EPA and Ecology comments on Lower Duwamish Waterway Draft Feasibility Study, submitted April 24, 2009
August 8, 2009

General Comments

Overall Report Content and Structure

1. Overall, EPA and Ecology recognize and appreciate that an enormous amount of technical work went into drafting this FS. Unfortunately, there are several fundamental problems which will require a major redrafting. These include:
   - Many of our previous comments on the RI report and those provided in FS milestone meetings have not been addressed.
   - The FS overall reflects a bias towards natural recovery and against active remediation. Several examples of this bias are provided in our comments. Among the most critical is an overreliance on the natural recovery model and insufficient attention to the many uncertainties associated with model predictions in the analysis and discussion.
   - There is much redundancy in the text, and too much advocacy of preferred positions at the expense of a straight-forward presentation. The combined effect that it is difficult to find important information needed to evaluate the alternatives.
   - The method for selecting technologies is convoluted and difficult to follow. There are several assumptions embedded in this process that are flawed and require correction, and in many cases, the agencies couldn't discern what assumptions were used.
   - The alternatives must be significantly restructured, and the discussion of what cleanup standards are met when and through what technology must be made clearer for each alternative.
   - The ultimate use of anthropogenic background in light of MTCA (see next bullet) needs to be much clearer. Anthropogenic background concentrations need to be revised to reflect conditions upstream of the site and unaffected by site sources.
   - The FS needs to address the MTCA requirement to clean up to natural background and the SMS requirements to set cleanup standards. Natural background concentrations also require revision to reflect recent relevant data.
   - CERCLA ARARs must include all relevant and appropriate federal and any stricter applicable state surface water quality standards. MTCA requirements for compliance with other laws are similar and must be appropriately cited. Water quality considerations, beyond reiterations of short term adverse effects from dredging, must be an integrated part of FS analyses. Water quality monitoring is required as part of long-term compliance monitoring.

   Because of the great length and need for substantial revision of this document, we have focused on providing general comments to summarize the major revisions required. While reviewers have provided some specific comments to assist LDWG in revising the FS, they are by no means complete. The agencies will work with LDWG to discuss how issues raised in these comments can best be addressed. We will also provide additional comments on the revised draft, once the fundamental issues raised in these comments have been addressed.

   In some cases, our comments present FS deficiencies and then several options for addressing those deficiencies. For example, comments about uncertainties associated with the BCM model could be addressed by some combination of additional model runs, heavier reliance on empirical data, and sampling to verify model conclusions. LDWG should review the

comments and discuss with the agencies which options would best address the comments. All comments should be read to be required unless the agencies determine that an alternative approach is sufficient after discussion with LDWG.

2. **Addressing previous comments:** It is frustrating that many of the agencies' comments on previous documents were not addressed in the FS. For example, many items commented on by the agencies in the RI text have been corrected in the RI but still appear uncorrected in the FS. In addition, although many of the comments that the agencies made in pre-FS meetings have been addressed, many of the important ones have not. To illustrate this point, we have provided some examples in these comments where previous comments have not been addressed.

3. **Redundancy/readability of report:** There was significant redundancy and repetition across numerous sections of the report, especially in describing the remedial action objectives, alternatives, and technologies. Overall organization of the document made review challenging and it was difficult to follow what information applied to each clean up option. Information about a particular alternative, technology, or issue should be gathered in one place then referenced when discussed elsewhere in the document, so the reader doesn't have to hunt for it in several sections of the FS. Similarly, some of the tabulated information was much more detailed than the accompanying text. Some of this more detailed information, especially when presented as a catalog of itemized descriptions, should be moved to appendices (with appropriate text references) unless it is critical to understanding the subject matter in the text. In summary, the main text should be streamlined so the reader can easily find important information and is not overwhelmed by details that are circumstantial to the main objectives of the Feasibility Study. We have provided some examples of text that would benefit from editing and recommendations, along with many specific directives, for revising it in the specific comments.

   Due to the redundancy of information provided throughout the document, our comments include references to sections from which the comment was derived or may be pertinent, but is not inclusive of all sections for which the issue arises. They must be addressed in all locations where similar text is found.

SMAs, Alternatives, and Technologies

4. **SMA and technology designations:** This FS places far too much emphasis on SMAs, and not enough on describing clear criteria for future cleanup decisions. The FS must provide clear decision rules that can be used in design to implement a selected alternative. It should be made clear at every opportunity that the SMA footprints and designations shown in the FS are solely for area, volume, and cost estimating purposes, and that they will be modified in the design phase based on additional sampling. The many iterations declaring or implying that SMAs will or can be "independently" manageable areas must be removed. The site must be treated as a whole. A smaller number of consolidated SMAs would simplify the analysis, be less geographically arbitrary, and still meet the needs of the FS. Options for SMA simplification include combining some SMAs and subSMA (including ones that are not proximate to one another) or reducing the SMAs to one SMA per technology (one for mechanical dredging, one for capping, one for MNR, etc). This is not a design or pre-design document; precise cleanup area boundaries are not merely unnecessary, they create an appearance of precision that is misleading. The entire waterway will need to be sampled in the design phase, except possibly areas where the RI data clearly indicate the area either meets cleanup standards or needs to be cleaned up. RD sampling may suggest an entirely

different configuration of SMAs. The FS and cleanup alternatives must be robust enough to be applied independently of FS SMAs.

As noted in our September 11, 2008 SMA meeting comments, the FS must provide clearer and simpler decision rules for defining SMAs (defining RALs, spatially weighted upper confidence levels [SWUCLs], and cleanup standards for each alternative, as well as details on how erosion and deposition are being addressed), and SMA designations should follow those rules (we recognize there may be some exceptions based on unique circumstances). Similarly, within the proposed SMAs, the FS should provide decision criteria for which technology would be applied (e.g., physical conditions and COC concentration). Provide a table or flow chart that states for each alternative the conditions and concentrations that were used to determine the technology to be applied, i.e., dredging, capping, ENR and MNR. These decision criteria must be provided to the agencies for review and comment prior to inclusion in the revised draft FS.

5. **SMA categories**: The "Category 1, 2, 3" designations must either be eliminated or they must at least be used consistently. Definitions of these categories are different in ES, Section 6 and Section 8. It then does not appear that the alternatives in Section 8 match up with these categories, making the meaning of these designations very confusing.

6. **Use of subsurface data in developing SMAs:** Our review noted several deficiencies in the way subsurface data were used in developing SMAs, as listed below:
   - The FS must consider the severity of subsurface contamination in determining whether an area should be capped, dredged, or partially dredged and capped. Sediments with very high concentrations of contaminants in the subsurface should be dredged, or partially dredged and capped, to enhance the long-term effectiveness of the cleanup in that area.. The FS must also clearly identify areas where surface sediments are clean, but subsurface sediments are contaminated, for both scour and non-scour areas. Once these areas are identified, LDWG and the agencies must discuss how they should be addressed.
   - In berthing areas, where stability is less certain, institutional controls may be difficult to implement, and future maintenance dredging may be required. Leaving contaminated subsurface sediments in place in these areas may have more severe consequences than presented in the FS.
   - As noted in our June 30, 2008 Milestone 3 comments, the rationale used in and process for including subsurface core data in delineating AOPCs and SMAs is neither clear nor sufficient. Although the AOPC area appears to include a larger area where subsurface contamination is present in areas subject to scour, this area appears to have been reduced in the SMAs (e.g. SMA3 and 11). It appears that a fixed area near each subsurface core was selected from a larger area where scour has been identified. Because we have limited core data, interpolation between cores would yield much larger areas than presented in the FS. Conceptually, any area within scour areas where there is reason to believe there is subsurface contamination and scour potential should be included.
   - It is difficult to track how empirical evidence was incorporated where core data contradicted model results. It appears that only sedimentation rates from cores were qualitatively used to verify deposition. The FS must be revised to show how the differences in deposition rates between the cores and the model results and evidence of scour in the cores was addressed in the evaluation of alternatives.
   - Capping, ENR, or MNR may not be appropriate in areas where upwelling ground water may pass through contaminated subsurface sediments and contaminate surface sediments and porewater. While insufficient information was collected in the RI for the FS to

include a comprehensive evaluation of groundwater recharge/discharge areas, the FS must discuss the severity of unaddressed subsurface contamination and the potential for this contamination to move to the surface through advection or groundwater flow for each alternative when proposing capping, ENR, and MNR. Post-cleanup decision baseline monitoring must include collecting information on groundwater recharge/discharge.

7. **FS Alternatives:** The FS alternatives discussion should clearly describe the following for each alternative:
   - RAL (concentrations that trigger active remediation)
   - PRGs to be achieved in 10 years
   - List PRGs that cannot be achieved in 10 years, and state how long it will take to achieve them.

   The following modifications should be made to the alternatives:
   - All alternatives must meet human health-based cleanup goals (direct contact and background for seafood ingestion) and SMS standards within 10 years of completion of the cleanup. See comments on MTCA compliance below.
   - For alternatives that have treatment or disposal options other than upland landfill (i.e., 2 and 4d), these options should be presented as sub-alternatives, alongside a sub-alternative that disposes of the same volume in an upland landfill. This will allow comparison of costs, timeframes, etc, for the CAD and treatment options to the landfill options.
   - Alternative 5 must be carried through to the detailed analysis of alternatives, and should be structured like Alternatives 3 and 4 a – d (i.e., include a limited dredging option as well as a full dredging option. This alternative should allow for verification monitoring, consistent with other alternatives (including an assumption that some percentage of these areas will require cleanup for cost estimating purposes). It should not appear from most of the FS, as it does currently, that this alternative is more (or less) disfavored than any other, an FS (except in a preferred alternative section) should not be or read like an advocacy document.
   - RALs will need to be adjusted to assure that background values are met using the revised background values discussed in the comments below.
   - Organize alternatives based on RALs and cleanup standards, with sub-alternatives for varying technology assumptions.

   One recommendation for restructuring alternatives is as follows:
   - 1 – no further action
   - 2 a, b, and c (add capping emphasis and landfill disposal sub-alternatives)
   - 3 a and b (currently 3a and 4a)
   - 4 a and b (currently 3b and 4b)
   - 5 a and b (currently 3c and 4c)
   - 6 a, b, and c (currently 3d and 4d, adding an option for landfill disposal rather than treatment)
   - 7 a, b and c (currently 5, with sub-alternatives similar to the current 3 and 4, and adding a treatment sub-alternative similar to 6).

   An alternative restructuring achieving similar ends could be acceptable, but restructuring is required to be responsive to this comment. LDWG must consult with the agencies regarding any alternative restructuring before it is developed into the next iteration of the FS.

8. **ENR is not containment:** Throughout the FS, ENR is characterized as a containment technology. This is not correct. ENR is a method of increasing the rate at which natural recovery occurs. It is not intended to provide long term isolation of contaminants.

9. **Treatment:** The FS must be revised to include more discussion of treatment technologies. Information about currently available treatment technologies from the 2005 Candidate Technologies Memorandum and subsequent issue papers developed by LDWG must be summarized in the FS, and updated to include any new information since those documents were written. A "true" treatment technology must be included in one of the alternatives (as opposed to the particle separation technology currently in the FS).

Natural Recovery Estimates

10. **Use of empirical evidence to evaluate MNR predictions:** As written, the FS does not make a convincing argument that recovery has and will continue to take place in the locations specified. Natural recovery predictions are primarily based on the Bed Composition Model (BCM). The BCM is a simplistic model that uses the output of the Sediment Transport Model (STM) and makes estimates of contaminant concentrations in the surface sediment based on predicted rate of net deposition, the proportion of depositing sediment from upstream and lateral sources, and the concentrations of contaminants in the sediment source material. Two types of primary empirical information are used to support the predicted rates of natural recovery: surface concentrations in nominally co-located cores collected more than 5 years apart and vertical segmentation of concentrations in sediment cores. Both of these "lines of evidence" are limited and have insufficient resolution to support model predictions.

    Throughout the FS, there is an overemphasis on those lines of evidence that support the BCM results and a discounting of a similar weight of evidence that does not support those results. The sections describing the supporting empirical evidence are written in a way that focuses on generally confirming model results, rather than using the data to determine whether the model should be applied in certain areas based on actual observed conditions. Greater emphasis on the types of empirical data that went into corroborating predictions and a better explanation of how the data were used is necessary to provide greater confidence in its predictions. There are also newer data sets that could be added to the analysis. For example, there was a 2008 LDW-wide bathymetry study of the navigation channel conducted by USACE – recommend comparing this to the 2003 survey as an additional line of evidence. Also, evaluating depths of materials deposited on caps after their placement could be helpful.

    The current data may be sufficient to support the model to supplement decision-making, but it is insufficient to support the use of model output as a primary much less exclusive basis for decision-making. The FS must be revised to rely on empirical evidence first for determining which areas can be considered for MNR/ENR versus active remedies. The modeling can be used to predict how well the remedy will work over time in those areas. Additional data collection to validate model results should be considered, see comments below.

    An example where empirical data should be more heavily relied upon is the comparison of STM-predicted sedimentation against empirical data. Core locations that did not demonstrate sediment accumulation were often associated with pilings, piers, dolphins, or bridge abutments (Figure 5-15; SC-5, SC-24, SC-29, SC-48). This incongruity demonstrates that the presence of in-water obstructions and berthing activities impedes sediment deposition, and may be associated with scour. The resultant technology selection must address the uncertainty in deposition rates and whether sediment would remain uniformly distributed

over these areas. Based on this uncertainty, dredging to remove contaminated sediments, or dredging followed by hard surface capping, if contaminants remain *in situ*, may be the remedial action with the best long-term reliability in these areas. Dredging around obstructions is difficult with a conventional dredge, but can be accomplished using a diver-directed hydraulic dredge.

11. **Revise BCM input parameters:** The input parameters used in the BCM must be revised as described in Section 5 comments. The FS must better describe the uncertainties associated with these estimates. While the range of BCM model outcomes obtained by varying input parameters are shown in a few tables and figures, the range of possible BCM outcomes must be highlighted more in the description and comparative analysis of alternatives which rely on the BCM model.

12. **Physical transport does not adequately address risk:** Since the BCM has not been developed to be a full fate and transport model, one of the factors impacting remedy effectiveness and risk reduction but missing in the BCM analysis is the impact of soluble loading not associated with particle transport. Soluble concentrations are essential to understanding fish uptake and this aspect must be considered in selecting remedial options to reduce fish tissue concentrations. For example, with respect to risk, the mass or percentage of contaminated sediments that are resuspended and then deposited in some other area is secondary in importance to the fate of contaminants associated with sediment. It is the concentrations on surface sediment and the concentrations of COCs dissolved in the water column that are related to the risk pathways. The evaluation of remedial alternatives should be focused on evaluating both aspects. The approach of generating conclusions that concentrate on physical sediment transport, specifically when/where and to what depth sediment would erode as well as where it would deposit without considering the associated movement of contaminants to the water column and biota during resuspension, is a major deficiency in the FS.

    For example, Section 5.3.3.5 (that discusses Scenario 5: sediment scoured from greater than 10 cm depth) concludes with the following sentence: “About 50% of eroded material redeposits in the same reach and makes a very negligible contribution to the potential for redistribution of subsurface chemicals during high-flow events”. This conclusion is not based on a consideration of chemical transport and fate processes. What is the fate of the COCs adsorbed to the 50% that does not redeposit in the same reach? For the remaining 50%, how has the impact of where it is deposited in the reach been evaluated with respect to alternatives? The 50% of the sediment that redeposits in the same reach might be subsequently eroded and transported out of this reach by the next high-flow event. How is a 50% value considered negligible to redistribution of sediments overall?

    The emphasis here should be on the surficial exposure of COCs adsorbed to this eroded subsurface sediment. Subsequent desorption of the COCs to the water column might occur; thus increasing exposure of water column feeders to dissolved chemicals. It would also increase the exposure of benthos feeding biota to the sorbed COCs on the newly eroded subsurface sediment or on newly deposited sediments from contaminated areas. Conclusions based on the physics of sediment transport must be shifted to emphasize the increased exposure of biota to COCs as a result of the erosion and subsequent transport of the contaminated sediment.

    In addition to comparing the results of the natural recovery analysis to sediment-based remediation goals, the FS must include at least a qualitative analysis of the movement of

contaminants from the sediments to the water column and biota. This is a major factor in determining how much reduction in fish and shellfish tissue concentrations and human health risks could be achieved through natural recovery which is currently missing in the FS.

13. **MNR/ENR not suitable in berthing areas**: The analyses presented in Section 5 and Appendix C indicate that localized vessel scour can be as high as 25 cm under emergency conditions. Given this potential for disturbance at this depth, how is MNR suitable in berthing areas? This potential for disturbance has not been addressed in the MNR analysis. Rather, evaluation of prop scour is based solely on a review of the bathymetric survey (admitted in the FS to be a one time look at features in the subsurface). The FS argues that since berthing areas are in net depositional areas that any scour is subsequently filled with new sediment. This argument is inherently flawed. It would allow for buried contamination to be scoured and transported away. As noted above, the ecological impacts of this dispersion are not discussed. The development of SMAs and Alternatives must be revised to assume that any berthing area where prop wash can occur cannot be proposed for MNR/ENR unless the stability of the sediments in the area can be demonstrated by empirical data. There are very few areas (e.g., SMA 11A, 33, 14B, 27A, 32) that are Category 2 that fall within berthing areas. Most of these areas also have empirical evidence of erosion, which supports removing MNR from consideration as a technology. In the design phase, it may be possible to develop site specific information to demonstrate that scour in particular areas is highly unlikely, however the FS should assume the potential for scour in all berthing areas.

14. **Bed composition model runs:** Multiple uses and runs of the BCM are presented in this document, making it difficult to keep track of which runs were used for various evaluations presented in the FS. Were the re-distributed lateral load runs used for all MNR evaluations? Text refers to initial simplified analyses of bed sediment (section 5), evaluations of percentage lateral (Figure F-24), and detailed runs of each alternative (Section 9). Runs in Section 9 are not discussed in detail so it is not clear what was used. How were all of these analyses used? Since these analyses are presented as critical to the evaluation of MNR, they should be simplified and clearly presented. If exploratory analysis were not used in evaluation, they need not be discussed. Finally, all analyses should be focused on area-specific interpretations, as opposed to LDW-wide, since this is ultimately the level of analysis required for decision making.

    As noted in the agencies' December 19, 2008 Milestone 4 comments, there is insufficient emphasis in the tables and figures on the STM sensitivity runs for the BCM model. The FS should carry forward uncertainties derived from these analyses where appropriate (see specific comments in Section 5).

15. **Comparison of MNR and active remediation:** As has been noted in previous comments, there is an overall underemphasis in the FS on uncertainties associated with the MNR models. Highly uncertain model-predicted MNR projections are inappropriately presented on the same basis as far more certain construction timeframe estimates. Timeframes based on model projections do not have the same certainty as timeframes based on construction schedules, and should not be compared on an equal basis.

    The phased BCM runs shown in Fig 10-6 show a large difference in estimated recovery times – approximately 7 years to get to high end of background range for 3a and 4d as opposed to regular run estimates of approximately 16 and 23 years, respectively. This shows that the way the BCM has been used in the rest of the FS – starting the natural recovery model at the end of construction – potentially grossly overestimates recovery times for alternatives with

larger cleanup footprints. This results in an FS analysis that is biased in favor of alternatives with smaller cleanup footprints. This bias must be corrected so more realistic comparisons can be made among cleanup timeframes for the different alternatives. One approach to address this concern is to be more explicit about the uncertainty in recovery times and carrying this uncertainty through in the comparative analysis of alternatives.

The FS also underestimates the cost and schedule implications of MNR. Relying on MNR after the remedial actions to attain PRGs means waiting 10+ years to determine whether the remedy is complete and risks have been reduced to PRGs. It requires having to intensively sample specific areas again, and having to select, mobilize, and implement an appropriate action if the MNR does not occur as predicted. These steps would also have to be employed at remediation areas that do not meet the expected PRG. The FS must present a more balanced analysis of the pros and cons when comparing MNR to active remediation.

16. **BAZ/Bioturbation assumptions in STM:** The STM model assumes that the upper 10 cm layer is 100% mixed and this mixing represents, in part, the impact of bioturbation. The FS should clearly articulate this assumption, the rationale behind it, and the resulting implications in the BCM analysis. The basis for the 10 cm biologically active zone (BAZ) assumption for benthic invertebrates should be discussed in the FS, drawing from the text being developed for the RI. Documentation of the type and density of benthic organisms in the LDW and how these organisms interact with (mix) the sediment bed (i.e., burrowing depth and activity as a function of substrate type with respect to the assumption of 10cm) is needed to support this assumption. This discussion should include support for the assumption that the full 10 cm will be instantaneously mixed. Benthic organisms generally mix the top few centimeters more rapidly, then deeper zones get mixed more slowly. The sensitivity of the model to mixing depth and rate and the uncertainty introduced by these simplifying assumptions must be fully discussed.

17. **Data gaps:** The agencies have made several previous comments about FS data gaps, to which LDWG has responded that they would prefer to defer discussion until after completion of the draft FS. Based on our review of the FS, the agencies have concluded that the data sets the FS relies on for the MNR are not sufficient for this purpose. Because there are few underlying premises and arguments in the FS that don't rely on the on the BCM model, additional data are needed to appropriately support any proposed cleanup decision that relies more than minimally on MNR predictions. We suggest collection of the following data:
    - Reoccupying some of the 1998 and 2004 sampling locations to check BCM model predictions
    - Collecting cores in areas proposed for MNR to verify sedimentation rates and chemistry profiles. Other methods of confirming sedimentation rate (for example, collecting more information on incoming suspended sediments) should also be considered and discussed with the agencies.
    - Dioxin/furan sediment data to allow for better estimates of cleanup areas associated with various RALs and PRGs

    This data collection effort would not have to delay the submission of the revised draft FS. It could be incorporated into a separate technical memorandum to support or modify FS conclusions and support agency decision-making. LDWG and the agencies must meet to discuss potential data collection activities shortly after receipt of these comments so that sampling can begin as quickly as possible.

Background

18. **Natural background**: The FS must revise natural background predictions as described in Section 4 comments and address the MTCA requirement to meet natural background (unless an interim action or some other approach is proposed) as part of the FS analysis of alternatives.

19. **Anthropogenic background:** Anthropogenic background concentrations must be revised to reflect conditions upstream of the site and unaffected by site sources. The agencies disagree with the FS assertion that it would be possible or advisable to adjust background to reflect "urban influences" in the vicinity of the LDW. See Section 4 comments for details on acceptable data sets to use for anthropogenic background.

20. **BCM predictions appear to contradict background discussion**: Several reviewers noted two apparently conflicting premises in the FS: 1) lateral loads are predicted to have very little impact on LDW SWACs, thus LDW is a good candidate for natural recovery, as it will eventually be dominated by incoming sediments from upstream; and 2) future LDW sediments will be highly influenced by inputs from the urban environment surrounding LDW, thus upstream sediments concentrations are not appropriate background values. If lateral loads have little impact, urban influence s would be similarly limited. Is there some other source that would explain this seeming contradiction (direct deposition into the water body or disturbance of existing bed sediments)? If so, this should be discussed and quantified to support the concept of regional influences and it should be reflected in the BCM. The concept of anthropogenic background must consider only upstream data and be clearly separated from discussions of inputs to the LDW from within the site boundaries (which can be addressed in sections discussing the BCM).

Discussion of Regulatory Requirements

21. **Inclusion of MTCA and SMS:** MTCA and SMS requirements are not presented with equal treatment to CERCLA requirements. This analysis is necessary in any case since either MTCA/SMS requirements have to be met to implement these laws, or they have to be met to implement CERCLA to the extent that they may be stricter than CERCLA as ARARs. To accurately assess whether and to what extent they are or may be stricter they must be carefully analyzed in their own terms & in CERCLA terms for all cleanup alternatives. Ecology recognizes the efforts made to capture MTCA requirements in Appendix J, but MTCA/SMS requirements must be addressed alongside CERCLA requirements (throughout the document but particularly in Chapters 9 and 10) pursuant to the jointly issued RI/FS AOC. The entire appendix needs to be migrated into appropriate parts of the main body of the text and referenced alongside comparable CERCLA requirements. Likewise, because SMS is a regulatory requirement, description and application of SMS requirements must be included. Should MTCA or SMS and CERCLA requirements somehow be construed as not comparable, the text describing MTCA or SMS requirements should stand on its own. To this end, many references in tables and text to cleanup requirements (or "remedial alternative screening criteria") and ARARs require revision. There is no reason why MTCA and SMS can't be described as both laws being implemented and as ARARs under CERCLA, in either case satisfying their most stringent requirements. Specific issues are summarized below:
    - MTCA threshold criteria do not appear to be met. For example, it is unclear how any alternative complies with cleanup standards. The relationship between cleanup standards,

RALs, and PRGs is often confusing. In addition, it is not clear how the threshold requirement for compliance monitoring will be met for all alternatives.

- MTCA/SMS requirements for a FS are not sufficiently addressed.
    - Cleanup levels and standards are not proposed, as required. WAC 173-340-350 & 173-204-560. The use of remedial action levels (RALs) (chemical-specific sediment concentrations that trigger the need for active remediation) is confusing because different alternatives use different RALs, RALs are only applied to define areas requiring active remediation (vs. monitored natural recovery), and the relationship between RALs, PRGs and cleanup standards is often unclear.
    - The restoration time frame for many alternatives has not been shown to meet MTCA/SMS requirements. The default period to achieve cleanup standards is 10 years. WAC 173-204-580(3)(ii) & 173-204-590(2)(f).
- The disproportionate cost analysis (DCA) requires substantial revision. Ecology will meet with LDWG to discuss needed revisions. As written, there is insufficient justification to eliminate Alternative 5, and it should be carried through the comparative analysis in Chapter 10. More generally, the set of alternatives should represent more of a continuum of costs and benefits so that a more defensible analysis can be performed. Several other problems with the analysis will need to be corrected. Ecology will provide further direction in forthcoming documentation and meetings with LDWG.
- Because the CERCLA RI/FS process has been determined to be substantively equivalent to a NEPA EIS, performing a SEPA evaluation may not be required. Thus, Ecology is not requiring any action from LDWG at this time and will notify LDWG if a SEPA evaluation is required.

22. **Water quality standards:** As stated in several previous agency comments, RAOs must include protection of surface water. The FS must describe how the alternatives meet all federal and state water quality standards and criteria.

Source Control

23. **Source Control (SC)**: Many assumptions are made throughout the FS regarding control of sources of contamination. Ecology is the lead agency for SC but is not "responsible" for investigating sources. When discussing SC, quote or cite Ecology's SC Status Reports, Ecology's SC Action Plans, or the SC Strategy rather than reinterpreting published material. Several SC assumptions have insufficient support, including:
    - Contaminant loading will result primarily from outfalls (lateral loading) and upstream sources. Insufficient consideration is given to contaminant transport from banks, uplands, and groundwater. Aerial deposition is mentioned but not quantified. The focus is on upstream loading, which implies that SC is not important because the upstream sediment loading is so high. There is a lack of focus on addressing recontamination potential and the management of contaminant sources near the LDW.
    - The notion that SC will be achieved in a short period after issuance of a remedy decision is noted or implied without basis. It further does not meet the SMS requirement to describe "sources of active and inactive waste disposal and other sediment contaminant discharge sources" affecting the site, including the status of SC actions. WAC 173-204-560(4)(d).

    The FS should also summarize the current status of source control, using information from the RI and Ecology's source control status reports. Overall, the discussion of source control throughout the FS is inadequate and must be revised. Rather than provide detailed comments on how source control should be addressed in the FS, the agencies will meet with LDWG to

discuss needed revisions on this topic. LDWG, the agencies, and the source control workgroup should also meet to discuss the sufficiency of source control assumptions in the FS, particularly with respect to the lateral load estimates used in the FS.

Measuring Compliance with Cleanup Standards

24. **Assumptions for beach and clamming areas:** Because children (and dogs) dig holes in beaches, and because clams burrow to depths of 45 cm or more, a depth of 45 cm must be considered the depth of compliance for the direct contact RAO for beach and clamming areas (in addition to the 10 cm depth of compliance for RAOs 1, 3 and 4). The FS should note that all of these areas must be resampled to a depth of 45 cm in the design phase. The paucity of data in most beaches should be identified as a data gap to be filled in the design phase.

    The method for determining the area and depth requiring removal for a given beach in the FS must be explicitly identified. Remediation assumptions must consider the depth of exposure in the associated risk scenario. FS assumptions for remediation of clam beds must be of sufficient depth to provide clean, suitable substrate for the clams to live in. Impacts on depth of dredging and capping based on this must be included in the engineering assumptions. For example, enhanced natural recovery (ENR) of 6 inches would not be adequately protective in these areas based on the depth of exposure. Potential future habitat and the potential effects of climate change in modifying habitat zones should be also considered.

    In addition, the clamming areas shown in FS Figure 3-1 do not appear to take into account the current physical condition of the area, (mud, marsh, riprap) as presented in Map 6-1 of the RI. It is not clear whether the FS considered the actual condition of the area when applying clamming PRGs to cleanup areas. Are riprap banks proposed for remediation based on clamming or beach use scenario? What are the assumptions in term of cleanup technologies and costs based on current condition of the areas? Please clarify this in the revised FS.

25. **Use of dry weight PCB values:** As noted in our 10-16-08 comments from the stakeholder meetings, rationale for and use of 240 ppb must be explicitly explained in the FS, obviating any inference that 240 ppb is intended to be used as a surrogate for the SQS in the design and cleanup phases. Only the 12 ppm OC or 130 ppb LAET value may be used in discussions of whether the SQS was or will be met or exceeded. The FS must clearly and explicitly state that the actual values to be used in determining compliance are the OC-normalized SMS values.

26. **Averaging area for SWUCLs:** Determining achievement of PCB RAOs/PRGs by averaging (or doing other statistical analyses) over the entire 5 miles of LDW allows clean upstream areas that were never contaminated to "compensate" for or mask the severity of contaminated areas downstream. Averaging over the entire length of the LDW to establish compliance is not consistent with many of the exposure scenarios for both human and ecological receptors:
    - It does not account for exposures to human and non-human receptors who use one portion of the LDW exclusively or more frequently than other portions.
    - Research using radio-telemetry by the University of Alaska, Fairbanks, demonstrated that denning female river otters do more than 50% of their foraging within a 4 km (2.5 miles) stretch of shoreline (Blundell et al, Wildlife Life History, pgs 325-333, Table 2). Thus, averaging exposure over the entire LDW is not appropriate for estimating the exposure of denning female otters, a critical lifecycle consideration for PCB exposure.

It is also impractical to implement a river-wide measurement exclusively. While periodic river-wide measurements will be necessary to calculate a SWUCL, remediation will occur in phases over several years at various locations and will require SWUCL calculations based on concentration changes over smaller areas. While it is acceptable to use an LDW-wide SWUCL as one compliance measure, the LDW should also be broken up into smaller segments for the purposes of sampling for SWUCL compliance.

27. **Arsenic and cPAH sediment tissue relationships**: The FS must provide more information and more explicitly discuss the lack of relationship between sediment concentrations and clam tissue concentrations for arsenic and cPAHs. Because of the high risk associated with consumption of arsenic in clams, it is not sufficient to say that sediments will ultimately be remediated to background levels, but we have no idea whether this will result in reduction in arsenic in clam tissue. The FS should state that it is unlikely that sediment remediation will address the 10^{-3} arsenic human health risk associated with tribal consumption of clams. It should also state that further research should be done in the design phase to investigate how these risks could be reduced, and describe what might be included in such a research project.

    The agencies anticipate that our decision document will call for monitoring of inorganic arsenic concentrations in clams during baseline and long-term monitoring as well as arsenic bioavailability studies to determine why clams are accumulating so much inorganic arsenic and what, if anything, can be done to reduce their uptake (e.g., amendments to sediments placed in clamming areas.) We welcome input on what these additional studies might entail. We also recognize that they may change with developing or future technologies.

Analysis of cleanup alternatives

28. **Costs estimates:** FS projected remediation costs are extremely high when compared to similar completed projects. Examples include the ongoing Fox River cleanup, where dredging and disposal costs are approximately $160/cubic yard, see http://enr.ecnext.com/coms2/article_inen090729RiverCleanUp-1, and Head of Hylebos Waterway, which cost approximately $100/cubic yard for dredging and landfill disposal. In contrast, the FS projected costs for dredging appear to be in the range of $360/cubic yard when considering all capital costs and over $200/cy considering only pre-construction, project management, dredging, sediment handling, and compliance monitoring costs. FS cost estimates must be revised to be closer to known costs of completed projects, or explain what is different about this project to justify these higher cost estimates.

29. **Production rate:** The FS states that the removal rate is limited by the transloading rate. However, transloading rate calculations have not been presented. In addition, dredge production rates have assumed a single dredge with a 6 CY bucket, resulting in a dredge production rate that is lower than the transloading rate. It would not be difficult to increase dredge production rates to a rate that is greater than a transloading rate (for example, by using multiple dredges). It is also reasonable to assume that for the large cleanups envisioned in the FS alternatives, modifications to the transloading rate through infrastructure enhancements would be made to increase the actual production rate. Since the bases for the FS assumptions have not been presented, the assumption that the transloading rate is the limiting factor and cannot be adjusted cannot be adequately assessed. Include the transloading rate calculation and all bases for it. Also, state the assumptions about type and size bucket in the description of the alternatives. Unless a more convincing case can be made to support the lower production rate, the higher rate should be used as a base case, and the text revised to discuss sensitivity around that number.

30. **Cleanup sequencing**: It may be advantageous and more practical to divide the LDW into reaches for sequencing remediation and SWUCL compliance, rather than the "worst first" approach advocated in the FS. One way to do this would be to utilize the three reaches identified by the STM. The STM results indicate LDW sediment dynamics generally divide into three reaches. Most of the unremediated early action areas (EAAs) are in the middle reach, RM 2.0 to 4.0. Because 1) this is the area of highest scour, and remedial actions may disturb and redistribute some of the contaminated sediment; 2) the highest contaminant concentrations are within these areas; 3) it contains high human use areas in South Park and near Georgetown, there are good reasons to address these areas first.

    The most upstream reach, (RM 4.0 – 5.0) had smaller areas of contamination, mainly focused around the immediate area of the Norfolk CSO and the Rhone Poulenc RCRA site. Fish from this reach had consistently lower concentrations than the other two reaches. The STM indicates all of this reach, including Slip 6, has an average net annual sediment accumulation of >2 cm (Figure 5-15, pg 5-64). Thus, according to the STM, all areas of RM 4.0 -5.0 will have accumulated more than 20 cm [8 inches] of "background" sediment between years 2000 and 2010. This upstream reach is likely to most easily meet compliance with any and all RAOs, and could be addressed second. Additional rounds of baseline/verification monitoring would be conducted as each segment is completed, to refine model predictions and determine areas where additional remediation is needed.

    The downstream reach (RM 0.0 to 2.0), has most of the CSOs and SDs, so leaving remediation of the downstream reach until last provides more time to address the complex CSO/SD sources of contaminated sediment. Delaying remediation of the downstream reach until the middle reach is addressed also provides the greatest opportunity for natural recovery in the downstream reach. LDWG and the agencies should discuss this option for cleanup sequencing as an alternative to the "worst first" approach, along with any other potentially viable alternatives.

31. **Projected post-cleanup tissue concentrations**: The FS must discuss the projected post-cleanup tissue concentration achieved by the cleanup alternatives, in addition to the discussion of risk. For example, the risks shown in Table 9-5a should also be expressed in a separate table in terms of tissue concentrations, for projected post-cleanup sediment concentrations as well as background sediment concentrations. Post-cleanup tissue concentrations should also be compared to current tissue data for non-urban areas in Puget Sound. We recognize this is a difficult comparison because data for all of the LDW "market basket" components is not available for other Puget Sound areas, but LDWG and the agencies should discuss how a comparison should best be made.

Discussion of EAAs in the FS

32. **Clarify discussion of EAAs:** While it makes sense to provide information on completed and planned EAAs in the FS, these actions need to be kept separate from the other cleanup alternatives, because they are not part of the cleanup alternatives evaluated in this FS (except as part of the no further action alternative). The actions in Alternative 1 are not part of the alternatives evaluated in the FS (because they will be [or have been] implemented prior to the cleanup decision supported by this FS). While cleanup areas, volumes and costs for these EAAs can be included in the FS Alternative 1 discussion for informational purposes, they may not be included in overall area, volume and cost estimates for other alternatives.

In addition, reviewers found the discussion of EAAs in the FS confusing because there are several references to seven EAAs, but only five in Alternative 1. The FS should mention the seven candidate early cleanup areas proposed in 2003, but then state that only some of the areas (and in the case of the NRDA cleanups, some portions of the areas) identified as candidates in that memorandum became EAAs. The rest of the FS should only refer to the five EAAs included in Alternative 1. The two additional areas (at RMW 2.2 and RME 3.8) should be removed from the text discussion of EAAs and figures (e.g., Figures 2-13b, 2-13d, 6-2b and 6-2d) to reduce confusion. The word "sponsored" in reference to EAAs is no longer needed and must be discarded. It is confusing and has implications that are arguably inappropriate for at least some EAAs.

When showing EAAs on maps, those without approved boundaries must be explicitly described as having only approximate boundaries. In addition, it appears that the Slip 4 boundary is not correct. Please check against design documents as revise as necessary.

33. **EAA datasets:** Due to timing of the FS, this document is missing new data collected as part of the T117 evaluation. As this was done in part to verify natural recovery south of the site, this information should be included in the FS. See the specific comments regarding other data sets to be included in the FS.

34. **Stakeholder involvement in FS revisions**: The agencies have provided stakeholder FS comments to LDWG under separate cover. Many of the comments provided in this letter are of great concern to stakeholders, and many of their comments have been included here. A series of stakeholder meetings on FS revisions of importance to them will be needed.

Specific Comments

1. Title page (and elsewhere): The name of the Ecology office in Bellevue is the Northwest Regional Office, rather than the Northwest Field Office.

Executive Summary

2. **General comment**: Although we have several concerns about the content, as noted below, adding pictures and diagrams contributes nicely to a "public friendly" Executive Summary.

3. **Page ES-1, 1st paragraph, penultimate sentence**: Delete "also known as Superfund.".

4. **Page ES-1, 2nd paragraph, 2nd sentence**: Delete "relative costs, benefits, and tradeoffs" – this does not accurately reflect CERCLA and MTCA evaluation criteria.

5. **Page ES-1, 3rd paragraph, last sentence**: Delete "in their respective decision documents."

6. **Page ES-1, graphic caption**: The last clause should read "…before the agencies issue decision documents."

7. **Page ES-2, 1st bullet on page (editorial):** For clarity, please note that the Human Health and Ecological Risk Assessments are Appendices A and B of the Remedial Investigation Report.

8. **Page ES-4, 1st bullet**: Should mention multiple salmon runs, not just Chinook.

9. **Page ES-4, 1st bullet:** This paragraph should include a sentence that describes ongoing restoration sites and efforts, rather than "remnant habitat."

10. **Page ES-4:** Replace ".. is an engineered waterway built in the early 1900s to serve developing industries in Seattle" to "was an existing river that was modified to an engineered waterway in the early 1900s…".

11. **Page ES-4, 2nd bullet on page**: Modify 2nd sentence. As noted in the agencies' March 2, 2008 comments on the draft Remedial Investigation Report, residential and industrial uses are roughly equivalent and this balance should be noted in the executive summary. See RI Section 2.9.3 Site Use: "Approximately 43% of the Duwamish estuary sub watershed (extending from RM 11.0 to Elliott Bay (Map 2-2) is used for commercial/industrial purposes, and approximately 39% is residential (King County 2005f)." Please also note existing public parks, publicly accessible shorelines, and recreational areas and the fact that there are plans to increase these areas (such as Slip 4). Identify neighborhoods by name and include a reference to the Suquamish and Duwamish Tribes.

12. **Page ES-4, 2nd bullet on page**: As stated in comments on the draft RI, replace the current statement about tribal use of the waterway with the following: "The Muckleshoot Indian Tribe and Suquamish Tribe are both federally-recognized Tribes that are Natural Resource Trustees in the Duwamish River. As Natural Resource Trustees, their resources are impacted by degradation within the Lower Duwamish Waterway study area. The Muckleshoot Indian Tribe currently conducts seasonal netfishing operations in the LDW. The Suquamish Tribe actively manages resources up to the Spokane Street Bridge."

13. **Page ES-5, 1st bullet on page**: Revise to state that the LDW wide physical CSM was generally confirmed by several lines of evidence, and that exceptions to the general CSM caused by site specific features were also observed.

14. **Page ES-5, 2nd bullet on page**: We reiterate our March 2, 2008 comments on the draft Remedial Investigation Report, in which we stated that similar text should be deleted or substantially qualified. This text goes beyond the findings of the RI and must be modified. The sediment transport model evaluated only physical transport, not chemical fate and transport.

15. **Page ES-5, 3rd bullet on page (editorial):** State that the Washington State Sediment Management Standards SQS and CSL values were developed to protect the health of the benthic community. Also, add the total area where exceedances were observed.

16. **Page ES-5, 4th bullet on page**: Delete or modify the text in this bullet in accordance with our comments on the March 2, 2008 comments on the draft Remedial Investigation Report.

17. **Page ES-5, 5th bullet on page**: Either state that some areas show evidence of recovery based on empirical evidence, not many areas, or eliminate this bullet. Quantification of this percentage could be added for clarity. Based on the comments on Appendix F, there are likely equal areas that do not show recovery. Delete "localized".

18. **Page ES-5, last bullet on page:** As stated in the general comments (and in comments on previous documents) the concept of "sponsored EAAs" must be eliminated. These are the only EAAs in the LDW at this time. The fact that two others were proposed in 2003 is

irrelevant and only adds to confusion in the FS. There is no need to discuss "sponsored" versus "unsponsored" EAAs.

19. **Page ES-7, 1st bullet on page**: "Risk drivers" will not mean much to the general public. Add more text explaining what this means.

20. **Page ES-7, 2nd bullet on page**: Please confer with Windward Environmental and LDWG members involved with the Human Health Risk Assessment. The seafood consumption rates used in the HHRA are not subsistence values. Modify second sentence to state that the HHRA used seafood consumption rates representative of populations who consume more seafood than the general population.

21. **Page ES-7, 4th bullet on page**: For clarity, state that 41 chemicals were identified as presenting risk to benthic invertebrates.

22. **Page ES-8**: Lines of evidence for background values and their derivation should be mentioned.

23. **Page ES-8, bulleted list**: RAOs must include surface water.

24. **Page ES-8, background discussion**: Please modify consistent with Section 4 comments on background.

25. **Page ES-9, Table ES-1**: Change the first column to read "other" SMS chemicals. Is the UCL used properly here (see footnote a)? Also, footnote e (3rd sentence) should specify the "cleanup standard" rather than "cleanup level."

26. **Page ES-10, first bullet:** Add that resuspension can also be associated with natural high flow events.

27. **Page ES-10, bullets:** Bullets must be more carefully worded to reflect the STM model findings. For example, the model did not derive that ship-induced scour is a mixing process. It merely tracked the depth of erosion that occurred in certain scenarios.

28. **Page ES-10:** Include a discussion of the prop wash analysis provided in the FS that indicates erosion depths of 25 cm or more.

29. **Page ES-10, Figure at bottom of page**: The term "urban source sediments" is confusing. Change to sediment inputs from storm drains, CSOs, and streams.

30. **Page ES-10:** last sentence. Revise to read " with a general estimate of the chemical concentrations entering …"

31. **Page ES-11, 2nd bullet:** Revise text to state "many areas with moderate chemical concentrations and sufficient deposition from the Green River."

32. **Page ES-11, 3rd bullet:** Add the fact that areas with low sedimentation rates and those that are physically disturbed may also not recover.

33. **Page ES-12, 1st paragraph**: Text is not accurate. Seven "candidate" EAAs were identified. Of these: 5 were accepted by the agencies as EAAs with only 3 to be addressed with EPA or

Ecology oversight: Terminal 117 and Slip 4 as EPA CERCLA removal actions, and Boeing Plant 2 sediments pursuant to an outstanding 1994 RCRA Corrective Action Order

- Norfolk CSO: King County did a partial cleanup pursuant to a Natural Resource Damages settlement with federal, state and tribal Natural Resource Trustees in 1999 prior to the identification of EAAs. The EAA process identified additional areas outside of that cleanup area that could benefit from early cleanup action. Boeing did a very small (60 cy) additional cleanup in 2003, but this did not address the entire candidate EAA area.
- King County did a cleanup at Duwamish/Diagonal CSO in 2004/5 under the NRD CD that partially addressed the candidate EAA.
- The two CERCLA removals and Plant 2 RCRA sediment Interim Measure are in the late or final stages of design, and awaiting verification of adequate source control completion to eliminate or adequately minimize recontamination potential.

It is not necessary to include all of this text in the ES, but all discussions of EAAs in the FS must be consistent with these facts. As noted previously, the identification of seven candidate EAAs should be briefly mentioned, then the rest of the FS should focus on the 5 actual EAAs, for clarity.

34. **Page ES-12**: See general comments about SMA designations. Emphasize that these were developed for FS area, volume and cost estimating purposes only. Delete "in which a remedial approach may be applied independently of adjacent areas" and any similar language conveying this idea anywhere in the FS.

35. **Page ES-12, Early Action Areas (EAAs) and Sediment Management Areas (SMAs), second bulleted item:** See general comments about inconsistent definitions of these categories.

36. **Page ES-14, bulleted list**: List active remediation options first, then ENR, then MNR, then institutional controls.

37. **Page ES-14, Figure at bottom of page:** Revise figure:
    - Thin caps are not a containment technology. It is not clear why reactive caps are listed under thin caps, as they are often used as a component layer within thick caps.
    - The text on the trend arrows is confusing because "impact" apparently refers to disturbance rather than risk to human health and the environment, while protectiveness should be associated with the increasing removal/containment arrow.

38. **Page ES-15, 2nd paragraph, 1st sentence**: Delete "within an SMA".

39. **Page ES-15, footnote 3**: Arsenic and PAHs are also risk drivers for the benthic community.

40. **Page ES-15, 4th and 5th paragraphs**: Description of EAAs is incorrect, it should say there are 2 completed and 3 planned actions, rather than 5 planned actions.

41. **Page ES-16, Table ES-2**: Table mistakenly implies that RALs are all that is important in distinguishing alternatives. The ES needs a more comprehensive summary table that provides RALs, levels to be achieved in 10 years, time to achieve the long-term PRGs, and clarifies what each of these values are for each alternative.

42. **Page ES-17**: Delete or adequately explain what "Lower maximum values within 10 years" means.

43. **Page ES-17**: Delete "adaptive management" in 1st (partial) paragraph – it's not clear what it means in this context. In any case, the description of the alternative will have to be modified once we reach agreement on modifications to FS alternatives.

44. **Page ES-18**: Figure ES-4 should include a description of the alternatives, especially what PRGs are achieved by when. Figure inappropriately implies that cost and schedule are all that's important in distinguishing between alternatives.

45. **Page ES-19, last paragraph**: Delete "reasonable period of time" – this is a subjective statement. Replace with the range of estimated recovery timeframes.

46. **Page ES-20, Figure ES-5**: Delete this figure. It inappropriately implies that cost is the most important factor in cleanup decision-making.

47. **Page ES-21, Table ES-3:** MTCA evaluation criteria must be presented on an equal footing in this table or an immediately subsequent table.

48. **Page ES-22, Protection of Human Health and the Environment and Compliance with ARARs**: Statements that alternatives are protective of human health must be qualified. None of the alternatives will bring human health risks posed by bioaccumulative contaminants down to an acceptable range.

49. **Page ES-22, Figure ES-6a**: Delete this figure. It is too simplistic and glosses over many important details.

50. **Page ES-22 – 32**: Extensive edits are required to address our comments elsewhere in the FS on the comparative analysis of alternatives. Delete figures ES-6b and ES-8.

51. **Page ES-25, Figure ES-7:** There is no apparent basis presented for attaining RAOs for Alternative 1 in the restoration time frame indicated (40 yrs).

52. **Page ES-28,** Major sources of uncertainties should be highlighted here to include the list below:
    - Rate of sedimentation and source of sediment applied to site specific areas
    - Success of natural recovery
    - Exact volume requiring removal based on age of data, and extrapolation of cores
    - Rates of dredging
    - Impacts of dredging on reducing COC concentrations
    - Inputs from lateral sources
    - Input from Green River

53. **Page ES-30:** Revise to reflect comments on Section 11.

54. **Page ES-31**: The ES should say more about what documentation is available that demonstrates the success of natural recovery.

Section 1, Introduction

55. **Page 1-1 – 1-2, bulleted list**: The following documents do not have the same status and should not be listed together:
    - The AOC and SOW for LDW is a binding legal agreement and should not be listed together with the following two bullets, the "Clarification of Feasibility Study Requirements" and "Feasibility Study Work Plan"
    - Laws and regulations must be listed separately from guidance documents.

56. **Page 1-3, Section 1.1, Purpose of FS (editorial)**: Last paragraph in section, last sentence appears incomplete. Edit as follows: "The FS lays the groundwork **for development of cleanup alternatives** that represent the best balance of tradeoffs for managing risks to both human health and the environment."

57. **Page 1-3, Section 1.2**: Add that alternatives were evaluated with respect to how they addressed contaminants other than the risk drivers.

58. **Page 1-3, Section 1.2, FS Process**: For completeness, add that identification of ARARs is also part of the FS process.

59. **Page 1-3, section 1.2, bullets:** Include reference to the prescribed MTCA and SMS cleanup processes here.

60. **Page 1-4, Section 1.2.1, 2nd full paragraph on page:** 3rd sentence incorrectly implies that CERCLA does not require that cleanup actions use permanent solutions to the maximum extent practicable. Revise according citing CERCLA Section 121(b)(1).

61. **Page 1-5, Section 1.2.2 bullets**: SC should be specifically included in this list. Include reference to SC Strategy. Remedy selection could be influenced by SC status.

62. **Page 1-5, Section 1.3.1, Regulatory Terms**: Use "health protective" rather than "conservative" when discussing the human health risk assessment.

63. **Page 1-7, section 1.3.1, Regulatory Terms**:
    - Cleanup levels and standards must be proposed in the FS. WAC 173-340-350(9)(a). WAC 173-204-560(4)(b)(ii)(C). Clearly state that PRGs are the proposed cleanup standards, if that is in fact what LDWG is proposing. See WAC 173-340-350(9)(a).
    - Define MTCA "point of compliance".
    - Use the term "decision document" rather than ROD, to encompass either a CERCLA ROD or a MTCA CAP (and SMS cleanup study report).

64. **Page 1-8, Section 1.3.2, Sediment Concentrations**: Expand this section to discuss spatially weighted upper confidence limits.

65. **Page 1-9, Section 1.3.3, Early Action Areas**: Similar to the footnote for the Norfolk EAA, note that the Duwamish/Diagonal EAA as identified in the 2003 Windward EAA memo is larger than the area addressed under the EB/DRP cleanup. Be consistent with EAA comments on ES above.

66. **Page 1-9, Section 1.3.3, Sediment Management Areas:** Ensure consistency with agency general comments on SMAs here and in all SMA references throughout the FS. Several different definitions are provided for SMAs throughout the FS and they are all somewhat different. This definition says that a single management method will be applied within an SMA, but this is not the case for Alternative 3. The statement about RALs and SMAs is also not correct – some SMAs have different RALs within them (e.g., where a beach or clam bed is present on only a portion of an SMA).

67. **Page 1-10, section 1.3.3:** The text notes that SMAs can be divided into smaller areas during design; it remains unclear why so many SMAs were generated for a "river-wide" FS.

68. **Table 1-1: Several revisions are required**:
    a. The table should be titled "…Cleanup Requirements" rather than Remedial Alternative Screening Criteria.
    b. Because this is a joint AOC, MTCA and SMS are requirements, as well as ARARs, and need to be completely listed rather than trying to map only those that match specific CERCLA requirements. Ideally, this table would relate MTCA/SMS and CERCLA terminology concerned with risk-based protective concentrations, remedial actions, and goals.
    c. SMS requirements need to be added to the 3rd column (or in a 4th column) throughout the table.
    d. The MTCA threshold requirement to meet cleanup standards should be in the first row (protectiveness), not the second.
    e. The description of the threshold requirement for compliance monitoring should include the three types of monitoring.
    f. The citation for DCA is WAC 173-340-360… rather than …360-340….
    g. The provision for restoration time frame is unrelated to short-term effectiveness. Also, the SMS default time frame of 10 years should be cited here.
    h. The citation for evaluating protectiveness in the DCA is …(3)(f)(i) rather than …(3)(f)(ii).

Section 2, Site Setting, RI Summary, and Current Conditions

69. **CSM**: The sparse text presented here is repeated throughout subsequent sections. As this the first time the CSM is introduced, add more information connecting receptors, exposure pathways, and exposure areas (the exposures that matter) so that connections to remedial alternatives are clearer.

70. **Page 2-1, Section 2.1, Environmental Setting**: State the width of the river (in addition to the navigation channel).

71. **Page 2-2, Section 2.1.1, Site History, 3rd paragraph**: Delete the last sentence in this paragraph. It is out of place in this section.

72. **Page 2-4, Section 2.1.3, Hydrogeology, Sediment Stratigraphy, and Surface Water Hydrology:** Are the references to river miles from the actual mouth of the Duwamish Waterway at the north end of Harbor Island or specific to the LDW study area? Clarify.

73. **Page 2-4, Section 2.1.3:** The "Fill" bullet implies "local" fill was always used along the waterway, when we only know this to be true for the period of straightening (i.e., circa 1913-

1919). It is our understanding that fill placed between 1919 and 1960's came from various unidentified sources, possibly including ASARCO slag. Revise accordingly.

74. **Page 2-8, Section 2.1.4.2, Biological Communities:** Mention threatened and endangered species. Revise the sentence in the 3rd paragraph regarding 1-2 week residence time of outmigrating juveniles (Chinook and Chum) to reflect the information provided in the LDW Ecological Risk Assessment (ERA) (Section A.2.2.3.1; pg 22-23). Results of studies cited in the ERA suggest residence times in the LDW up to several months.

75. **Page 2-9, Section 2.1.5, Historical and Current Land Uses**: See comments on page ES-4. Residential and industrial uses are roughly equivalent, state this in this section.

76. **Page 2-9, Section 2.1.5**: Under primary activities of Tribes add "gathering" (previously submitted comment).

77. **Page 2-9, Section 2.1.5, final paragraph on page**: Add a discussion of the Muckleshoot Tribe's LDW fishing activities.

78. **Page 2-10, Section 2.2.1**: Is there a way to include animations (based on the STM) in a link to a website? Also, reiterate flow control by Howard Hanson Dam and discuss recent developments with respect to water levels and flow due to maintenance of that structure.

79. **Page 2-11, Section 2.2.1, Physical CSM**: Reach 2. Add that sedimentation rate is variable.

80. **Page 2-12, Section 2.2.1.1, Sediment Bed Stability and Scour Potential**: Revise second sentence on page to read "Based on historical data, high-flow periods are more tempered than before construction of the Howard Hansen Dam."

81. **Page 2-12, Section 2.2.1.1, sentence before bullets**: Indicate that these conclusions are derived from the model.

82. **Page 2-12, Section 2.2.1.1, 3rd para, 4th line:** change "to predict bed shear stress" to "to predict erosion rates and critical shear stresses for resuspension."

83. **Page 2-12, Section 2.2.1.1, 1st bullet,** Revise bullet to indicate for Reach 1 event shear stress on the shelves was equivalent to channel shear stress.

84. **Page 2-12, Section 2.2.1.1, 2nd bullet below 3rd para:** change "against shear stress" to "against the high flow velocities occurring above the salt wedge".

85. **Page 2-13, Section 2.2.1.1**: Discussion of maximum scour depth from high flow events must include references to the section discussing the uncertainties behind these values.

86. **Page 2-13, Section 2.2.1.1, Ship Induced Bed Scour from Passing Vessels transiting the Navigation Channel**: Add maximum scour observed from this analysis.

87. **Page 2-13, Section 2.2.1.1, Ship Induced Bed Scour from Passing Vessels transiting the Navigation Channel**, t**hird bullet:** Explain how this upper bound value was determined since it does not coincide with either prop mixing (<2 cm) or event scour depth (22 cm). Is this relative to maximum scour on the benches?

88. **Page 2-13, Section 2.2.1.1, Ship Induced Bed Scour from Passing Vessels transiting the Navigation Channel**, **4th bullet:** Explain briefly why prop erosion does not effect erosion rate.

89. **Page 2-14, Section 2.2.1.1, Ship-Induced Bed Scour from Maneuvering Vessels, 2nd paragraph:** Explain in the text that in this situation, material often redeposits where it was disturbed or sides slough in, so while visual analysis is important (and welcomed), scour occurs deeper than indicated solely by bathymetry. Compare to STM finding that there is scour to a "maximum of only about 22 cm in relatively small areas".

90. **Page 2-14, Section 2.2.1.1, Ship-Induced Bed Scour from Maneuvering Vessels, last sentence on page**: Revise sentence to read that the bathymetry analysis can only be used to evaluate a general pattern of scour for a covered area. Indicate that detailed evaluations of vessel-related scour are more appropriate on a site by site basis.

91. **Page 2-15, Section 2.2.1.2, Net Sedimentation Rates**: Import text from the RI report regarding comparison of the empirical vs. modeled datasets. The text presented is too general. It is misleading to state that there is generally strong agreement among the lines of evidence (some areas were higher and some were lower). Also, since this section discusses this comparison, the associated figure should be added to this section (replaced Figure 2-6) that includes the presentation of both data sets. Also, in the first paragraph, the term “validation” is misleading and reflects too much certainty, use “supported”.

92. **Page 2-15, Section 2.2.1.2, 2nd bullet:** Indicate that the stated >50 cm/yr is caused by the turning basin which acts as a sediment trap. State that if this basin were permitted to infill, natural sedimentation rates would be much less.

93. **Page 2-16, Section 2.2.2.2, Chemical Concentrations**: UCLs are the statistic upon which compliance with risk based criteria are determined. Add these tables should contain SWUCLs or arithmetic UCLs to these tables.

94. **Page 2-16, Section 2.2.2.2:** This section reads as if SMS standards were the only relevant values for comparison to site data. This section has a discussion of how LDW sediment contaminant concentrations pair up with SMS values. There should be a corresponding discussion of how LDW sediment contaminant concentrations relate to direct and indirect contact risk based sediment concentrations, as well as background values. We recognize that this information has not yet been introduced in the FS. Either include these comparisons in this section, cross referencing sections where these values are introduced, or provide these comparisons later in the FS.

95. **Page 2-17, Section 2.2.2.3, Interpolative Mapping of Risk-Driver Chemicals**: This section must discuss how SWUCLs are used.

96. **Page 2-18, Section 2.2.2.3, Dioxins/Furans**: There is NO basis for using SMS Thiessen polygons to represent the extent of dioxin/furan influence. Remove this approach from the FS.

97. **Page 2-20 Section 2.2.2.4, Chemical Distribution Patterns**:

- The discussion of high sediment concentrations for risk drivers in Early Action Area-2 (Trotsky) should cite the Ecology report. Include the 4 surface sediment samples there. The citation for the data report is: SAIC 2009. *Lower Duwamish Waterway, Early Action Area 2,*

Summary of Additional Site Characterization Activities: Trotsky and Douglas Management Company Properties. Science Applications International Corporation for Toxics Cleanup Program, Northwest Regional Office, Washington State Department of Ecology. March 2009.

- The text in the second bullet states, "Dioxins/furans were not analyzed in samples from Slip 4 (and are below 4 ng TEQ/kg dw just outside of the slip)". Strike the reference to area outside the EAA.
- "Other areas" should identify all locations near the LDW with MTCA (including VCP), CERCLA, TSCA or RCRA orders.

98. **Page 2-20, Section 2.2.3, Sources and Pathways-General Comments:** Much has changed during RI revisions since this draft FS was written. Ecology worked extensively with Windward on the RI SC section, and the FS must be consistent with the most recent (July 2009) version of the draft RI.

99. **Page 2-21, Section 2.2.3.1, Potential Historical Chemical Sources and Pathways:** Provide citations for the association of contaminant releases with these sources. Use peer-reviewed or agency-approved publications whenever possible. Include, for example, the source(s) of arsenic associated with watercraft being specific with respect to the type(s) of watercraft.

100. **Page 2-21, Section 2.2.3.1, 1st paragraph:** The text states, "Today, many of these historical sources, including direct discharges of municipal and industrial wastewater and spills, are largely controlled by regulatory requirements, housekeeping practices, technology advances, the elimination of product use (such as the ban on PCB production)…." This section should state that ongoing releases of some contaminants continue and lead the reader into the next section where these sources are discussed. Revise 4th and 5th sentences to read as follows:

> Today, many historic sources, including direct discharges of municipal & industrial wastewater and spills, have been identified and limited subject to regulatory requirements, housekeeping practices and technology advances. The reduction of some chemicals, such as PCBs, is due in part to banned production and use in the US; however, significant sources of historical origin are still in the environment and releases are ongoing. Such PCB legacies include older paints, caulks and building materials still on or in existing structures, as well as soils and groundwater that were contaminated while PCBs were still actively used and produced in the US. Also, direct discharge of sanitary sewer discharges have also been reduced as King County developed the industrial waste pre-treatment program in accordance with requirements of the Clean Water Act. Since 1981, many industrial discharges have been re-routed from the LDW to the West Point wastewater treatment plant, along with redirected sanitary & CSO/SD flow from areas surrounding Lake Washington. Although the pre-treatment program is responsible for reducing the number of daily direct industrial discharges to the LDW, CSO rain events still occur and direct sanitary/storm discharge still impacts the waterway, along with septic systems located adjacent to the waterway.

101. **Page 2-21, Section 2.2.3.1, 3rd paragraph, 1st bullet**: It's unclear whether sealants include paint. Include paint specifically. Also, include a statement (similar to that for PAHs) regarding PCB loading from stormwater runoff carrying non-point and point source contamination (e.g., Rainier Brewery building still has paint with up to 10,000 mg/kg PCBs on the exterior walls).

102. **Page 2-21, Section 2.2.3.1, 2nd paragraph**: This paragraph seems out of place. Provide context or move it to a more appropriate location (e.g., the next section where wastewater discharges are briefly mentioned).

103. **Page 2-21, Section 2.2.3.1, 3rd paragraph:** "Figures 2-14a through 2-14d illustrate the potential historical chemical sources and pathways for total PCBs, arsenic, cPAHs, and dioxins/furans, as summarized below:" The figures do not show actual chemical sources and pathways, only a conceptual site model. The text should be revised accordingly.

104. **Page 2-22, Section 2.2.3.2, Potential Ongoing Chemical Sources and Potentially Complete Pathways:** This section is frustrating to read, is not well organized, and has many errors based on misconceptions.

- Reorganize this section to clearly outline the ongoing sources and pathways, similar to the following example, and include the text provided below:

> **Discharges via Outfalls**: Discharges to the LDW may occur from public or private storm drain systems, CSOs, and emergency overflows (EOFs). The LDW area is served by a combination of separated storm drain and sanitary sewer, and combined sewer systems. Storm drains convey stormwater runoff collected from streets, parking lots, roof drains, and residential, commercial, and industrial properties to the waterway. In the LDW, there are both public and private storm drain systems. Most of the waterfront properties are served by privately-owned systems that discharge directly to the waterway. The other upland areas are served by a combination of privately- and publicly-owned systems.
>
> Storm drains entering the LDW carry runoff generated by rain and snow. A wide range of chemicals may become dissolved or suspended in runoff as rainwater flows over the land. Urban areas may accumulate particulates, dust, oil, asphalt, rust, rubber, metals, pesticides, detergents, or other materials as a result of urban activities. These can be flushed into storm drains during wet weather. Storm drains can also convey materials from businesses (i.e., industrial stormwater permits), vehicle washing, runoff from landscaped areas, erosion of contaminated soil, groundwater infiltration, and materials illegally dumped into the system.
>
> <*insert number*> private outfalls are present in the LDW. Contaminants discharged via these outfalls could affect waterway sediments. There are <*insert number*> municipally-owned outfalls within the LDW and <*insert number*> facilities that are currently covered under an NPDES permit.
>
> **Surface Runoff (Sheet Flow)**: In areas lacking collection systems, spills or leaks on properties adjacent to the LDW could flow directly over impervious surfaces or through creeks and ditches to the waterway. Surface runoff is a potential pathway for transport of COCs to the LDW.
>
> **Spills to the LDW**: Near-water activities and over-water infrastructure and activities have the potential to impact adjacent sediments from discharges of material containing contaminants of concern. Over-water activities are currently conducted at <*insert locations and reference to a figure showing over-water structures*>. Near-water spills at the properties adjacent to the LDW may flow directly to the waterway.

Groundwater Discharges: Contaminants in soil resulting from spills and releases to adjacent properties may be transported to groundwater and subsequently to the LDW. Contaminated groundwater has been documented at several properties adjacent to the LDW where groundwater flows toward the LDW. Many seeps have been observed along the LDW… <*include information here from Windward 2004*>. Groundwater discharge is therefore a potential pathway for transport of COCs to the LDW. Groundwater transport might be a significant pathway for some sites that have yet to conduct remedial investigations, such as Boeing Isaacson/Thompson where the levels of arsenic in groundwater could be a significant source in that part of the river.

Bank Erosion: The banks of the LDW shoreline are susceptible to erosion by wind and surface water, particularly in areas where banks are steep. Shoreline armoring and the presence of vegetation reduce the potential for bank erosion. Contaminants in soils along the banks of the LDW could be released directly to sediments via erosion.

Based on a review of oblique aerial photographs, it appears that wharfs have been built into Slip 1 and other areas. Few areas of natural shoreline exist within the LDW. These include <*describe and reference a figure*>.

Atmospheric Deposition: Atmospheric deposition occurs when air pollutants enter the LDW directly. Contaminant loading from atmospheric deposition is also transported via stormwater. Air pollutants may be generated from point or non-point sources. Point sources include industrial facilities, and air pollutants may be generated from painting, sandblasting, loading/unloading of raw materials, and other activities, or through industrial smokestacks. Non-point sources include dispersed sources such as vehicle emissions, aircraft exhaust, and off-gassing and degradation of common materials such as plastics and building materials. Air pollutants may be transported over long distances by wind, and can be deposited to land and water surfaces by precipitation or particle deposition. <*insert number*> facilities within the LDW are currently regulated as point sources of air emissions.

- Strike “Potentially Complete” in the title of Section 2.2.3.3 and do not divide Section 2.2.3.2 and Section 2.2.3.3 based on “incomplete pathways or potentially complete pathways in limited areas.” Put all the ongoing pathways in one section and discuss each one. Because insufficient information is presented here, EPA and Ecology do not agree with the classification of “incomplete” pathways; therefore there is no reason to separate these pathways from “pathways in limited areas.” Discuss them all together. As written, the text seems designed to draw conclusions and set up the arguments that these pathways are not important. Such arguments must be deleted. Absent significant new information, the FS should simply describe the pathways and refer to the RI for specifics.

- The first three paragraphs minimize the impact of current ongoing sources and pathways. This is going to be the biggest challenge to controlling sources & preventing recontamination. Stop qualifying that these are smaller in magnitude than historical releases or are limited to legacy chemicals because the (hypothetical) relative magnitude is practically much less important than evaluating absolute impacts. For example, PCBs are legacy chemicals since the ban but ongoing PCB releases will remain significant into the foreseeable future. State

the source of ongoing contamination and the pathways. Include "building materials" after "old equipment".

- Paragraph 4: The statement about inspection and compliance programs is overly optimistic regarding comprehensiveness and level of control. The inspection and compliance programs monitor but don't necessarily control the handling and disposal of manufacturing waste. There are approximately 6 FTEs doing compliance inspections for approximately 2,500 industrial facilities in the LDW basin. Approximately 40% of businesses inspected should, but do not have, Clean Water Act permits. Facilities that are large quantity generators claim to be small quantity generators, and inspectors are finding facilities that are still illegally dumping waste into storm drains and ditches. Furthermore, while chemical loading from stormwater and CSOs has been greatly reduced because discharge frequency and volume have been reduced, General Industrial Stormwater permitting does not monitor or attempt to control the COCs (including the risk drivers in the waterway) present in discharges.

- Paragraphs 4-7 bounce back and forth between past practices, current operations, CSO's and stormwater. Provide a clear explanation of the various types of pipes that discharge. Explain how CSOs are different from storm drains. Eliminate descriptions of how certain inputs have been greatly reduced. It's either a historical release or a current release, but don't compare past and present unless quantitative data are presented. For example, delete this sentence, "In addition, chemical loading from stormwater and CSOs has been greatly reduced through regulatory programs that require the monitoring and control of discharges that could otherwise enter the LDW" and all other similar statements in the FS.

- Paragraphs 8-10 contain sampling information that may be valuable, but it is described in a confusing way. It says that the storm drain samples were collected, "to understand the nature of potentially ongoing pathways of chemicals to the LDW." This is misleading. This was not done to understand the nature of all pathways; it was done as source tracing by SPU in one specific pathway: municipal storm drains. This just adds to the confusion of this section. First explain all the pathways, and then explain the source tracing.

- Include building materials such as caulk and paint in the description of current PCB sources. Also, commercial "production" was banned, not commercial use. Revise accordingly.

- The last 2 paragraphs in this section are related to what Ecology and the SC Work Group will do and contain factual errors requiring revision. Revise as follows:

  > Ecology is the lead agency for LDW source control. The Lower Duwamish Waterway Source Control Strategy (Ecology 2004) describes the process for identifying source control issues and implementing effective source controls for the LDW. The goal of the strategy is to minimize the potential for recontamination of sediments to levels exceeding the LDW sediment cleanup goals. It is based on the principles of source control for sediment sites described in EPA's Principles for Managing Contaminated Sediment Risks at Hazardous Waste Sites (EPA 2002), and SMS (WAC 173-204). The source control work is identified in a series of detailed, area-specific Source Control Action Plans (SCAPs), which are prioritized to coordinate with sediment cleanups.
  >
  > The purpose of SCAPs is to identify potential contamination sources and the actions necessary to keep sediments from being contaminated again after any

cleanup occurs. The SCAPs document what is known about each source control area, identifies the potential sources of sediment contamination, past clean up actions taken to address them, and actions necessary to achieve adequate source control for an area. The SCAPs also evaluate whether ongoing sources are present that could recontaminate sediments after cleanup.

Ecology divided the LDW drainage basin into 24 source control areas. Ecology is in the process of published SCAPs for each of these areas. Seven of the source control areas are the drainage areas associated with previously identified as EAAs (see Section 2.6) based on sediment contamination.

Source control priorities are divided into four tiers. Tier 1 consists of source control actions associated with the EAAs. Tier 2 consists of source control actions associated with areas where sediment cleanup appears likely to be necessary. Tier 3 consists of source identification and potential source control actions in areas of the LDW that are not identified for cleanup, but where source control may be needed to prevent future contamination. Tier 4 consists of the remaining study area and will be the target of source control work identified by post-cleanup sediment monitoring (Ecology 2004).

105. **Page 2-26, Section 2.2.3.3, Incomplete pathways or potentially complete pathways in limited areas, 2nd bullet below 1st para**: Either include sufficient data that support the statement "elevated concentrations of metals in sediment adjacent to Boeing Plant 2 were not likely associated with groundwater, but more likely associated with erosion of contaminated shoreline fill" or remove it.

106. **Page 2-27, Erosion of Shoreline Banks**: State that this pathway was not addressed in the FS because there is limited bank data. It may have an effect on the size and type of remedial actions on a case by case basis. Figure 2-23 only presents areas as armored or exposed. This is misleading, especially when areas known to require bank removals (Trotsky and T117) are labeled as armored. Areas where debris is present above the elevation constraints in the FS should be noted.

107. **Page 2-27, Section 2.3, Key Observations and Findings from the RI**: Many of these statements need to be modified to address our comments on the Executive Summary and our comments on the draft Remedial Investigation Report.

108. **Page 2-28, Section 2.3, continued bullet from previous page**: Comparison of dioxin data to "greater Seattle urban environment" is inappropriate. Delete last sentence or at least the last part of it. Compare to background values.

109. **Page 2-28, Section 2.3, 2nd bullet, last sentence:** Define the dimensions/size of the "small spatial scales" mentioned in this sentence.

110. **Page 2-28, Section 2.3, 4th bullet, first sentence:** Quantify the period "over time" mentioned in this sentence. Will this be 5 years, 1 decade, etc.?

111. **Page 2-29, Section 2.4.1.1, Grain Size Composition and Total Organic Carbon, 2nd para, 1st sentence:** Define terms used in Figure 2-17. Since the TOC is generally not very high, it is likely this material is dominantly inorganic silt.

112. **Page 2-29, section 2.4.1.1, Grain Size Composition and Total Organic Carbon:** The text should address uncertainty in interpolating composition based on limited cores.

113. **Page 2-33, Section 2.4.2.1 Navigation Channel**: Text states that navigation channel material in the turning basin consists of fine to medium grained sand"... Fig 2-18 show the surface as mostly silt and clay. Clarify this discrepancy.

114. **Page 2-35, Section 2.4.2.3, Contaminated Sediment Dredging and Capping with Clean Material, 4th bullet**: Provide a reference for this information.

115. **Page 2-40, Section 2.4.6, Vessel Traffic Patterns**: This analysis does not indicate whether multiple vessels transit during one bridge opening. As presented, it's unclear how two bridge openings occurring within an hour everyday equates to the conclusion that "cumulative scour potential is expected to be minimal."

116. **Page 2-42 – 43, Section 2.5, Recent Data and Application in the FS:** It is not clear which datasets are being used in which analysis (RI vs FS dataset). Section 2 indicates that the FS dataset is only used for specific evaluations. Section 6 suggests it was used for temporal trend analysis and selection of remedies. Was it used in the derivation of SMAs, in the BCM input, or in the alternative design, or only to check that the analysis using the RI dataset didn't change? If only used in verification, this process must be explicitly addressed in every analysis that is potentially relevant. Include a figure showing RI and post-RI datasets and note which ones were used in the various sections of the FS where data analysis is being discussed.

In the agencies' June 30, 2008 comments on the Milestone 3 data package, we provided a list of data sets to be used in the FS. Some of these are listed in this section, but the data produced by Ecology or under Ecology oversight at Trotsky and PACAAR are not (however they do appear in Table 2-11). Ensure the text is consistent with the table and that all of the data sets listed in the agencies' previous letter were included. See also comments on Section 2.6.5; T-117 sediment data have been available since fall 2008 and should be included in the FS dataset. Other data, including upstream bedded and suspended sediment, must be included in the final FS dataset.

117. **Page 2-43, Section 2.6, Status of Early Action Areas:** It is not clear what the purpose of this section is. Please include a couple of sentences describing the purpose. Include other upland actions/studies being implemented under MTCA here or in a separate section. Consistent with earlier comments on EAAs, clarify that there are not 7 EAAs. Windward's 2003 report identified 7 areas that might be candidates for early action – there are only 5 EAAs where investigation or cleanup work has occurred. Clarify that Duwamish/Diagonal and Norfolk cleanups had limited or no EPA or Ecology oversight. The revised FS must evaluate the actions taken or planned at the EAAs and state whether they are consistent with the cleanup alternatives being proposed in the FS.

Shouldn't the status of all relevant remedial actions in the LDW be summarized here (e.g., MTCA orders)? The status should include associated upland cleanups (many of which need more information). For ease of reference, include the EAA number next to the subheading (e.g., EAA #2 and EAA #6).

118. **Page 2-44, Section 2.6.1, Duwamish/Diagonal and Section 2.6.2, Norfolk**: For Duwamish/Diagonal, clarify in this section that pre-cleanup sediment data are used in the RI

data set. For both Duwamish/Diagonal and Norfolk, state that neither cleanup addressed all of the contamination present in these areas.

119. **Page 2-45, Section 2.6.4, Boeing Plant 2/Jorgensen Forge**, 2nd paragraph; Edit as follows: " . . . .cleaned as needed and **some** soils in the area . . . There have also been **some** hot spot removals . ..Finally, Boeing has conducted **an evaluation of alternatives** ~~design work~~ for a sediment removal project . . ."

120. **Page 2-46, Section 2.6.5, Terminal 117:** Edit as follows:
First paragraph: "~~A portion of~~ The Terminal 117 upland Area at RM 3.5W was historically used for the manufacture **and storage of** asphalt products . . . Asphalt manufacturing operations ~~are suspected to have included the use of~~ used waste electrical equipment oils, as fuel oil during the 1970s, which ~~were believed to have~~ contained PCBs."

Third paragraph, second sentence: "In addition, PCB-contaminated areas in the rights-of-way have been paved, and a ~~new~~ **temporary** stormwater collection system was installed that conveys most runoff from the roadways adjacent to Terminal 117 to the combined sewer system.

Fifth paragraph, second sentence: Additional sediment data . . . ~~are not yet available for the FS data set~~ **have been available since Fall 2008**."

121. **Page 2-46, RM 2.2 and 3.8 EAAs:** Per previous comments, delete this section.

122. **Table 2-1, last row on page 2-47**: The smelter on Harbor Island was a secondary lead smelter, not a copper smelter. For Renton WW treatment plant ceasing operations, seems like the notes and event should be reversed.

123. **Page 2-49, Table 2-2**: UCLs and SWUCLs should be presented in this table. This comment is also relevant to Table 2-3.

124. **Page 2-50, Table 2-3**: There should be some summary of human health risks associated with sediments. What are the current risks associated with SWUCL 95 sediment concentrations of various contaminants for different exposure scenarios and areas? This information could be presented here on in Section 3.

125. **Figure 2-3**: Provide more information on the figure about how "easy" and "difficult" access are defined.

126. **Figure 2-7 (and other applicable figures):** As noted in general comments, figures should show a distinction between cleanup area boundaries that are part of completed cleanups (the NRDA actions) or agency-approved designs (Slip 4) versus all other boundaries, which should be noted as approximate. We suggest that a note be included on this and similar figures explaining the discrepancy between the approved boundary for Slip 4 and the IDW interpolation showing potential contamination beyond the boundary. (This does not apply to other EAAs where cleanup boundaries have not been approved.) Also, please check the Sip 4 boundaries against design documents – it appears to be incorrect on FS figures. Remove the RM 2.2 and 3.8 EAAs.

127. **Figures 2 -9 and beyond, general comment**: To the extent possible (unless it would make the figures too difficult to read) outfalls should be shown on all maps showing contaminant distributions.

128. **Figure 2-13 a-e**: It would be helpful to have leader lines from station locations to contaminant depth profiles. Also, please make these figures 11x17 so they are readable.

129. **Figure 2-14**: Diagrams for source control CSM are flawed because "non-point" and "point" comparison seems to be based on the idea that if a source can't be (or hasn't been) conveniently identified/controlled is, by default, it is a "non-point" source. This is not true. Most of the activities or sources labeled as "historic" on these diagrams still happen today. Very few no longer occur at all, many have changed with regulation, but they have not turned into "non-point" sources. Likewise, "ongoing" is not exclusive to "historic." All of the activities/sources currently shown as "historic" on all subsets of Figure 2-14 should also be listed as "ongoing," the following sources should also be added: historic building materials (caulks, paints, roofing reaching via stormwater); historic releases/spills to soil & groundwater pathways; uncharacterized fill & bank materials; industrial stormwater discharges; waterway use; municipal stormwater and CSO discharges.

130. **Figure 2-14:** These CSM graph**s** show a direct link from sediments to organisms. This is too simplistic. The CSM must provide information about what exposures are driving organism uptake; typically it is diet or water. The food web model must be more fully discussed in this section or in Section 3, along with a better CSM showing movement of contaminants through the food web.

131. **Figure 2-15:** The left-hand figure should remove RM 2.2 and 3.8 so that it matches up with the EAAs included in Alternative 1. The right-hand figure is out of date and should be removed, it's unclear why both this figure and 2-16 are needed. Also note that the label on the figure on the right side should be changed from "Ecology in-water areas for source control." Ecology does not have in-water areas. Source control areas are defined by the upland drainage. Each drainage area has a boundary adjacent to the LDW.

132. **Figure 2-16**: This figure shown is out of date and needs to be updated. Also, the map shows only the boundary of the source control areas at the point where they are adjacent to the LDW rather than showing the entire source control area. LDWG needs to work with Ecology to generate a map that shows the whole SC area.

133. **Figure 2-17**: Legend should be revised to show what criteria were used in determining categories (percent sand as example).

134. **Figure 2-17:** Separate out labeling of debris vs odor/sheen as the presence of these features have different implications for alternatives.

135. **Figure 2-22:** This figure is incomplete – LDWG needs to discuss with the agencies additional items that should be included. Cable areas are shown to cover large areas, is this correct? Please clarify the type of cable present and the source of the location information.

Section 3, Summary of Site Risks

136. **Page 3-1, Sections 3 and 3.1**: Minor – Sect 3, Para 2 lists exposure pathways that are not repeated. Sect 3.1 para 1 says "sediment-associated." Expand to say what is excluded as well as what sediment-associated means with respect to water and food.

137. **Page 3-2, Section 3.1.1:** Analysis of chemicals without SMS numerical criteria (such as those listed in the DMMP) should be included here briefly.

138. **Page 3-3, Section 3.1.1**: Provide a figure showing the referenced areas of the LDW (75% less than SQS; 18% >SQS, <CSL; 7% >CSL). Discuss in the text the geospatial nature of the exceedances (in addition to the frequency). Same comment for bullet 2 on page 3-9.

139. **Page 3-4, Section 3.1.2, 1st full paragraph on page**: Suggest stating as follows: "… risks to ecological receptors associated with ***tissue burdens or*** dietary exposure…"

140. **Page 3-5, Section 3.2.1**: Revise as follows: "The tribal seafood consumption rates ~~represent relatively high rates~~ **of resident seafood are likely overestimates of current use. However,** ~~that might~~ **such rates may** be achieved in the LDW at some future time. **The rates used are generally similar to those seen for other populations that consume large quantities of seafood in the absence of seafood consumption health warnings.**"

This section should define the utility of the different seafood consumption risk estimates:

1) RME used in risk analysis and decision making.
2) Average and upper bound are used in determining the range of risks.
3) Unit risk estimates are useful in risk communication and to allow individuals to determine what their risk might be.

Change "conservative" to "health protective" throughout the FS when conservative is used in the context of the HHRA findings.

141. **Page 3-6, Section 3.2.1, 2nd paragraph:** Change "3 x 10 3" to "3 x 10^3"

142. **Page 3-6, Section 3.2.2, Risks Associated with Direct Sediment Contact**: While it is true that direct contact risks are lower than seafood consumption risks, they are still significant. This discussion should focus on how significant the risks are relative to regulatory risk ranges.

Section 4, Remedial Action Objectives and Preliminary Remediation Goals

143. **RAO Language**: Revise RAOs to be consistent with direction in our June 5, 2007 comment letter on LDWG's draft Remedial Action Objectives (RAOs) memorandum and in several subsequent comment letters. Amend RAOs 1 and 4 to include the need to reduce COC concentrations in surface water, as well as sediments, the cleanup objective is to meet ARARs and protective levels. Remove the word "surface" in reference to sediments.

144. **Derivation of Background Values**: As discussed in the general comments, the background section must be completely rewritten. Delete text regarding urban to rural gradients leading to an underestimate of background. This should be accounted for in the

lateral loading portion of the BCM model. Rather than provide page-specific comments, we have provided general comments to guide the redrafting of this section. We first provide our determination of which data sets can be used, and then general comments on the FS background section, including our rationale for rejecting some of the proposed data sets. The agencies propose to work with LDWG in a collaborative fashion to determine the appropriate statistics to use to derive background numbers from these data sets. However, if we find that we are not able to reach agreement within a few months after receipt of these comments, the agencies will derive the background values and provide them to LDWG to ensure that this issue is resolved in time to be incorporated into the next draft of the FS.

145. **Natural Background:** This section must describe MTCA requirements regarding natural background. It must then provide natural background values.

Because the 2008 EPA OSV Bold survey was a robust study and did not have the problems associated with the previous studies (high detection levels, multiple study purposes and areas, varying data quality), use the Bold survey data as the primary data set for defining natural background, except as noted below. The FS mistakenly states that the Bold survey includes only PCB and dioxin/furan data. All SMS chemicals were analyzed. For arsenic, development of a natural background value must include consideration that the Bold survey sampling locations were not screened for location relative to arsenic smelters in Everett, Tacoma, or elsewhere. Arsenic natural background values should be derived from the Puget Sound deep core data representative of sediments deposited prior to the start of smelter activities in the region. For PCBs, use congener data from the Bold survey because the Aroclor data is all non detect.

The following additional data sets can be included in the FS as supporting information for natural background (i.e., may be presented in the FS but not used to calculate background values):

- Data from the four cores collected at the Howard Hanson Dam.
- The historical non-urban bay data currently provided in the FS.

146. **Anthropogenic Background:** The following data sets may be used to derive anthropogenic background values for the FS:

- 2008 upstream data collected by Ecology (including the recently analyzed archived samples). Outlier value of 770 ug/kg PCBs must be removed because it appears to be related to an outfall. .
- Suspended sediment data from Ecology 2008 study. However, we must discuss how this data set is used. Because these represent loading values during various flow and rainfall events, they cannot be simply averaged to derive a background value.

The agencies are also willing to consider use of Corps of Engineers turning basin sampling data (in DAIS database) for RM 4.5 – 4.75 only and excluding 1989 data, if it can be shown that these data are not influenced by sources.

The following additional data sets can be included in the FS as supporting information for anthropogenic background:

- Upstream bedded sediment data collected prior to the 2008 Ecology study
- Upstream suspended sediment data derived from water quality data (which must be used with caution and appropriate qualification, and the arsenic data should not be used)

- Regional water body data presented in the FS excluding inner Elliot Bay. A note should be included that these data have not been screened to exclude local sources.
- Data from Ecology EAP study in Lake Washington, to be provided by Ecology.

Green/Duwamish River Upstream Water Quality: Data may be used as supporting information, but the FS must state that, due to the assumption that all contaminants measured in whole water samples are attached to particles, these data likely overestimate the actual incoming load. As noted regarding the Ecology suspended sediment data, loading values must be used with caution and with appropriate qualification in discussions of background values.

Upper Reach LDW Sediment (RM 4.0 – RM 4.75): Surface sediment values from RM 4.0 – 4.75 may not be used as background values or supporting information. The argument that this area may be used as background because it contains none of the worst hot spots that are targeted for immediate action is not acceptable. Any current or historical source of contamination, regardless of whether it is considered "high priority," would make this area ineligible for use as a background location. There are many historical and current sources of contamination in this area, for example, Rhone-Poulenc, several outfalls at the head of Slip 6, the Boeing Developmental Center, and the upstream Norfolk CSO. Delete this entire subsection.

USACE Core Data from the Navigation Channel: These data may not be used for the same reasons described for the RM 4.0 – 4.75 surface sediment data set. As noted above, the agencies are willing to discuss the potential use of RM 4.5 – 4.75 core data, because contaminant concentrations are lower than those collected further downstream, if it can be shown that these data are not influence by in-waterway sources.

"Adjustments" for TOC and percent fines: Such adjustments, as shown in Figures 4-10, 12, and 14, are unjustified and must be removed from the FS. The positive correlation between PCBs and TOC was not strong (with an $r^2 = 0.4$). The correlation coefficients touted as being significant in Table 4-15 are less than those of the regression relationships between Mya arenaria As_i / cPAH tissue and sediment concentrations, which LDWG argued are unacceptably poor. The reference in the text that the distribution of TOC/fines in the upstream data is different/lower than that in LDW site sediments, that COC concentrations are generally correlated with increasing TOC/fines, and that low TOC/fines may bias the COCs in the upstream sediment data somewhat low is sufficient. No "adjustment" needed.

Other Regional Data: As we have stated in numerous previous comments, inner Elliott Bay data must be excluded since it receives inputs from the Lower Duwamish site. For the rest of the data set, note that the data screening process was minimal (removed only data from clean-ups and DMMP site monitoring) and likely includes proximity to other point sources that are not indicative of area background. In addition, any discussions about arsenic in regional datasets should consider to what degree arsenic concentrations were influenced by regional smelters.

In addition, when regional data sets are specified, there should be some discussion as to whether or not the data were collected using biased or unbiased sampling. If samples were collected in a biased fashion, it is not legitimate to assign distributions to the data sets.

"Greater Seattle Area Surface Sediment Samples:" Do not present this data set (even with the three samples with highest dioxins excluded) as a line of evidence for background.

These values would be appropriate to use in comparison to lateral loading estimates for what contaminant concentrations might be expected in close proximity to outfalls. In addition to all of the other concerns the agencies have expressed previously about inappropriateness of using the "greater Seattle" dataset to derive background values for the Duwamish, it should be noted that the TOC values associated with all but one of these eight data points were substantially higher (4.64 – 16.4%) than typically observed on the LDW. As a matter of consistency, LDWG's positions on TOC and percent fines make these data of questionable relevance to the LDW. The only greater Seattle sample with TOC similar to the LDW is LU-SS9a (2.66%) which happened to have the lowest TEQ (5.46 pptr) measured in that study.

147. **Page 4-1, Section 4:** What is the basis for asserting that surface water meets WQ standards? Strike "potentially" in the 2nd paragraph and use "final cleanup decision" rather than "Record of Decision" in the 4th paragraph (and elsewhere).

148. **Page 4-2, Section 4.1.1, Remedial Action Objectives, 2nd paragraph**: MTCA references are missing. Also, add a discussion of MTCA requirements for addressing human health risk.

149. **Page 4-4, Section 4.1.1:** For readers not familiar with the SMS, include a brief note as to why cleanup to SMS standards meets RAO 3.

150. **Page 4-5, Section 4.1.2:** This section has many problems and will need to be revised in consultation with Ecology and by referring to Ecology's SC Strategy, SC Status reports, and information in the SCAPs. The primary issue is that Ecology is the lead Source Control agency, so LDWG needs to cite Ecology documents rather than constructing alternative text when discussing what SC will and will not do. Delete footnote 2.

151. **Page 4-7, section 4.2, 3rd paragraph, last two sentences:** Because this is a joint MTCA/CERCLA order, MTCA and SMS are governing regulations. Revise the text to read, "Because this FS is being conducted under a joint CERCLA and MTCA order, MTCA and the SMS are evaluated as governing requirements. Applicable or relevant and appropriate provisions of MTCA and the SMS are considered to be ARARs for CERCLA, as well.

152. **Section 4.2, ARARs**:

- Don't separate ARARs into chemical, action, location-specific. EPA has been moving away from this because people often find the distinctions confusing.
- Revise this section to clarify that the more stringent of Federal Ambient Water Quality criteria or State Water Quality Standards are ARARs (chronic as well as acute, freshwater as well as marine), which this cleanup must meet at the completion of remedial action pursuant to Section 121(d)(2)(A) of CERCLA. Text in Sections 9 and 10 should be revised to discuss and compare whether/how each alternative can meet these ARARs.

153. **Page 4-9, Section 4.2.2**, **Action-Specific Requirements:**

- 4th paragraph: Strike "led by Ecology." Revise paragraph to state that state and federal water quality criteria are ARARs for the cleanup as a whole.
- 5th paragraph: Delete paragraph.

154. **Page 4-11, Section 4.3.2, Role of RBTCs:** Revise to include MTCA requirement to meet 10^{-5} excess cancer risk for all chemicals, and 10^{-6} for individual chemicals. State that federal and more stringent state water quality criteria must also be met.

155. **Page 4-11 – 13, Section 4.3.3, Role of Background**: The FS must be revised to address MTCA and SMS requirements. The text does not adequately support the conclusion that attainment of natural background is impractical and the subsequent focus on attainment of anthropogenic background as attainment of RAOs. While the text is correct that CERCLA cleanups typically do not clean up below anthropogenic background, CERCLA cleanups still need to be protective and attain ARARs, including specifically in this instance stricter MTCA requirements in Washington,. EPA's 2002 "Role of Background in the CERCLA Cleanup Program" Guidance states that "In the case where a law or regulation is determined to be an ARAR and it requires cleanup to background levels, the ARAR would normally apply and be incorporated into the Record of Decision,." See Appendix J comments with respect to providing a discussion of setting cleanup standards in consideration of background. Also, include reference to WAC 173-340-110(2) in discussing alternatives.

156. **Page 4-13, Section 4.3.4 Natural Background in Sediment**: The first sentence in the 4th paragraph states: "Sediment data for dioxins/furans were not available from the 10 reference areas…." This may seem academic but sediment data <u>are</u> available from several of the reference areas due to the Bold sampling (which included Carr, Dabob, and Samish Bays). The first paragraph at the top of page 4-14 appears to be a better version of the Bold data description at the bottom of page 4-13; delete the latter. Revise this paragraph to appropriately describe the Bold data and reference information available.

157. **Page 4-15, Section 4.3.4.4**: Indicate that the TEQ is mammalian diet TEFs applied to sediment. Explain whether there are any issues associated with applying mammalian dietary TEFs to sediment dry wt concentrations. There probably are not big issues associated with developing background, but the uncertainties underlying TEQs should be explained here or elsewhere in the FS.

158. **Page 4-18, Section 4.3.5.2, Upstream Surface Sediment Quality**: Last paragraph on page and Table 4-15 state that there is a positive correlation between TOC and percent fines and concentrations of COCs. Provide plots of COCs vs TOC and percent fines for our 4 risk driver COCs.

159. **Page 4-20 (DAIS core description/justification), 3rd paragraph**: Although previous comments note that these data should not be used, for information purposes, this section contains several inaccuracies. For example, it is incorrect that all samples in the RM 4-4.75 area have passed for DMMP suitability. DMMUs in adjacent to and south of Slip 6 have failed in past testing (1989, 1995, 1996). Explain the basis of the statement that the lowest horizons may contain pre-industrial sediments. Neither the Corps or EPA agree with this statement.

160. **Page 4-24, Section 4.3.6.1, Preliminary Evaluation of Anthropogenic Background:** Use ProUCL for all FS statistical evaluations.

161. **Page 4-24, Section 4.3.6, Estimates of Anthropogenic Background for Use in the FS:** Some discussion should be included regarding whether natural and anthropogenic background values are expected to change over time. Are land use changes, site cleanup, urbanization, etc. expected to significantly affect background values?

162. **Page 4-26, paragraph 2**: Minor – References are a mix of date and alphabetical order.

163. **Page 4-30, Section 4.3.6.1, Dioxin/Furans:** Summary of DMMP data is confusing relative to which averages represent on-site versus off-site concentrations. Why are the 2005 and 2007 Elliott Bay site data presented separately? Why are Anderson-Ketron data presented but none of the other data from the other disposal sites?

Other data discussed on this page is provided without context or justification as to why it's relevant or helpful for understanding anthropogenic background. The summary of Ecology's study of dioxin in WA State surface soils appears to indicate that soils from the Seattle area have mean and median dioxin concentrations similar to those observed upstream of RM 5.0. Why would typical urban Seattle soil have lower dioxin concentrations than typical urban sediments?

164. **Page 4-33, section 4.4:** The use of indicator hazardous substances (under MTCA) appears to coincide with the definition of "risk drivers" and should be introduced here.

165. **Page 4-35, Table 4-1**: Update this table based on the SC status report that was published July 2009.

166. **Page 4-66**: The 95% UCL for arsenic for the RI data and the mean are the same value, 10. This appears to be an error.

167. **Page 4-73, Table 4-31**: This table is organized around human health (HH) exposure units but also evaluates site-wide ecological effects. Revise to clarify. We suggest dividing vertically within the table and putting in sub headings indicating HH & Eco and HH only, or, moving the Human Seafood Consumption next to the Direct Contact and putting the Eco & HH subheadings in horizontally.

168. **Tables 4-2 – 4-4**: These tables contain many errors and reflect a significant misunderstanding of CERCLA ARARs. A few examples are noted below. Either meet with the agencies to discuss needed revisions, or have attorneys rather than technical consultants make revisions, or both.
- ARARs and TBCs should be listed separately
- Add federal water quality criteria for protection of human and ecological health
- NEPA is not an ARAR
- Aquatic Land Management Act is not an ARAR
- Why are RCRA and/or State Dangerous Waste regulations listed as only applicable within the floodplain?

169. **Tables 4-6 through 4-9**: The assignment of data distributions requires justification beyond a best-fit analysis by ProUCL.

170. **Table 4-10**: Provide the number of detected values for PCBs in the Green River (Ft. Dent) and Duwamish River (Marginal Way) datasets.

171. **Table 4-11**: Issues with methodology, representativeness and comparability need to be addressed.

172. **Table 4-15**: This is difficult to interpret and requires additional explanation in both the text and in footnotes. We anticipate that this will be addressed when revising Sections 4.3.4 and 4.3.5.

173. **Table 4-20:** This table appears to lack units and any notes to make it useful in any way. Even the title is indecipherable.

174. **Table 4-23**: It is not clear that this table is complete. Ecology may provide additional references during the revision of the background analysis.

175. **Table 4-28**: The footnotes for the Regional/National data provided in Table 4-28 are mixed up, making it difficult to determine the source of information. For example, what is the difference between the Elliott Bay disposal site monitoring data (cited as Hoffman 2008 with n=17) and the Elliott Bay data on the next line (n=11)? Is the latter from the EIM data base (as is the case for Tables 4-26 and 4-24)? If so, there is no footnote explaining how/if this data was screened. Furthermore, the screen applied to the PSAMP 2008 monitoring data from Elliott Bay which excludes only samples less than 250 ft from the shore is not protective enough to minimize the potential for point source influences on that data set. The resulting data set includes two values in the 50-100 pptr TEQ range, while the rest of the data ranges from 1.3 - 8.5 pptr.

176. **Table 4-30:** Revise RLs for contaminants analyzed by method 8270-SIM. Lower RLs can be achieved by this method.

177. **Figure 4-10 (and similar figures for other contaminants)**: These figures must be revised to include only data sets considered acceptable for deriving background values, or clearly separate these from other data sets being included for informational purposes. It's not clear what the boxes around the symbols are meant to do. They don't appear to represent the maximum values.

Section 5, Modeling and Analysis of Sediment Movement and Recovery Potential

178. **BCM Chemical Input Parameters:** BCM input parameters must be revised as discussed below. The agencies disagree that 90%ile values are an appropriate statistic for BCM input values. As with the background values, the agencies are willing to work with LDWG in a collaborative fashion to derive these values, but if we find that we are not able to reach agreement within a few months after receipt of these comments, the agencies will derive the BCM input values and provide them to LDWG

- **Green/Duwamish River Inflow:** These values should be based on the same data sets used for anthropogenic background, as discussed in comments on the previous section. We recommend discussing with the STM modeling group how contaminant concentrations from Ecology's suspended sediment study should be used as input values to the BCM model.
- **Lateral Inflow:** There should be more discussion in the FS that lack of information on lateral loads, including future inputs from storm drains and CSOs after source control implementation, likely represent a large source of uncertainty in the BCM analysis. The sediment trap and in-line solids samples taken by SPU were not sampled or analyzed for the purposes of lateral loading, so the use of this data for this purpose should be carefully examined. As has been stated previously (see our August 5, 2008 memorandum), and in

our general comments, we view lateral load inputs as highly uncertain for several reasons, including:

- Only stormwater is considered in lateral load estimates. Contaminated banks and seeps may also contribute to lateral loads – these are not accounted for.
- No data has been collected with which to estimate point loads from outfalls, CSOs, seeps or banks. Note that this type of information will be needed in remedial design and long-term monitoring phases to ensure that sources have been sufficiently controlled to start remedial action, and that source control measures continue to be effective post-cleanup.
- Aggregating pipes and assuming all lateral loads are the same may be plausible for theoretical waterway-wide predictions, but it not only doesn't comport with physical reality, it provides no useful information about inputs to particular SMAs where remedial decision making and implementation will occur. We understand the need for simplifying assumptions such as this, but resulting predictions need to be appropriately caveated. Instead, the FS considers the predictions as the basis of subsequent decisions.
- All lateral loading information is based on current data, and does not attempt to project future conditions after source control measures are considered sufficient to start remedial action.

Although the current lateral loading methodology appears generally sufficient for a system-wide understanding of this type of loading, we continue to emphasize that it will require refinement during the chemical loading analysis if BCM results are to be used on a sediment management area-specific basis. More refined area-specific assessments will be needed in the areas near outfalls if MNR is to be considered in these areas.

- **Post-Remedy Bed Replacement Values**: These values should reflect a combination of background values (the agencies anticipate specifying that any capping/ENR materials would be at least as clean as LDW background) and the surrounding unremediated sediments, assuming some mixing during remediation. Recommend that the post-remedy concentrations be remediation technology specific; clearly capping will give a different post-remediation surface sediment concentration than dredging.

179. **BCM uncertainty**: There are several additional areas of uncertainty in the BCM results that should be explored more in the FS to provide a better understanding of the implications of these uncertainties in the evaluation of alternatives. Resolving this uncertainty can be done by either additional BCM runs or being more conservative in interpretation of model results, as discussed below and in the general comments:

- **Application of chemistry to grain size classes:** As noted in previous comment letters, LDWG's proposed approach of assigning a load chemistry value equally for all grain size classes conflicts with the wealth of literature showing higher contaminant concentrations associated with smaller sediment grain size. Section 5.3.4 indicates that the BCM could be used to evaluate this impact, but a sensitivity analysis showing the effect of varying assumptions about chemical loading on grain sizes was not conducted. It is important to evaluate the impact of this assumption on resultant bed chemistry, especially since the STM predicts low trapping efficiency of Class 1 sediment and high trapping efficiency for coarser sediments. Additional BCM runs must be conducted to examine the impacts of grain size fractionation. Then, the justification of the class size assumption (including discussion of the recent Ecology suspended sediment sampling) can be made.

- **Tracking Erosion depths**: The STM provides information on temporally small-scale events (for example, deep erosion) that should be used to define final chemical distribution scenarios. The methods proposed in the draft BCM mechanics memo indicate that it will use final bed composition from three time steps in the STM (5, 10 and 30 year). This is a suitable approach for grain size. However, chemical composition is a function of ALL erosion and deposition events that have occurred during the model simulation. This is not currently being tracked in the BCM; i.e., does the chemical concentration associated with each class of suspended load and initial bed sediment evolve with erosion/deposition processes? This is important when infilling or erosion is greater than 10 cm (or surface layer depth). Grid cells where infilling or erosion depth is greater than 10 cm at any time must be tracked using STM output since changes in this zone indicate that application of existing bed chemistry is no longer appropriate for the area. Although it would be ideal to then replace the bed chemistry with values representing a deeper interval, this information is not readily available throughout the LDW. Therefore, flagging impacted grid cells and evaluating BCM results with caution in those areas may be the only way that erosion deeper than the depth of proposed natural recovery can be tracked and included in the MNR evaluation.
- **Movement of existing sediments**: The BCM does not currently track contaminated sediments coming in from in adjacent cells in the BCM. General analysis was done on a reach basis, but this did not include evaluation of chemistry. Assuming the existing bed chemistry input stays the same is a gross estimate, at best. One would think that future predictions of Cbed would contain input from adjacent cells (because sediments move). Indeed, Appendix C states "In its current form, the BCM does not specifically account for the potential movement (i.e., erosion and redeposition) of bed sediment throughout the study area." This could potentially significantly impact accuracy of BCM predictions of contaminant concentrations. The BCM would require reworking to allow this potentially significant impact to be tracked.
- **Flow rates**: Add a hydrograph of flow rates to help show what was assumed for the time frames evaluated. Most importantly, discuss what assumptions were used for the 10 year time frame. Once presented, the implications of potential changes in flow should be qualitatively discussed. This could in part be examined by looking at the STM bounding runs, as discussed in the specific comments below.
- **Bathymetry changes**: Due to the coupling method for the hydrodynamic model and the STM, changes in bathymetry are not tracked in the current STM. The impacts of this with respect to the BCM must be discussed. Include discussion of impacts to alternative analysis for alternatives with dredging and no backfilling. In addition, changes in bathymetry caused by changes in federal or non-federal navigation dredging practices should be discussed. Examples of possible changes could be impacts on loading downstream from either increases in current footprint of the USACE federal navigation channel dredging (causing a larger sediment sink) or the cessation of dredging within the same navigation channel (allowing more sediment to move further downstream).
- **Removal of turning basin sediments:** The agencies and LDWG need to discuss the influence of Corps maintenance dredging on the upstream values that should be used in modeling. The majority of sand from upstream will be dredged and removed from the river. Therefore, it will not be part of the long-term chemical balance.
- **Incoming load inputs**: The FS must summarize the major uncertainties associated with the incoming load values, as were evaluated in the STM. Potential reasons for

variations in these loading values based on changes in land use and precipitation changes likely to occur from climate changes should be qualitatively discussed. This discussion must then be framed quantitatively with the bounding runs to be used to evaluate overall uncertainty in sedimentation rates, and effectiveness of MNR.

180. **Use of STM bounding simulations:** The FS is correct that the bounding simulations did not compare as favorably to the data as the final model simulation. However, this statement seems to negate their importance as upper and lower bounds of reasonable model parameterization from an input data standpoint. These bounding simulations are critical to demonstrate model reaction to changes in parameterization that are data-based. The bounding simulations are particularly important when analyzing erosion, for which no validation data exist. The STM workgroup needs to discuss how these bounding runs will be used in the FS. Relating uncertainties based on the bounding simulations to limitation in model application and general uncertainties in recovery time is critical to evaluating success of alternatives.

181. **Clarify STM results**: The STM concludes that "approximately 90% of the total bed area in the LDW receives 10 cm of new sediment within 10 years or less". It is difficult for the reader to understand why, if this is the case, the LDW is still contaminated or why it hasn't been filled in? This simple contrary concept should be explained to readers.

182. **Quantifying Output from LDW:** The FS must include an evaluation of chemical and physical export from the LDW to East and West Waterways and Elliott Bay. This evaluation must be conducted to provide information on the loading of LDW derived sediments to the other waterways. Evaluation of the reduction of this loading from each alternative should also be discussed.

183. **BCM review**: The latest versions of BCM spreadsheet(s) need to be available for agency review.

184. **Page 5-1, Section 5.0, 1st paragraph, 2nd sentence:** Delete parenthetical statement: "(natural recovery potential)".

185. **Page 5-4, Section 5.1.1**, **Composition and Sources of Sediment Loads:** Since ten years is a more relevant time frame, use this time frame for discussions on sediment loading and composition.

186. **Page 5-4, Section 5.1.1**, **Composition and Sources of Sediment Loads:** Specify how much of the upstream bedload is deposited and captured in TB3. Also, reiterate in this section that the model does not account for mechanical disturbances, waves, *et al.*

187. **Page 5-4, Section 5.1.1, Composition and Sources of Sediment Loads**: Delete the last sentence on page. It cannot be supported solely based on physical composition.

188. **Page 5-4, Section 5.1.1, 3rd paragraph:** According to figure 5-3, reach 3 is net erosional. It has a negative value for the bed source. This should be discussed.

189. **Page 5-5, Section 5.1.3, Scour Potential from High-flow Events**: Delete all text up to the reference for Figure 5-4. Some generalizations are not appropriate and supporting evidence for the statements are presented in later sections of the FS.

190. **Page 5-5, Section 5.1.3**: Describe the areas that show significant erosion potential rather than providing an ambiguous reference to Section 6.

191. **Page 5-5, Section 5.1.3, 1st paragraph**: Subsurface contamination is mentioned repeatedly. What about contaminated sediment in the surface layer? It is stated that "most areas with significant subsurface contamination do not show significant erosion potential beyond a few centimeters depth during high-flow events." Is the sediment in the upper few centimeters in these areas contaminated, and if so, what is the fate of this eroded contaminated sediment, and more importantly, what are the concentrations of COCs on this eroded sediment?

192. **Page 5-7, Section 5.2.1, The BCM Calculation, 2nd paragraph:** Does this mean the concentration represents a multi-year time period or that the same average is used for multiple years?

193. **Page 5-8, Section 5.2.2, BCM Assumptions:** Justification for the first bullet has not been provided. As discussed in Appendix F, and in Section 5 general comments, not allowing for changes in existing bed chemistry is a major source of uncertainty. Worst case scenarios of transport with applicable chemistry must be examined before this assumption could be acceptable.

194. **Page 5-7, Section 5.2.2:**The assumption that subsurface sediments are "generally" not exposed needs to be supported with STM modeling (i.e., model the distribution of surface and subsurface contamination in a high scour potential area such as RM 3.6 and report the findings). In addition, an assessment of the impact of violating the specified assumptions is needed in the text.

195. **Page 5-8, Section 5.2.2, first bullet (beginning with "All COCs are conservative"):** Quantify the high bias or delete the term. A "high bias" implies significance. It is likely that the bias produced is second order and therefore not significant or worth declaring as a "high bias." Just note that COCs are modeled as conservative materials. See also general comments – this assumption likely results in an underestimate of risk.

196. **Page 5-8, Section 5.2.2, 2nd bullet:** "Expected" is different than model assumptions. Explain (with specifics) and, if possible, quantify how non-measured point sources are treated in the model. Provide references to more details on source assumptions for non-measured outfalls. This should be provided in Appendix C

197. **Page 5-8, Section 5.2.2, BCM Assumptions, last bullet on page:** See general comments about BAZ.

198. **Page 5-8, Section 5.2.2, 3rd bullet: Page 5-8, Section 5.2.2, 3rd bullet:** It may be true that model assumptions are conservative. However, if it is a second order effect (it probably is unless the model is ignoring first order processes), then the text should not state that it "slows recovery estimates". It would be clearer if the text explicitly connects the conservativism to recovery (i.e. the assumption will not overpredict recovery estimates).

199. **Page 5-8, Section 5.2.2, 3rd bullet:** Relate the BCM assumption to how the composition was calculated in the STM. Our understanding is the STM tracked changes on discretized 5 cm bed layers. How was this translated into a 10 cm interval, were the two layers averaged?

200. **Page 5-10, Section 5.3.2.2, Chemical Concentrations Associated with Lateral Source Sediments:** Text needs to discuss ramifications of flow-weighting the data.

201. **Page 5-11, Section 5.2.3.3, Chemical Concentrations of Existing Bed Sediments:** Explain how the sediment toxicity hits trumping were incorporated into the BCM process. Was the chemistry value deleted?

202. **Page 5-13, Section 5.2.4, Inputs and Application of the BCM for Other Point-Based Chemicals:** Are all chemicals considered to be in particulate form, as with the major COCs? If so, this should be stated as an assumption and Section 5.2.2 reviewed to confirm that the existing BCM assumptions for these compounds are still appropriate.

203. **Page 5-13, Section 5.2.4:** Which chemical exceedance value was used? Was the value for the chemical on the list used or the exceedance value for the chemical that was the maximum value, but not on the list? A comparison of how much greater the exceedance ratio for the actual chemical was compared to the compound used should be conducted.

204. **Page 5-14. Section 5.2.4.1, Recommended Input Values for Representative SMS Chemicals:** Indicate if the areas near the outfalls containing outliers are already defined as sites designated for remediation.

205. **Page 5-16, Section 5.3.1, Propeller-Scour Model of Maneuvering Vessels, 3rd paragraph:** Add that an additional big issue in berthing areas is duration of propeller wash at a specific location. The tugs are at virtual standstill. This may be the largest contributor to scour at berthing areas.

206. **Page 5-17, Section 5.3.1, 1st paragraph:** Add that the heavier material will be more likely to re-settle within the area, while finer-grain material will be more likely to travel greater distance. It would be difficult to quantify the "portion" of sediment that resettles in the same footprint. Depending on the stage of the tide, the portion could vary from a few percent to more than 50 percent. Since most of the contamination is likely associated with fine-grained sediment, this emphasizes the importance of these areas as sources of contaminant loading to other areas.

207. **Page 5-17, Section 5.3.1, 1st paragraph, last sentence:** Revise sentence "which would not necessarily expose buried concentrations" to the less speculative "which could expose buried concentrations."

208. **Page 5-17, Section 5.3.1, 1st paragraph**: Is 10 cm for a single event or over some period of time where several tug scour events may occur? A big issue in berthing areas is cumulative effects of prop scour because the tug or ship location will be similar for multiple scenarios. Assumptions used and potential cumulative effect of multiple events must be explicitly discussed.

209. **Page 5-17, Section 5.3.1, 2nd paragraph:** We must look at a very localized scale here. Samples demonstrating deposition and burial should be taken at very localized areas that are most vulnerable to prop scour before stating that the boat slips are recovering. There is plenty of evidence of localized deep scour in boat slips at other locations. See general comment.

210. **Page 5-17, Section 5.3.2, 1st para, 3rd sentence:** Change the phrase "but some or most of that material is expected to settle in the same area" to "but, depending on the stage of the tide, some of that material may redeposit in the same area."

211. **Page 5-17: Section 5.3.2, Predicting the Applicability of Enhanced Natural Recovery, 1st paragraph**: Remove reference to MNR; this section only applies to ENR.

212. **Page 5-18, Section 5.3.2:** This exploratory analysis is more relevant on an alternatives basis for evaluation of long term effectiveness, as the year 10 values waterway wide would vary based on amount removed or subjected to ENR. In addition, introducing low-OC quarry sand will affect bed concentrations (and SMS compliance) for organic chemicals evaluated on an OC-normalized basis. Recommend deleting this analysis.

213. **Section 5.3.3, Additional STM Special Scenario Runs, general comment:** The scenarios presented are never tied back to chemistry, so any conclusions derived from them are limited. Specifically, for Scenario 1, the impact will vary on an area by area basis. Scenario 3 does not take into consideration potential sources within the turning basin, so conclusions as to the suitability of this area for background must be deleted from this section.

214. **Page 5-19, Section 5.3.3.1, Scenario 1**: Less than 5% of the material is true for some large fraction of the EAA. Quantify how much.

215. **Page 5-19, Section 5.3.3.2, Scenario 2:** Some of the cells in these figures look like the lateral load contribution is greater than summarized in the text. Please clarify

216. **Page 5-20, Section 5.3.3.2**: The final conclusion appears to be that the lateral load contribution may significantly change due to different representation of the load distribution. This statement is somewhat lost in the discussion above. Clarify that a change in contribution of 5% is significant to help the reader understand the importance of these simulations.

217. **Page 5-21, Section 5.3.4, Influence of Grain Size and Organic Carbon on Sediment Chemistry, 2nd paragraph, 3rd sentence:** With reference to Fujisaki et al. (2009), if the sediment that was contained in the near-field deposition from outfalls was fine-grained, i.e., cohesive, it would be incorrect to calculate their settling velocities based on particle size classes. The settling velocities of aggregated cohesive sediment, i.e., flocs, should be determined.

218. **Page 5-23, Section 5.4.1.1: Net Sedimentation Rates:** Note that sedimentation rates were not calculated for some cores. State that one reason for this is the potential that scour interrupted the time-marker signals.

219. **Page 5-23, Section 5.4.1.1:** A problem with comparing "net sedimentation" to the BCM is that the BCM predicts annual sedimentation. The empirical observations could have all occurred during a few years. Discuss the flaws in this comparison.

220. **Page 5-23, Section 5.4.1.1, Net Sedimentation Rates:** The text appears to suggest that the model is universally conservative unless there is a process not accounted for in the model. This is too strong a claim, given the data and model uncertainties. Revise text accordingly.

221. **Page 5-23, Section 5.4.1.2, Vertical PCB Concentrations Trends**: This section must be revised to incorporate agency comments and LDWG revisions to similar text in the RI report.

222. **Page 5-25, Section 5.4.1.3, Chemical Trends at Resampled Surface Sediment Stations:** The analysis presented here and in more detail in Appendix F must include analyses of spatial heterogeneity in nominally co-located samples in order to define what could be considered a meaningful difference among samples.

223. **Page 5-26, Section 5.4.2, Empirical Comparison to Predicted Time Frames**: This analysis and Table 5-6 only discuss locations where decreases were observed. As discussed in comments on Appendix F, a complete analysis of empirical vs predicted time frames must be summarized in this section.

224. **Page 5-26, Section 5.4.2:** The text generally summarizes how areas where the data matched BCM data were handled. Add a discussion on how areas where the empirical data do not match BCM results were handled.

225. **Page 5-26, Section 5.4.2, 1st bullet:** This refers to a bed layer of some thickness, not the entire bed. Explain how the "sediment bed" and "half of the existing bed to be replaced" were defined.

226. **Page 5-26, Section 5.4.2:** Explain how "half-time" was calculated.

227. **Page 5-27, Section 5.5, Uncertainties Related to Predictive Modeling**: Uncertainties associated with erosion depths must also be explicitly discussed.

228. **Page 5-27:** This range of +/-0.5 cm/yr must be compared to average and high values of actual sedimentation per year from the bounding runs, which is on the scale of 1 cm/yr.

229. **Page 5-28, Section 5.3.2, 3rd paragraph:** Half time decreases as net-sedimentation increases. Therefore, shouldn't less than 5-year half life be a result of HIGH sedimentation in the last sentence of this paragraph? Clarify.

230. **Page 5-29, Section 5.5.2, first paragraph:** This paragraph is confusing. Which level of uncertainty is acceptable for the FS? Is it the uncertainty acceptable near locations of model calibration only? Should we use the bounding simulations for areas further away from locations where calibration data exist? Should we use the bounding simulations for areas where calibration data show no trend or are ambiguous? Clarify.

231. **Page 5-29, Section 5.5.3, Confidence Around the BCM Input values**: Add text to explain the uncertainty around assuming a constant load over time. It is not entirely clear how high end and low end values adequately address this uncertainty.

232. **Page 5-30, Section 5.5.3**: The statement that post construction values are always higher than detection limits and natural background is not correct and should be revised. Depending on the time since construction, type of construction, and chemicals of concern, this is not always true. Generally, we are able to achieve very low concentrations at caps, except were there are SC problems.

233. **Page 5-30, Section 5.5.3, 1st paragraph, next to last sentence**: The method used to determine that the "probability that site conditions will produce high-high-high chemical concentrations has less than a 0.001 chance of occurring" must be described in this section, or the statement must be deleted. Is this value produced through some method of probability analysis? If so, please explain. It seems improbable, especially since it is within the range of reasonable parameterization.

234. **Page 5-30, Section 5.5.3, 3rd paragraph, 6th sentence:** Does "equilibrium" refer to chemical equilibrium? The statement that post-construction surface sediments are likely to come quickly into equilibrium with the sediments surrounding the remediated site is an unproved assumption. This statement seems to directly contradict the results of the first STM scenario discussed in Appendix C, Part 4.

235. **Page 5-33, Section 5.5.6.1, Anaerobic Dechlorination:** Provide a time period for this 10% degradation.

236. **Page 5-34, Section 5.5.7, Scour Potential:** Does this 30 cm maximum erosion include the bounding cases or is it just for the best estimate case?

237. **Page 5-35, Section 5.5.7:** It is important to explicitly note that recovery is long-term, while deep erosion may be a short-term event that can expose sub-surface sediments at any time.

238. **Page 5-35, Section 5.5.7:** Is expected recovery due to MNR at the prop-wash location or event-driven dispersion of sub-surface sediments into MNR locations outside the prop-wash influenced areas? Clarify.

239. **Page 5-35, Section 5.6, Modeling Summary and Conclusions, 1st paragraph, last sentence:** Revise the phrase "all of which will likely accelerate chemical recovery" to "all of which will likely result in a slight acceleration of chemical recovery".

240. **Page 5-36, 3rd bullet**: The amount removed annually by dredging must be accounted for. Otherwise the reader will assume that 100,000 MT deposits.

241. **Page 5-37, Section 5.6, 2nd bullet, 2nd sentence:** Explain and justify or remove the statement that "The aging assumptions in the BCM more than compensate for STM/BCM uncertainties."

242. **Page 5-37, Section 5.6, 2nd bullet:** Explain the basis for the conclusion that error is quantitatively small. Has error actually been demonstrated quantitatively to be "small" or is it assumed small because of the strong data set and model validation?

243. **Table 5-2, Summary of Range of Chemical Input Parameters for Risk Drivers**: In addition to the revisions called for in the general comments, check values in this table. There are some data sets that are reported more than once (e.g., LDW RI upstream sediment samples) but different sample counts and values are provided.

244. **Tables 5-3**: Per our previous comments, use only RM 4.5 – 4.75 data. Are there any King County water quality data from upstream stations that can be used for comparison purposes?

245. **Tables 5-5 and 5-6:** Why were early action areas excluded from evaluation of temporal change in "co-located" surface sediment samples? Given the limited amount of data for this evaluation, it would make sense to include all of the data and then evaluate differences.

246. **Figure 5-11:** Is it meaningful to show percentage values for RM 0-4? The legend on this figure is misleading as it should only show the percentages in the Turning Basin that came from RM 0- 4. Please clarify.

247. **Figure 5-13:** Re-label as Figure 5-13 a and b.

Section 6, Sediment Management Areas

248. **Section 6, General Comment**: Overall, the logic for development of SMAs and RALs was difficult to follow. It was also difficult to track how these were developed into the alternatives presented in Section 8. Consider merging Section 6 with at least parts of Section 8, if it will make the transition from SMA and RAL development to alternatives more clear. That the SMAs in the FS are projections anticipated to change in design should permeate every aspect of SMA discussion.

249. **Section 6, General Comment**: There is no discussion of SWAC UCLs in this section. Explain in the text how the concept of UCLs was incorporated into the development of SMAs.

250. **Remedial Action Levels**: The limitations of deriving alternative-specific RALs should be discussed. Typically. cleanup levels are established and alternatives designed to meet them. This FS follows a different paradigm, one that relies heavily on the ability to predict environmental behavior under various alternatives into the future. Given that this understanding is limited and filled with uncertainty, the implications on deriving RALs using future predictions must be clearly and fully explained and related to adaptive management concepts.

251. **Going from AOPCs to SMAs**: The AOPC analysis shows an area of 210 acres (although Table 6-3 says there are only 158 acres in the AOPC - which value is correct?). SMAs encompass 158 acres. If the former AOPC area is correct – what happened to reduce the area from 210 acres to 158? The FS needs to overlay the AOPC layer with the SMA layer so that the volume discrepancy can be reviewed. This area change is much larger than would have been expected given the described process. If this is correct, the process should be revised to make the areas closer.

252. **MNR in SMAs:** Areas with major outfalls or other major sources are not appropriate for MNR unless a near-field modeling effort is conducted specific that outfall or source predicting that cleanup standards can be met through MNR. The sediment transport and BCM models are not sufficiently refined to allow for reliable MNR predictions for these SMAs.

Please clarify in text that Category 2 areas are those in which natural recovery is predicted to occur within 10 yrs independent of construction.

253. **Page 6-1, Section 6.0, 2nd bullet**: State that the purpose of SMAs is to provide spatial estimates to define volumes and areas for the FS, and that they will be redrawn in the design

phase. All statements that SMAs represent areas that can be independently managed must be deleted from the FS (e.g., page 6-2, first full paragraph). See general comments.

254. **Page 6-1, Section 6.0, 3rd bullet**: Delete "might".

255. **Page 6-4, Section 6.1.2.1**: Recommend deleting this section. It is exploratory in nature, and not helpful in review of the SMAs.

256. **Page 6-5, Section 6.1.2.2**: The purpose of this section is not entirely clear since Alternative 5 was designed to achieve background without expanding the footprint. Delete or clarify why this analysis is different.

257. **Page 6-7, Section 6.1.3.1, Dry Weight:** Please make sure it is clear in this and subsequent sections that (for example) the PRG is still 12 mg/kg OC to meet SQS for PCBs, not 240 ppb dw. Clarify that both the dry weight and OC-normalized values will be needed as PRGs, to ensure that both the background-based and SMS-based PRGs are met.

258. **Page 6-8, Section 6.1.3.3, Data Mapping and Interpolation:** Revise text to clarify that the FS is based on the RI. Delete the first sentence, which reads as simply "numerous site investigations" of similar import.

259. **Page 6-9, Section 6.1.3.3, 1st bullet:** This is an inadequate rationale for not considering non-detect data in development of cleanup areas. Even though this has been discussed in other documents, the FS needs to make the case as to why this is appropriate.

260. **Page 6-10, Section 6.2, Mapping SMAs**: See previous comments about descriptions of SMAs and SMA development.

261. **Page 6-11, Section 6.2.1, SMA Boundaries**: A lot of the assumptions in this section appear in Table 6-1, which appears to be used for AOPC delineation. This section must be rewritten to simply demonstrate how SMA footprint was changed from AOPC footprint (Section 6.2.1.2). Then, the evaluation of associated category derivation should be presented.

262. **Page 6-13, Section 6.2.1.2 SMA Designations:** Explain why the 100 X 100' grid cell was defined when it wasn't used to delineate dredging areas and doesn't make sense for capping and ENR. Some alternatives have much smaller areas defined as SMAs and for application of dredging, so how was the 100x100 grid actually used?

263. **Page 6-13, Section 6.2.1.2 SMA Designations, Last bullet on page:** Clarify the decision process/criteria and provide a table showing which SMAs were excluded based on toxicity test results. Is it possible that one sample below the toxicity threshold could be sufficient to exclude an SMA even if other samples showed high chemistry? Were there any such instances?

264. **Page 6-15, Section 6.2.1.3, Additional Considerations for Determining SMA boundaries, 1st complete paragraph on page**: This paragraph must be substantially modified or deleted. Very little RI data was collected in the navigation channel, so the statements in this paragraph cannot be supported with data. For example, Figure 2-7 provides interpolations showing high predicted PCB concentrations in the navigation channel between Boeing/Jorgensen Forge and T-117, contrary to statements in the last sentence. There should be a Category 3 SMA in this area (as we have comment previously). Any similar areas where

interpolations predict concentrations exceeding RALs, and there is no empirical data, should be flagged as a potential cleanup area.

265. **Page 6-15, footnote 10:** These observations of erosion and mixing (1-2 ft or 31-63 cm) are significantly greater than the depth of scour/erosion used in any other part of the analysis. A one-time snapshot of the sediment bed showing furrows of this magnitude indicates LDW sediment is subject to deep scour and mixing by vessel passage, and/or other forces that create valleys and ridges of 1-2 ft magnitude. These observations also indicate a soft, unconsolidated sediment bed that is vulnerable to erosion, mixing and transport, not just within SMAs, but in many areas of the LDW, for example east of the navigation channel at RM 0.2-0.5, and RM 1.2-1.4, RM2.55-2.8, and RM 3.9-4.1 (Figure 2-5, pg 2-68). Revise this analysis consistent with Section 5 comments.

266. **Page 6-17, Section 6.2.2, Evaluating Recovery Potential of SMAs**: The last paragraph states, "This FS analysis is consistent with that principle. It predicts recovery potential through: (1) predictive modeling that assumes lateral sources will be controlled in the future, (2) empirical trends demonstrating that recovery is underway, but that "final" recovery will require additional source control measures and time, (3) recontamination potential from external sources (see Section 8.3.1)." State that near-field modeling (and the sampling necessary to do the modeling) will need to be conducted as part of remedial design.

267. **Page 6-18, Section 6.3, Remedial Action Levels**: SWUCLs must be used rather than SWACs to develop RALs based on human health risk assessment.

268. **Page 6-18, Section 6.3, 3rd paragraph:** This text implies that alternatives only remediate areas within SMAs that exceed RALs. This is true for Alternative 3 but not 2, 4, or 5. In these alternatives, the entire SMA is remediated if a RAL is exceeded within the SMA.

269. **Page 6-18, Section 6.3, last paragraph**: Clarify what was done when a special land use area such as a clamming beach covers only a portion of the SMA. We assume the clamming RAL was only applied to the clamming beach not the entire SMA?

270. **Page 6-19 – 21, Section 6.3.1, Development of RALs**: This section is very difficult to follow. Explain that the goal of the RALs is to support a set of alternatives that allow for increasing cleanup footprints that meet certain goals, e.g, meet SQS and background in year 10. It would make more sense to discuss the RALs in the context of the cleanup alternatives, rather than separately (as noted in the 4th paragraph). As discussed in the general comments, many of these RALs will need to be changed as necessary in order to meet revised background values.

271. **Page 6-20, Section 6.3.1, 3rd paragraph**: Delete. It is not clear how the BCM analysis discussed was used to select RALs. This analysis only evaluated physical components, not chemical.

272. **Page 6-20, Section 6.3.1, 4th and 5th paragraph**: As noted in previous comments, there is no justification for use of an "effectiveness index". . This analysis is obtuse. Replace it with a more simple discussion of the potential cleanup areas and volumes associated with various RALs.

273. **Section 6.3.2, Selecting an Array of RALs**: This section is poorly organized and difficult to follow. The section could simply state the range selected, with a sentence for each

describing what it was based on. (see Table 6-4) Again, present RALs in the context of the alternatives, rather than separately.

274. **Section 6.3.2.4, Dioxin/Furan RAL:** The agencies' September 11, 2008 comment that a dioxin/furan RAL of 49 pptr TEQ is unacceptably high has not been addressed. The range of 28 pptr TEQ to 12 – 15 pptr TEQ recommended in that comment letter should be incorporated into the FS, in addition to reevaluating the RAL to meet the new background values discussed in these comments.

275. **Section 6.3.2.6, Lowest Technology-based RALs:** Alternative 5 RALs must be presented here.

276. **Table 6.4 (and associated text):** Modify this table to show only RALs selected for alternatives along with a rationale for their selection. Provide the acreage of affected sediments for each RAL.

277. **Figure 6-2a – e**: While this map includes helpful information, FS must show a transparent comparison of SMA and alternative footprints to RI (and post-RI) data to ensure that data points that exceed the FS decision criteria are included in SMAs. It must be clear whether mapped footprints are being driven by interpolated data, rather than real data points. Neither this figure nor other FS figures accomplish this. Work with the agencies to come up with figures that better show that the footprints encompass areas that exceed the PRGs and RALs, either in this section or in Section 8, or both.

Discrepancies in these figures based on presented rationale include the following. These are provided as examples of how the rationale does not seem to be consistent with multiple lines of evidence and should be considered during reworking of the alternatives:

- SMA 14B: Appendix F indicates scours and highest concentrations are in the surface. This should be category 1.
- SMA28: This was labeled category 3, but scour was observed and a core is present that indicates subsurface contamination is present.
- SMA 32: chemistry shows increases and BCM says not recovering. Should be category 1 based on that.
- SMA 43: Appendix F indicates MNR is not occurring, but this SMA is labeled category three.
- Consider extension of 16A or 14A along the shore between these areas. Evidence of sand blast grit has been documented in this area.

In addition:

- Add outfalls to maps
- SMA 20 A/B: Older maps showed a hexachlorobenzene CSL exceedence north of RM 1.8. Have these data changed?
- SMA 17: Missing the SQS hit at RM 1.5E. Not shown on figure. Have the data changed?

278. **Figure 6-5a**: Include starting SWAC and maximum point at Year 0.

Section 7, Identification and Screening of Remedial Technologies

279. **Organization:** The same case studies are used to evaluate different technologies in different sections. Recommend reorganizing section to present the case studies in one place and create bullets on lessons learned from each.

280. **Dredge residuals:** Very little information is provided as to the chemical impact of dredge residuals on dissolved and particulate materials. How much is assumed? How was this derived? Where are impacts anticipated? Empirical examples should be used to discuss this, where available.

281. **Page 7-1, Section 7.0, 1st paragraph**: The statement "Since the publication of the CTM, a review of literature has confirmed that no new fundamental technologies for cleanup of contaminated sediments have been developed and advanced to the implementation stage" is insufficient. It has been four years since the CTM was written, and the FS must discuss any new advances in the technologies discussed in the CTM since it was written. For example, provide any new information or reports from the EPA/Corps project to test treatment technologies for contaminated sediments at NY/NJ Harbor. See general comments.

282. **Page 7-2, Section 7.1.1, Dredging and Excavation**: Please specify the type and size of mechanical dredge assumed for this work.

283. **Page 7-2, Section 7.1.1, Dredging and Excavation**: It is not clear if cost estimates include use of excavator dredging or if was solely based on mechanical dredging. Please clarify. Environmental buckets should be assumed.

284. **Page 7-15, Section 7.1.4, Capping, 3rd bullet**: The text acknowledges that chemical isolation is a function of a cap, but it doesn't appear that the potential effectiveness of proposed caps in providing chemical isolation for contaminants that may be solubilized and transported through the water column was evaluated. This must be evaluated. See general comments.

285. **Page 7-16, Section 7.1.4:** Carbon amendment was not used at Pacific Sound Resources. Please correct.

286. **Page 7-16, Section 7.1.4**: Add that reactive caps will have to be considered if other pathways (groundwater/surface water) require addressing.

287. **Page 7-17, Section 7.1.5, Monitored Natural Recovery, 1st paragraph**: Delete the last sentence.

288. **Page 7-18, Section 7.1.5, Monitored Natural Recovery:** The discussion of natural recovery at Duwamish/Diagonal should mention the potential influence of newly placed capping material on non-capped areas during natural recovery.

289. **Page 7-18, Section 7.1.5:** The discussion of natural recovery at Sip 4 must be revised. The 2006 samples were all at the shoreline; their inclusion is misleading when compared to the other datasets.

290. **Page 7-19, Barge Dewatering:** Add that water may need to be treated prior to discharge from the barge.

291. **Page 7-21, Section 7.2.3, Best Management Practices**: Add that resuspension could be caused from leakage or overfilling of the bucket.

292. **Page 7-22, Section 7.2.3**: Add a discussion of limitations of silt curtain with respect to currents (see ERDC guidance TR-08-29).

293. **Page 7-22 – 29, Institutional Controls**: This section reflects major misconceptions about the nature and implementation of institutional controls (ICs). (Legal counsel for each LDWG party should collectively redraft this section and all ARARs sections). ICs are selected in decision documents as remedial actions. The purpose of ICs is to prevent or at least minimize the potential for human exposure to contamination and/or protect the integrity of a remedy. The fact that environmental and other regulation exists, in the form of permitting and enforcement, or state leasing of aquatic lands exists, and these things along with many other aspects of modern society may limit future releases or generally help preserve remedies for hazardous substances left on site, does not make them ICs in any meaningful or significant sense of the term. They are generally not selected as remedial action in agency decision documents beyond RNAs which have problems, see below. Zoning changes are rarely effected due to agency site-specific decision documents, and as noted below are also of limited utility. Similarly, we all anticipate some continued reliance on fish health advisories, at least in the short term, but we are all aware of their unverifiable wholly voluntary and consequently limited efficacy and of issues arising from their intersection with tribal treaties with the United States. A realistic description of what an agency decision document will need to consider in selecting a remedy should form the basis for this section.

294. **Page 7-23, Section 7.2.4.1, Government Controls:** Most of this language is irrelevant. Conclude the section if it is retained with "Government controls will have only very limited applicability." None of the FS alternatives include, and the final remedy will not likely select, changes in regulatory programs, state leasing practices, or other things beyond EPA or Ecology's capacity to require the implementation of. Affected tribes in any case should be consulted regarding any proposed changes in land/waterway use or activities that may impact the LDW. See comments below for more on specifically referenced ICs.

295. **Page 7-23, Section 7.2.4.1, Agency Permits:** The extent to which permitting could or would become different following implementation of one remedy as opposed to another (e.g., capping as opposed to dredging) and what limitations could be imposed on prospective permittees with rights of appeal raise myriad potential legal issues. Two LDWG members are exploring some of these issues at Slip 4. In any case, successful implementation of post-remedial protective permitting would require that all permitting agencies are fully aware of any remaining contamination at the site, are aware of what actions must be taken to avoid risk long into the future, and be empowered to act accordingly on these bases. For these reasons, this is not a reliable IC to the extent it may be usefully characterized as one at all.

296. **Page 7-23, Section 7.2.4.1, Zoning:** The discussion in this section doesn't seem to have any bearing on ICs. It is not even clear what is being proposed here about how zoning could be used to protect the public from risk or preserve the integrity of an implemented remedy, much less habitat restoration projects apart from remedial action. In any case, existing zoning is considered a weak IC which should only be relied upon in conjunction with other measures in layering ICs. A fundamental weakness generally is that zoning boards, which

have authority to provide variances along with other means to allow non-conforming uses, are not required or expected to have environmental expertise or necessarily institutional knowledge or expertise of remediated hazardous waste sites or their remedies.

297. **Page 7-24, Section 7.2.4.1, WDNR Aquatic Lease**: Delete.

298. **Page 7-24, Section 7.2.4.1, Regulated Navigation Area and Vessel Speed and Wake Control:** State how these ICs, particularly an RNA, would be enforced. Uncertain enforcement is a major weakness of these ICs. RNAs have proven difficult to implement when EPA has sought to employ them. The stated limitation in the text to areas "closed to all commercial uses now and in the future," severely limits utility in any case. Shorten this section to avoid being misleading.

299. **Page 7-25, Section 7.2.4.2, Proprietary Controls:** This section should reference WA UECA, which allows EPA to enforce restrictive covenants without taking a proprietary interest prohibited by Section 113(j).

300. **Page 7-25, Section 7.2.4.2, Restrictive Covenants**: Edit the first sentence as follows: "Restrictive covenants **can be** an effective and implementable institutional control . . . privately owned property **if they are timely and adequately enforced**." State that commonly a responsible party subject to an enforcement agreement with EPA or Ecology will enforce a restrictive covenant or environmental easement based on an obligation to do so in the agency enforcement agreement.

301. **Page 7-26, Section 7.2.4.3, Enforcement Tools, 2nd bullet:** EPA's MOU with the Corps for permit coordination at Superfund sites is not an enforcement tool, nor is there any requirement or guarantee that it will reliably remain in effect over the long term. It could be noted under Agency permits but this limitation must be stated.

302. **Page 7-28, Section 7.2.4, Advisories**: Duwamish fish advisory information is incorrect. It should be: do not eat flatfish, shellfish, and crab. The limited efficacy of advisories and the tribal treaty issues they raise, noted in the first IC comment above, must be explicitly stated whenever advisories are discussed.

303. **Page 7-28, Section 7.2.4.4, State Registry and Mapping:** While these tools are a source of valuable information for those who use them, they are not ICs that will more than tangentially help to reduce risk or protect a remedy. Informational devices generally are much more effective with the well informed. Deed notices have genuine value in informing property owners and prospective owners, but not anyone else. State that all informational devices are passive and aren't literally "controls." Consider deleting or at least shortening the descriptive general Informational Devices paragraph and all subsequent subparagraphs except for advisories and the very significant issues they raise.

304. **Page 7-28 – 29, Section 7.2.4.4 Advisories**: Many studies have shown that fish advisories are an unreliable IC. While Advisories and associated signage may be implementable, to be even minimally successful such controls require public outreach and education, which should be discussed in the text. The text must address how advisories intersect with and would be feasible with respect to tribes, as an impingement upon tribal fishing rights in treaties with the United States. Tribes strenuously maintain that institutional controls which limit or restrict treaty rights, such as fishing and consumption restrictions, abrogate treaty rights, in addition to being unacceptable to tribes as permanent or long-term

solutions. Information devices are also not considered effective or practical for subsistence harvesters and are also not protective of ecological receptors. All of these issues should be fully discussed in the IC sections proposing advisories.

305. **Table 7-1, 7-2b, 7-3**: MNR information in these tables seem to indicate that downstream dispersion/transport of sediments is an acceptable mechanism for MNR. It is not. In fact, evidence of this being the primary MNR mechanism at any location would be grounds to for EPA to not select MNR as an effective alternative. Revise accordingly.

306. **Table 7-2b, Monitored Natural Recovery and Enhanced Natural Recovery.** This table fails to indicate the costs associated with the "intense" monitoring needed to demonstrate consistent MNR. It incorrectly equates the costs of MNR to those in Table 7-2a, No Action and Institutional Controls. Revise cost for MNR and ENR to say "moderate".

307. **Table 7-2c,** Containment Process Options should note the conflict of armored capping, composite capping and reactive capping with the use of inter-tidal areas for clamming and/or recreational beaches. This table should also note that use of a shotcrete cap reduces the habitat value of the intertidal sediment bed.

308. **Table 7-2e,** Physical Solidification using lime or another solidification agent. The addition of lime to (wet) sediment causes an exothermic (heat generating) chemical reaction which has been shown to volatilize PCBs, transferring them to the air. This is phase transfer, not treatment. This should be noted.

309. **Table 7-3, Summary Assessment of Effectiveness, Implementability and Cost**:

- For the process option named, Access/Deed Restrictions the "Disadvantages" column must use the same language for ecological receptors as it does for the Fish and Shellfish Consumption Advisories, i.e., "Not effective for ecological receptors because COPCs remain in place".
- For the process option named Resuspension and Transport, revise disadvantages to indicate (2)"facilitates PCB contamination of the marine food chain".
- For the process option named Composite Cap, include in the disadvantages a requirement for institutional controls.
- For the process option named Spray Cap, include in the disadvantages requirements for institutional controls, for long-term monitoring and maintenance, and a potential requirement for replacement habitat.
- For the process option named Reactive Caps, note in the disadvantages: "probably not acceptable in beach areas".
- For the process option named Hydraulic Dredging, the last disadvantage, "*limited experience with mechanical dewatering and water treatment facilities*" is hard to believe, since one of the parties responsible for this FS is the agency that operates all of the wastewater treatment facilities for Seattle and King County. Contrast this with the similarly difficult to believe, comment in the Soil Washing advantages column on the following page, which states: "*mobile units available for quick set-up and take-down time*". Mobile dewatering and wastewater treatment plants also are available from numerous vendors, and have the potential to be barge mounted. Numerous engineering firms have the ability to operate these "package" wastewater treatment plants. Revise both entries.
- For the process option Dry Excavating, it is difficult to understand the following disadvantage (2), "*Runoff water may contain high concentrations of TSS and COPCs*".

What run-off water? The excavated material can be directly loaded into lined trucks, railroad tankers or settling containers; or loaded onto a shallow-draft barge, as would be done for a water-based dredge. Why is this a problem for a land-based excavator and not for a water-based excavator? Please clarify.

310. **Figure 7-7, Surface Sediment PCB Trends at Slip 4 EAA: .** Delete this figure. The graphical treatment of these data is very misleading. There are only 6 samples in 2006, 4 of which are clustered outside the EAA and none of which were located near previous samples.

Section 8, Development and Final Assembly of Remedial Alternatives

311. **Technology selection within SMAs**: For Alternative 3, there appear to be some constructability issues that need to be corrected. The shape and size of the technology footprints should be reexamined from an implementability perspective. There are very small areas of dredging next to areas of ENR. The dredge areas should follow the decision rule set forth by LDWG in previous sections of the FS, that a minimum dredge footprint should be 100' X 100'. In addition, the FS needs to explain how decisions were made to identify dredging/capping, versus ENR areas. It appears that this was done purely from the IDW concentrations. This approach is flawed especially for areas where there is no data. A reality-based look at the existing data, physical locations, and understanding of likely areas of contamination should be conducted to make this alternative more realistic.

312. **Page 8-5, Section 8.1.5.2, Alternative 2:** According to Table 8-4, under pier areas are assumed to be capped. However, no capping is presented on Figure 8-2 for Alternative 2 or on Table 9-9. Please explain was assumed for this alternative**.**

313. **Page 8-8, Section 8.2.1, 1st bullet:** Clarify how the 5 cm was used since a majority of the surface data was 10cm.

314. **Page 8-9, Section 8.2.2, Waterway Use and Elevation Constraints**: Note that waterway use needs to be considered for ENR/MNR as well as capping.

315. **Page 8-9. Section 8.2.4, Vessel and High-flow Event Scour:** Text states that areas of scour >5 cm were designated for active remediation. However, all of the analysis in appendices C and F was based on 10-cm depth. Please clarify.

316. **Page 8-9. Section 8.2.4:** Please quantify areas with scour as a percent of total bed. It would be more clear if the equivalent figure in Appendix C was referenced, instead of the STM.

317. **Page 8-11, Section 8.2.6, Data Age and New Data:** The FS must show new data not included in the RI report. Replace this general and not very useful discussion with a map showing all new sampling stations and data (perhaps using a revised version of Figure 4-14 from the RI, identifying the new stations).

318. **Page 8-12, Section 8.3.1, Source Control:** It seems as though the following are confused: The Source Control Strategy, which is an Ecology publication that describes the goals and approach for Source Control; the Source Control Work Group, which is an interagency group that meets monthly; and the SC work, which is the work that has been and needs to be done.

- The distinctions among these terms are described in Ecology's SCAPs and SC Status Reports. It is a good idea to mention the Source Control Work group. Include a few sentences about who is in it and the functions it performs.
- The first sentence in this paragraph should say the Source Control Work Group, not Source Control Strategy.
- The sentence before the bullets states, "Over the next 5 to 10 years, the Source Control Strategy's activities…" but should say Source Control activities rather than source control "strategy's" activities. The strategy describes the goals but doesn't actually specify activities.
- Bulleted list: Where did this list come from? Ecology is the lead for Source Control. Reference Ecology documents. This information is located in the Source Control Status Reports and Source Control Strategy. Use these documents and cite them.
- Change the reference "Windward 2008" to cite Ecology documents. Ecology worked very hard with Windward to get the SC section of the RI to reflect our approach, but this effort is not reflected in the FS. This is not a complete account of the SC efforts. Refer directly to Ecology publications for the most accurate information.

319. **Page 8-13, Section 8.3.1.1:** Refer to the July 2009 Source Control Status Report for the information on the schedule and revise text accordingly. Also, source control efforts are ongoing by nature and should not be predicted to be "complete" by 2011. This is an oversimplification.

320. **Page 8-13, Section 8.3.1.2**: Clarify that the referenced work with the BCM was not conducted by Ecology. This section begins by describing Ecology's lead role for SC but then transitions to a discussion of using the BCM to evaluate recontamination. Also, on page 8-14, provide the basis for the assumption that sources will be controlled in a timeframe that will not delay remediation. There are several underlying assumptions in such a statement, and the text needs to clearly and completely address SC with respect to remedial alternatives.

321. **Page 8-13, Section 8.3.12, Sediment Recontamination Potential Evaluation**: Please specify which BCM run ("unaggregated pipes" or "aggregated pipes") was used.

322. **Page 8-14, Section 8.3.2.2:** The FS describes a pre-clearance routine for expected debris in the dredge mud. This is only effective for surface debris, within the top two plus feet. Text should be revised to indicate that unless there is a side scan sonar survey that indicates substantial debris in the remediation area, it is not likely that a debris removal pass is required. The assumptions behind the amount of debris clearance for each alternative should be outlined in Section 8 and Appendix I. Debris clearance assumptions will be different depending on both dredge areas and disposal option assumed in the alternative. For example, for the CAD disposal, separation of the debris is generally not necessary.

323. **Page 8-18, Conventional Excavation:** Clarify what assumptions were made for handling/transport of sediments excavated using conventional excavation.

324. **Page 8-18, Conventional Excavation, 2nd paragraph:** The FS should acknowledge that the work window for the LDW can only be determined in formal consultation. The current riverine work window is August 1-August 31. The estuarine window, which is July 16-Feb 15 for bull trout, July 2-March 2 for salmon. The windows are determined during the consultation process. The most recent NMFS BiOp for the LDW Turning Basin states that the "dredging schedule limits dredging between December 1-January 31". Current assumptions

on work window are suitable for the purposes of the FS, but the need to determine actual windows and associated monitoring should be mentioned. Add the total volume that may be viable for excavation in the dry. Without an evaluation of this volume, it is difficult to determine if working outside the fish window in these areas impacts the schedule or not.

325. **Page 8-19, Section 8.3.3.1 Removal, Volume estimation, 3rd bullet:** Was the depth to lower alluvium assumed to be 23 feet below mudline for all dredge volume estimates or the partial dredging to 3-feet and capped used? Revise to reconcile these contradictory statements. It what instances would the 23 foot estimate be needed?

326. **Page 8-19, Section 8.3.3.1, Removal, Volume estimation, last three bullets:** 2.5' total overdredge is very conservative and inflates costs. Since additional volumes are added to account for residuals and a sensitivity analysis was done to allow for inaccuracies of depth of contamination, these assumptions should be revised.

327. **Page 8-19, Section 8.3.3, Common Alternative Remedy Elements, Volume Estimation**: Include a standard or assumption for when subsurface excavation of dioxins/furans , since there is no SMS standard, along with a basis for that assumption.

328. **Page 8-19 and 8-20, Section 8.3.3.2, Isolation Capping**: The degree of contamination below the capped area must be considered in deciding whether areas can be capped. Highly contaminated subsurface sediments should be dredged or partially dredged before capping. See general comments.

329. **Page 8-20 - 21, Section 8.3.3.3, Enhanced Natural Recovery**: As stated in our October 16, 2008 comments, because ENR relies on mixing to dilute contaminant concentrations, it may only be considered in areas with low levels of surface and subsurface contamination. With biological activity and other mixing/erosive actions, the contaminated material will not be buried and releases to the water column will occur. Benthic organisms will be exposed to contaminants which will continue to move through the food web.

The FS must to clearly state the goals of ENR, e.g., to meet a cleanup goal in year 10 or perhaps to accelerate attainment of a goal, e.g., to year 5. It must clearly articulate the criteria used to determine which areas should be considered for MNR versus ENR versus capping. Based on the criteria discussed in this section, seems ENR would seemingly be viable virtually pretty much anywhere. There are several areas where this is not the case. Explain what conditions led ENR to be removed from consideration.

330. **Page 8-20, Section 8.3.3.3, ENR**; Include these additional decision criteria for ENR:

- ENR is not an appropriate technology for areas needing to be maintained at a certain depth, unless elevation is still well below navigation depths after ENR placement.
- It is not suitable in beaches and clamming areas. See general comments.
- ENR is not an appropriate technology where underlying sediments are highly contaminated, particularly if upwelling groundwater through more contaminated underlying sediments will contaminate porewater in ENR areas.

Add these criteria to the MNR section as well.

331. **Page 8-22, Section 8.3.3.5, MNR:** Clearly define criteria for contingency actions. "Trending toward" or "not recovering adequately" aren't quantitative enough for this process. In addition:

- 1st bullet: Add that surface sediments must recover to background concentrations as well as SQS.
- 2nd bullet: Appears to be a typo – we assume it should say that MNR areas are predicted to be less than SQS in 10 years. Add to last sentence ", and further active remediation may be required."
- 3rd bullet: Delete statement that there will be no monitoring after PRGs have been achieved. Under CERCLA, long term monitoring and 5-year reviews must occur as long as waste remains at the site (and if the primary MNR mechanism is burial, waste will remain at the site). Add that if site-wide SWACs are selected as a compliance metric (as advocated in the FS), the entire site will have to be sampled on a periodic basis to calculate the site-wide SWAC. Revise page 8-29 as well.

332. **Page 8-23, Section 8.3.3.6, Verification Monitoring of SMAs:** Recast verification monitoring discussed in this section as baseline monitoring to be done in design. If contaminant concentrations exceeding standards are found in these areas, they will become "active" or "MNR" areas. It is confusing to call these contingency actions, a term generally applied to a remedy not meeting cleanup goals.

333. **Page 8-23 – 8-26, Section 8.3.3.7, Institutional Controls:** ICs must be evaluated in an FS as thoroughly as other alternatives or components of alternatives. The general discussion of ICs in this section is a start, but the text in 8.4, and the subsequent analysis (Section 9, table 9-13, etc.) and comparative analysis of alternatives must be more detailed and complete. An Institutional Controls Plan will need to be developed as part of Remedial Design but the significant differences in the types and scope of ICs required with the various alternatives must be more fully discussed in the FS to ensure the IC component of each remedial alternative is adequately evaluated and considered to support selection of remedy. For example, each alternative should more clearly articulate the goals and components of the ICs program that are most relevant for the alternative being evaluated – merely stating as in 8.4.2.4 that "the institutional controls are generally the same as described in Section 8.3.3.7" is inadequate. Other critical factors include the scope/scale of the required ICs and the capability and willingness of government and the community to implement and enforce ICs as necessary. Actions like "prevent any current or future land and waterway uses that could compromise the integrity of a remedial action," or "provide for the Muckleshoot Tribe to continue to exercise its treaty-protected fishing activities" will likely be extremely difficult to effectively accomplish. (Revise the latter statement as follows; change "activities" to "rights" and strike "to continue." It assumes they currently exercise their rights which extend significantly beyond salmon.) These difficult issues are most appropriately discussed in a CERCLA context under the long-term effectiveness criterion, but also impact overall protectiveness, short-term effectiveness, implementability and cost of the various alternatives. The complexity and scope of ICs required for a given alternative require that uncertainties be fully discussed. The text should acknowledge that just as for other remedial alternative components, ICs will require monitoring, reliable and predictable enforcement, and "adaptive management" to be successful and discuss how that would factor into each alternative. All of the above contribute to an under-representation of the implementability challenges and costs associated with ICs that must be more fully addressed as the FS is revised. See our IC comments on Pages 7-22--29 above, and revise in a consistent manner.

334. **Page 8-25, Section 8.3.3.7, Institutional Controls, CERCLA/MTCA Enforcement**: State that CERCLA remedial actions addressing hazardous substances may only be performed by a responsible party under a Consent Decree or Unilateral administrative Order. CERCLA Orders on Consent are not permissible to implement responsible party agreements.

Cite Sections 122(d)(1)(A) and 122(e)(6). MTCA cleanups may proceed through Agreed Orders, Enforcement Orders, Consent Decrees, or less formal actions.

335. **Page 8-26, Section 8.3.3.7, Institutional Controls**: A section should be devoted to proprietary ICs, including restrictive covenants pursuant to UECA or environmental easements, which may be purchased from property owners. These are commonly the most effective ICs at hazardous waste sites, though their effectiveness is more limited within a surface water body, but should nevertheless be a carefully considered IC with regard to owners of riparian rights.

336. **Page 8-26, Section 8.3.3.7, Institutional Controls:** Paragraph under bulleted list is redundant with last bullet. See Section 7 comments on advisories.

337. **Page 8-26, Section 8.3.4, Monitoring and Adaptive Management, 1st sentence**: Monitoring is not a control technology.

338. **Page 8-28, Section 8.3.4.2, Short-term monitoring during implementation:** Specify that water quality sampling includes sampling of COCs.

339. **Page 8-29, Section 8.3.4.4, Long-term Operation and Maintenance Monitoring**: This section should cite Appendix K. In addition:

- Add porewater sampling to assess contaminant flux anywhere wastes are being buried or otherwise isolated (capping, ENR, MNR).
- Add placing a visually distinctive layer or measuring stick at the onset of capping or ENR so that depth to that layer can be easily monitored without vagaries of comparing sediment and contaminant characteristics.
- Add long-term sediment monitoring for recontamination for all remedies (including dredging)
- Delete statement that no long-term monitoring is needed in dredged areas. Monitoring will be needed for recontamination, and because the FS proposes that cleanup levels be SWAC based, proposed monitoring in the FS will be needed throughout the waterway to assess compliance with SWAC based standards (this is covered under next section, but as is the two sections appear contradictory.) Eliminate the distinction between "compliance" and "performance" monitoring and merge these two sections. WAC 173-340-410 defines performance monitoring, along with protective and conformational monitoring, as 3 types of compliance monitoring, as the FS appropriately states on page 9-4. Revise this discussion to be consistent with these requirements.

340. **Page 8-30, Section 8.3.4.4**: Discussion the types of monitoring required for MNR. State that MNR will require higher levels of monitoring than other remedies, including sediment sampling, toxicity testing, tissue testing, benthic abundance sampling, and potentially porewater sampling.

341. **Page 8-30, Section 8.3.4.5, Long-term Performance Monitoring**: Add water quality testing and monitoring to assess the status of source control.

342. **Section 8.4.3, Alternative 3:** The title of this section - "Increasing Active Cleanup with an Emphasis on Containment" is incorrect, as Alternative 3 relies heavily on ENR. ENR is not a containment technology, and all statements in the FS that imply that it is must be corrected.

343. **Page 8-37, Section 8.4.3.1, RAL Basis, Alternative 3a**: Text states that MNR and ENR are not applied where sediment chemistry is above the RAL, however, Figure 8-3 shows several areas where MNR or ENR were applied where the RAL is exceeded. This discrepancy appears in figures for the other alternatives as well. Please clarify.

344. **Page 8-41, Section 8.4.4 Alternative 4**: Explain why dredging (and backfilling) would not be acceptable in a clamming area, or delete this statement.

345. **Page 8-42, Section 8.4.4.2 Alternative 4 Conceptual Details:** Does the soil washing option in 4d result in a net cost increase or decrease under the potential dispositions?

346. **Page 8-47, Section 8.5.1, Source Control:** Provide a basis with citations for the summary conclusions in the following statement, "Much of the contamination in the LDW originated from historic sources that are no longer operating. However, some level of ongoing contamination continues, mainly from atmospheric deposition, stormwater runoff, and combined sewer overflows." Such generalizations require support, and it must be clearly stated that Ecology has not made such determinations. Also, in the 3rd paragraph, replace "Source Control Strategy" with "source control work".

347. **Page 8-48, Section 8.5.2.2: Remedial Design-level Sampling**: As noted in the general comments, the notion that the SMAs are fixed and sampling would only occur within SMAs must be removed from this discussion. SMAs defined in the FS are preliminary, to be redefined in the design phase.

348. **Page 8-49, Section 8.5.2.3, Consideration of Newer Feasibility Study Data**: In addition to determining if new SMAs need to be defined, newer data must be used to redefine FS SMA boundaries and to assign of technologies within SMAs. As noted previously, maps are needed showing these new data. Provide more detail on the statements made in footnote 16 (QA issues with Ecology SPI study). (This can be done in a separate memorandum. It does not need to appear in the FS.)

349. **Table 8-2**: This table must provide clearer criteria for when technologies would be applied, especially dredging vs capping vs ENR, plus dredging w/backfill and dredging w/capping. The many open-ended statements like "may be required" or "may be considered" make it unclear what was assumed in the FS.

350. Table 8-4, Engineering Constraints and Generalized Assumptions for Implementation: Land-based excavation can certainly be controlled with greater precision than the 3 ft assumed here as a minimum cut. How was this constraint used?

351. **Figures 8–2 through 8-11**: Per previous comments, these figures do not provide sufficient information to verify that the decision criteria set forth in the text have been met with these cleanup footprints. In addition, many of the figures are not consistent with the text, e.g., text states that MNR is not used above the RAL, yet many figures show MNR areas where RALs are exceeded. Discuss with the agencies how these figures can be improved.

Section 9 Detailed Analysis of Individual Remedial Alternatives

352. **Sections 9 and 10, general comment**: The agencies focused most of their review on the alternatives themselves, and less on the detailed analysis of alternatives. We will have more

comments on the detailed analysis in the review of the revised draft FS, when we have reached agreement on the alternatives to be analyzed. In these sections in particular, there is a lot of text that is redundant or similar among alternatives and, and between text and tables. Our comments on any subsection should be interpreted to be applicable to similar text elsewhere in the report.

353. **Overall Protection of Human Health and the Environment:** Generally, analyses of the available alternatives to be protective in the most fundamental terms, i.e., reducing risks, achieving RAOs, relative permanence, and meeting ARARs in a reasonable timeframe, are underemphasized while the short term risks of taking any action, especially dredging, are overemphasized to a degree that unduly biases the FS toward passive remedies over active remedies. Emphasize the extent to which alternatives meet regulatory requirements and protectiveness criteria in these fundamental terms, including the MTCA 10^{-5} human health risk standard, SMS standards, state and federal water quality criteria, as well as background. Include the projected time frames to achieve these standards. Emphasize how, when and to what degree human and ecological receptors the alternatives are intended to protect will benefit in terms of how, when and to what degree RAOs are projected to be met.

354. **Long Term Effectiveness and Permanence, Magnitude and Type of Residual Risk:** While general statements to the effect that any buried contamination left in place is unlikely to increase residual risk associated with site or large area-wide RAOs (since disturbance would be localized and temporary) may be generally true from a physical perspective, as noted in the general comments, the potential impacts to human and ecological health due to these disturbances has not been evaluated and its significance is unknown. These analyses must include much more robust consideration of the potential impacts of leaving contamination behind over the long term.

These analyses must identify all areas where MNR and is proposed and include the uncertainties associated with natural recovery for specific alternatives in different areas. Explain how natural recovery areas were selected. State that they must generally be limited to areas where erosion is not anticipated, and may not include berthing areas. Ultimately for all natural recovery areas, the range of concentrations left behind, their location, and potential for exposure must be examined.. Where data limitations make these quantifications uncertain, the uncertainty must be stated.

355. **Seismic Risk**: There is no evaluation of the potential likelihood or effects of seismic events in the evaluation of alternatives. This should be discussed in the in terms of long term effectiveness for each alternative, including impacts on caps as well as on contamination left in place.

356. **Institutional Controls:** The discussion of ICs should include constraints on future dredge depths or disturbances in areas where contamination is left in place, especially for MNR areas. Include more alternative-specific details, including objectives, timing, mechanisms, areas requiring ICs, and anticipated costs. See comments on Sections 7 and 8 on ICs.

357. **Community and Worker Protection:** While risks to workers are invariably greater for active as compared to passive remedies, the risks associated with the active remedies under consideration are not greater than those for most significant development or construction projects. For this reason, along with requirements that modern worker safety procedures be carefully followed, these risks should not be overemphasized, or be a significant factor in

LDW remedy selection. General industry statistics for worker injury and death are irrelevant and must be deleted and the text revised.

358. **Time frames:** While we agree that the point-in-time estimates have considerable uncertainty (especially for any one location or grid cell), the estimates of restoration time among the various remedial actions should be distinguishable. Forcing these estimates into rigid intervals eliminates the capacity to identify relatively small differences in time to restoration among remedies that are quite similar. For example, restoration time estimates of 16 years and 20 years (a four year difference) would both be reported as 15 to 20 years, but an estimate of 21 years (only one year different from 20) would be reported as 21 to 25 years. Provide the exact estimate of point-in-time to restoration, then discuss uncertainties associated with these estimates. This will allow for a better evaluation of the incremental improvement between remedial alternatives.

359. **Tissue recovery**: As discussed in Appendix F, the assumption of a 3 year post-construction recovery period for fish and shellfish tissue concentrations is not warranted. Recent data from several sites including the Grasse River (Connolly et al 2007), Kalamazoo River (Kern et al 2009), the Queensbury site on the Upper Hudson River (Field et al 2007), and the Duwamish River (Figure 1) indicate that any increases in fish PCB concentrations associated with dredging are short-term and reduction in fish tissue PCB concentrations often occurs in Year 1 post-removal or sooner. Revise accordingly.

360. **Dredge Residuals**: It's not clear where management of dredge residuals is considered in this analysis. Please clarify.

361. **Page 9-1, Section 9.1, Overview of NCP and MTCA Analysis Criteria**: Replace state acceptance with State/Tribal acceptance.

362. **Page 9-2, Section 9.1.1.1, Overall Protection of Human Health and the Environment**: Revise the 2nd sentence to add permanence and compliance with ARARs as key factors (in addition to LT and ST effectiveness) for assessing Overall Protectiveness, and analyze these factors in the text.

363. **Page 9-3, Section 9.1.1.2, Compliance with ARARs: Page 9-3, Section 9.1.1.2, Compliance with ARARs:** Start with the explanation that "The alternatives shall be assessed to determine whether they attain applicable or relevant and appropriate requirements under federal environmental law and stricter state environmental or facility siting laws," then edit the text to be consistent with this requirement. This evaluation must extend far beyond the SMS and MTCA. Specifically include surface water quality standards, see CERCLA Section 121(d)(2)(A) and (B).

364. **Page 9-3, Section 9.1.1.2, second paragraph:** Delete all the following: 1) all text associating "uncertainty" with "low levels" of SMS exceedances and their potential acceptability based on practicability; 2) alleged scientific uncertainties in discerning environmental effects associated with low levels of point exceedances suggesting that some number of remaining cleanup standard point exceedances may be acceptable following a large-scale sediment cleanup; 3) the statement that "once an alternative is selected and implemented, minor isolated exceedances may not lend themselves to being delineated, managed, or verified and the cost may be disproportionate as discussed in Appendix J." While Ecology may determine that isolated exceedances do not merit further action, based on a number of factors, this text overreaches. Evaluate alternatives according to the degree to

which they predict attainment of the sediment quality goals (i.e., an alternative where 100% of the site is predicted to be below SQS immediately following remedy construction would get the highest rating for net environmental effects under SMS, 99% immediate attainment would yield a lower score, etc., and an alternative that does not reach CSL within 10 years would score lowest.).

365. **Page 9-3, Section 9.1.1.2:** The SMS discussion does not include an evaluation of human health criteria. See general comments and WAC 173-204-570(2)-(5). State that the SMS require site-specific human health criteria to be achieved by year 10 after completion of active cleanup action or remediation (i.e., all capping, dredging, ENR or other active remediation which would not include MNR or ICs).

366. **Page 9-3, Section 9.1.1.2**: Add bullets for Water Quality Criteria per CWA Sections 303 and 304 consistent with CERCLA Section 121(d)(2)(A) and (B).

367. **Page 9-4, Section 9.1.1.2, 2nd bullet on page**: The Endangered Species Act should not be designated as an ARAR, it is, like all other federal laws, a law that nevertheless must be complied with. This comment applies to all "ESA as ARAR" references. Many misconceptions seem to surround ARARs. Federal and state legislation and formal rulemaking are never negated by the absence an ARAR designation in a CERCLA ROD (an administrative act). ARAR designations give EPA authority to decide whether designated laws have been adequately complied with in lieu of other authorities who may usually or also make such decisions, and (significantly) to waive them. While EPA RODs have not been consistent, the ESA Section 7 requirement to consult with species-listing agencies (to gain their expertise), to obtain their formal Biological Opinions, are requirements EPA as a federal action agency will comply with, at least at this site. OSHA is often called out in EPA RODs as an "other law" that is not an ARAR but must be complied with. Current thinking is that ESA, historical and archeological preservation acts, animal or species protection acts, all laws which may be classifiable as environmental if the term is used broadly, that are hard to fit into the Section 121(d)(2)(A) meaning of ARARs as minimum standards or levels of control that hazardous substances remaining onsite at the completion of remedial action must meet or waive, should be designated as OSHA has been designated. These laws continue to be expressly cited in RODs because they are anticipated to have provisions that implementing the ROD may reasonably likely require compliance with.

368. **Page 9-4, Section 9.1.1.3, Compliance Monitoring Required Under MTCA, last paragraph:** While it *may be true* that monitoring required under CERCLA would fulfill MTCA compliance monitoring requirements, that is not necessarily the case. The MTCA requirement is specific and prescriptive, and a threshold requirement, so compliance monitoring must be addressed for every alternative. It would be best to explain how the proposed monitoring plan was designed to meet both CERCLA and MTCA requirements.

369. **Page 9-6, Short-term Effectiveness:** Under MTCA, restoration time frame is evaluated under long-term effectiveness discussion, while under CERCLA, it is evaluated under short-term effectiveness. Briefly explain this difference.

370. **Page 9-6, Section 9.1.2.2, Reduction of Toxicity, Mobility, and Volume through Treatment:** The FS provides no analysis, either here or in Section 7, to support the claim that none of the contaminated sediments in the LDW are principle threat wastes. While we agree that this is the case for most LDW sediments, there are some sample locations with

very high contaminant concentrations, so we disagree with statements that there are no principle threat wastes in the LDW.

371. **Page 9-6, 9.1.2.3, Short-Term Effectiveness:** Consistent with our general risk to workers comment above in this section, state that MTCA does not specifically call out worker protection when evaluating short-term impacts because those are expected to be managed through engineering design and health and safety plans later in the process. See WAC 173-340-400 & -810.

372. **Page 9-8, Section 9.2, Summary of Contaminant and Risk Reduction over Time For Each Alternative:** Text indicates that it was assumed active remedies achieved PRGs after construction. However, Section 8 assumed that remediated SMAs were assigned "replacement values" equal to anthropogenic background. Please revise text.

373. **Page 9-8, Section 9.2**: The 95% UCL on the SWAC should be compared, not the SWAC.

374. **Page 9-11, Section 9.2.1, Reduction of Site-wide and Area SWAC and UCL95 over time, bullet 2:** Text states increasing concentrations are anticipated, but all of the Alternative 3 series and Alternative 4 series for SMA 43 propose only verification monitoring, indicating an expectation that the area is already meeting the lowest RALs. Please correct this apparent discrepancy.

375. **Page 9-13**: Change risk to hazard quotient when discussing non-cancer risks.

376. **Page 9-14 – 16, Estimation of Restoration Timeframes:** As noted in the general comments, the method used for estimating restoration timeframes underestimates timeframes for alternatives with larger cleanup footprints and does not provide a reasonable basis to compare between alternatives. The uncertainty introduced by the assumption that natural recovery occurs only after completion of construction should be discussed. The large uncertainty associated with natural recovery estimates should be contrasted with the more certain construction estimates.

377. **Page 9-19, Section 9.3.3.1, Magnitude and Type of Residual Risk**: State the post-cleanup residual risk associated with this alternative. Discuss the uncertainty associated with estimates of residual risk for MNR. This comment applies to similar discussions for other alternatives.

378. **Page 9-23, Section 9.4.2, Alternative 2, Compliance with ARARs:** The detailed analysis of alternative 2 indicates that 7% of the points exceeding SMS after 10 years are not addressed, but would be compliant anyway because remaining effects are negligible, and it would be technically infeasible to resolve and manage the remaining effect and that any effort to do so would be cost disproportionate to potential benefits. The discussion adds that adaptive management will address these areas through monitoring and contingency actions. Alternatives 3 and 4 do not consider any areas as technically infeasible. See our related comment on page 9-3 above. Revise the contradictions according and remove the hyperbole in this section and elsewhere.

379. **Page 9-24, Section 9.4.2, Alternative 2, Compliance with ARARs:** Revise all ARAR sections in a manner consistent with prior ARAR comments and with the ARAR list developed after consultation with the agencies as directed in ARAR comments on the confused table in Section 4.

380. **Page 9-25, Section 9.4.3.2., Alternative 2, Adequacy and Reliability of Controls:** This section must discuss the extensive MNR monitoring requirements for this alternative.

381. **Page 9-30, Section 9.5.1, Alternative 3, RAO 2:** The risk associated with beach play in Alternative 3 is not the same as that for Alternative 2. This should be discussed.

382. **Page 9-38, Section 9.6.2, Alternative 4, Compliance with ARARs:** It is not clear what the ARARs compliance problem is with this treatment alternative. Wastewater is generated and must be discharged under all alternatives, and as noted in the FS, wastewater treatment technologies are well established. What law or regulation prevents beneficial use of ostensibly clean sands as referred to in the last sentence of the second paragraph?

383. **Page 9-40, Section 9.6.4, Alternative 4, Reduction in TMV, 1st full paragraph:** This paragraph states that COCs would be released from discharge of contaminated wash water to the LDW. This release mechanism can and would be controlled, so it would not be an unmanageable concern. Text should be revised to indicate this waste stream will require management to ensure discharge does not occur.

384. **Page 9-44, Section 9.7.1, Alternative 5, Overall Protection**: Risks should be explicitly stated here rather than cross referenced as being the same risks as elsewhere.

385. **Page 9-45, Section 9.7.3.1, Alternative 5, Magnitude and Type of Residual Risk:** Revised 3rd sentence to read "Alternative 5 theoretically removes all sediment that poses risk above background levels.."

386. **Page 9-45, Section 9.7.4,Alternative 5, Reduction in TMV:** It's unclear why this is the only alternative where dredge residuals and other residual contamination are discussed. A more thorough discussion of residual management is warranted in Chapter 8 rather than one sentence in this section. State that remedial action can be synchronized with structural maintenance, particularly when responsible parties are motivated to coordinate these activities.

387. **Section 9.8, Uncertainty Considerations:** The FS likely overestimates actual cleanup footprints, and consequently, area, volume and cost estimates. If the FS natural recovery model is correct, the SMA footprints based on 2004 and earlier data will be smaller when baseline sampling is done several years from now. Add this to the uncertainty discussion.

388. **Page 9-47 Section 9.8 Uncertainty**: Discuss the influence of background concentrations on uncertainties. There is some discussion on 9-49, paragraph 4, with the discussion of closeness to background levels. Indicate to the extent to which the ranges discussed earlier in the FS may contribute to uncertainty.

389. **Page 9-48, Section 9.8.1, Recontamination Potential:** The STM runs used to evaluate movement of sediment from outside EAAs to inside them were too general to be used to make the statements in this section. Depending on the location of the EAA, the setup of this run does not allow for conclusions on chemistry and recontamination to be made. If adjacent sediments are contaminated, the influence of their transport to the EAA in terms of recontamination would be different than if they were not contaminated. The conclusion that the STM indicated that recontamination potential from sediment transport should not be a factor influencing sequencing except when SMAs are adjacent is also not supportable by this

run. This determination will likely need to be made on a reach by reach basis. Revise text accordingly.

390. **Page 9-48. Section 9.8.2**: Discuss the spatial and temporal uncertainty of the BCM results in greater detail. Include that since the BCM assumed that all lateral inputs have the same concentration, it is likely that the accuracy of the BCM on a smaller than site-wide scale will be poor, especially near outfalls. Also state that the use of average concentrations instead of time-variable ones leads to uncertainties in both spatial and temporal scales.

391. **Page 9-50, Section 9.8.3, Dredging**: Even though it's not a major issue, include benthic community recovery timeframes following dredging/capping and compare them to timeframes for other alternatives including natural recovery. This could be discussed elsewhere, perhaps in 10.2.3.2 p 10-11.

392. **Page 9-50, Section 9.8.3, Dredging Limitations and Dredging Residuals:** Delete first bullet. East Waterway was not a site-wide remediation project, and post-cleanup contamination was likely due to contaminated sediments outside the dredge footprint not being addressed.

393. **Page 9-54, Table 9-2a**: Which end of the background range is being used? Tables should include both the upper and lower end. Rationale for use of iterations for Hall's boot strap should be provided.

394. **Page 9-56, Table 9-3a**: What does "Assumed population of 44" mean for the Hall's bootstrap calculation?

395. **Page 9-57, Table 9-3b:** As noted elsewhere, comparison should be to UCLs, not SWACs.

396. **Table 9-5a and subsequent tables:** All tables showing human health seafood consumption risks, including informational and central tendency scenarios, must include the Suquamish seafood consumption scenario. RME risks must be segregated from other risk characterizations.. Readability of table could be improved by enhancing the "Time after remedy completion" column.

397. **Table 9-5b – d (and 9-7):** Revise this table when background values are revised. Background risk should be presented along with total and site risk. Show predicted tissue concentrations in addition to risk. A comparison to non-urban Puget Sound tissue concentrations should also be made for informational purposes.

398. **Page 9-61, Table 9-5c:** According the legend, HQs =1 should be green, but they are not. Please revise.

399. **Page 9-64, Table 9-7**: Presumably these risk estimates were generated using SWACs. SWUCLs should be used instead.

400. **Page 9-77, Table 9-13**. A discussion of all RAOs should be included under the Overall Protection of Human Health and the Environment section.

401. **Table 9-13**:

- Be careful when talking about RAO 1 risk reduction (here and elsewhere in the FS) to clarify that statements only apply to PCBs, and that risk reduction for other chemicals cannot be predicted with the information provided in the RI/FS. The FS cannot say that any alternative achieves a certain risk level for seafood consumption without qualifying the statement.
- Risks should be stated for all alternatives rather than cross-referencing risks for another alternative. It might be helpful to use the color coded risks for earlier tables in conjunction with exposure scenarios.
- Alternative 2, Implementability, expand on the administrative difficulties associated with obtaining the necessary approvals to site a confined aquatic disposal facility.
- See previous comments on risks to workers & revise accordingly, delete worker death and injury statistics..

402. **Figures 9-2 through 9-6:** These are key figures for the FS and they are not very readable. In general, the Agencies and LDWG need to discuss better ways to discuss and display uncertainties associated with natural recovery estimates as this is a key element in the analysis of alternatives.

Section 10: Comparative Analysis

403. **Section 10, General comment:** The text on comparative analysis does not provide sufficient analysis of the sub-alternatives. Revise accordingly. Please remove duplicate text also found in Section 9 to enhance focus on the comparative analysis.

404. **Page 10-1 – 10-4, Section 10.1.1, Overall Protection of Human Health and the Environment**: Alternatives with a larger cleanup footprint should get increasingly higher rankings for overall protection because of the higher certainty (as compared to MNR) that the cleanup targets will be met. Overall, the uncertainty associated with natural recovery estimates must be an important weighting factor in the nine criteria analysis. State that no Superfund site has successfully met sediment cleanup goals through a natural recovery remedy to date.

405. **Page 10-4 – 10-6, Section 10.1.2, Compliance with ARARs**: As noted in previous comments, alternatives where a higher percentage of stations with SQS exceedences are being actively remediated should rank higher for compliance with ARARs and overall protection. This section should discuss how alternatives meet MTCA risk and background requirements.

406. **Page 10-5, Section 10.1.2:** The cleanup must address water quality as well as sediment quality. Alternatives must meet federal water quality criteria for protection of human health (consumption of seafood) post-cleanup.

407. **Page 10-6 – 10-10, Long-term Effectiveness and Permanence:** Provide more information on the volume and concentration of subsurface contamination left in place under each alternative, and the possibility that this contamination could come into contact with organisms. The FS seems to be saying that the only mechanism for exposure of subsurface contamination is scour due to high flow events, however mechanisms such as advection, migration via groundwater, erosion, or human use (ship scour, anchor drag, excavation for construction), must be discussed, as well as reliability and trade-offs associated with controls that could be put in place to prevent exposure.

408. **Page 10-13, RAO1, 1st full paragraph, last sentence:** This phased run can't be used to evaluate impacts to changes in post-cleanup sediment values. Delete this sentence. Text reaches for an interpretation that MNR is likely to reduce risks just as quickly as active remediation. However, this text does not consider the uncertainty associated with the MNR time frame. This must be added.

409. **Page 10-16, Section 10.2.5, Costs**: As noted previously, while the cost of implementing the EAAs can be provided for informational purposes, it is not a part of the cleanup alternatives being evaluated. Alternative 1 costs must be clearly separated from cost estimates for the subsequent alternatives.

410. **Page 10-17, Section 10.3, State, [add Tribal] and Community Acceptance**: Because we solicited public comment on the first draft FS, the revised draft should provide some information about the comments received from Tribes and the community on the first draft.

411. **Page 10-18 – 10-19, Section 10.4, Managing COCs other than Risk Drivers (and Table 10-2):** Table 10-2 should include an explanation about why Alternative 2 was used – is the idea that if risks are sufficiently reduced under Alternative 2, they will be sufficiently reduced under all other alternatives?

412. **Page 10-20, Section 10.5, Construction Rate Considerations on Restoration Time Frame**: Delete first, fourth and fifth bullets on page, and the phrase "from simultaneous implementation of several projects" in the first paragraph. The agencies disagree that a higher dredge construction rate will lead to water quality compliance problems. As noted in previous comments, all assumptions about which parties will do what cleanups, and whether SMAs will remain the same after RD sampling, must be removed from the FS.

413. **Page 10-20, first full paragraph, third sentence**: This sentence is not clear, please revise.

414. **Page 10-20, Section 10.5:** The problematic assumptions discussed seemed to be contradicted by the examples given. If higher production was possible on smaller projects, it would seem the economies of scale could be realized due to the size and number construction activities proposed in Alternatives 3 and 4 The FS lacks an evaluation of the economies of scale to be realized by implementing activities as a single coordinated project.

415. **Table 10-1**:

- Connect the concept of disturbed areas and depleted sources to dredging and capping volumes, since referenced in text.
- It is not clear why long term effectiveness has the same ranking for sub-alternatives.
- In general, the agencies disagree with many of the starred rankings, as is evident from our previous comments.

416. **Table 10-2:** Why is the detection frequency (3rd column) sometimes less than 4th column, which is percent removed? Are these not both in %? Please reconcile.

417. **Table 10-3:** Include a physical location in the discussion or on a map so the ecological risk assessment doesn't have to be referred to.

418. **Figure 10-5**:

- It is not clear what time frames are being shown. Are RAO 1 recovery times sediment recovery times + 3 years? What is MNR-predicted sediment recovery time? Clarify by showing sediment and tissue recovery times separately.
- For RAO 4, it doesn't make sense to say that 3c, 3d would take longer to reach this RAO than other alternatives, if cleanups are being done sequentially – all 3a area, then 3b areas, etc.

419. **Figure 10-7:** Cost scale can be reduced by making maximum value $1,000 Million to show differences in Alternatives.

Section 11 Conclusions and Recommendations

420. **Section 11, general comment**: The adaptive management approach discussed in this section provides some interesting ideas but is not sufficiently developed or detailed to allow for serious consideration. In general, the concept of adaptive management needs to be refined to reflect the ability to adopt a conservative approach initially and subsequently make decisions, based on data analysis, that are protective but may require less remediation. It should be employed from the beginning, starting with verification monitoring. Triggers for contingency actions must be clearly identified. The process for obtaining and evaluating new information through monitoring and determining if areas they have been successfully remediated or have successfully recovered, or are recovering and will need further monitoring, must be clearly delineated. Discuss whether part of adaptive management includes updating and adjusting the original models, including the BCM and FWM, as new information is obtained. In addition, please revise this section to incorporate comments on similar text elsewhere in the FS.

421. **Section 11, general comment:** Verification monitoring is not a 'selected remedial approach', but is a recharacterization of older data to determine whether further action is warranted or not. This concept should be utilized in conjunction a cleanup remediation prioritization scheme (worst-first or other) by designing a rigorous enough monitoring program and clear decision-making criteria to decide whether a given area has recovered or not. Therefore, the 'continuum of actions' should not be limited to worst-first sequencing, but should also include the proposed adaptive management of resolving the remedial status of as many SMAs as soon as feasible. It would seem that verification monitoring (in the FS Category 3 areas) should occur before Phase 1 and the ROD, to see what can be considered already recovered, but category 1 and 2 subSMAs would be further evaluated at the time of remedial design when the footprint for active remediation is formally defined. Is that the planned approach?

With the extended time periods projected for the various remedial alternatives, it will be important to be able to demonstrate progress for waterway-wide recovery—the identification of SMAs or areas as recovered will be a process-oriented way to indicate progress of management towards recovery. Therefore, milestones should be established for demonstrating progress under the various alternatives in the overall site remediation. This is consistent with item 2 under Section 11.4.1, but should be implemented from the start, not after active remediation.

422. **Page 11-10, Section 11.2, 4th bullet:** Remove reference to individual projects.

423. **Page 11-12, Section 11.3, Risk Management Principles and National Guidance:** Suggest citing the original 2002 "Principles for Managing Contaminated Sediment Risks at Hazardous Waste Sites" memorandum, and putting the list in the FS in the same order as that memorandum.

424. **Page 11-12, Section 11.3:** Under item 2), the discussion misses the point of this criterion, which is to fully understand and explain the uncertainties associated with site data and modeling results. Clarify.

425. **Page 11-14, #9:** Text should mention that this a joint order, so state coordination is ensured.

426. **Page 11-18, Section 11.4.1, Conceptual Approach, Item 5**: The bullets shown here are confusing, because they do not use the same criteria used elsewhere in the text for the proposed alternatives. Clarify.

427. **Page 11-18, Section 11.4.1, Item 8:** CERCLA states that hazardous waste sites with waste left in place will be monitored at least every 5 years. In order to monitor whether MNR is progressing as predicted by the model, monitoring must occur more frequent than every 5 years.

428. **Page 11-21, Section 11.4.2, Phasing of conceptual Approach:** Text seems to indicate that MNR monitoring would not begin until 2022, which is much too late. If baseline/verification monitoring is conducted within the first five years following a signed ROD, the long term monitoring should be implemented in regular increments starting from the time the baseline is completed. The long term monitoring should be used to evaluate sediment and environmental quality improvements and to assess recovery trends through the duration of active construction and recovery periods. Revise text to reflect this approach.

Appendix C – Sediment Modeling Memoranda

1. **Part 1, Scaling of BCM**: There are likely problems with certainty when applying chemical concentration or sedimentation rate (from STM) onto a 10x10 ft grid. The chemical data are sparse relative to this grid. Similarly, the sedimentation rates may not accurately reflect local-scale deposition near outfalls, for example. What is the impact of extrapolating to this scale? We have stated in the past that it makes more sense to revise the scale to match the lowest resolution we have (STM scale). Using a more refined grid for future analysis implies that we know way more about the system than we do. The scale used for the BCM should be discussed with the agencies.

2. **Part 1, Page 6, 2nd paragraph, last sentence:** This statement can be provided further support by indicating that chemical concentrations in eroded sediments are not significantly higher than typical bed sediments. Is this correct? If not, how might these percentages change for chemical loads? - should the percentages look similar or might they increase? A simple calculation looking at eroded mass and COC concentration in the eroded mass might be sufficient to indicate that erosion/redeposition are not important from a chemical standpoint.

3. **Part 1, Page 8, 2nd paragraph**: Text states, "Long-term changes in sediment concentrations in the region from RM 4.8 to 5.0 will need to be addressed in the FS by a different approach." There is no text in the main body that discusses a different approach. Please explain what the "different approach" was for these areas.

4. **Part 1, Page 8, 2nd paragraph**: No proof or reference is provided to support the statement "the surface sediment in remediated areas tends to chemically re-equilibrate with adjacent unremediated areas within a relatively short time frame (e.g., within 1 to 2 years)". Delete or provide better justification for this statement.

5. **Part 2, Page 2, 2nd bullet**: From previous reading, there is no potential for erosion post-remediation (for example, re-distribution of residuals). Are residuals assumed to disperse shortly after dredging? How is chemical mass conserved if it is assumed that residuals will be dispersed shortly after remediation (as described on page 8 of this appendix)? Clarify.

6. **Part 3:** Reviewers are surprised that berthing area conditions do not indicate 25 cm erosion. Include a table showing shear stress. The agencies are concerned that un-developed boundary layer is not reflected in the calculation of shear stress. Shear stress calculation assumes developed boundary layer and may significantly under-estimate actual bottom shear stress. Discuss with the agencies tug-generated erosion scenarios and methods and needed revisions to this analysis.

7. **Part 3, page 8, first equation**: This equation is valid for fully developed flow, which is not the case for propeller wash. However, it should be a conservative assumption in this case since v_max is being utilized.

8. **Part 3, page 11, Table 6 note**: This note should reference should be shear "stress", not "strength".

9. **Part 3, Page 13**: The most susceptible areas for erosion should be the shallowest areas in which the tug operates, correct? If so, please describe how 7 and 9 m depths were assumed as appropriate indicators. It is likely that the tug operates in less than 7 m water.

10. **Part 4, General**: Include tables and figures outlining 1) model assumptions, 2) model framework, and 3) model input to allow for better assessment of model validity and sources of uncertainty.

11. **Part 4, General:** Provide more information in this memorandum about the FS questions these scenarios are attempting to answer and how the information derived from the simulations was used in the FS.

12. **Part 4, page 3, Scenario 1**: Are sediments transported between EAAs (i.e. eroded in one EAA and deposited in a different EAA) represented in the percentages listed in Figure 1.3? Clarify.

13. **Part 4, Scenario 2**: This scenario is hard to interpret. It may have been more beneficial to make some significant changes in loadings to see the influence of distribution. This appears to be small "tweaks" to the loadings overall (with a few exceptions), resulting in only small changes to the bed fractions from loadings. How were the values derived for scenario 2? It does not look much different than the original STM scenario.

14. **Part 4, page 12, Scenario 4**: Does the final fractions include not only initial deposition of a particle from one reach to another, but also subsequent re-entrainment and deposition of these particles (i.e. these sediments are tracked as a separate class of sediment in the STM). For

example, does the amount of sediment from reach 3 that exits the river increase with time? Does the rate of material exiting the river increase with time?

Appendix D – Supporting Analysis for SMAs and RALs

15. **Page D-3, Section D.3.1, Metric 1: BCM-predicted Year 10 Concentrations:** This analysis appears to only consider achieving SMS standards and direct contact PRGs in 10 years. It must also include achieving background values in 10 years.

16. **Page D-5, Section D.3.2, Metric 2: Effectiveness Index**: This metric (and in fact much of the analysis in this section) presumes that the most important goal of remediation is to reduce the SWAC. It neglects RAO 3, which requires reducing contaminant concentrations on a point-by-point basis. Per our previous comments, this effectiveness index approach lacks transparency. Delete text and associated figures in favor of the much more straightforward D-1 series of figures.

Appendix E – Methods for Calculating Volume of Contaminated Sediments Potentially Requiring Remediation

17. The interpolation process is not exact and to quantify the required dredging to some level of confidence is difficult if not impossible or impracticable on a large site such as Duwamish Waterway. The uncertainty of the volume estimate must be approximated based on comparison of accuracy rates (FS vs actual) at other sites.

Appendix F – Empirical Evidence of Natural Recovery and Comparisons to Model Predictions

18. **General Approach:** The analyses presented in this section attempts to make the best of very limited data of the type needed to assess temporal changes in sediment concentrations. The interpretation of these data appears biased to support the authors' hypothesis that natural recovery is taking place throughout the LDW at a rapid rate. Alternative ways of looking at the data are ignored and observations that do not support the hypothesis are explained away. The information supporting natural recovery is particularly sketchy for the STM middle reach (RM 2.2 - 4.0), the area with 5 un-remediated EAAs and identified by the STM as an area of mixed deposition and erosion. The appendix must be revised to take a more conservative approach in comparing the model with the data. Areas where the empirical data do not support model predictions of recovery may not be proposed for MNR. Add a discussion of the limitations of the data used for this analysis and state that conclusions must be regarded with caution.

19. **Conclusions with respect to Alternatives:** Although there is a lot of analysis presented in the section, a different criteria set is used in each analysis, so it is difficult to track the application of the results to the conclusion of natural recovery. To improve clarity, please add to this appendix the criteria resulting from this analysis that classifies sites as recovering so that the reader can follow this material. This appears to be started on Figure F-25 but is missing supporting text.

20. **Case Studies:** Any discussion of the case studies used to demonstrate the success of natural recovery in the FS should include a statement that none of them demonstrates the reduction of both sediment and tissue concentrations to the required cleanup standards. The examples have

either 1) not been in place long enough to indicate successful cleanup, based on the issue dates of their Records of Decision or 2) are not the sole selected remediation remedy. Consequently, the FS should not state that these examples show that MNR was "successful" at these sites, but instead should make more qualified statements about the status of these projects.

21. **Page F-3, Section F.1.2, Common Tools for Assessing Recovery:** Measured deposition rates are used to calibrate the model, but are not generally used as model input. Measured settling speeds may be used as model input. Please clarify.

22. **Page F-4, Section F.1.2, Common Tools for Assessing Recovery, 2nd paragraph:** It is not clear what is meant by "significantly desorb", but data from other sites indicate that PCBs are released from the sediment to the water column at rates greater than predicted by equilibrium partitioning. This uncertainty in MNR estimates should be discussed.

23. **Page F-4, Section F.6.2.2: Case Studies of MNR as Part of Remedy:** Palos Verdes Shelf, California is a highly depositional site that has been studied for a long time. Although cleanup goals have not been met through MNR, this site could be added to the case studies as there is good documentation of MNR processes.

24. **Page F-6, Section F.1.4.1, Federal Guidance, last paragraph in section**: This paragraph should more accurately state that these studies documented that MNR processes were occurring at some portions of these sites. "Documented the success of MNR" could be read to mean that all remedial goals were met through MNR, which was not the case at either of these sites.

25. **Section F.1.5, Influence of Ongoing Sources, general comment:** It's not clear what the overall point or conclusion of this section is. Is it to support the lateral loading estimates used in the BCM? Clarify.

26. **Page F-13, Section F.2.1.1, Net Sedimentation Rates Estimated from Cores, 1st sentence on page:** Some of this burial is probably due to river-bathymetry adjustment to the introduction of the dam in 1961. Any more recent (say, post-1980) data would be the most relevant to predicting ongoing sedimentation rates. There is also no evidence on when and how the burial occurred, only that there is general evidence that it did. This statement should be caveated appropriately.

27. **Page F-14, Section F.2.1.3, Effect of Scour on Net Sedmentation Rates and Recovery, 2nd paragraph on page:** This analysis of SMAs is difficult to follow. Which RAL was used to do this analysis? SMAs were identified based on SQS exceedences, so had to have contamination in the upper two feet. As written, it sounds like some areas may never have had high chemical concentrations and therefore remediation may not be occurring? Please clarify how these 16 cores indicate that an area is recovering.

28. **Page F-14, Section F.2.1.3, Effect of Scour on Net Sedmentation Rates and Recovery, 2nd paragraph on page:** The assumption here is that a prop-induced bedform is stable over long periods. Is there any evidence indicating that this is true? Can we identify the scour and post-scour sedimentation portions of these bedforms? See general comment on the handling of prop wash in this analysis.

29. **Page F-15, Section F.2.2, Changes in Surface Sediment Chemical Concentrations**: Although the report acknowledges the importance of analytical variability and spatial heterogeneity, how is this taken into account in the analysis? Many of the re-sampled locations were selected to re-visit samples with SQS exceedances. What is the probability of re-sampling elevated concentrations from a lognormal distribution? Include this analysis in the appendix. In addition, because of the major differences in deposition and erosion identified by the STM among the three reaches, rather than conducting a site-wide analysis, complete separate analyses by Reach are recommended.

30. **Page F-15, Section F.2.2.1, Analysis of Resampled Surface Sediment Locations:** Why were EAAs excluded from this analysis?

31. **Page F-16, Section F.2.2.1.1, Analysis of Population Trends for Resampled Locations:** Please explicitly state significant decrease at 21 sites, no change or quasi-equilibrium at 18 sites, and significant increase at 8 sites. Therefore, approximately 40% of the sites exhibited MNR.

32. **Page F-17, Section F2.2.1.2, Location-by-Location Comparisons at Resampled Locations, 2nd Paragraph, 1st sentence:** Does this statement include sites with reduction less than 50% (gray dots)? Looks like there are only 21 sites demonstrating reduction >50%. If we declare the gray dots as 'not changing', then on a location-count basis, we would state that the surface PCBs are 'not changing'. However, if we compute surface concentrations as an average of all 47 sites, then surface concentration is decreasing. Please clarify the difference in these two methods and relevance for assessing remediation.

33. P**age F-18, Section F.2.2.2.1 Duwamish/Diagonal:** The data indicate that there were some hot spots during the capping process. However, is it still too early to determine if natural recovery is occurring in these outlying areas as a general trend? There is a pattern, but it may be too early to declare natural recovery is demonstrated over this 3-year span Data from Feb07 do not look that much different than data from Jun06 (except for one outlier in June). Please discuss the influence of outlier points on trends. Issues to note include 1) why there was an increase in 2006 in cap B (as shown on Figure 10a) and 2) whether there similar dramatic decreases in PCB concentration occurring on an oc-normalized basis in the ENR area?

34. **Page F-19, Section F.2.2.2.2 Norfolk Area:** Please discuss the magnitude of these cuts compared to the overall cap. What were the PCB concentrations in the sediment beneath these cuts? Did the cuts go all the way through the cap. What percent of the cap was compromised by these drainage cuts? Is the cap the same size as the 0.04 acre removal site? Additional discussion of this capping is needed. If a reference is available, please cite.

35. **Page F-20, Section F.2.2.2.2 Norfolk Area:** This is a very shallow area, so even small boats can contribute to cap and near shore sediment erosion. Is this area not used by small crafts?

36. **Page F-20, Section F.2.2.2.3, Slip 4**: As noted in previous comments, the agencies disagree that comparison of samples taken in different locations provides any evidence to support natural recovery. Delete.

37. **Page F-21, Section F.2.3.1, Percent Reduction of Total PCB Concentrations in Cores**: Text states percent reduction in bed sediment over 40 years. Figure 14 states percent

reduction in bed sediment after 30 years. Despite clarification on the 40 year estimate given below, this is still confusing and must be clarified.

38. **Page F-21, footnote 5:** Almost all of the information used to support the conclusions in this section is based on cores downstream of River Mile 2. Excluding cores from the navigation channel and within slips, only 3 cores from upstream of RM 2.0 show higher concentrations at depth (Table F-5a), while 9 cores show no pattern with depth (Table F-5b) and 5 cores showed higher concentrations in the surface (Table F-5c).

39. **Page F-22, Section F.2.3.1, Percent Reduction of Total PCB Concentrations in Cores, bullet 1:** The agencies disagree there is sufficient evidence to make this conclusion. To really show this, it would require repeated data from the same sample interval. It appears that "some recovery" at these locations is still questionable.

40. **Page F-22, Section F.2.3.1, Percent Reduction of Total PCB Concentrations in Cores, bullet2:** Besides scour or ongoing contaminant deposition, it appears that these core trends could indicate a zone that is neither depositional nor erosional.

41. **Page F-22, Section F.2.3.1, Percent Reduction of Total PCB Concentrations in Cores**: Given the complexity that has to be included in the analysis, please re-define "conservative" and place quantitative values on the terms "some recovery" and "many of the areas".

42. **Page F-23, Section F.2.3.3, Dredged Material Characterization Chemistry in the Frequently Dredged Area:** This section should be revised to reflect new 2009 dataset. .

43. **Page F-25, Section 2.4.1, Biotic Health**: Please discuss how much of this is believed to be due to cleaner water vs. cleaner sediment.

44. **Page F-25, Section F.2.4.2, Tissue Concentrations:** As reviewers have repeatedly pointed out, presenting PCB concentrations in fish on a wet weight basis for trend analysis, particularly when comparing fish collected in the spring with very low lipid content (pre-2004) with fish collected in late summer (2004-7) with much higher lipid content, is misleading at best. If the data are presented on a lipid-basis, the apparent trend is a reduction in English sole fillet concentrations post-dredging, including fish collected later in the same year dredging was completed. [see Figure 1 in NOAA comments]. Present both wet weight and lipid-normalized data.

45. **Page F-25, Section F.3, Bed Composition Model Predictions of Natural Recovery:** The specific areas evaluations should be limited to specific areas where the model/data comparison is reasonable. There are locations where the data do not compare favorably. The agencies disagree that it is appropriate to use the BCM in these areas.

46. **Page F-28, Section F.3.1.4 Dioxins/Furans and other SMS Chemicals:** Providing results for dioxin is a bit confusing because section F3.1 says there was insufficient data to interpolate onto the BCM grid. Please clarify.

47. **Page F-28, Section F.3.2, SMA-Specific Chemical Predications:** Please reference figure showing SMAs and sub-SMAs.

48. **Page F-31, Section F.4.1, Surface Sediment Trends Compared to STM and BCM Model Predictions: Add a** discussion of areas initially below the SQS that are now above the SQS.

49. **Page F-31, Section F.4.1, Surface Sediment Trends Compared to STM and BCM Model Predictions:** If possible, quantify “exceptions” as a percent of all comparisons of model and field data. "Majority" is too vague an approximate quantification can be provided.

50. **Page F-32, Section F.4.2, Trends in Cores Compared to Model Predictions:** See general comments. Areas with highly contaminated subsurface sediments should be considered ineligible for MNR.

51. **Page F-33, Section F.4.3, Comparing Empirical and BCM Rates of Chemical Change**: This section should acknowledge that a majority of the high resolution cores were selected in areas where natural recovery was suspected.

52. **Page F-33, Section F.4.3:** The increases in empirical data sometimes do not have corresponding BCM increases. Are these areas prioritized for consideration in the FS? Please clarify.

53. **Page F-33, Section F.4.3, 2nd paragraph:** Please place percent values on BCM underprediction compared to core intervals and resampled surface locations (for example, "BCM underpredicted recovery 80% of the time when compared to core interval recovery trends") throughout this paragraph.

54. **Page F-34, Section F.4.3:** How many acres are outside of areas targeted for active remediation? How many acres of the LDW are not recovering, but are not at hot spots, physical obstructions, or scour locations. Specifically, are there locations where recovery is simply not occurring (based on core interval data) for unknown reasons? Clarify.

55. **Page F-34, Section F.4.3.2:** Should the reference to Figure F-29 be F-31?

56. **Page F-35, Section F.4.3**: What is the 1:1 trend line in this figure? Is it a comparison of model to data?

57. **Page F-35, Section F.5.1, Uncertainty in Resample Surface Sediment Locations**: The importance of spatial heterogeneity is acknowledged, but no analysis is presented to evaluate the potential influence of the uncertainty. It is not clear how setting a minimum number of years between sampling events minimizes spatial variability. Samples with less than 5 years between sampling events could be used to evaluate the uncertainty associated with re-sampling a location (nominally within 10 feet).

58. **Page F-36, Section F.5.1, 2nd paragraph:** Such “random errors” are commonly observed small-scale spatial heterogeneity at contaminated sediment sites. An analysis conducted for the Portland Harbor Superfund site indicated that “variation between replicate samples typically averages 40% relative percent difference for most chemicals.” (Integral and Anchor 2007) A study designed to address the uncertainty associated with co-located samples concluded that “concentration differences measured in same-day pairs approximately equals or exceeds the range measured in samples collected up to 3000 days apart” and that spatial heterogeneity was greater than temporal differences (Integral et al 2007). A similar study should be conducted for the LDW to quantify this uncertainty before data from nominally co-located samples can be used to support natural recovery estimates.

59. **Page F-44, Section F.7.1, Assessment of Ongoing Sources:** As with the rest of the FS, it is insufficient to simply state that Ecology is the lead agency for source control, and leave it at that. This appendix should acknowledge that difficulties in controlling sources may be the most likely impediment to achieving the MNR rates predicted by the BCM, especially near outfalls.

60. **Page F-46, Section F.7.4, Biological Endpoints:** As discussed above, the data indicate that any short-term effects were over within the first year. Lipid-normalized results for English sole indicate recovery 7 months post-dredging and continued decline in subsequent years.

61. **Page F-47, Section F.7.5, Predictive Tools and Models, second bullet**: Add "except in some localized areas". This sentence must also include a caveat that application of BCM results is not be suitable in some areas where either the STM doesn't capture sediment transport (berthing areas, pilings, bridges) or empirical evidence indicates BCM is not accurate.

62. **Table F-2:** A lot of data in Table F-2 are for pre-1961 deposition. These data are not relevant to ongoing deposition because of the Howard Hanson Dam. There was a table in the STM that evaluated changes in sedimentation rate for different time periods. Please add.

63. **Table F-2:** This table (and Figure F-13) lacks chemical data from Reach 2 in anything other than 1-2 foot cores, which are too coarse to provide useful resolution. Since this area is identified by the STM as an area of mixed deposition and erosion, this is an important data gap.

64. **Table F-3, Percent Change in Resampled Surface Sediment Location PCB Concentrations Ordered by Original Total PCB Concentration**: The PCB sample concentrations for approximately co-located samples are compared to estimate a half-life for PCBs, one line of evidence for natural recovery. It is interesting that when the data are ordered from the highest initial concentration to the lowest, the 12 highest concentrations all decrease (all but one by 50% or more), and six of the lowest 12 concentrations **increase**, **three by 50% or more**. That is, the highest and lowest concentrations in the dataset all are closer to the mean when resampled. This suggests mixing of sediment within the LDW, rather than uniform burial with sediment at background concentrations.

65. **Table F-5:** This table is for all of the cores identified in Figure F13? A few plots vs depth are provided in Figure F13. Please provide reference for other locations discussed in Table F5. Also, what do U and J indicate in the last column of Table F5b? Figure 13 is difficult to comprehend with the three smaller figures inserted into it. Clarify.

66. **Figure F-4**: Appears to be missing some cores. All cores on Figure F-2 should be included.

67. **Figure F-13:** This figure contains insufficient description and is difficult to interpret**.** More discussion is needed if complex figures are going to be used.

68. **Figure F-16, Trends in English Sold Muscle Tissue Total PCBs in LDW and Nisqually/Carr Reference Area:** There appears to be in error in the wet weight concentration for English sole fillet in 2004-the highest measured concentration in English sole fillet in 2004 was 2010 ng/g wet wt., much lower than the approximate 3500 ng/g shown in the figure. Please correct.

69. **Figure F-28:** The surface and subsurface cores shown on the graphs may not be on the same time scale on the y axis. Confirm that approximate year of sample is checked for consistency. Otherwise, plotting on Year Elapsed may not make sense or be meaningful when compared to one another.

70. **Figure F-29:** If Category 1, 2, 3 designations are retained, color-code SMAs or otherwise note which ones are in which category.

71. **Figure F-30:** Revise Legend to show which areas are not recovering. How are these areas demarcated? Are the areas not showing recovery noted by red boxes, or are they the yellow shaded areas? It is difficult to determine how this figure compares to the SMAs. Include a figure which overlays the SMAs on the yellow shaded areas.

Appendix H – Computing Hall's Upper Confidence Limit (UCL) for IDW-Interpolated Data

72. On 11/21/08, EPA provided a memo to LDWG's consultant, ENSR (now AECOM) discussing how Lower Duwamish Waterway (LDW) Hall's bootstrap (HB) 95% spatially weighted upper confidence limit (SWUCL95) coverage simulations were to be conducted. Given that the impact of the skewness of the data on coverage was the greatest concern, EPA stated that PCB data should be used for coverage evaluation. AECOM was instructed to determine coverage as a function of:

1) The interpolated PCB surface concentrations associated with three different scenarios:
   a) The pre-remediation RI inverse distance weighting (IDW) statistical distribution
   b) Alternative 4 (manage to the SQS time 10 not expected to recover and achieve SQS or background by year 10)
   c) Alternative 2 (manage to the CSL at year 10 not expected to recover)
2) A range of samples sizes (i.e. 30, 50, 100, 200, and 500)

For each combination of interpolated surface and sample size, 4000 HB SWUCL95s were to be determined. For each HB determination, the SWUCL95 was to be compared to the mean of the interpolated grid and coverage calculated using the formula:

Coverage = # of times HB SWUCL95 determination > SWAC / 4000

Appendix H did not use the approach required by EPA for assessing coverage. Single HB determinations of SWUCL95s were conducted for all remedial alternatives for arsenic, PCBs, and cPAHs. These single HB SWUCL95 determinations utilized the RI data set sample size. HB SWUCL95 were then compared to the SWAC for each contaminant and it was noted that in only one instance was the HB SWUCL95 less than the SWAC. This appendix concludes that these results suggested that HB SWUCL95 computations had adequate coverage when applied to the Duwamish data.

The approach employed in this appendix is inadequate for the following reasons:

1) The qualitative method of computing coverage employed simply does not provide a true quantitative estimate of coverage as required by EPA.

2) Given that LDW cPAHs and arsenic concentration distributions are less skewed than PCB concentration distributions, and that concentration distributions for alternatives with longer remediation time frames are also less skewed, inclusion of these scenarios in the qualitative estimate of coverage gives a false sense that HB performs adequately when applied to LDW data. It would be expected that application of HB would result in SWUCL95s that exceed SWACs less frequently for distributions with less vs. more skewness. EPA specifically directed evaluation of HB for PCB distributions with short remediation time frames because the performance of HB in cases with highly skewed contaminant distributions was most questionable.

3) Suggesting that the coverage of HB as applied to Duwamish data sets is demonstrated by Housatonic HB coverage simulations requires further justification. In particular, the variability and skewness of the Housatonic data appear to be less than that of certain Duwamish data sets. Consequently, using Housatonic HB coverage simulations to support LDW HB performance is questionable (See NOAA comments on this Appendix).

4) The degrees of freedom used to compute individual SWUCL95s provided in Table H-2 should not have been set at the RI data set sample size, but rather must use potential compliance monitoring data set sample sizes, as previously directed by EPA. The information provided in Appendix H does not show the relationship between coverage and sample size. Such information will be important in developing a realistic compliance monitoring program, unless the FS envisions compliance monitoring with sample numbers approaching those of the RI data set.

NOAA's comments on this appendix have been provided under separate cover. NOAA has proposed that rather than performing SWUCL95 coverage simulations on a single interpolated data set, that an alternate simulation approach should be employed that involves:

1) Characterize spatial distribution properties of a contaminant concentration distribution.
2) Develop a hypothetical map of contaminant distributions that match the spatial properties determined in step 1.
3) Sample the map developed in step 2
4) Compute a UCL
5) Compare UCL to mean
6) Repeat steps 2-5 and determine coverage.

NOAA's simulations using LDW data suggest that HB may not provide the desired coverage in developing SWUCL95s and as a corollary that HB SWUCL95s are underestimates of true SWUCL95s. NOAA suggests several other methods that might be employed to derive SWUCL95s. One or more meetings with the agencies is needed to discuss the validity of NOAA's comments and their impact on the methods used to derive SWUCL95s.

Specific Comments:

73. **Page H2**: It's not correct that Hall's method is "not adversely affected" by data skewness. State that Hall's method was *designed to account for* skewness in the data.

74. **Page H2**: The main reason that ProUCL wasn't used for the Housatonic, or for the LDW for that matter, wasn't the limits on the sample size it could handle, but the fact that the program couldn't be used with the spatially interpolated data. Clarify.

75. **Page H2, footnote 2**: Dr. Ferson was not the "lead contractor" for the Housatonic, and did not run the software for most of the calculations done for the Housatonic. Dr. Ferson developed the application of Hall's method for spatially interpolated data sets and wrote the software program to make the calculations. Clarify this discussion.

76. **Page H4**: In the first paragraph of page H-4, there is a major problem with the sentence "This was evaluated by comparing the UCL95 estimate against the estimated SWAC from the original sample data." Coverage can not be assessed by a single comparison. Coverage assessment is a statistical process in which many UCL estimates are compared to the average of a distribution, in this case the average of interpolated grid values. Please correct.

77. **Page H4, H.4.1 Bias Evaluation**: The significance of differences between UCLs for different versions of the software can't really be determined unless multiple simulations are done using both versions of the software. There will be some variation from run to run within each version simply because a boot strap procedure selecting random numbers is employed. The question is whether or not variation within versions is significantly greater than variation between versions. Clarify.

Appendix I – Detailed Cost Estimates

78. **Page I-2, Section I.1, Cost Assumptions, 4th bullet:** What assumption was made for the percentage of dredged areas that would require thin-layer capping for dredged residuals management? If it is 100%, this is an overly conservative estimate and must be modified to be more consistent with experience on completed projects.

79. **Page I-3, Section I.1, 1st paragraph**: Delete first two sentences. As we have stated many previous comment letters, the FS may not make any statements or assumptions about whether this cleanup will be implemented as multiple independently planned and executed projects, or one large project implemented by a group of parties under one cleanup agreement. The agencies agree with the assumption that the number of separate mobilizations/demobilizations would equal the number of years needed to implement the cleanup.

80. **Volume Assumption on Tables:** There appear to be the following discrepancies when comparing areas in the alternatives to the areas in the Appendix I tables. Please correct:
    - Table I-7: Remediation area should be 35 for Dredge and 0 for Cap (in top 2 tables)
    - Table I-8, Remediation area should be 38 for Dredge, 4 for Cap, and 35 for ENR (in top 2 tables) Table I-9, Remediation area should be 42 for Dredge and 5 for Cap (in top 2 tables)

- Table I-10, Remediation area should be 50 for Dredge and 14 for Cap (in top 2 tables)
- Table I-11, Remediation area should be 61 for Dredge and 0 for Cap (in top 2 tables)
- Table I-12, Remediation area should be 77 for Dredge and 0 for Cap (in top 2 tables)
- Table I-13, Remediation area should be 89 for Dredge, 0 for Cap, and 42 for MNR (in top 2 tables)
- Table I-14, Remediation area should be 105 for Dredge and 0 for Cap (in top 2 tables)
- Table I-15, Remediation area should be 0 for Cap (in top 2 tables)
- Table I-16, Remediation area should be 281 for Dredge and 0 for Cap (in top 2 tables)

81. **Table I-1**: Please provide the rationale for use of 6 CY bucket. The assumption that this bucket effective capacity is 70% is higher than recommended in USACE guidance for environmental buckets (ERDC/EL TR-08-29. Please adjust to 50-65 %. Also it is not clear why the prescribed volumes are presented in this table. The dredge rates should be applied to the volumes associated with each alternative.

82. **Table I-24**, O&M Cap for year 5 should be $106,896 + $99,205

83. **Table I-28**: How was area on Table 1-28 for residuals management developed?

84. **Table I-29**:
    - Need to provide justification for the mobilization cost other that professional judgment, as this value seems high
    - Need to provide justification for implementation monitoring costs of 5,000.day.

85. **Page I-38 to I-40, Table I-28:**
    - Table is not labeled for each alternative
    - How is "Additional Dredge Volume" incorporated in Table I-28 (see bottom page I-17 – I-26 for calcs)?
    - Revise the durations to show how they relate to the durations presented in the Alternative costs tables. Although the totals match, it is difficult to track the individual durations from this table to the Alternatives tables.

86. **Page I-42, Table I-30**: Total cost is not the sum of above costs. Need to add total values (not zero) to total cost column.

87. **Page I-45, Table I-33**: Compliance Testing (ENR) should be $670,720

88. **Page I-47, Table I-35**: Compliance Testing (ENR) should be $713,000

89. **Page I-51, Table I-39**: Compliance Testing (ENR) should be $170,000

90. **Page I-52, Table I-40**: Compliance Testing (ENR) should be $170,000

Appendix J – Detailed Evaluation of MTCA Requirements for Cleanup Actions

91. **General Comment:** The FS needs to present information with respect to MTCA/SMS and CERCLA on an equal footing. Much of the text in the appendix needs to be moved into

appropriate parts of the main body of the text and integrated alongside the CERCLA requirements. All comments on this appendix are made with the expectation that text throughout the main body of the document will be made consistent with these comments. Keeping the appendix as a MTCA primer may be useful and remains open for discussion. Many of these comments apply to the CERCLA analysis in Sections 9 and 10 and should be addressed there as well.

92. **Page J-1, section J.1.1, MTCA Requirements for the FS**: The bulleted list for this section of the MTCA regulation needs to be complete. Include requirements for points of compliance, compliance with other laws, and permanent alternatives. The "providing for a reasonable restoration time frame" citation in MTCA should be WAC 173-340-360.

93. **Page J-3, Section J.2.1.1, *et seq.***: This text is inconsistent with that in section 4.3 (p. 4-12). Here, PRGs are "considered equivalent to cleanup levels under MTCA," but MTCA does not consider anthropogenic background in setting cleanup levels. Conversely, SMS considers practicability in setting sediment cleanup standards. The discussion of practicability and setting sediment cleanup standards within the regulatory context of MTCA and SMS needs to be more detailed and transparent. LDWG's proposal to treat PRGs as CULs (and thereby as sediment cleanup standards) has merit, but a clear proposal with detailed analysis needs to be presented in the FS. The FS discussion should describe the conflict between SMS and MTCA (and CERCLA, as appropriate) in setting cleanup levels and discuss advantages and disadvantages of, for example, a strict reading of MTCA alone (resulting in an interim action until natural background-based cleanup standards are met) or use of SMS.

94. **Page J-4, Section J.2.1.3**: Risks to the community and workers are proportional to the amount of work being conducted that presents a risk, not the amount of time required for implementation. For example, no risk is attributable to periods of time required to meet administrative or technical requirements not involving field work, and risks from sampling and monitoring activities are negligible.

95. **Page J-4, section J.2.1.4**: The first paragraph asserts that the improvement to the quality of the aquatic environment in alternatives 2 through 5 is similar over the long term, but the phrase "long term" is undefined. The alternatives provide significantly different levels of protectiveness at various periods of time, particularly at the 10-yr mark.

96. **Page J-5, Section J.2.2.2, Cleanup Level Determination**: The text correctly states that protection of human health and the environment is the primary concern of the SMS. Even though the only numerical standards available in SMS are for benthic community protection, the SMS applies equally to protection of human health through a narrative standard that will be met using the completed human health risk assessment.

97. **Page J-5, Section J.2.2.2**: See comment for page J-3.

98. **Page J-6, section J.2.1.1, et seq.:** This text is inconsistent with that in section 4.3 (p. 4-12). Here, PRGs are "considered equivalent to cleanup levels under MTCA," but MTCA does not consider anthropogenic background in setting cleanup levels for final remedies. Conversely, SMS considers practicability in setting sediment cleanup standards. Whether this practicability can mitigate the MTCA requirement for final remedies to achieve natural background where RBCs are more stringent than natural background is unknown. The discussion of practicability and setting sediment cleanup standards within the regulatory context of MTCA and SMS needs to be more detailed and transparent and must frame any

use of SMS practicability in this context. LDWG's proposal to treat PRGs as CULs (and thereby as sediment cleanup standards) may have merit, but a clear proposal with detailed analysis of both approaches (setting cleanup standards at natural background and setting them at anthropogenic background while retaining a goal lower than the cleanup standard, and the risks to each from potential challenge needs to be presented in the FS. The FS discussion should describe in these alternatives the procedural as well as any substantive differences between state and federal law in setting cleanup levels and standards and discuss advantages and disadvantages of, for example, a strict reading of MTCA. (resulting in an interim action until natural background-based cleanup standards are met) or use of SMS.

99. **Page J-7, Section J.3.1.2, Restoration Time Frame**: include a discussion of the factors listed in WAC 173-340-360(4).

100. **Page J-8, Section J.3.2, Other MTCA Requirements**: The other MTCA requirements should be addressed systematically and completely. Also, SC is treated as a separate process rather than a critical path to implementing any cleanup. While the FS does not need to evaluate specific alternatives for SC implementation, it does need to do a more thorough treatment of characterizing sources and the status and implications of SC. See general comment related to SC.

101. **Page J-9, Section J.4.2, Weighting Factors Used to Assess Cleanup Action Alternatives**: The agencies will work with LDWG to revise specific elements of the DCA. Some issues include:
- Permanence is the subject of the evaluation, and a primary factor to be weighted. 10% is arbitrarily low.
- The risks to human health due to implementation of alternatives are overstated as potentially severe. Such risks can be (and routinely are) effectively managed through compliance with health and safety requirements. Additionally, risk to workers must be discounted because the risk is offset by economic benefits external to the DCA.
- Permits are standard operating procedures. This is a national and regional high priority site undergoing planning for a major cleanup; therefore it already has the attention and involvement of all permitting agencies. ECY and EPA will evaluate this weighting factor based primarily on technical implementability, with administrative requirements considered as a secondary concern.
- Elevate footnote 3 to a paragraph in the text. ECY agrees that public concerns are being addressed at a higher level than the DCA. Nevertheless, the alternatives should not be treated equally with respect to public concerns.

102. **Page J-11, Section J.4.3.1.2, Time Required to Reduce Risk**: Construction time for Alt 5 seems skewed to a much greater period. Work can be expedited, as mentioned elsewhere in this draft, especially considering LDWG's attribution of increasing risks and impacts to longer restoration time frames.

103. **Page J-12, Section J.4.3.2 Permanence**: The first paragraph of the last sentence states that "Overall, the alternatives are not greatly distinguished with regard to this criterion." This conclusion appears to inappropriately discount: 1) reductions in toxicity through removal of contaminants from the estuary, 2) reductions in risk of mobilizing contaminants through isolating them in a landfill (or other appropriate upland disposal) compared to MNR or ENR (or even capping), and 3) reductions in *ex situ* volume due to dewatering.

104. **Page J-12, Section J.4.3, Long-Term Effectiveness**: The bullets listed should include "magnitude of residual risk with the alternative in place."

105. **Page J-15, Section J.4.3.4.1, Implementation Risks**: See comment on p. J-9. Do not include risks to construction workers. Also, these same workers would have risks whether they are working on this site or elsewhere. Also, there are ways to mitigate for construction-related traffic through local communities. In summary, these factors should be discounted to a large degree.

106. **Page J-17, Section J.4.3.5, Consideration of Public Concerns**: "Corrective" Action Plans should state "Cleanup" Action Plans.

107. **Page J-19, Section J.4.4, Summary of DCA Results, 2nd paragraph**: Alternative 5 should not be removed.

108. **Page J-20, Table J-1, Cross Reference of MTCA Threshold and Other Requirements to Sections of the FS**: Under item (i) MTCA Minimum Requirements, in the FS Section in which Requirement is Evaluated column, the citation for Section J.2.1.4 appears incorrect. In the FS Evaluation Factors column under item (iii), the FS Evaluation Factors should use MTCA language, not paraphrase.

109. **Page J-21, Table J-1, Cross Reference of MTCA Threshold and Other Requirements to Sections of the FS**: Area background is not part of the referenced MTCA citation [WAC 173-340-360(4)(b)].

110. **Pages J-22- 23**: Tables J-2a and J2b have labels that are switched; "…CUL's for PCB's", yet the table discusses Arsenic in Column 2, or "…CUL's for Arsenic" says PCB's in Column 2.

111. **Page J-27 Table J-4a MTCA DCA Alternative Benefits Scorecard**: While the format is good, the content will have to be revised with proper weighting.

112. **Page J-28, Table J-4b Summary Findings of MTCA DCA**: How can two completely different alternatives such as 1 and 5 have the same weighting (of 5) for overall protectiveness?

113. **Figures J-1 through J-2** will need to be reworked to reflect a revised DCA. With respect to Figure J-2, using the slopes of lines connecting alternatives is the preferred method of evaluating disproportionate cost.

114. **Figure J-3** appears to attempt to revisit or reshape the DCA by comparing implementation time to (weighted) benefits. This is fallacious in at least 3 ways: 1) the scales are arbitrary, 2) the DCA already incorporates time into the analysis of benefits, and 3) weighted benefits derived for the purpose of a DCA appears to be a surrogate for overall benefit.

Appendix K -- LDW Conceptual Monitoring Program

115. **General Comment**: This appendix needs to specifically describe how it conforms to MTCA threshold requirements for all types of compliance monitoring.

116. **General Comment**: Although Appendix K is only meant to provide a "conceptual" monitoring program, the plan lacks detail in several critical areas:

Objectives: Appendix K lists four primary objectives for the monitoring program, yet there is little or no detail regarding how data is to be linked to these objectives. The plan should specify the particular parameters that are of interest and the scale at which they will be evaluated—river segments, whole river, point locations etc. Without this information it is impossible to evaluate whether the conceptual sampling plan will be adequate to support the stated objectives.

Justification for the number of sampling locations: The report indicates that 100 sediment locations will be sampled prior to remediation and again at 5 year intervals post remediation. Without precisely stated objectives it is difficult to determine an adequate number and spatial configuration of sampling locations. Importantly, the problems identified in SWAC calculations (see Appendix H comments) should be explicitly avoided for the proposed sediment monitoring. This should be accomplished by ensuring that sample inclusion probabilities are completely specified for each sampling location, so that subsequent efforts to estimate surface averages can be specified precisely without a lot of experimentation.

Description of the spatial layout of the sampling plan: It is not clear what is intended when a "stratified" plan is described. Specific polygons of interest, such as the early removal areas, the areas between specific removal areas, and any areas expected to see intense human or ecological uses should be identified. Those areas should then be sampled with an adequate number of samples to conduct statistical analyses within each stratum and that can be later combined into reach and river wide statistical summaries, including confidence intervals. This would include unbiased sampling designs within identified stratum polygons, and may include higher sampling intensity within some strata perceived to be of greater "value" or known to poses more variable contaminant concentrations. This would undoubtedly lead to stratum sample sizes of 30 or more locations, given our understanding of the degree of skewness of typical data from these areas.

Decision points and criteria used to evaluate data: Decision points and precision requirements must be clarified so that minimum sample sizes necessary to meet minimum power and precision requirements can be met. As the plan currently stands, it is difficult to discern what analysis is planned and whether the proposed 100 samples will be adequate to meet the objectives. It is clear from the SWAC simulations conducted for review of Appendix H that 100 sample locations including a mix of biased and unbiased sampling are likely to lead to poor statistical performance and ambiguous conclusions. A rigorous sampling design with known statistical properties and associated estimation procedures should be developed.

Description of anticipated statistical analyses: Correct statistical analyses are determined by the sampling design. Failure to adequately specify the sampling design will result in poor statistical performance and ambiguous results.

117. **Page K-3, Section K.3, Assumptions for LDW Monitoring**: "*Protection of ecological receptors – RAO 4, site-wide*." Monitoring to address protection of ecological receptors should include sampling from specific sub-areas.

118. **Page K-3, Section K.3**: "*Baseline data: Establish a point of reference for assessing long-term remedy effectiveness and achievement of RAOs*." While it may be reasonable to

establish a point of reference for sediment sampling, baseline data for biota (especially fish) requires multiple years of sampling to account for interannual variability. Because the remediation (including both active and passive components) will be taking place over a protracted time period, baseline conditions for biota will need to be updated on a regular basis to make it possible to assess recovery.

119. **Page K-4, Section K.3.1.1, Baseline Monitoring**: "*The pronounced rates at which sediment from the Green/Duwamish River system deposit in the LDW (as estimated by the Sediment Transport Model (STM) and discussed in Section 5.1) suggest that conditions may be improved through natural recovery by the time the Record of Decision (ROD) is issued. This argues for a new temporally and spatially consistent LDW-wide dataset.*" It also argues for a sediment sampling design to specifically to address temporal changes that can be used to evaluate the assumptions in the BCM and the predictions of the rate of natural recovery in the three reaches of LDW.

120. **Page K-5, Section K.3.1.2, Long-term Performance Monitoring**: "*Tissue samples are assumed to be collected to assess LDW-wide reductions in fish and shellfish tissues*." The tissue sampling program for shellfish and fish should be assumed to focus on specific subareas within the LDW. The tissue sampling program should be designed to distinguish between the remedial effectiveness of MNR areas and areas of active remediation.

"*These samples would be analyzed for the risk-driver chemicals (RAOs 1 and 4), with the analysis focusing on PCBs, arsenic, and cPAHs in particular.*" The analysis should include polychlorinated dioxins (PCDDs), dibenzofurans (PCDFs) and coplanar PCBs, which are important risk drivers. The limited characterization in the sediment and the absence of information on PCDD/Fs in tissue needs to be addressed in baseline and long-term monitoring to evaluate the remedial effectiveness in addressing risk from dioxin-like compounds to human health and ecological receptors via the foodweb pathway.

121. **Page K-5, Section K.3.1.2:** Sections K.3.1.2 and K.3.2.3 should be merged, so that all long-term monitoring is discussed in one section. In addition to the items listed in both sections, water quality sampling will also be required for long-term performance monitoring to assess compliance with water quality ARARs. Many other types of sampling will likely be necessary in the long term, including benthic community analysis, SPI camera, assessment of incoming sediment load and sedimentation rates, and porewater sampling.

It was understood during the RI, that it is difficult to ascertain adverse impacts due to site-related contamination based on benthic community analysis. However, benthic community analysis is a very effective tool in monitoring the recovery over time, and will serve as a very strong line of evidence that natural recovery is indeed occurring. The benthic monitoring program should be robust enough to allow for variance due to the various physical and environmental conditions encountered in the Duwamish.

The baseline and long-term monitoring programs should also include data collection efforts to verify and or update the sediment transport model. These data would be used to ensure that sediment deposition is occurring as predicted so that natural recovery can occur as projected. Based on the long time-frames of the various remedial alternatives, revision to model inputs may be needed due to changing conditions or observations. Data collection should also be sufficient to corroborate the findings of the food web model, and potentially update it.

122. **Page K-5, Section K.3.2.1, Implementation Monitoring**: *"Water quality testing includes daily turbidity monitoring, with periodic collection of downstream surface water samples for laboratory testing (e.g., turbidity and select chemicals)*." Water quality testing should include regular monitoring of PCBs and potentially other contaminants in the water column, since turbidity has not been found to be a good surrogate for PCB releases during removal actions at other sites.

123. **Page K-6 – K8, Section K.4, Case Studies/Other Examples**: Please note in the introduction that while these examples provide some useful information, their utility is limited because they were done under NRDA, which has different requirements, and the monitoring program was not designed to assess the long-term compliance with the cleanup standards being discussed in this FS.

124. **Table K-1**: tissue "*PCBs as congeners – 20% of samples*." Based on the significant problems with Aroclor quantification in recent LDWG tissue monitoring (overestimation of total PCBs in 2004 and underestimation in 2007), complete congener analysis for at least one-third of the samples should be considered. Congener analysis should include high resolution analysis for coplanar PCBs, PCDDs, and PCDFs.

Appendix L – Sustainability Metrics Evaluation

125. While including sustainability metrics is consistent with current EPA guidance, the evaluation in this FS misses the point of a sustainability analysis. It doesn't evaluate the drivers in terms of CO_2 emission or provide recommendations in terms of how CO_2 emissions can be reduced for a given alternative, (e.g, using alternative fuels). This discussion could in part be enhanced by generating a figure like L-1 for each alternative to show drivers. Then within the major pieces (like transloading), evaluations of what is driver the CO_2 generation can be made. This analysis will then provide information on how to reduce the associated footprint. This appendix must be updated to be consistent with the intent of EPA guidance.

126. Work Place Accidents: Evaluation of workplace accidents should not be considered in the sustainability evaluation.

127. Please revise this appendix to include the following adjustments to the analysis:
- Add material consumption calculations. Assuming that there is no impact from this because the materials would have been generate any way is not correct;
- Add impact of generating and hauling of cap material to site;
- Add PM10 calc and noise factor calculations; and
- Add landfill space consumption.

128. **Backup tables**: The calculations and assumptions used to derive the emission have not been provided. Please include, so that calculations can be checked. For example, specify assumption of miles per each alternative. Currently, the analysis appears to show emission from rail transport to be twice as great as truck transport, which is not correct.

129. **Page 1:** Text indicates that ecological footprint was examined. The information provided only included an analysis of GHG emission and not impacts to ecology. Text should be revised to indicate this limitation.