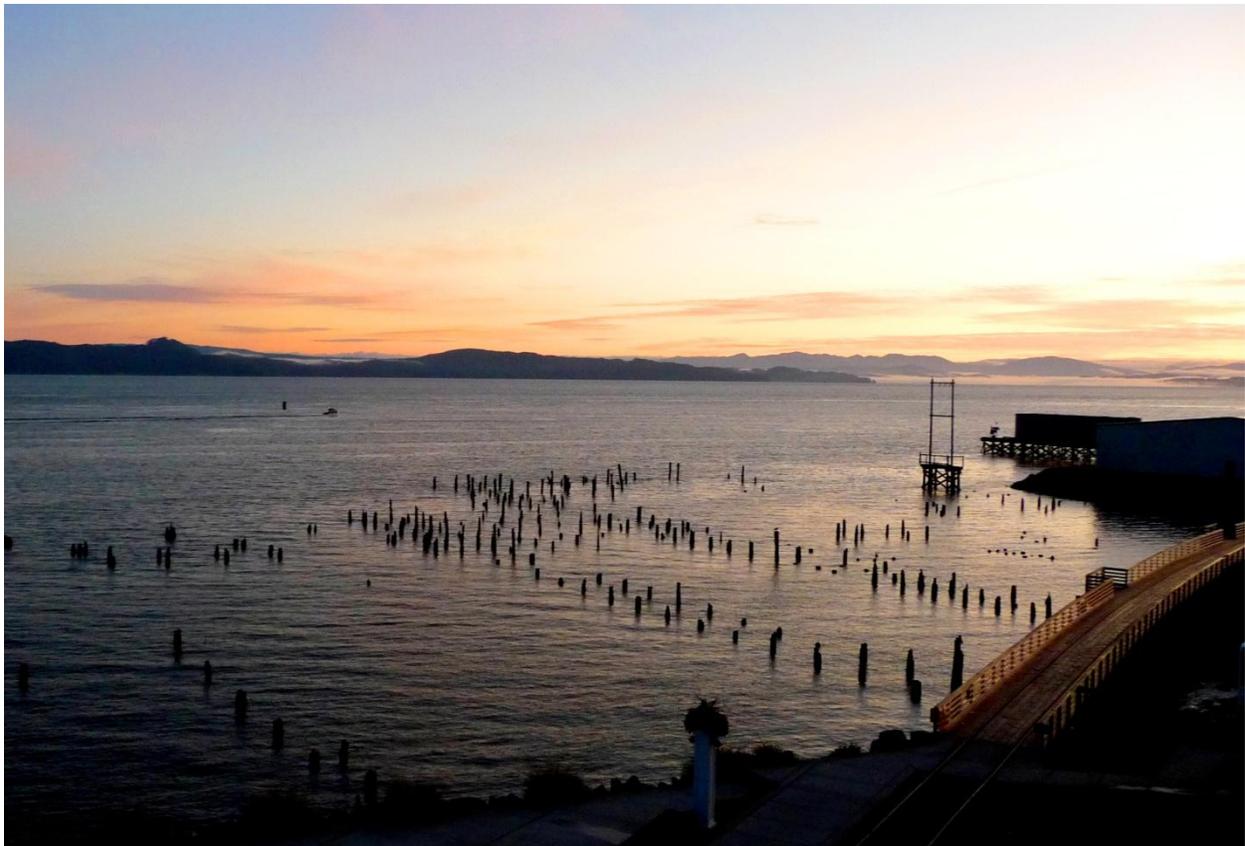# ISAB

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Review of the Columbia Estuary Ecosystem Restoration Program

Evaluation of three draft documents: 2012 Synthesis Memorandum, 2013 Strategy Report, and 2013 Action Plan

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ISAB Review of the Columbia Estuary Ecosystem Restoration Program

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Executive Summary

At the Northwest Power and Conservation Council's request, the Independent Scientific Advisory Board (ISAB) evaluated three draft documents that summarize past research and guide future work of the Columbia Estuary Ecosystem Restoration Program (CEERP): a 2012 Synthesis memorandum, a 2013 Strategy Report, and a 2013 Action Plan.

The three draft documents provide an effective overview of the current status of the CEERP. The authors have made an excellent effort to identify the relationship of the Synthesis memorandum to the Strategy report, which provides context for the subsequent Action Plan that through adaptive management will lead to an updated Synthesis.

The Synthesis is a well-written summary of the research history of the estuary that provides a basis for ongoing efforts. The regular communication among estuarine researchers and programs has contributed to rapidly improved understanding of the estuary in recent years. The estuarine research community has been actively developing methods that are proving useful in dynamic ecosystems, such as the estuary. Nevertheless, some aspects of the three documents would benefit from further explanation and additional details, as recommended by the ISAB in this report.

The ISAB's key recommendations:

1. While the primary approaches to restoration are plausible, it is not clear that these will be sufficient to achieve the three specific objectives and the overall goal of the CEERP. More information on why the Program decided to focus on these approaches and specific objectives is needed. As the CEERP authors have indicated, additional evaluation is needed to determine if inferences generated in the Synthesis (Section 6) allow the conclusion that restoration is working to help recover salmon. To examine the question a focused symposium involving scientists from outside the Basin or a weight of evidence approach might be useful.

2. The Synthesis should clarify how the three key concepts supporting CEERP ("habitat opportunity," "habitat capacity," and "salmon performance") relate to ecological concepts of habitat extent, productivity, and carrying capacity that are typically used in salmon population dynamic studies.

3. More information about the method of estimating survival benefit units (SBU) to evaluate potential effectiveness of habitat restoration work is needed before the scientific merit of the overall approach can be fully evaluated. An independent scientific review of the method and process is recommended.

4. The Synthesis identified the very serious shortfall in action effectiveness monitoring for the estuary restoration projects. The ISAB concurs. New approaches to RME and action effectiveness monitoring need to be identified, scientifically evaluated, and implemented. CEERP has developed a number of very useful monitoring protocols. It would be helpful to confirm that

these are agreed upon methods and that technology transfer is occurring. More detail on suggested methods for improved monitoring should be provided, so that others can follow the recommended approaches.

5. The Synthesis should include more discussion of the interaction with the upstream hydrosystem and ocean. All three habitats are tightly linked and of fundamental importance to juvenile salmon survival. Lack of understanding of hydrosystem-estuary and estuary-ocean interactions is likely hindering advancement of knowledge on limiting factors in the estuary and the effects of estuarine habitat restoration on salmon survival.

6. The Strategy document shows some relationships in jurisdiction graphically, but more discussion is necessary to convey how the different programs actually work together. It would be useful to discuss issues relating to restoration and provide steps for reviewing, revising, or creating a more structured process for prioritization with a landscape context. To be consistent with a true landscape approach, engagement is required with the public and other stakeholders who are not directly involved as project sponsors.

7. Given the acknowledgement of the critical role of coordination and diverse participation in the CEERP Strategy documents, an objective focused on the continued development or refinement of the broader governance/coordination process would be useful to make this point explicit and formalize the existing commitment.

Background

On August 2, 2012, the Council asked the ISAB to review three documents that constitute the Columbia Estuary Ecosystem Restoration Program (CEERP). These documents include July 2012 drafts of a 2012 Synthesis Memorandum, a 2013 Strategy Report, and a 2013 Action Plan. These documents were created partially in response to a Council recommendation made in July 2011 as part of the Review of Research, Monitoring and Evaluation and Artificial Production Projects. Specifically, the Council called for "the responsible entities to complete an estuary-wide synthesis prior to the initiation of the review of habitat actions."

In July 2012, the Bonneville Power Administration (Bonneville) and Corps of Engineers (Corps) responded to this recommendation and submitted the CEERP documents for ISAB review.
At the ISAB's August 8, 2012 meeting, the CEERP authors from Bonneville, the Corps, NOAA Fisheries, and the Pacific Northwest National Laboratory presented on the CEERP process, primary research conclusions, and plans for future actions. The presentations and ensuing discussion were invaluable to this review.

The Council staff asked the ISAB six questions to consider in the review. The ISAB's review below is organized around these questions.

Answers to Council Questions

1.   *a. Does the synthesis adequately summarize research and monitoring that have occurred or are occurring in the estuary? b. Specifically does the synthesis describe scientifically sound methods and procedures including standardized or compatible protocols that are being used in the estuary to evaluate the potential effectiveness of proposed habitat work?*

The Synthesis includes relevant information from journal publications and contract reports published from 1990 to mid 2012. The authors provide a very good synthesis of past and ongoing research and monitoring efforts of the CEERP in the lower Columbia River and estuary (hereafter referred to as LCRE or estuary). They have a deep understanding of the research history of the estuary and have used it to build the basis for this document as well as for ongoing efforts. There is considerable cohesiveness among the estuarine researchers and programs, and the regular flow of information and ideas among groups in recent years has resulted in an accelerated understanding of estuarine structure and processes. The record on reporting and publication is good, although there is much information yet to be published in peer reviewed literature.

The Synthesis emphasizes the ecology of sub-yearling Chinook salmon and restoration of their shallow water habitats in the tidally-influenced mainstem Columbia River and lower tributary sites below Bonneville Dam. This focus is reasonable given that subyearling Chinook salmon typically inhabit estuaries for longer periods than yearlings and longer than other salmonid species. However, the relationship between length of estuarine residence and survival of Chinook salmon and other species is not well known.

In general, then, ISAB found the Synthesis memorandum to be well-crafted and informative, but it could be improved by attention to a number of issues, as detailed below.

The document states (p. iii) that the overall goal of the CEERP is to "understand, conserve, and restore ecosystems in the LCRE."

Three specific objectives are listed:
1. Increase the opportunity for access by aquatic organisms to shallow-water habitats.
2. Increase the capacity and quality of estuarine and tidal-fluvial ecosystems.
3. Improve ecosystem realized functions.

The CEERP's primary approaches to restoration are to "restore hydrologic connections between mainstem and floodplain, create and/or enhance shallow-water habitat, and reestablish native vegetation."

Background information on why the program decided to focus on these specific objectives and approaches is needed. Whether it is possible to achieve these broad objectives is difficult to evaluate given past performance and the lack of long time series of ecological and ecosystem data. The current approaches to restoration are designed to provide most benefit to Lower Columbia River Chinook salmon ESU. Could the CEERP Program be improved to provide more benefit to other salmonid species that might be experiencing low estuarine survivals?

Conceptual Approach and Definitions - The conceptual approach used to assess overall effectiveness of restoration programs is not entirely clear. The authors define the concepts of "habitat opportunity," "habitat capacity," and "salmon performance" as follows:

1. "Habitat opportunity is defined as the availability of environments salmon can access and from which they can benefit (Simenstad and Cordell 2000; Gray et al. 2002; Bottom et al. 2005, 2011)." [p. 3.6].

2. "Habitat capacity is defined as the ability of a habitat to support functions benefiting salmon (Simenstad and Cordell 2000; Gray et al. 2002; Bottom et al. 2005)." [p. 3.10].

3. The performance of salmon in a wetland is a synergism of opportunity and capacity indicating accrued benefit (Simenstad and Cordell 2000; Gray et al. 2002; Bottom et al. 2005)." [p. 3.11].

These definitions are vague making it unclear how to relate or reconcile these habitat concepts with the ecological concepts of habitat extent (the area of the habitat type), productivity, and carrying capacity.[1]

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[1] "**Productivity** - A measure of a population's ability to sustain itself or its ability to rebound from low numbers. The terms 'population growth rate' and 'population productivity' are interchangeable when referring to measures of population production over an entire life cycle. Productivity can be expressed as the number of recruits (adults) per spawner or the number of smolts per spawner. **Carrying capacity** - The number of individuals of one species that the resources of a habitat can support. That is, the upper limit on the steady-state population size that an

In the Synthesis memorandum, "habitat opportunity" seems to refer to whether a patch of habitat can be accessed by the species, or in other words, whether that patch is currently part of the ecological model of productivity and capacity. Is opportunity related to the extent of accessible habitat? If "habitat capacity" is in fact "the ability of a habitat to support functions benefitting salmon," then it seems to be analogous with "productivity" of a patch of habitat, if it could be accessed, without any consideration of its extent. Yet this use seems incongruous with the usual meaning of carrying capacity. "Salmon performance" also seems to be related to productivity, but it is not clear how it differs from habitat capacity, particularly if "habitat capacity" does not involve extent as well as suitability. More clarification of these concepts is warranted; it would be helpful to explain how they relate to the more traditional terms of productivity and carrying capacity, as used in salmon population dynamic studies that are widely used elsewhere in the Basin and referred to in the Fish and Wildlife Program (see footnote 1).

Standardized methods to evaluate the potential effectiveness of proposed habitat work have been developed by the authors. The paper by Roegner et al. (2012) was a very helpful contribution to the program. The Columbia River estuarine research community has been proactive in developing methods, approaches, and procedures that are suitably adapted to the dynamic system. Many of these "protocols" have already appeared in peer-reviewed publications and are receiving considerable interest from researchers in other dynamic ecosystems.

What is not clear is whether the methods are being implemented by all the other groups doing restoration work in the estuary. The concentric circles shown in LCREP (2012) and in the Appendix to this review suggest considerable overlap between CEERP and the project sponsors of habitat protection and restoration programs, for example, Columbia Lands Trust and Columbia River Estuary Study Taskforce. It would be helpful to confirm that these are agreed upon methods and that technology transfer is occurring between CEERP and these groups.

There is no discussion in the Synthesis memorandum about how survival benefit units (SBU) are estimated by the ERTG (Expert Regional Technical Group) and will be used to estimate the potential effectiveness of habitat restoration work. In fact in Section 8.1 the authors state "Finally, because we expect site-scale projects to positively affect the state of the broader estuary, there needs to be a systematic and repeatable method for assessing the net changes in the ecosystem." The ISAB notes that the method used to compute SBU, described in the ERTG document provided for context, has not undergone independent scientific review and is still a work in progress. It would be useful to know if CEERP scientists are generally in agreement with the current method of estimating SBUs as an interim measure and if they see a need to replace the current version of SBU in the near term?

The authors point out that it is very difficult to determine survival rates on the smaller fish they are sampling. Inference about survival benefits of estuary restoration will improve with advancements in tagging technology. In this regard, the detailed and necessary life history work done over the past 20 years is not adequate for understanding how estuary habitat use affects survival. The authors indicate awareness of this situation by stating (3.3.1), "However, the overall loss of marshes in the LCRE and the reduction of a macrodetritus-based food web may have reduced the overall capacity of the system compared to historical levels." This is essentially the same conclusion reached by Sherwood et al (1990).

environment can support. Carrying capacity is a function of both the populations and their environments." (NWPCC Document 2009-09, Appendix A).

The concept would suggest subyearling Chinook would be smaller upon entry to ocean (reduced productivity) and perhaps they would enter the ocean earlier due to fewer "opportunities" for rearing and lower capacity of habitats to support subyearlings before they enter the ocean. There are metrics (e.g., age or size at ocean entry, growth rate, and residence time in relation to fish densities) that could be used to inform the inference.

It would be informative to more completely weave the results of the Ocean Synthesis (ISRP 2012-3) into the CEERP Synthesis, especially to give a perspective on estuary survival rates relative to the ocean. It is clear that the researchers regard ocean-estuarine interactions as significant ecosystem-scale drivers of estuarine conditions, but the ISAB notes that within the larger program it seems that no one is tasked to consider this aspect. This seems to be a programmatic issue rather than a researcher-scale decision. The ISAB believes this aspect will become increasingly important as ocean conditions continue to change. The Fish and Wildlife program should actively consider this dimension – the ocean and estuary are tightly linked and of fundamental importance to juvenile salmon survival at a critical transition period. As well, the hydrosystem has had a major effect on the estuary and the link to the ocean (e.g., the plume).

As discussed by the authors, the past monitoring efforts were often inadequate and lacking a systematic and well-designed (statistical) approach to evaluating effectiveness of habitat work. The suggested new approach would include "statistical design, collection of pre- and post-restoration data, use of reference sites, acquisition of data that directly allow inferences to realized function of the sites, and period of sampling." Unfortunately, the level of detail on methods and procedures in the report is insufficient to scientifically evaluate the proposed new approaches. It would be helpful if CEERP scientists provided more detail on suggested methods, so that others can follow the recommended approaches. For example, the proposed use of references sites might be inadequate given the high variability and dynamic nature of estuarine habitats. How would the CEERP scientists resolve this difficulty? Research to date has focused on wetland habitats. But to understand how ecosystems in the estuary can be restored, other critical habitats need to be considered, for example, main navigation and off-channel habitats, shoal habitats, and dredge-spoil habitats.

A highly focused RME approach that estimates stock-specific survival rates in all major estuarine habitat types is needed, including identification of habitats/locations where there are survival bottlenecks for species and stocks that migrate through the Federal Columbia River Power System (FCRPS). If estuary bottlenecks can be identified, it will be much easier to determine the most cost-effective approaches to habitat restoration to benefit Columbia River fish and wildlife. However, it is difficult to obtain data to test the bottleneck hypothesis because of interactions among the three major factors often thought to be affecting survival in the estuary (predation, food availability, and osmoregulation success [Simenstad et al 1982; Moser et al 1991]).The bottleneck concept makes sense if there are areas of high predation related mortality, such as from birds. Low habitat capacity and few habitat opportunities, as defined by the authors, probably means that the fish keep moving in search of habitat while foraging the best they can. Good habitat downstream or in the ocean might compensate for poor habitat in the hydrosystem or upstream portions of the estuary. If not, fish growth and survival are impacted. A bottleneck might be also defined as an area where there are few opportunities for rearing, especially where acclimation to salinity is beneficial. More research in the hydrosystem, estuary, and ocean is needed to evaluate these factors.

2.   Does the synthesis describe the results of past research and monitoring?

The Synthesis provides an excellent and extensive summary of results from past studies. However, for reasons that are acknowledged, the Synthesis does not provide a compelling general conclusion about the benefits to salmon arising from restoration activities to date. The lack of such a conclusion should not be viewed as evidence that restoration projects do not provide benefits salmon. Rather this situation reflects the current limitations of understanding stemming from a lack of experimental (e.g., Solazzi et al., 1991) or modeling (e.g., Greene et al 2005) approaches. It might be worthwhile to apply a weight of evidence approach to see if the inferences generated in Section 6 allow the conclusion that restoration is working to help recover salmon or whether the effort is too little relative to the current status of the estuarine ecosystem. Another approach might be to hold a focused symposium or summit, involving scientists from outside the basin, to examine the question of the level of benefits due to estuarine restoration.

3.   Does the synthesis assess levels of uncertainty and risk in the research, and monitoring and evaluation strategies such as is described in the Council's draft Monitoring, Evaluation, Research and Reporting (MERR) Plan?

The analysis of action effectiveness monitoring and stressors was badly needed, and the conclusions were sobering. The authors made it clear through their quantitative analyses that the situation regarding action effectiveness monitoring needs to change, and quickly. The Synthesis identified the drastic shortfall in research, monitoring and evaluation (RME) on action effectiveness for the estuary restoration projects with only a minority (16 %) receiving adequate monitoring. Clearly further effort is needed to improve this record. This issue needs to be dealt as a priority by project sponsors of habitat protection and restoration programs.

Levels of risk and uncertainty are not specifically assigned to proposed RME but the authors recognize that shortfalls in knowledge and long term data sets are problematic even for basic water quality parameters such as temperature and dissolved oxygen, see page 6.12. The authors also realize that non-indigenous species, such as reed canary grass, present formidable challenges for restoring habitat. Although the level of uncertainty and risk assessment is inadequate the situation is improving. The general approach to evaluate change in the estuary, which incorporates more ecosystem-scale measures of functional processes and stresses, is promising. The approach could form a foundation for MERR as it seeks to consider issues at landscape and larger scales.

The use of stressors was particularly revealing in terms of overall estuarine evaluations and how they change over time, but the methods used to analyze stress could be explained further (see comments below concerning Evans et al. (2006). The authors' comparisons with other estuarine monitoring programs (e.g., Chesapeake Bay) as they seek to find the best approaches for the Columbia estuary is appreciated as is their willingness to address climate, population and land use changes.

Further emphasis is warranted on the following uncertainties:

1. P 4.4, 1st and 3rd paragraphs – The interpretation that some surprising results from genetic stock composition analyses are a legacy of past hatchery transfers raises doubts about the adequacy of the genetic sampling characterization of the reference populations and should be investigated further. Any past transfers capable of causing errors in the mixed-stock analyses should also be evident in the reference samples, if they are recent and truly representative. If such a legacy of past transfers is not evident in the reference samples, then the conclusion that the surprising results are spurious should be questioned.

2. P 4.6, 2nd paragraph – In a similar vein, it is not clear in the text whether the interpretation about stock transfers into the Sandy River basin refers to a legacy of past releases implying genetic introgression or to current (F1) releases that do not imply any introgression.

3. Inferences about the benefits of restoring hydrodynamic connections summarized in Table 6.3 (P 6.17 and reprinted from Table 2.23 in Thom et al. 2012) seem plausible. However, the inferences are not compelling because they are inconsistent, or at least are not well supported by the case studies of monitoring described in Chapter 5. Are they supported by arguments or other findings not presented in this report? Further effort is required to reconcile contradictions in Chapters 5 and 6, and summary statements in the conclusions (For example please see the second to the last bullet on p 7.5, and the last theme in Table 8.1 on page 8.5). Additional data are required to support the important conclusion that the substantial efforts to restore flow into diked habitats using flood gates has been only partially successful and that full breaching may be required in many situations.

4.   Are knowledge gaps and strategies for addressing the gaps identified?

Table 8.2 identifies numerous knowledge gaps and strategies for addressing gaps. The most critical gap identified is to determine the relative contribution of salmon life histories in the estuary to returning adults. As discussed by the authors this is a "fundamental but unproven assumption of CEERP." Methods to address this gap are briefly discussed in the report, but provision of further details would facilitate scientific review. The recommendations do not identify focal species to address this gap; however, it needs to be addressed for all anadromous species migrating through the Columbia River estuary, tailored to their specific life histories. In fact, subyearling Chinook are the focal species for CEERP because they are the most abundant salmonid species in the tidal shallow habitats, which have been the focus of past research. Genetic stock identification results indicate that a high percentage of subyearling Chinook distributed in the lower and mid estuary tidal shallow habitats are stocks entering the river below Bonneville Dam (Lower Columbia River ESU), but some results may be equivocal, as explained above. Thus, the stock-specific benefits of habitat restoration in lower and mid sections of the estuary to subyearling Chinook salmon moving through the FCRPS need to be evaluated. For example specific habitat areas could be identified and targeted for restoration depending on the stocks that use them.

A fundamental question is whether "more of the same" research on life history and general ecology, as recommended in the Synthesis, will advance our understanding of benefits of restoring the capacity of specific habitat types in the estuary. It is possible that new strategies involving improved tagging

technology, ecophysiological indices, or other innovative approaches may be more effective. The authors recognize the issue (see page 4.9). However, a genuine strategic approach for prioritizing the numerous possible research avenues is not provided.

5.   *Do the CEERP documents explain: a) how the information is used to inform management decisions and priorities for restoration and project selection; and b) the roles of the various agencies and entities? For example, is the role of the Lower Columbia River Ecosystem Monitoring Project adequately described?*

a) The 2013 Strategy Report and 2013 Action Plan documents were useful in helping understand how the large numbers of Action Agencies coordinate their efforts to restore and manage the Columbia River estuary to benefit listed salmonids, and the ecosystem in general. A general adaptive management process is used, with cycles of planning, action, and monitoring. These plans are informed by analysis of SBUs, are evaluated by various entities, and are examined through several processes of peer review. The 2013 Strategy Report and 2013 Action Plan contain substantial jargon and acronyms that could limit understanding of the process by those readers not well versed in Columbia River Basin issues. That said, inclusion of the acronym list and the glossary are very useful.

Restoration
The documents provide a link to current information via the Synthesis and an overview of the processes in place, or in development, to guide management decisions and establish priorities. The guidance is particularly strong at the project level. As a general example, the refined focus on reconnection of habitats to the mainstem river appears to be a direct response to the synthesis of information regarding the relative ecological importance, loss of mainstem wetland habitats, and the general outline of an ecosystem basis for restoration. More specifically, application of the ERTG derived SBUs and formal logic discussed in the strategy document and operationalized in the Action document provides a consistent and transparent prioritization process at the project level. The ISAB found the graphics and tables given in the August 8 briefing about key findings of the projects to be particularly useful. The action plan (Figure 5) outlines a logical review and decision process that incorporates available information and shows the responsibilities associated with each step.

However given that the SBU process draws on the "limiting factor" data from the estuary module, and that the ISAB had some misgivings about the latter (see ISAB 2008-2) the underpinnings of the project selection process may need to be reexamined in light of the recent findings documented in the Synthesis.

The discussion of a broader landscape context for restoration is important, but the process for integration of information in that context is less developed, limited to a relatively vague "GIS analysis" and subsequent "facilitated discussion" of the "opportunity areas." Several important sources of information including "characterization of disturbance regimes," "habitat change analysis," "habitat suitability index," and such have been developed and could contribute to a more refined or formal process in the future. Although the landscape element of the prioritization is still vague, it is a key step to acknowledge and consider the broader context and constraints. Given the importance of this larger perspective, the potential issues with implementation, and the uncertainty of ecological interpretation, the report would be improved by discussion of some of the apparent or potential issues and provide some steps for reviewing, revising, or creating a more structured or quantitative process for

prioritization with a landscape context in the future. This might be the implication of the last bullet on page 5 of the Strategy document, but it should be stated more explicitly.

The report by Evans et al (2006) appears to be a key document that was used to prioritize restoration opportunities (see page 6.3 of the Synthesis memorandum and Fig 4 of the Strategy report) but the methodology for developing the stressor scores is not described and more details would be useful.

Research, Monitoring and Evaluation
The Strategy document provides a clear statement of monitoring approaches with three levels of intensity. It also provides standardized methods and data collection for key metrics, use of reference sites and controls, statistical design, and the notion of focusing with key questions regarding ecosystem functioning. These are generally consistent with recommendations from the Synthesis. The general monitoring strategy seems technically strong and well supported, with the limitations mentioned in question 3 above. There is acknowledgement of adaptive management and the critical uncertainties outlined by the ERTG are listed. There is not a clear statement of the priorities for RME or the questions that will be addressed in the short term, but rather only a statement that those questions are under consideration. The process for prioritization is tentative and apparently will be tested in 2012. The process for selecting, refining, and revising those priorities needs to become explicit. Table 9 in the Strategy report is incomplete and cryptic, so it is impossible to judge whether the process anticipated is logical. For example, what do the asterisks (*) mean in the weighting column? If the process is ready for testing this year as suggested, it would be useful to outline the tentative approach for prioritization and show how efforts are coordinated with others to make the process as efficient and effective as possible. If the process is not ready for testing, it would be useful to outline the anticipated process to develop and refine the prioritization. It is not clear that the RME monitoring and RME strategies follow from the specific recommendations in the Synthesis. The Strategy document references uncertainties by the ERTG and Thom (2012), but it is not clear how those relate with the CEERP's own Synthesis recommendations. It would be useful to reproduce or reference Tables 8.1 and 8.2 in the latter with some cross walk to the recommendations that are being addressed along with and an explanation of how those are, or will be, selected.

The landscape component of the research and monitoring program remains does not seem to be completely developed. Clearly, considerable work and effort have gone toward methods for landscape monitoring, but a more extensive discussion of the critical issues and important steps needed to refine or select an appropriate prioritization process would be helpful.

b) The CEERP documents are an important attempt to clarify the process for guiding the priorities and decisions for Corps/BPA projects in the estuary. The package provides an important statement for all partners of what is known or hypothesized and what remains uncertain, a process for prioritization for restoration and a framework to guide decisions. The documents are an important step to outline intentions and roles for the Corps, BPA, and their project sponsors. By formalizing the information and the process, others can anticipate and contribute, comment or critique, more effectively. Because the documents build on the work of others and because they communicate intentions, assumptions, and conclusions, they will facilitate and clarify the roles others can or might play and support an open dialogue for broader collaboration.

The roles and responsibilities of different entities participating in the CEERP are outlined in the Action plan (succinctly stated in Tables 1 and 2) and Strategy documents. The Action plan also provides considerable discussion of coordination processes involving a diversity of entities that includes dissemination and peer review of results in reports and a series of annual reviews or conferences. In addition it outlines a collection of working groups that meet weekly, monthly quarterly, or semi-annually with established points of contact.

The introduction identifies other stakeholders in the Basin and Figure 2 in the Strategy document shows some relationships in jurisdiction. However, the discussion does not effectively convey how the different programs work together. That is, what are the relationships among these programs and the CEERP program supporting the research described in this Synthesis? Perhaps more reference to the concentric circle plots given in LCREP (2012) and shown in the Appendix to this report would help, as would further discussion of the Estuary Partnership or other mechanisms that actually work to ensure that coordinating actions are effective and all partners engage. The Strategy Plan does state that other entities contribute to CEERP purposes and that coordination is important. The Action Plan has a section on coordination and peer review that outlines regular working groups or committees and review schedules. Further, because effective governance is critical for landscape restoration and because it has proven to be extremely difficult in other settings (ISAB 2011-4), some discussion of the success or lack of it here would be useful. Given the acknowledgement of the critical role of coordination and diverse participation in the documents, a fourth objective focused on the continued development or refinement of the broader governance/ coordination process would be useful to make this point explicit and formalize the commitment that seems to exist.

One element that seems to be entirely missing in the broader coordination efforts is engagement with the public and stakeholders other than the agencies, NGOs, or other groups that are directly involved as project sponsors. The reports point to the ISAB's Landscape-scale Restoration Report (ISAB 2011-4) as support for the landscape approach, but that document focused heavily on the social component and the issues of gaining public support and involvement that are needed to be successful. Conflict between agencies doing restoration and private landowners or local governments has been a common stumbling block throughout the Columbia Basin. It seems likely the same issues exist in the estuary. If so, it would be helpful to point to any efforts of outreach, education and collaboration with stakeholders that control opinion, access, and action on private or public lands. As explained in the briefing on August 8, 2012, ultimately the process for selecting restoration projects falls back to opportunities arising from land use and land owners in the estuary. The CEERP Strategy Report, page 15, explains, "A facilitated discussion about each 'opportunity area' is then used to determine which sponsors may be already having discussions with the corresponding landowners." The report would be improved by inclusion of information on what happens after these discussions.

*6.	Based on the synthesis information and related CEERP documents, is the work in the estuary sufficiently comprehensive in its attention to species important to the Council's Fish and Wildlife Program, including listed salmon and steelhead, important non-listed salmon and steelhead, lamprey and sturgeon? From a landscape scale, are the actions working to address the Fish and Wildlife Program and CEERP objectives?*

The CEERP Strategy report (page 6.4) states, "According to the latest information from LCREP, these actions have restored a total of 2991 acres." This figure excludes conservation purchases, however. How does this fit into the goal of 19,000 acres mentioned in the LCREP press release of August 24, 2009 (decided in collaboration with the U.S. Environmental Protection Agency)? In turn, how does this figure merge with CEERP and BiOp targets and the estuary macrodetritus deficit identified by Sherwood et al. (1990)? These questions need to be answered in order to determine if the work is sufficiently comprehensive.

The work described in the 2012 Synthesis Memorandum appears comprehensive with regard to the factors that affect various life history types of Chinook, coho, and chum salmon that use shallow wetland habitats. Current studies on lamprey and sturgeon are not mentioned in the reports. Some limited work was done on sturgeon habitats and feeding in the 1980s and these studies are noted in the historical review. Sockeye salmon, steelhead, and cutthroat trout are only mentioned as "incidental catches at most shallow-water sites" (p. 3.5, Synthesis), and the authors acknowledge much further work is needed on these species. Residence time, survival rates, growth rates, densities, and feeding habits are some of the basic data needs for these species.

The CEERP effort, particularly the Synthesis and Strategy documents focuses strongly on the reconnection of mainstem wetland habitats because of their clear ecological importance and the well documented loss of these environments. Creation of shallow water habitats and riparian restoration is also important. These actions are justified primarily because of their perceived importance for juvenile salmon. The reports acknowledge that these habitats appear to be most heavily used and presumably important for wild subyearling Chinook and chum salmon, but that reconnection should also influence the flux of prey, organic material, and nutrients that could be important in mainstem habitats and, presumably, for other life histories and species. In one sense, the CEERP is narrowly focused on a subset of the species relevant to the Fish and Wildlife Program. Given the magnitude of the problems, sampling limitations, and lack of comprehensive knowledge on existing and historic species distributions and habitat use, however, that focus seems appropriate. The anticipated benefits associated with shallow, tidal wetlands close to the mainstem are justified based on existing knowledge. The efforts will almost certainly have other benefits in the ecosystem, but quantifying those and justifying an alternative or broader focus in restoration is premature.

Editorial Comments

Action Plan and Strategy Report:
The glossary was very helpful for these documents. However, the definitions of intensive and extensive monitoring given in the glossary are not the same as the definitions given at the briefing on August 8. The definitions given at the briefing match better with how these terms are used in the text and seem more appropriate. The ISAB would also like to see these terms defined clearly in the Synthesis memorandum since they are used there as well.

Synthesis memorandum:
P 1.1 (Introduction, bullet 3) – improve clarity by adding "…performance of **individual** juvenile salmon…" (as opposed to the performance of a population of salmon).

P 2.2, Table 2.1 – suggest adding column to describe the key features that define each reach.

P 3.1, first paragraph – the switch from "theme" to "initiative" is confusing. Instead of "The second initiative has focused for the first time on…" suggest "The second theme includes a new focus on…"

P 3.4 – Text describing Table 3.1 states "Densities vary widely but can exceed 1.0 individuals per meter square (ind/m2)." It would be helpful to give the specific data in an appendix.

P 3.5, section 3.1.3 – check use of "compose" (versus comprise? here and elsewhere) and sense of "population" in: "…coho salmon composed 8% of the salmon population..."; we suggest "coho salmon accounted for 8% of all salmon…"; and in same paragraph, explain use of "nomads."

P3.5, section 3.1.5 – the sentence "Marking of yearling fish, in contrast, remained relatively high…throughout the monitoring period." seems misplaced, and is confusing. It might make more sense as the 3rd sentence in this paragraph, then change "This increase…" to "The increase in marked subyearling…"

P3.6, first line – fix "cannot ~~not~~…"

P 3.13, second paragraph – "migration" and "residency" are distinguished as separate attributes in the first sentence, so "maximum migration times" in the next sentence should be "maximum residence times".

P3.13, last paragraph, first line – suggest changing "…that indicates contact…´to "…to detect contact…"

P3.13, last paragraph, last line – suggest simplifying last clause after colon to: "20% at <55 mm, 48% between 55 and 75 mm, and the remaining 32% at >75mm."

P3.14, sec 3.4.3 – meaning of "the condition of these fish was also reduced" is unclear – does "these fish" refer to the 66% of fish with high values (in the previous sentence) or the fish sampled in the Pacific Northwest (previous clause in same sentence)?

P4.3, Table 4.1 – at the briefing, this table was presented as a graphic that was more effective in presenting the data.

P.6.1, last paragraph – suggest that use of "tidal prism" jargon be explained or rephrased.

P6.4, section 6.2.1.1 – use of acres (instead of hectares) seems inappropriate in a scientific report and inconsistent with use of metric system for river distances (rkm).

P 6.16, sec 6.3 – typo, fix spelling of "comparison."

p.8.2, first sentence, last paragraph – clarify relationship of new themes to those previously discussed. Suggest rephrasing as: "To augment the existing RME program, we have proposed recommendations in 4 *[or perhaps 5? including the 'final RME theme']* additional areas (Table 8.2)."

Tables 8.1 and 8.2 need some further editing for typos, wordiness, and parallel structure. At present, they fall short of the standard set by the rest of the document. For example, the last column in Table 8.1 appropriately refers to the recommended actions in column 2, whereas entries in the last column of Table 8.2 often refer to the attributes that are problematic rather than the recommendations to resolve the problem. Other examples, Table 8.1, column 2 " perform a statistical analyses"; "proved a context" should be "provide a context"; "at a restored sites"; column 1 (p. 8.4) "evaluate response of juvenile salmon to restoration year round" should be "evaluate year-round responses of juvenile salmon to restoration"; unnecessary subheading? Should "Organic matter ("OM") composition/food web" and "residence time" be deleted on p. 8.7?

p.8.10 – Conclusion section needs attention (updating).

A general comment – the "Conclusions" at the end of each section and at the end of the report are all excellent.

Strategy Report Table 9 – Draft AEMR Prioritization Framework (to be tested in 2012). "These are not necessarily the most important restoration actions, but are important elements for restoration implementation and RME"– is this appropriate? One would think the most important actions would fall out of a prioritization framework.

Strategy Report Figure 10 – Columbia River Estuary Conceptual Model (Thom et al. 2004) - it would be helpful to learn the status of this model and to find out if it is actually being used.

Appendix. Illustration of Overlap among Lower Columbia River Ecosystem Restoration Programs

There are many active habitat restoration and ESA listed species recovery programs in the lower river, and their goals overlap significantly. This allows both funders and restoration practitioners to leverage dollars and address recovery objectives for multiple species. Coordination and communication among these programs and partners can ensure the vision/goals and objectives of the Lower Columbia River Ecosystem Restoration Program are fully addressed.

(Figure 2 in Lower Columbia Estuary Partnership, 2012. A Guide to the Lower Columbia River Ecosystem Restoration Program, Technical Review Draft, Prepared by the Lower Columbia Estuary Partnership, Portland, OR, August 6, 2012.)
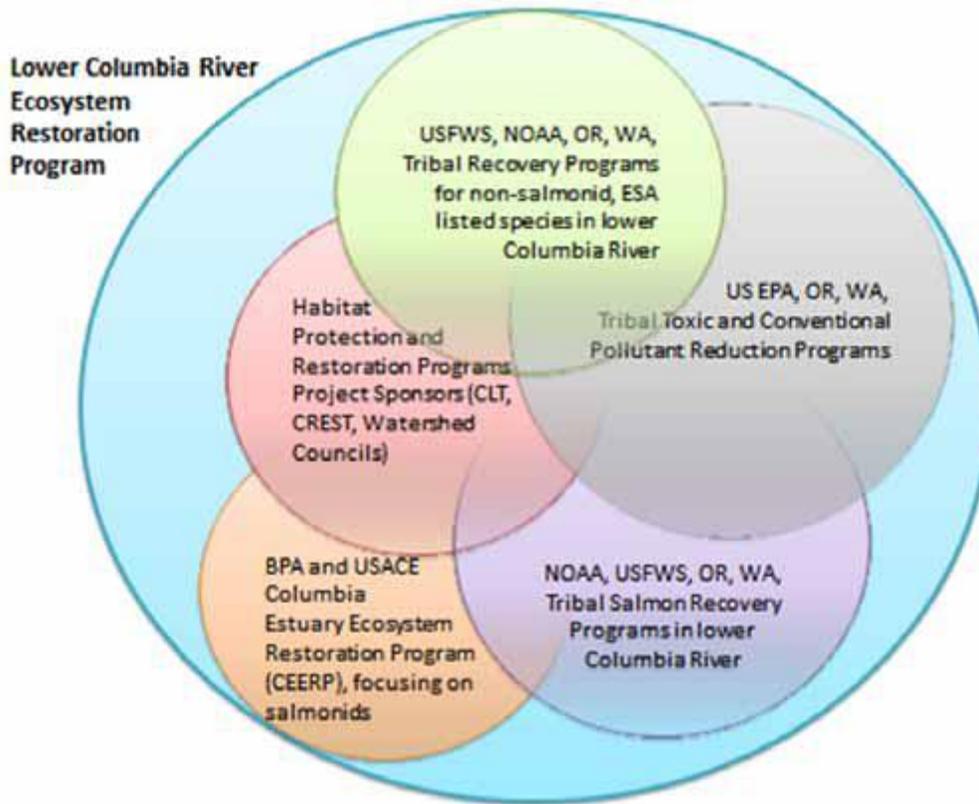
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