coordinated. At this time, it is anticipated that the following URS field personal will assist in completing field sampling activities (all of whom have site-specific experience from other RI/FS field sampling events; surface water, white sturgeon sediment sampling and methods development sampling, and beach sediment). Subcontractors to URS will include: 1) Columbia Navigation Inc., Marine and Land Environmental Contractors; and 2) Gravity Environmental, LLC. Therefore there are no new team members. David Enos, LG, LHG — Field Supervisor Jeff Leppo, LG — Project Manager John Flanders — Boat Team Leader J.R. Sugalski, EIT — Boat Team Leader Dave Hose — Shore Team Leader Mike Kelly — Archaeologist Sarah McDaniel, MS — Archaeologist Michele Stegner — Archaeologist Gary Panther, LG — Field Technician Jake Dial, P.E. — Field Technician Demetrio Cabanillas — Field Technician Deborah Ruskell — Field Technician Katherina Diemer — Field Technician Alexandra Vermeulen — Field Technician
20	A9.3	A-18, Line 19 and 21	Clarify if and how serial dilutions of sediment will be prepared for toxicity tests.	Serial dilutions of sediment will not be prepared – no revisions to the document are needed.
21	-	Figure A7-1, Table B1-3	List all toxicity endpoints that will be evaluated for *C. dilutus*, including biomass.	Comment acknowledged. A summary of all toxicity endpoints to be evaluated for *C. dilutus* are presented within Table B1-2, and is first called out in Section B1.3.1 of the document.
22	-	Figure A7-1	List all toxicity endpoints that will be evaluated for *H. azteca*, including biomass and others described in the Problem Formulation Expansion document.	Comment acknowledged. A summary of all toxicity endpoints to be evaluated for *H. azteca* are presented within Table B1-2, and is first called out in Section

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				B1.3.1 of the document.
23	-	Table A7-2	Please check and make any necessary corrections or updates to the TECs (chromium through mercury) and MRLs in Table A7-2.	Comment acknowledged. Please note that with the addition of new tables within the draft final document, the table being referenced within this specific comment is now Table A7-3. We wish to confirm that values in Table A7-3 (formerly A7-2) were reviewed for accuracy. TEC values were corrected, according to MacDonald et al. (2000); and MRLs were also reviewed by the analytical laboratory and corrected as needed.
24	-	Table A7-2	Provide the range of site hardness values and the value used to determine hardness dependent water quality criteria in Table A7-2.	Comment acknowledged. Please note that with the addition of new tables within the draft final document, the table being referenced within this specific comment is now Table A7-3. We wish to confirm that the hardness-dependent criteria were derived using the mean hardness value of 66.89 mg/L from Ecology surface water data (Ecology 2006) and is appropriately cited within the updated table, refer to note "d". Similarly, the range of hardness values from Ecology 2006 (i.e., 58.3 to 77.3 mg/L) has been included within note "d" of Table A7-3 (formerly Table A7-2).
25	B1.1	B-1 and B-2	Describe how potential internal reference sites will be evaluated and selected. For example, the reference envelope approach considers chemistry (mPECQ<0.2) and biological responses (> 75% of control survival) among other criteria for identifying acceptable internal reference samples. Other approaches for assessing reference conditions, such as toxicity testing with sediment samples from shallow subsurface cores (i.e., below depths where sediment is affected by slag deposits) may also be considered.	Comment acknowledged. Please refer to response to specific comment numbers 6, 14, and 15.
26	B1.1	B-2, Line 10-12	A requirement of >70% survival of amphipods is not an acceptable requirement for a reference sediment (amphipod reference sediment survival should be >80% of controls). Justification for reference sample designation must also be based on a biomass endpoint for midge or amphipods, and chemical criteria (e.g., mPECQ <0.2).	Comment acknowledged. Text was modified to read: *"Similarly, the Regional Sediment Evaluation Team (RSET 2009) has developed standardized approaches for sediment quality assessments in the Pacific Northwest (i.e., Washington, Oregon, and Idaho). Considering these approaches, the following desirable characteristics and/or performance standards will be considered as part of identifying internal references as well:* • *Similar sediment grain size distribution* • *Uncontaminated (e.g., $mPECQ_{metals}$ <0.2; [USEPA 2010])* • *10-day Chironomus and 28-day Hyalella survival > 75 percent of control* • *28-day Hyalella biomass > 0.15 mg/individual dry weight* • *10-day Chironomus biomass > 80 percent of negative control biomass."*
27	B1.2	B-3, Line	Footnotes are numbered and none were found on	The subscript "d" referred to in the comment is not a footnote, but a subscript

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		10	Page B-3. Explain the subscript "d" on line 10 of page B-3.	indicating that units are on a dry weight basis. The unit "µmol/g_d" means "micromole per gram (dry weight)." Since this unit is already defined in the "Units of Measure" list, no changes are needed.
28	B1.3.1	B-5, Line 1	List all toxicity endpoints that will be evaluated for *C. dilutus*, including those described in the Problem Formulation Plan Expansion and ensure that biomass will be measured and reported according to EPA guidance.	Comment acknowledged. Please refer to response to specific comment numbers 21 and 22.
29	B1.3.1	B-5, Line 10-12	Add additional text detailing how samples would be selected for reproductive tests. The EPA agrees that samples with "medium-high" exposure should undergo reproductive tests. Teck has proposed to make this decision *a priori*, based on the sediment bed mapping work. The EPA would prefer for that decision to be made based on the results of the 10 and 28 day growth and survival tests and on the initial chemistry results. Preliminary toxicity and chemistry results must be available within a month of sample collection but may not be validated in time to support selection of samples for reproductive tests. While not a perfect solution, the EPA believes that the uncertainty of using unvalidated data and exceeding holding times before beginning the reproductive tests is considerably less than the uncertainty of relying on the sediment bed mapping and provides greater confidence that the tested samples will meet DQOs. The survival and growth results and the initial chemistry results must be used to select samples that are not acutely toxic, but show low to moderate toxicity (first priority) and cover a range of other conditions (geographic and physical / chemical). Teck must propose a list of stations for reproductive tests, using the initial data, for approval by the EPA before proceeding with the tests. Additional text in the QAPP must make this clear and provide a general list of the factors Teck will consider in recommending stations for reproductive toxicity tests. For example, Sample selection could target sediment with 1) low to moderate toxicity response; high metal concentrations in pore-water or bulk sediment; and, represent a range of sediment and porewater characteristics (e.g., grain size, TOC, DOC,	Text within Section B1.3.1 has been modified to reflect EPA's alternate sampling location and rationale. As such, language has been added to the text to indicate that samples for the reproduction tests will be selected based on the results of the short-term bioassays. This portion of the document now reads as follows: "*In addition, reproductive endpoints will be evaluated on 18 split-samples. Preference for these 18 split-samples will be given to sampling stations located within high-medium exposure gradients. Sample selection will be evaluated using results of the above-listed 10- and 28-day survival and growth tests in conjunction with preliminary chemistry data; and presented in a technical memorandum for EPA's review and concurrence. It is anticipated that sample selection will target sediment with 1) low to moderate toxicity response in short-term studies; 2) high metal concentrations in porewater or bulk sediment; and/or 3) a range of sediment and porewater characteristics.*" It is important to note that EPA's suggestion of providing preliminary toxicity and chemistry results within a month of sample collection to support selection of samples for reproductive tests cannot be guaranteed. Rather, we wish to confirm that TAI is committed and will, as previously completed for the RI/FS (e.g., 2010 white sturgeon sediment toxicity tests), make available as soon as possible preliminary data such that we may jointly determine which locations (sediments) require further analyses. As noted within the modified text this would be documented in a technical memorandum.

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			etc...).	
30	B1.3.2	B-6, Line 6	Confirm the intent to measure each of the listed parameters in all replicate beakers. EPA notes that measuring water quality in all the replicate beakers would represent thousands of water quality measurements when made at the beginning, during, and at the end of exposures as outlined in ASTM E1706 (2011).	Yes, the collection of water column water quality measurements (e.g., temperature, dissolved oxygen, hardness, ammonia, and pH) in each replicate beaker in every bioassay will result in thousands of measurements. These measurements are part of the laboratory's quality assurance procedures and will be documented. The water quality data will be used to confirm that the bioassays were performed under conditions in accordance with the methods laid forth in the QAPP.
31	B4.1	B-8, Line 8	Edit the document as needed to ensure that the text and tables are consistent with regard to the COIs to be measured.	As per EPA direction, the COIs to be measured are the target analyte list (TAL) for metals. This includes: aluminum, antimony, arsenic, barium, beryllium, cadmium, calcium, chromium, cobalt, copper, iron, lead, magnesium, manganese, mercury, nickel, potassium, selenium, silver, sodium, thallium, vanadium, zinc. The document text and tables have been searched and all instances that refer to the analytes being assessed now clearly indicate the list of TAL metals.
32	B4.2	B-8, Line 18; Figure B4-1	Please check and update the number of replicates required for each toxicity test. The QAPP states a minimum of 8 replicates/ sediment will be tested. This statement is inconsistent with Figure B4-1 which indicates a minimum of 15 (amphipod) or 15 (midge) replicates in reproductive tests. Include chemistry-only beakers in the total count and specify the number of test beakers and chemistry only beakers.	Text in Section B4.2 has been revised to provide clarity regarding the total number of bioassay replicates needed for each sediment sample. The document has been updated as follows: *"Bioassay endpoints will be evaluated using a minimum of 8 replicates per sediment sample for each short-term bioassay (Figure B4-1), and a minimum of 12 replicates for each long-term bioassay (Figure B4-2). Additional replicate bioassays will be run on each sediment sample exclusively to assess porewater. Chemistry replicates will not be used to evaluate biological endpoints (i.e., survival, growth, or reproduction). Thus, H. azteca bioassays will have a total of 14 replicates (8 for biological endpoints and 3 each for porewater chemistry analysis at day 7 and during the week prior to day 28). The C. dilutus assays will have 12 replicates for the 10-day test (8 for biological endpoints 3 for porewater chemistry analysis at day 7), and a total of 21 replicates for the reproduction test (12 for biological endpoints and 3 each for chemistry analysis at day 7, sometime between days 21 and 27, and again between days 42 and 49). For the long-term C. dilutus bioassay, four additional test chambers will be run to produce auxiliary males for possible use in the bioassay test. These chambers are not test replicates and will not be assessed for biological endpoints. Schematics illustrating the above-mentioned anticipated number of bioassay and chemistry-only replicates are presented in Figures B4-1 and B4-2, and the total number of replicate chambers is shown in tabulated form in Table B4-1."*
33	B4.2	B-8, Line	Please check and update the number of organisms	EPA 2000 specifies 10 organisms per replicate for both the *H. azteca* 42-day

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		21	per replicate required for each toxicity test. For example, the text incorrectly indicates 10 midge/replicate for reproduction tests when EPA (2000) requires 12.	bioassay and *C. dilutus* 10-day bioassay. It specifies 12 organisms per replicate for the *C. dilutus* long-term bioassay. The text in Section B4.2 was revised to explicitly reflect the appropriate number of organisms per replicate. The text has been changed to: "*From the laboratory culture population, 10 test organisms (except for long-term C. dilutus tests which have 12 test organisms) will be randomly distributed to each replicate and allowed to burrow into the sediment.*"
34	B4.2	B-8, Line 24	Update the QAPP to reflect that growth (weight and biomass) is to be determined in all whole sediment toxicity tests conducted with amphipods and midge. Moreover, ASTM E1706 and USEPA (2000) do not recommend measuring the weight of <24-h midge larvae at the start of an exposure (virtually impossible).	Comment acknowledged. Please refer to response to specific comment numbers 21 and 22.
35	B4.2	B-8, Line 24	Remove statements that injured or dead organisms will be replaced within 1 hour. This is not a common practice; nor is this recommended in ASTM E1706 or USEPA (2000). Moreover, it would be difficult to remove <24-h old midge larvae 1 hour after the start of the exposure in the *C. dilutus* reproduction toxicity test.	Comment acknowledged. The sentence: "*Replicates will be re-examined in 1 hour after test organism introduction and any injured or dead animals will be removed and replaced*" has been removed.
36	B4.2	B-9, Line 24	Revise statements that dead organisms will be removed daily to indicate that any observed dead organisms will be removed. It is not common practice to remove dead organisms; this is not recommended in ASTM E1706 or USEPA (2000), and this practice is impossible for most dead organisms (particularly <24-h old midge at the beginning of the *C. dilutus* reproductive test).	Comment acknowledged. Further to response to specific comment number 35, the sentence, "*Organism health will be monitored daily and any observed dead individuals recorded and removed.*" has been removed.
37	B4.2	B-9, Line 25	Additional details describing *Hyalella* and midge reproduction are required in a revised QAPP. Please list all endpoints and describe how reproduction of *H. azteca* or *C. dilutus* will be evaluated.	Comment acknowledged. Please refer to response to specific comment numbers 21 and 22.
38	B4.2	B9, Line 6	The revised QAPP must include a more detailed description of sampling procedures from chemistry only beakers, including what will be sampled, how, and the sampling frequency. For example, overlying water is sampled at the beginning, middle, and end of the exposures (ASTM E1706 and USEPA 2000).	The following language has been added to Section B4.2.1 to confirm that the chemistry-only beakers will be used for porewater collection. "*The additional chambers set-up for chemistry analysis of each sediment sample will contain test organisms, but will only be used for porewater chemistry measurements. Porewater will be collected using airstones (5 cm long, 1.5 cm diameter) and one "minipeeper" (semipermeable membrane devices; see Doig and Liber 2000) per test chamber. Porewater chemistry*

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				measurements from airstone collections (up to 115 mL total composited from three chambers) will include TAL metals, DOC, chloride, sulfate, hardness (as calcium carbonate), and pH. Because of the small volume in the minipeepers (1.5 mL), porewater collected by this method will likely be analyzed only for the major metals (cadmium, copper, lead, and zinc)." Analysis of overlying water will be performed in the bioassay (biology) beakers as per standard protocol. These measurements are listed in Tables B1-2 to B1-9, and are incorporated into the text (Section B4.2) as: *"Throughout the duration of the bioassays, test organisms in all replicates will be observed daily as outlined in EPA (USEPA 2000) and ASTM (2011). Lighting, room temperature, and other environmental operations of the exposure system will also be monitored daily. As required in EPA, 2000 and ASTM 2011 (and listed in Tables B1-3 to B1-10), conductivity, hardness, pH, alkalinity, and ammonia will be measured in the overlying water of test chambers at the initiation and termination of the bioassays. Conductivity will also be measured weekly, and DO and ammonia on a daily basis. Dissolved oxygen will be maintained above 2.5 mg/L; water temperature will be measured daily in at least one test replicate per treatment to ensure that the daily average temperature is within ±1°C of 23°C."*
39	B5.2	B-13; Table	The draft Sediment QAPP states that "Non-detects will be reported to the MDL)..." However, footnotes in Table A7-2 state that "*...non-detects will be reported to the MRL.*" This inconsistency must be clarified. A recent analysis of the detection limits in the UCR database compared to the approved QAPPs for prior sampling efforts (memo from Kris McCaig/TAI to Helen Bottcher/EPA dated 12/5/11) found similar discrepancies. Results indicated that non-detects were not represented as the MDL, SDL, or RL in a consistent manner within or across UCR RI/FS studies. A consistent procedure for representing non-detects must be clearly described in the revised QAPP to avoid further confusion.	Comment acknowledged. Text within Section B5.2 has been modified to read as follows: *"The laboratory will quantify analytes at concentrations above the MRL. Analytes detected at concentrations between the MDL and MRL will be flagged with a "J" qualifier to indicate that the value is an estimate (i.e., the analyte concentration is below the calibration range). Analytes that are not detected will be reported as the MDL and will be flagged with a "U" qualifier. MDLs will be adjusted by the laboratory as necessary to reflect sample dilution or matrix interference."* Similarly, note "c" within Table A7-3 (formerly A7-2) reads: *"Non-detects will be reported to the MDL. Values between the MDL and the MRL will be estimated (i.e., "J" qualified)."*
40	D1	D-1	Add "...<u>and documented</u>" to "*All errors found during the verification of field data, laboratory data, and the database will be corrected prior to release of the final data.*"	The words "and documented" have been added so that the text now reads: *"All errors found during the verification of field data, laboratory data, and the database will be corrected and documented prior to release of the final data."*
41	B	Figure B4-1	List all toxicity endpoints that will be evaluated for *C. dilutus*, including biomass and others described in the Problem Formulation Plan Expansion.	Comment acknowledged. Please refer to response to specific comment numbers 21 and 22.

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42	-	Table B1-2	Test methods for the 28-day *Hyalella* bioassay need to be updated in a revised QAPP. For example, the starting age of organisms for the 28-day *Hyalella* test must be 7-8-days old as specified in EPA (2000; Table 14.1). Also list all toxicity endpoints that will be evaluated for *H. azteca*, including biomass and others described in the Problem Formulation Plan Expansion.	The test methods for the 28-day *H. azteca* bioassay have been updated in the text and tables. The methods specified in the QAPP for the 28-d bioassay match those for the 42-day *H. azteca* bioassay as specified in EPA 2000. Toxicity endpoints have been accounted for; please refer to response to specific comment numbers 21 and 22.
43	-	Table B1-3	Toxicity testing: List all toxicity endpoints that will be evaluated, including biomass.	Comment acknowledged. Please refer to response to specific comment numbers 21 and 22. In addition, we wish to confirm that Tables B1-2 to B1-5 have been updated to specify the growth endpoints (i.e., weight and biomass).
44	-	Table B1-3	Include a requirement for the lab to describe the source of overlying water and the source of control sediment in the bioassay reports. In addition, list all toxicity endpoints that will be evaluated for *C. dilutus*, including biomass.	Tables B1-2 to B1-5 list the test conditions for each of the 4 bioassays. Tables B1-6 to B1-9 are the associated QA requirements. Therefore, the requirement to report the source of overlying water and control sediments was added to Tables B1-6 to B1-9. Toxicity endpoints have been accounted for; please refer to response to specific comment numbers 21 and 22.
45	-	Table B1-3	Provide updated references. EPA (2000) must be cited (EPA 1994b is an outdated reference) and provide details describing how the *H. azteca* test method will be modified from ASTM (2009) and EPA Guidance.	Tables B1-2 to B1-9 reference the updated EPA 2000 as their source. Only the title of Table B1-4 previously contained a reference to "EPA 1994b." The reference to "EPA 1994b" in this table has been removed. The tables now include footnotes indicating which bioassay parameters have been modified from standard EPA methods.
46	B3	Table B3-1	Table B3-1 must be checked to ensure it lists the correct holding times for all chemical COPCs and for toxicity tests.	Holding times have been verified with the analytical laboratory; they are all correct.
47	-	Table B3-2	Clarify in the text and Table B3-2 whether sediment samples will be collected for bioassays and chemistry after pore water removal by air stones, or if separate samples will be collected for each purpose.	Section A7.3.1 states that the porewater samples will be collected at the time of sample collection, while the sediment is still in the VanVeen sampler. The text is as follows: "*Field porewater samples will be collected ex situ via suction (i.e., airstones). In short, this will involve the careful insertion (horizontally) of an airstone within the sediment as it remains in the sampling equipment (i.e., VanVeen sampler) at the time of sample collection (prior to any compositing that may be performed). Upon insertion, the top of the airstone will sit approximately 3 in. (7 cm) below the sediment surface. The airstone will be connected to a large (≤140 mL) syringe via decontaminated polyethylene tubing through which field porewater will be extracted.*" No change is needed to Table B3-2 which merely lists the sample containers, preservation, and holding times for any porewater samples.
48	-	Table	The National Functional Guidelines for Inorganic	Table B5-1 and B5-2 have been revised to indicate a spike recovery of 75 –

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		B5-1 and Table B5-2	Superfund Data Review (EPA 2010) provides the most up to date control limits, which should be 75-125% for accuracy (matrix spike recovery). Revise Tables B1 and B2 to be consistent with the 2010 guidance or provide a rationale as to why a more generous range is required. EPA notes that the beach program successfully used a control limit of 75 – 125%	125% for metals.
49	App A	A-3, Line 26	The revised QAPP will need to include an updated schedule that is consistent among sections. Also edit the document as needed to ensure consistent terminology when referring to "alternate sampling sites" in Appendix A, and "reserve samples" in the main text; explain the difference if these terms do not mean the same thing.	The Main Text and FSP have been reviewed to include an updated schedule that is consistent among sections. References to "alternate sampling sites" in Appendix A have been changed to "reserve" sampling sites to be consistent with the terminology used in the main text.
50	App A	A-7, Line 21	Revise Appendix A text to say "coarse" substrates rather than "course" substrates.	Comment acknowledged. Thank you for bringing this to our attention and the document has been updated accordingly.
51	App A	-	Add text to the QAPP and/or field sampling plan requiring all sampling vessels and watercraft to be thoroughly cleaned at a certified station both before and after field sampling to prevent transport of exotic species, such as zebra mussels.	We wish to confirm that a Standard Operation Procedure (SOP-8) has been included in the draft final version of the document. We would like to point out however that the upper Columbia River and Lake Roosevelt are not located in an area extreme or moderate concern as defined by the Department of Ecology for Aquatic invasive species refer to http://www.ecy.wa.gov/programs/eap/InvasiveSpecies/AIS-PublicVersion.html. As a result, watercraft leaving the water (e.g., at the conclusion of sampling activities) do not require cleaning and this allowance has been incorporated in SOP-8.
52	App A	Table A-2	Revise the proposed sample volume based on the adjusted number of replicates required for toxicity testing (see SC-32), to account for archived sediment that may be required for slag characterization (GC-8) , and TIEs (GC-9), and include split sample requirements for EPA and DOI (see General Comment 10).	Comment acknowledged, please refer to response to General Comment No. 10.
53	App A	SOP-1	Clarify what alternative navigation methods for sample location identification if ..."*In the event normal GPS reception of four or more satellites is not available at a given location because of terrain blocking or other causes, alternative methods will be used to establish positions.*"	Comment acknowledged. The specific language sought by the reviewer exists in the following paragraph. Therefore, to ensure that readers are aware of the alternative method the text has been modified by added the words "*(see next section).*"
54	App A	SOP-2	Clearly list all sample identification abbreviations that may be used for sample labeling.	This standard operating procedure provides direction for how to label field-collected samples and is an attachment to the field sampling plan. All

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				abbreviations have been clearly identified in the field sampling plan. Therefore, no additional modifications are required to the individual standard operating procedure.
55	App A	SOP-3	The porewater suction sampler must include dimensions, material specifications, and a picture or diagram of the apparatus.	Comment acknowledged and the requested revisions have been made.
56	App A	SOP-3	Field documentation of sediment samples will include an estimate of the presence/absence and percent of visible slag in each sample to accompany each sample photograph.	As documented within TAIs' July 3rd correspondence, the following text has been added to the standard operating procedure: *"9. Visually examine the sample for the presence/absence of black silica glass particles and estimate the percent of the sample that is made up of these black particles; record result on the field data form:* *a. Presence/absence and percent of black silica glass particles will be based on vitreous, conchoidal fracture(s) and a translucent appearance* *10. Photograph the sediment and record the photograph number on the field data form."* Additionally, SOP-5 "Field Documentation" specifically "Sediment Collection Field Forms" has been modified to include a field in which to record the above information.
57	App B	-	The list of COPCs for bulk sediment chemistry proposed by Teck in Appendix B must be expanded to include EPA's full TAL metal list. Missing from Teck's list are: antimony, barium, beryllium, calcium, cobalt, cyanide, magnesium, potassium, selenium, silver, sodium, and thallium. .	Comment acknowledged. Please refer to response to specific comment number 31 (SC-31). It should be noted that cyanide is not on the target analyte list as suggested within EPA's comment, and as such, changes to the document are consistent with response to SC-31. Further to response to General Comment Nos. 2 (GC-2) and 3 (GC-3); and SC-4, we wish to confirm that methods presented within Appendices B and C of the draft and draft final quality assurance project plan (e.g., sediment bed maps) will be updated with results from the Phase 2 sediment study, and other studies completed to date for the Remedial Investigation/Feasibility Study (e.g., beach sediments, white sturgeon sediment toxicity testing). At this time however, no modifications to either Appendix B or C are warranted as EPA has chosen not to respond to TAI's technical concerns associated with the alternate sediment sampling locations. Therefore and further to the above-mentioned response to general- and specific-comments, although the methods presented within Appendices B and C may not have fully been considered for EPA's alternate sampling locations, they remain appropriate. In addition and as requested by EPA, these materials and methods, will be updated following data collection and the analyses outlined within the draft final document.

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58	App C	C-9	An mPECQ of 5 or higher must be used to identify samples most likely to be toxic. The criteria for samples in the high bin must be revised to an mPECQ of 5 (see GC 2).	Comment acknowledged. Please see response to GC-2, -3; and SC-4, -57.
59	App C	-	The mean PECQs derived by Teck include only lead, zinc, cadmium, and copper, which Teck identifies as the "*primary risk drivers.*" This caused a considerable degree of confusion during EPA's review of the draft QAPP because Teck's method does not conform with the Sediment LOE or with other reports that include mPECQ calculations (e.g., Ingersoll et al. 2009, CH2M HILL 2012). As Teck noted in a footnote in Appendix C, "*mPECQ values approximated using the four primary metals are typically greater than values calculated for all eight metals because the sums of PECQ values are divided by four rather than eight. For example, mPECQ values for the four primary metals average 2.04 and a have a maximum of 22.44 while values for eight metals average 1.14 and have a maximum of 11.63.*" Teck then chose an mPECQ value of 2.0 or higher to describe high metal concentrations. As a result, EPA is concerned that the QAPP does not identify enough sample stations at the high end of the toxicity range (see General Comment 2). For the purposes of sediment sample location selection and preliminary binning, Teck must use calculations of the mPECQ based on the mean of metal PECQs for As, Cd, Cr, Cu, Pb, Ni, and Zn. This method is consistent with past practices and will simplify comparisons among documents. However, Teck may be correct that fewer metals are primary risk drivers in sediments. In the data analysis phase, various mPECQ calculations may be used with the purpose of identifying predictive concentration-responses relationships. EPA notes that the maximum PECQ for cadmium in the 2005 data set was 1.06, only slightly higher than the maximum PECQ for chromium of 1.0, which was dropped in Teck's calculations. Teck may wish to consider an mPECQ using only copper, lead and zinc in the data	Comment acknowledged. Please see response to GC-2, -3; and SC-4, -57.

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			analysis phase.	
60	App C	C-14, C-18	Clarify the rationale for creating a mapping layer related to sediment grain size. While not incorrect, it is simply not clear from the text or maps what role, if any, this layer played in Teck's selection of proposed sediment sample locations (e.g., identifying areas of past sample refusal where future sampling success is unlikely). Maps with these data must be included in a revised QAPP.	Comment acknowledged. Please see response to GC-2, -3; and SC-4, -57.
61	Appendix D	NA	Remove Appendix D from the QAPP and remove references to Appendix D from the text (see SC-12).	Comment acknowledged. Please refer to response to specific-comment number 12.