S. AMANDA MARSHALL
United States Attorney
COBY HOWELL, Senior Trial Attorney
U.S. Department of Justice
c/o U.S. Attorney's Office
1000 SW Third Avenue
Portland, OR 97204-2902
Tel: (503) 727-1023 | Fax: (503) 727-1117
Email: Coby.Howell@usdoj.gov

JOHN C. CRUDEN, Assistant Attorney General
SETH M. BARSKY, Section Chief
MICHAEL R. EITEL, Trial Attorney
ANDREA GELATT, Trial Attorney
U.S. Department of Justice
Environment & Natural Resources Division
Wildlife & Marine Resources Section
999 18th Street, South Terrace, Suite 370
Denver, Colorado 80202
Tel: (303) 844-1479 | Fax: (303) 844-1350
Email: Michael.Eitel@usdoj.gov; Andrea.Gelatt@usdoj.gov

Attorneys for Federal Defendants

UNITED STATES DISTRICT COURT
DISTRICT OF OREGON
PORTLAND DIVISION

NATIONAL WILDLIFE FEDERATION, et al.,

Plaintiffs,

v.

NATIONAL MARINE FISHERIES SERVICE, et al.,

Defendants.

Case No.: 3:01-CV-00640-SI

2015 DECLARATION OF LYNNE KRASNOW, Ph.D. NATIONAL MARINE FISHERIES SERVICE, WEST COAST REGION
In support of Federal Defendant's' Cross-Motion for Summary Judgment

I, Lynne Krasnow, declare and state as follows:

1. I am a Fisheries Biologist for NOAA's National Marine Fisheries Service (NMFS) in the West Coast Region, which includes the states of Oregon, Washington, Idaho, Montana, and California. I have worked as an ESA Section 7 biologist since 1997, currently for the Columbia Hydropower Branch in the Interior Columbia Basin Office. I have participated, with technical staff from BPA and the Corps of Engineers, in the Steering Committee for the Expert Regional Technical Group (ERTG)[1] of the FCRPS estuary habitat program since the fall of 2011. The Steering Committee's role is to review the ERTG's assignments, progress, and work products, including habitat improvement project scores. I have visited many of the proposed restoration sites with the ERTG and Steering Committee.

2. I earned an undergraduate degree (Bachelor of Science) in Wildlife and Fisheries Biology from the University of California, Davis, in 1974. I obtained my Masters in Science from California State University, Sacramento (course work and research at Moss Landing Marine Laboratories in Moss Landing, California), in 1978, and my doctorate in Oceanography from Oregon State University in 1992. My doctoral research concerned estuarine biology and ecology.

3. I have participated in NMFS's ESA consultations concerning the FCRPS since 1997, including writing portions of the draft and final 2008, 2010, and 2014 Biological Opinions and the 2008 Supplemental Comprehensive Analysis. To prepare for this declaration, I reviewed the Supplemental Comprehensive Analysis; the 2008, 2010, and 2014 Biological Opinions and the

[1] The Expert Regional Technical Group (ERTG) is a committee of regional scientists formed by the Action Agencies to evaluate the potential survival benefits of the RPA 36 and 37 estuary habitat improvement projects. NMFS described the composition of the ERTG and its accomplishments during 2009 through 2013 in Section 3.2.1.3 of the 2014 BiOp. [2014 BiOp, pgs. 325-8]. I describe the work of the ERTG as it relates to the development and success of this program throughout this declaration.

supporting materials for these documents; and the declarations filed on behalf of the plaintiffs' motions for summary judgment by Mr. Frederick Olney.

4. This declaration is also based on information provided and analyses prepared by NMFS's biologists at the Northwest Fisheries Science Center, the U.S. Department of Energy's Pacific Northwest National Laboratory, the U.S. Environmental Protection Agency's Estuary Partnership, and researchers at Oregon State University, Oregon Health Sciences University, and the University of Washington. The purpose of this declaration is to respond to the plaintiffs' declarant, Mr. Frederick Olney, and address technical issues concerning the effects on listed salmonids of the offsite mitigation program for estuary habitat required by the 2008 FCRPS Biological Opinion and as reviewed in the 2010 and 2014 FCRPS Supplemental Biological Opinions.

Benefits from Habitat Mitigation Program

5. **The RPA estuary program is improving juvenile salmon and steelhead survival by restoring lost ecological function below Bonneville Dam.** Before modern development, fish that survived downstream passage through the mainstem Columbia River had an opportunity to rest and feed in abundant estuarine marshes and wetlands before entering the ocean. As NMFS describes in its "Columbia River Estuary ESA Recovery Plan Module for Salmon and Steelhead" (hereafter: "Estuary Module" or "module"), the estuary and plume are where every anadromous salmonid that spawns in the Columbia River basin completes the physiological changes needed to make the transition between freshwater and saltwater—during the first year of life (or soon after) when migrating out to sea [2]—and as an adult returning to spawn 1 to 3 years later. [2014

[2] These changes include an increase in the concentration of an enzyme called the sodium-potassium pump in the gills. This enzyme pumps sodium out of (and potassium into) the gills, allowing the young fish to adapt to life in seawater.

NOAA B296:31599]. Much of the estuary's historical floodplain is now diked and filled for agriculture, industry, and other uses (Figure 1). A land-cover analysis by the Lower Columbia Estuary Partnership shows losses of 70% of vegetated tidal wetlands and 55% of forested uplands below Bonneville since the late 1800s. [2014 BiOp, pg. 192].

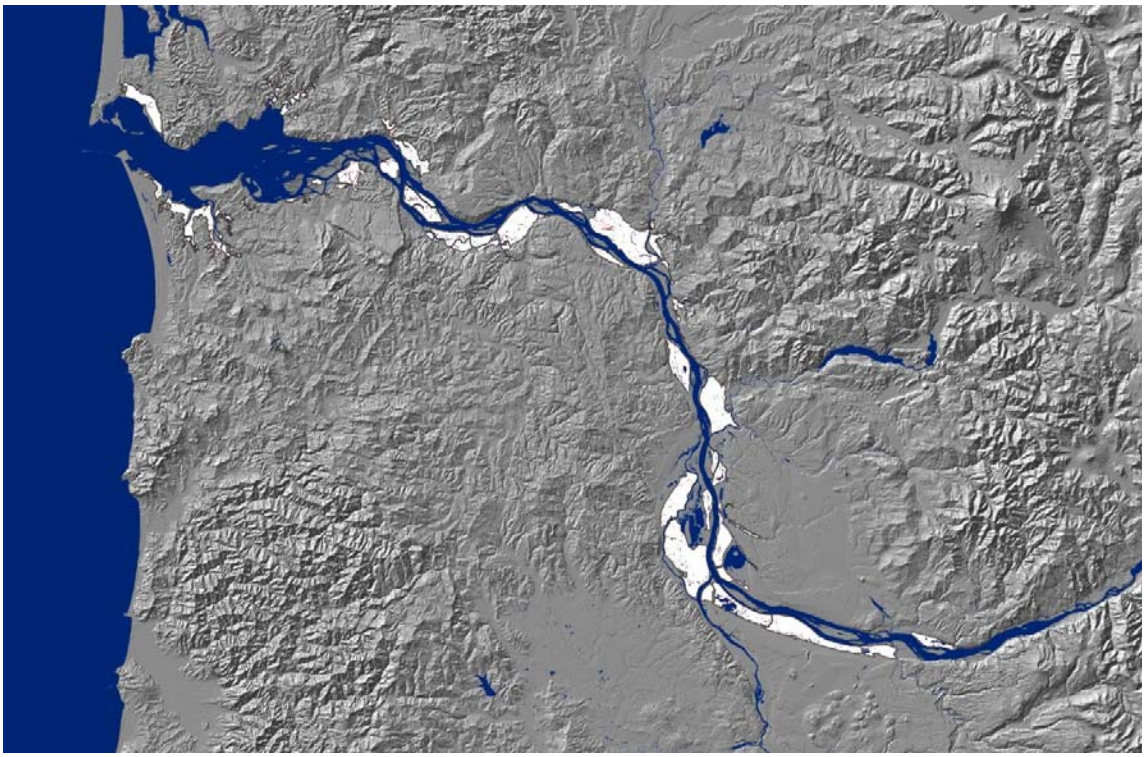

Figure 1. Diked areas in the Columbia River estuary. The areas shown in white are part of the historical floodplain, but are no longer connected to the mainstem and cannot contribute to the growth, condition, and survival of juvenile salmonids. [2014 BiOp, pg. 321].

6. This change in the floodplain of the lower river has created factors that limit the recovery of Interior Columbia salmonids. When NMFS completed the Estuary Module in 2011, it described the differences in limiting factors for ocean- versus stream-type juvenile salmonids based on their residency times in the estuary and plume and their use of different habitats:

> *"For ocean-type juveniles, mortality is believed to be related most closely to lack of habitat, changes in food availability, and the presence of contaminants including persistent, bioaccumulative contaminants present in sediments in the shallow-water habitats where ocean-type juveniles rear in the estuary. Stream types are affected by these same factors,*

although presumably to a lesser degree because of their shorter residency times in the estuary." [2014 NOAA B296:31600-1].

7. In the years since NMFS completed the Estuary Module, research has shown that juvenile Chinook and steelhead from the Interior Columbia depend on resources both within and exported from these remaining floodplain habitats. NMFS reviewed these research findings in the 2014 BiOp (pgs. 323-4). These resources include the flux of particulate organic matter (including insect prey) to the mainstem Columbia from wetlands along the river margin. In addition, there is evidence that the stomachs of juvenile Chinook and steelhead sampled near the mouth of the estuary were substantially fuller than those of fish sampled at Bonneville and John Day dams, indicating that they relied on food produced by floodplain habitats. [2014 NOAA B96:8459-60].

8. Given that the Estuary Module identified the importance of habitat restoration to the viability of all Columbia River ESUs and DPSs, NMFS included an estuary habitat improvement program in the RPA (Actions 36 and 37). Its purpose is to restore some of estuary's lost ecological function, one of the "limiting factors," under the reasonable assumption that this will improve juvenile salmonid growth and condition and therefore survival. The Action Agencies are addressing the past effects of human activities principally by reconnecting side channels to the mainstem Columbia River (Estuary Module management action CRE-9) and breaching or lowering dikes and levees (CRE-10).[3] The positive changes on salmonids brought about by some of these actions (e.g., breaching or lowering dikes and levees) are rapid; the best available scientific information indicates that the processes that form and maintain floodplain habitat can be restored as soon as the natural hydrodynamics are reestablished and that juvenile salmonids'

[3] "CRE-" identifies a Columbia River Estuary management action from NMFS's Estuary Module. [e.g., 2014 NOAA B296:31654-5].

access to a site and the site's feeding and rearing capacity increase within a year. [2014 NOAA B108:9152; B404:40177].

9. **The RPA estuary program has evolved from its basis in NMFS's draft 2006 Estuary Module, incorporating the best available scientific information.** Mr. Olney asserts that because the information in NMFS's Estuary Module was supposed to be used for planning purposes only, it is not the proper basis for assigning specific survival estimates to mitigate effects of the FCRPS. [2014 Olney Decl. at ¶20]. In fact, the Estuary Module has been the starting point for a program to improve the viability of Columbia basin salmonids, which has developed and matured as new scientific information has become available. To explain this chronologically, the Remand Collaboration Habitat Workgroup (Collaboration Habitat Workgroup) from the 2007 BiOp collaboration based the methods and goals of the Action Agencies' estuary program on NMFS's 2006 draft Estuary Module. The method they used is described in Appendix D—Analysis of the Effects of Estuary Habitat Actions, Exhibit D-1—Estimated Benefits of Federal Agency Habitat Projects in the Lower Columbia River and Estuary to the Action Agencies' 2007 Comprehensive Analysis. [2008 NOAA S.47]. The Action Agencies then formed the ERTG, a group of regional estuarine scientists, in 2009 as a procedural requirement of NMFS's RPA Action 37. NMFS intended the ERTG to estimate survival improvements from estuary habitat projects using "the approach originally applied in the FCRPS BA … *and all subsequent information on the relationship between actions, habitat and salmon productivity models developed through the FCRPS RM&E* to estimate the change in overall estuary habitat and resultant change in population survival" [emphasis added]. [NMFS 2008 BiOp, RPA pg. 48; also 2008 Kratz Decl. ¶29]. This is what the Action Agencies have done,

improving the program based on the ERTG's adjustments to the survival benefits for certain types of management actions [2014 BiOp, pg. 325-8].

10. Although the 2006 draft module served as an important starting point for the estuary program, and the Estuary Module still serves as a useful building block in both the ERTG's calculations of the survival benefits of each project and NMFS's analysis, the ERTG has adjusted the number of survival benefit units that can be achieved under the RPA to more accurately reflect the latest science on the benefits of habitat improvements to juvenile salmon and steelhead. NMFS described these changes to the estuary habitat program in Section 3.2.1.3 of the 2014 BiOp. [2014 BiOp, pg. 325-7]. The ERTG's efforts, most importantly the application of a weighting factor[4] to each type of management action, have had the effect of increasing the survival benefits the Action Agencies can achieve by restoring off-channel habitat and reconnecting diked areas to the floodplain. In addition, the Action Agencies have made great strides in working with landowners and land trust organizations, which has reduced some of the constraints to implementation that NMFS anticipated in the Estuary Module. I explain these two points below.

11. One of the ERTG's most important accomplishments has been a spreadsheet for calculating survival benefit units (SBUs), known as the "SBU calculator." The SBU calculator made the Habitat Workgroup's method for scoring the survival benefits of habitat projects more transparent, objective, and repeatable. While developing the calculator, the ERTG found that the survival scores that the Remand Workgroup had generated, which were based on NMFS's Estuary Module, did not adequately reflect their understanding of the value of some of the

[4] In this context, a weighting factor is a number by which an SBU score is multiplied to emphasize the contribution of a given subaction (e.g., remove or lower dikes or levees) to the final result.

recommended management actions to juvenile salmonids. The ERTG thought that NMFS had overvalued the effects of riparian restoration (CRE-1) in the Estuary Module and corrected this by using a weighting factor of 0.16 in the calculator. But the ERTG thought that actions such as restoring off-channel habitats and breaching dikes to reconnect the floodplain were grossly undervalued and applied weighting factors of 16.67 and 6.25, respectively. The ERTG based its weighting factors on optimal fish densities in various off-channel habitats from the scientific literature. [2014 Corps 4:1147-8]. This had the effect of lowering scores for projects that restore riparian function (CRE-1) compared to those for projects that reconnect and improve off-channel habitat in the historical floodplain (CRE-9) or breach or lower a dike or levee (CRE-10). As a result, the Action Agencies and project proponents have reprioritized their programs to pursue projects that would provide the greatest biological benefit to Interior Columbia Chinook and steelhead, according to the latest science. Another outcome of the ERTG's use of optimal fish densities to assign weighting factors is that the Action Agencies will obtain more than the 45 SBUs required to achieve a 9% survival improvement for ocean-type fish.

12. The project proponents noted this change in the SBU scoring method. Knowing that the Action Agencies were looking for projects with high SBU scores, they focused on large tracts of the historical floodplain with remnant side-channels that could be reconnected to the mainstem, which the ERTG scores as providing high habitat complexity with unimpeded access. As stated by C. Corbett (Chief Scientist for the Estuary Partnership), "[a]round 2009/2010, the region definitely started considering dike breaches and inter tidal reconnections essential for projects in order to get A[ction]A[gency] funding; the plantings and L[arge] W[oody] D[ebris] are now considered 'icing' to intertidal reconnections." [Exhibit 1, pg. 3]. In short, the weighting factors, which reflect the best available scientific information, are driving the program toward large

floodplain reconnections and dike breaches rather than riparian restoration. This represents a major evolution in the Action Agencies' approach to implementing RPA Actions 36 and 37 and provides additional confidence that the Action Agencies are pursuing projects with the greatest biological benefits.

13. The RPA estuary program has grown in other ways that demonstrate the evolution of the program from NMFS's draft 2006 and final 2011 Estuary Modules. In the module, NMFS reduced the potential survival improvements that could be obtained for each of the management actions based on its perception of the likely social, political, and technical constraints. For CRE-9, protecting and restoring[5] off-channel habitat with high intrinsic potential, NMFS wrote that the concept of acquiring land for habitat protection was controversial in the estuary: "[r]ural county governments see land disappearing off tax rolls and also listen to citizen disapproval of public ownership of land. Land acquisition is expensive and depends on the willingness of landowners to sell. Restoring accessible off-channel habitat also depends on willing landowners." [2014 NOAA B296:31668]. These constraints turned out to be very real in the early years of implementation of the estuary habitat program, leading the Action Agencies to

[5] NMFS broadened the description of management action CRE-9 (Protect remaining high-quality off-channel habitat from degradation) in the final 2011 version of the Estuary Module to explicitly incorporate restoration as well as protection. NMFS initially expected that habitat restoration would be covered under actions such as CRE-1 (protect and restore riparian areas), CRE-8 (remove or modify pilings), and CRE-10 (breach or lower dikes). After considering stakeholder comments on the 2006 draft Estuary Module, however, NMFS changed CRE-9 to read "Protect remaining high-quality off-channel habitat from degradation and restore degraded areas with high intrinsic potential for high-quality habitat." [See NMFS (2011) "*Response to public comments received regarding the Columbia River Estuary ESA Recovery Plan Module for Salmon and Steelhead;"* Exhibit 2, pg. 17]. Changing the scope of action CRE-9 led NMFS to increase the survival improvement targets allocated to this action from 14% to 16% for ocean-type juveniles and from 6% to 9% for stream-type juveniles. [See Table 5-5, Survival Improvement Targets Allocated to Management Actions in 2014 NOAA B278:26234 (draft module) versus B296:31691 (final module)]. This demonstrates that NMFS expected the management actions and expected survival benefits to change as new information was applied to the problem of the survival benefits of management actions, not to remain static.

further empower their project partners during their "transition period," work which the Action Agencies describe in the 2013 Comprehensive Evaluation [2014 NOAA B47:3551-3] and which I explain further in ¶32, below.

14. One indication that the Action Agencies have been successful in their efforts to overcome these constraints is the purchase of 545 acres of the historical estuarine floodplain at the Columbia Stock Ranch in 2012. NMFS expects the acquisition phase to provide 0.7 SBUs[6] for ocean-type fish and 0.3 SBUs for stream-type fish by reducing cattle grazing, a form of passive restoration. In a second phase, the Action Agencies will achieve additional SBUs by breaching the levee in several locations to re-connect the property to the mainstem, achieving another 4.4 SBUs for ocean-type and 1.4 SBUs for stream-type fish. The total credit achieved through the acquisition plus restoration phases will be about 5.2 SBUs for ocean-type and 1.7 for stream-type fish. [NOAA C33622: Rows 63 for Phase 1 and 102 for Phase 2 on the tab labeled "Updated per CR(BPA)"]. The ERTG made the following general comments on the value of the restoration phase of this project:

> *"This site and project represent major addition to the floodplain wetlands that could be accessed and utilized by juveniles of many salmon stocks migrating downstream. The plan looks feasible, the size of the project is large, probability appears to be high that it will work as planned. Would expect natural processes of channel formation, sediment accretion, exchange of nutrients and organic matter with the river, etc. to occur almost immediately following breaching of the levee. The perforation of the railway probably would enhance hydrological reconnection, and the associated processes. It seems fairly well buffered from road disturbances. Long-term self-maintenance seems very good. The chances to add property to the project appear significant."*
>
> [2014 NOAA C12049:121961].

[6] Although SBUs are calculated to three decimal places, I am rounding off to one decimal place to simplify this discussion.

The Action Agencies identified a similar and nearby project that they were developing (Large Dike Breach-Reach E) in their 2014-2018 Implementation Plan. [2014 NOAA B48:4369; 2014 BiOp, pg. 337].

15. The fact that the Action Agencies were able to overcome the social and political constraints on acquiring and restoring large parcels of the historical floodplain at Columbia Stock Ranch (and potentially at the site called "Large Dike-Breach Reach E") increases the SBUs that they can achieve through management actions CRE-9 and CRE-10 beyond those shown in Table 5-5 of NMFS's Estuary Module.

16. NMFS expected the ERTG to have a different view of the potential benefits of the management actions than described in the Estuary Module, which NMFS intended to state initial hypotheses about the relative impacts of limiting factors and threats and the potential to improve conditions in and survival through the estuary. [See NMFS (2011) *Response to Public Comments Received Regarding the Columbia River Estuary ESA Recovery Plan Module for Salmon and Steelhead*; Exhibit 2, pg. 5]. As further demonstration that NMFS intended the recovery plan for the estuary to change based on new information, it stated in Chapter 6 of the 2011 final module that research, monitoring, and evaluation were needed to test the document's hypotheses and that the management actions would be adapted as NMFS's scientific understanding evolved ("The RME described in this chapter will result in new information for use in evaluating the status of statutory listing factors and limiting factors and adjusting management actions as needed.") [2014 NOAA B296:31727]. NMFS identified three critical uncertainties that are important to the Estuary Module:

- Extent of density dependent mortality in the estuary and the role of large releases of hatchery fish
- Effects of climate cycles and global warming on salmonid performance in the estuary

- The amount of increased juvenile survival in the estuary that could reasonably be expected if all 23 management actions in the module were implemented,[7] and the proportion of that increased survival that could be attributed to each action

  [2014 NOAA B296:31726].

17. The latter point is particularly relevant here. NMFS synthesized existing knowledge in the Estuary Module, but recognized that its assumptions should be tested. The ERTG has refined the approach in the module by applying a different type of data set to the problem of juvenile Chinook and steelhead survival benefits: optimal fish densities in different types of off-channel habitat. NMFS expects the ERTG to continually advance the habitat improvement program based on new scientific information, including further changes to the scoring process. In the next few years, these could be based on findings from the Action Agencies' Action Effectiveness Monitoring and Research (AEMR) Program, which focuses on the ERTG's uncertainties. For example, under the heading "Scientific Basis for Estimating Salmon Survival Benefit Units," the ERTG noted that they developed the SBU concept as a surrogate for survival, but that they needed field validation of whether literature estimates of habitat capacity and opportunity provide a reasonable approximation of the salmon survival response to the restoration actions. [2014 NOAA B110:9167]. The Action Agencies are obtaining data on juvenile salmon density, condition, growth, genetic stock, diet, residence time, prey production, and macro-detritus export

[7] In the Estuary Module, NMFS expected that all 23 management actions would be implemented to a reasonable degree to achieve a 20% survival improvement for both ocean- and stream-type fish. As described in Footnote 5 in this declaration, NMFS has adjusted the potential survival benefits of implementing management action CRE-9 (Protect remaining off-channel habitat from degradation and restore degraded areas with high intrinsic potential). In addition, the Action Agencies have overcome some of the social and political constraints that NMFS thought would limit survival benefits. Most significantly, the ERTG applied a set of weighting factors to the calculation of survival benefits that increases the value of some actions compared to others. The combined effect of these changes, which are based on the best available scientific and technical information, is that the action agencies' ability to achieve survival benefits for Interior basin Chinook and steelhead is no longer limited to the percent improvements shown in Table 5-5 of the draft 2006 or final 2011 Estuary Module.

as well as physical, chemical, and biological changes in habitat quality and quantity at restored versus control sites through their action effectiveness monitoring program. These data will address this ERTG uncertainty, and whether the habitat restoration program has produced survival improvements consistent with the RPA performance standards of 9% for ocean- and 6% for stream-type fish, under the reasonable assumption that improved growth and condition at restored sites is an indicator of increased survival.

18. During consultation with the Action Agencies on the 2014 BiOp, NMFS reviewed changes to the habitat program to date and determined that the ERTG process, including adjustments to the scoring process based on new information, was a scientific and rational way to assess the benefits of the estuary habitat program to Interior Columbia basin salmon and steelhead.[8]

19. **The ERTG is addressing the ISAB's 2014 review and is making any changes needed to strengthen the scoring process.** The ISAB published its review of the ERTG scoring process on February 12, 2014. [2014 Corps 3671]. Although not available until a month after the BiOp was issued, NMFS anticipated this review, stating that it would discuss any recommended changes to the scoring process with the Action Agencies and the ERTG. [2014 BiOp, p. 330; 2014 RTC, Comment D-2, p. 39-40; also included in 2014 NOAA C34293:288254-5].

The ISAB made the following suggestions to the ERTG for improvement:

- Improve the reproducibility and transparency of the scoring criteria by providing more detailed documentation of its methods and citations to the scientific literature [2014 Corps 3671:135255].
- Findings should be viewed as informed hypotheses that require research, monitoring, and evaluation to verify results and conclusions (e.g., whether projects actually

[8] If and when NMFS updates its Estuary Module, it will consider the information developed through the ERTG process as well as any additional scientific and technical information relevant to improving the viability of Columbia basin salmonids through estuary habitat.

succeed in increasing the survival of salmon through their residence in the Columbia River estuary) [2014 Corps 3671:135256].

- Better incorporate a landscape approach into its scoring criteria [2014 Corps 3671:135260].

In addition, the ISAB recommended that the Action Agencies (1) monitor juvenile survival within and through the estuary and (2) further develop systematic, repeatable, and low-cost methods to collect assessment data to validate the ERTG's SBU estimates. [2014 Corps 3671:315261-2].

20. By the comments Mr. Olney selects from this review, he would like the Court to believe that the ISAB uncovered fatal flaws in the ERTG's scoring process. [2014 Olney Decl. at ¶23]. This is not true. NMFS, the Action Agencies, and the ERTG have had similar concerns over the last several years and have been developing technical products, some of which are described below, to fill information gaps that closely match the ISAB's recommendations.

21. As an initial matter, the ERTG published *its* list of uncertainties before the ISAB review. The list corresponds to the ISAB's "informed hypotheses that require research, monitoring, and evaluation to verify results and conclusions," showing that they were already interested in the same type of information. [2014 NOAA B110]. Examples include the potential benefits of reconnecting large floodplain lakes under RPA Action 37 and of pursuing the piling and pile dike removal program under RPA Action 38, both the subject of studies of their potential value to juvenile salmonids and in the case of the piling removal program, a structural and hydraulic assessment.

22. In the case of large floodplain lakes, the study led the ERTG to conclude that there were important uncertainties about how juvenile salmonids use the open water areas in these large

shallow impoundments[9] and so it applied a low weighting factor (<1) to this type of subaction in its SBU calculator. [2014 NOAA C33153:277627]. Although NMFS expects the SBU credits to be low for the floodplain lake components, the Action Agencies are planning to implement one project that includes this type of reconnection in the Shillapoo Wildlife Area and one at Dairy Creek/Sturgeon Lake. These will provide opportunities for research to improve the scientific basis for decisions on future projects. [See Exhibit 3, pg. 2, "Concluding Comments—Shillapoo," for ERTG comments on RME for the floodplain lake component at the Shillapoo Wildlife Area and C32868:275150 for comments regarding the Dairy Creek/Sturgeon Lake project].

23. As another example, in the case of the piling and pile dike removal program, the Action Agencies' study showed that the likelihood of survival benefits to juvenile salmonids was low for two reasons. Only a small percentage of the pile dikes are under the Corps' discretionary control and could be removed without endangering navigation safety or having a negative effect on currently functioning shallow water habitat. And cormorants could roost in many other areas near the main migration channel, preying on salmon, even if the pile fields were removed. [2014 BiOp, pg. 341; the results of the study are described in 2014 Corps 3287:128067-70; and NMFS's concerns about moving forward with the program are summarized in 2014 NOAA C13796]. For these reasons, NMFS and the Action Agencies decided that there was not enough

[9] The ERTG asked several questions about likely habitat use in a reconnected floodplain lake including whether:

- Juvenile salmon would use the entire surface area of a lake or large pond or just the habitat along the vegetated edges if one of these historical features was reconnected to the mainstem
- Fish predators such as non-native bass and diving and wading birds would use the same habitat
- These slow moving and relatively shallow water bodies would become too warm during the juvenile outmigration

[2014 NOAA C33152:277610].

evidence that the removal of pile structures would improve the survival of juvenile salmon and steelhead through the estuary. This investigation of one of the ERTG's uncertainties further ensured that the Action Agencies would focus their efforts on projects with greater biological benefits. [2014 NOAA B110:9163]. All of the survival benefit units that were attributed to this program in the Action Agencies' 2007 Biological Assessment will instead be acquired through additional projects under RPA Action 37. [2014 BiOp at 341-2].

24. The Action Agencies were already in the process of addressing the ERTG's (and the ISAB's) concerns with uncertainty through their Action Effectiveness Monitoring and Research (AEMR) program. The data collected at each restoration site are determined by the program's priorities with the highest rank given to a research project that allows the Action Agencies to address a key uncertainty. [2014 NOAA C22568:193845, "Topic D"]. For example, the Action Agencies have funded a study of the impacts of reed canary grass on juvenile rearing habitat to directly address one of the ERTG's uncertainties about riparian vegetation types. [2014 NOAA B110:9165]. This species is difficult and expensive to remove from riparian areas, so the ERTG has asked if removal is ecologically important in ways that would benefit juvenile salmon and steelhead. The Action Agencies funded research on this species during 2014, after the ERTG reviewed and commented on the Lower Columbia Estuary Partnership's proposal to resolve this uncertainty. [2014 NOAA C33539].

25. Another AEMR project that addressed an ERTG uncertainty is the Area-Time Inundation Model developed by researchers at the Pacific Northwest National Laboratory. The ERTG asked how tidal wetlands were likely to respond to different types of restoration designs (e.g., channel geometries, number and size of breach or channel openings, flooding and inundation patterns) and how these design elements would change ecological function at a site,

including access by juvenile salmon. [2014 NOAA B110:9163]. The model, described in Diefenderfer et al. (2012), is based on a Geographic Information System and allows project proponents to quickly assess habitat opportunity and capacity for fish under different mainstem flow and tidal conditions and to summarize that information in their project template. [2014 Corps 206:25264-7].

26. There are other examples of AEMR products that address the ERTG uncertainties. NMFS described some of the most significant in Section 3.2.1.2 of the 2014 BiOp [2014 BiOp at 323-4]. These include a 2013 report by Diefenderfer et al. titled "*An evidence-based evaluation of the cumulative effects of tidal freshwater and estuarine ecosystem restoration on Endangered juvenile salmon in the Columbia River.*" The authors describe the scientific evidence for and against the assumption that habitat improvement activities in the estuary are having a cumulative beneficial effect on juvenile salmonids. They concluded that "all five lines of evidence from the L[ower] C[olumbia] R[iver] E[stuary] indicated positive habitat based and fish based responses to the restoration performed under the CEERP[10] with the exception of tide gate replacements on small sloughs."[11] [2014 NOAA B96:8482]. They concluded that "Salmon in restored wetland areas are directly affected by the habitat structures and processes. Salmon actively transiting main stem river habitats are indirectly affected through the food web by allochthonous materials

[10] The CEERP is the action agencies' Columbia Estuary Ecosystem Restoration Program. [2014 NOAA B37 (CEERP Strategy Report) and B38 (CEERP Action Plan)].

[11] Diefenderfer et al. (2013) viewed tide gates as less effective than dike breaches for providing access by juvenile salmon to floodplain rearing habitats. However, they recognized that tide gates can make improvements possible at sites designed for multiple species including other threatened and endangered species such as the Columbia white tailed deer (e.g., Julia Butler Hansen National Wildlife Refuge) or where infrastructure must be protected (e.g., the Astoria International Airport at Vera Slough). [2014 NOAA B96:8478]. The ERTG applied a weighting factor of 2.0 to tide gate replacements (CRE subaction 10.3) compared to a weighting factor of 6.25 for breaching or lowering dikes and levees (CRE 10.1). [see Table 1 ("Derivation of weighting factors by subaction") in the 2014 Corps 4:1148].

from floodplain wetlands.[12] The beneficial effect of restoring tidal wetlands is expected to increase over time as existing restoration projects mature and new ones are implemented." [2014 NOAA B96:8483].

27. The ISAB recommended that the ERTG better incorporate a landscape planning framework into its scoring process, more explicitly considering interactions between projects.[13] This is another of the uncertainties the ERTG had already recognized in its 2012 document: how do various sites work together to provide survival benefits to juvenile salmonids? [2014 NOAA B110:9166]. As a result, two types of landscape planning frameworks are under development for use in the Columbia River estuary. The first is led by Dr. Charles Simenstad (Research Professor at the School of Aquatic and Fishery Sciences, University of Washington). Habitats from the mouth of the river to Bonneville Dam and from the mainstem channel to the estuarine floodplain and its uplands are classified by characteristics such as geological history, tidal and freshwater inundation, sediment inputs, vegetation types, and use by different groups of salmon and steelhead. The system is intended to help managers choose restoration sites based on their ability to support multiple salmon species and life history types (ecological complexity); proximity to

[12] In this context, the term "allochthonous materials" refers to insects and organic detritus (non-living plant and animal material) that originate in marshes and wetlands along the margin of the Columbia River and are exported to the mainstem where they are available to migrating Chinook and steelhead.

[13] From ISAB Document 2014-1: " … is easy to imagine cases in which some projects might be redundant, or in which synergies might result from combinations of projects, or in which a particular project might be necessary to bridge a gap that would otherwise preclude benefits from other projects. Presumably major gaps would be avoided by including a suite of projects (e.g., on a reach) that address all subactions. Even so, more explicit consideration and documentation of how projects interact to produce benefits (i.e., a landscape perspective) might achieve greater overall benefits." [2014 Corps 3671:135259]. In fact, most projects address a mix of the management subactions: restoring riparian vegetation (CRE-1.4), restoring degraded off-channel habitats (CRE-9.4), breaching dikes and levees (CRE-10.1), and removing invasives (CRE-15.3). [See column labeled "Estuary Module Action (Project Subactions Addressing Identified Limiting Factors)" in 2014 NOAA B47:4022-32 and B48:4339-80].

stressors of concern, especially human activities; and proximity to other restoration sites to create "stepping stones" along the estuarine corridor. [2014 NOAA B381:38324]. These are attributes that are thought to increase a project's benefits to juvenile salmonids. The ERTG reviewed this draft framework during spring 2014 (i.e., after NMFS issued the BiOp) and suggested that the Action Agencies and their project partners use this information to create a map of restoration priorities by habitat type within each reach for the ERTG to consider when they score projects.[14] The Action Agencies will make the landscape planning framework available to their restoration partners in 2015.

28. The second project, called the Restoration Prioritization Framework, is led by Ms. Catherine Corbett (Chief Scientist, Lower Columbia Estuary Partnership (LCEP). [2014 NOAA C27142:234381-3]. This effort bases restoration targets on predevelopment patterns (circa 1850) with the reasonable assumption that restoring the habitat patterns under which species like salmon and steelhead evolved, should improve their survival and viability. The team presented their framework to the ERTG at meetings during the spring of 2014, after the BiOp was issued.

29. The Action Agencies will instruct their restoration partners to incorporate metrics from each landscape tool into their ERTG templates starting in 2015. In the past, the ERTG has considered whether a proposed project is near a previous restoration site. These metrics will allow them to consider landscape ecology in a more quantitative and consistent fashion, and represent further evolution of the approach to habitat improvements in the estuary based on the latest and most complete research and tools available.

30. Finally, in response to the ISAB's recommendation that the ERTG comprehensively describe its goals, methods, and assumptions and the limitations of its scoring criteria in a single

[14] ERTG. 2014. ERTG reply to Steering Committee RE: Landscape Planning Framework [Exhibit 4, pg. 3].

paper, the ERTG is working on a publication for a peer reviewed journal. Given the working title "ERTG Process Paper," topics include the ERTG's refinements to the scoring process such as the SBU calculator, its list of uncertainties, and a statistical analysis of scores between ERTG members.[15] This will bring an additional level of quality assurance to the ERTG process itself. The ERTG hopes that practitioners in other areas will evaluate its scoring process and decide whether they can adapt these tools to their own habitat restoration programs.

31. In summary, the ISAB's review of the ERTG scoring process was useful, but did not reveal fatal flaws in the process as Mr. Olney would have the Court believe. The ERTG, NMFS, and the Action Agencies clearly recognized the need to strengthen the science supporting the scoring process and have been working to address key questions through the Action Agencies' research and monitoring program. These results are already informing selection and design of habitat projects to improve their biological benefits. One of the strengths of the RPA estuary habitat program is that the project selection and ERTG scoring processes both respond to new information, ensuring that the actions taken are enhancing the survival of Interior Columbia Chinook and steelhead.

32. **The Action Agencies have demonstrated a credible strategy for achieving the SBU targets by 2018.** It is true that the Action Agencies got off to a slow start in implementing the estuary habitat program. They candidly discussed the challenges they faced and their efforts to get the program on track in their 2014-2018 Comprehensive Evaluation. [2014 NOAA B47:3549-56]. A major change in the program that allowed them to move forward was that they expanded their financial support, increasing the partners' ability to develop projects to the

[15] Johnson, G. 2015. ERTG–Outline for process paper. Email from G. Johnson (ERTG facilitator) to the ERTG Steering Committee and ERTG members. February 19, 2015. [Exhibit 5, pg. 2**].**

feasibility stage. Prior to this, the partners (notably the Lower Columbia Estuary Partnership, Columbia Land Trust, Columbia River Estuary Study Task Force, and the Washington Department of Fisheries and Wildlife) had to bear the cost of landowner outreach, developing conceptual designs and feasibility studies, and securing any needed federal, state, and county permits from their own program budgets before they could bring a project to the Action Agencies for funding. As a result, the projects they brought forward during 2007-2009 were small scale actions such as planting native and removing invasive plants from the riparian zone—important management actions, but below the scale of ecosystem restoration needed for RPA actions 36 and 37 to succeed. Beginning in 2010, BPA added funding for project development to its contracts with these groups and added a new partner: the Cowlitz Indian Tribe. [2014 NOAA B47:3551]. The increased funding allowed these organizations to apply more staff to developing the habitat improvement projects that come to the ERTG for evaluation. Willing landowners are allowing these organizations to purchase or apply conservation easements to their property, mechanisms that permanently limit the types of human activities that can impair ecological function. Sometimes the landowners are families that have farmed or ranched for decades and are ready to retire, but want to stay in their homes. In these cases, the Action Agencies and their project partners are able to negotiate setting a levee back far enough to restore the connection to the mainstem over most of their land while protecting a home or other high value infrastructure.

33. Beginning in 2012, the Action Agencies introduced a new method for prioritizing restoration opportunities that considers cost per survival benefit unit (rather than cost alone) so that a project with exceptional benefits can be funded despite a relatively high total cost. The new process also improves coordination among the restoration partners and with the Action

Agencies. The Estuary Partnership facilitates a discussion around each "opportunity area" to determine if any of the restoration partners are already talking with a given landowner. If not, the partners discuss the pros and cons of performing work on that site. After all of the project opportunities are identified, the Action Agencies prioritize those that are cost-effective and likely to have high SBU values. The group ensures that all partners have an adequate workload and projects are assigned that are a good fit for each restoration partner's interests and skills. The resulting prioritized list formed the basis of the Action Agencies' out-year SBU projections in the 2014-2108 Implementation Plan. [2014 NOAA B48:4339-80]. Only projects with a reasonable cost per SBU and a reasonable likelihood of success are included in the Action Agencies' SBU projections. The likelihood of success score accounts for social complexity, including the number of landowners at a site. It also accounts for technical complexity—factors such as the need for a setback levee or to avoid a utility corridor. The Action Agencies described their collaborative prioritization process in their 2014-2018 Comprehensive Evaluation. [2014 NOAA B47:3551-3].

34. As a result of these expanded partnerships and systems for prioritizing projects, the Action Agencies achieved 3.9 ocean- and 1.4 stream-type SBUs in 2013, an amount roughly equal to the number produced during the previous six years (2007-2012). They achieved a similar number during 2014 and their performance during 2015 is likely to be equal to or better than in 2013 and 2014. This is clear evidence of a ramp-up as shown in this figure from their 2014-2018 Comprehensive Evaluation (Figure 2).

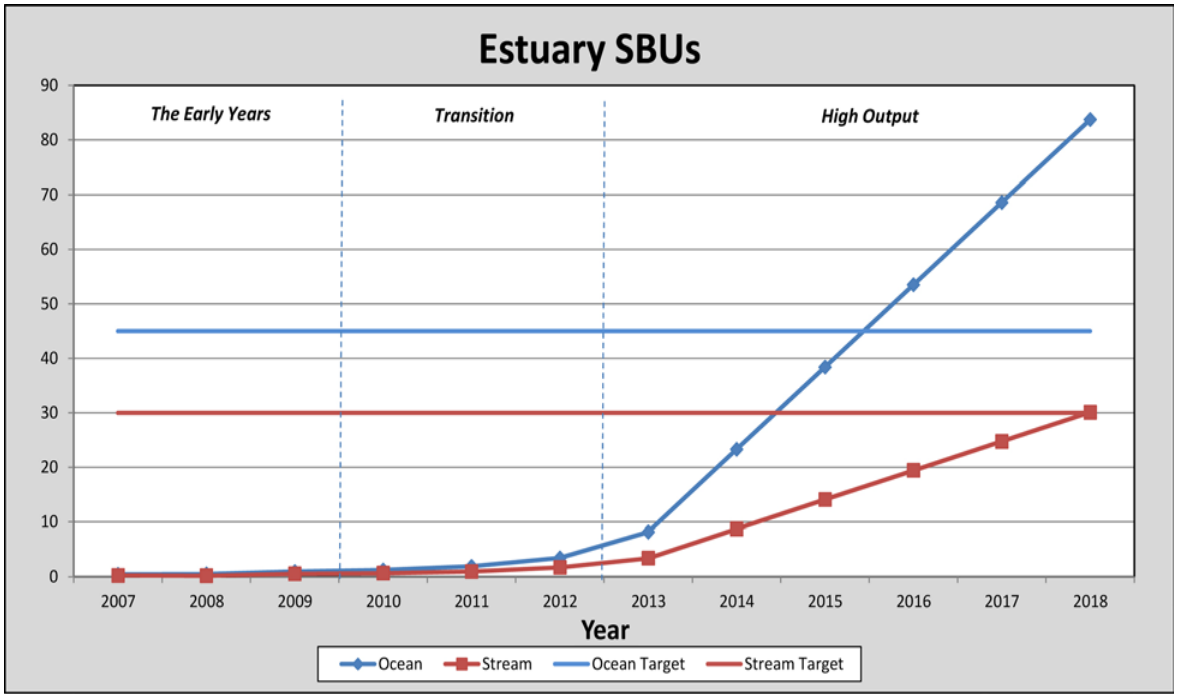

Figure 2. SBU progress by year. [2014 NOAA B47 at 3550].

35. In the 2014 BiOp, NMFS acknowledged the challenges that the Action Agencies have faced and evaluated their plan for achieving the survival improvement performance standards of 9% for ocean-type fish and 6% for stream-type fish by 2018. [2014 BiOp, pgs. 328-40]. NMFS included a detailed project spreadsheet in its 2014 Administrative Record to show the Court the type of information available during consultation. [2014 NOAA C33622]. This spreadsheet shows the ocean- and stream-type SBUs expected for each project and the method used to develop each set of scores.[16] NMFS included an example of a completed project template in the

[16] Mr. Olney makes several statements in his 2014 Declaration about the different methods that the Action Agencies have used to generate SBU scores since the estuary habitat program began in 2007. For example: "The 2014 BiOp reports that the ERTG scoring process the ISAB addressed in its review … was used to score all of the estuary projects completed, or expected to be completed, from 2007 through 2013, although it appears from the record that more than one third of these projects were actually scored by the action agencies or were scored (possibly using a different method) in the original action agency biological assessment." [2014 Olney Decl at ¶24]. Also: "The 2014-2018 Implementation Plan … , Appendix A lists the individual projects for 2014 and beyond with the SBU estimates and identifies whether they were given preliminary scores by the action agencies, preliminary scores by the ERTG, or final scores by the ERTG."

2014 BiOp to demonstrate the amount of detail that goes into a conceptual design at the 60% feasibility stage. [2014 Corps 4:1158-1195; see also ERTG SBU reports in 2014 NOAA C33150 and C33154]. Finally, if any of the anticipated projects prove infeasible or do not provide the expected number of SBUs based on the ERTG's final scores, the Action Agencies will implement other projects that collectively contribute the same number of SBUs per RPA Actions 36 and 37. All of this information led NMFS to reasonably conclude that the Action Agencies have a rational plan and are committed to achieving the required survival improvements by 2018.

36. **The ERTG's work has moved the RPA Estuary Habitat Program beyond the strategy laid out in NMFS's Estuary Module for Columbia Basin Recovery Plans.** Mr. Olney is concerned that NMFS has not addressed whether any or all of the other actions in the

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[Ibid. at ¶26]. It is not clear what point Mr. Olney is making by these remarks, but NMFS reviewed the history of the scoring process in the 2014 BiOp, explaining how, when, and why the different types of SBU scores were applied. [2014 BiOp, pg. 326]. We noted that "[w]hen the ERTG compared scores across all projects rated previously they found that the survival benefits generated using the 2008 RPA (or 'BA') method were slightly lower than those using the SBU calculator with its weighting factor (ERTG 2010). Thus, the benefits estimated by the Action Agencies using the RPA's method for projects implemented during 2007 through 2009, before the ERTG developed its calculator, are conservative in the sense that they likely underestimated the number of SBUs achieved by the habitat projects implemented." [Ibid.]. NMFS also wrote that "[s]ome of the projects that will be completed during 2014 through 2018 have received ERTG final scores which are based on the final project templates prepared at between 60% and construction-ready status. Four large projects have been given ERTG preliminary scores" [2014 BiOp, pg. 337] and "[t]he ERTG provided the Action Agencies with preliminary scores for each of these projects in the concept stage of development (2013 CE, Exhibit 4, Table 1) due to the significant investment each project required. All of the projects to be completed during 2014 through 2018 will be given ERTG final scores in the final planning phase before the Action Agencies proceed with construction. NOAA Fisheries will reevaluate the contributions of all these projects to meeting the RPA's survival requirements during the 2016 check-in. If any of these projects prove infeasible, the Action Agencies will ensure that the total sum of projects implemented, including any replacement projects, will collectively reach the BiOp estuary habitat survival benefit performance standards (2014-2018 IP)." [2014 BiOp, pg. 338 and 2014 NOAA B48:4217]. In short, projects implemented early in the process (which Mr. Olney derides as producing only small numbers of SBUs) were scored using the BA method, but the bulk of the SBUs that will be used to meet the BiOp survival performance standards will be assessed with ERTG final scores.

Estuary Module have been implemented to a reasonable degree in determining that the survival benefits of 9% for ocean-type fish or the 6% for stream-type fish are likely to be achieved. It is apparent from this remark that Mr. Olney does not recognize that although the Estuary Module was the starting place for the RPA Action 36 and 37 habitat program, the ERTG has made a number of refinements to bring in new science and to better support the calculation of survival improvements. I have already discussed these changes and explained that they are based on the best available science, in ¶¶ 10-11, above. The result has been that the number of SBUs that the Action Agencies can achieve by restoring off-channel habitat and breaching dikes has increased, because the most recent science shows such projects provide significant benefits for fish. Thus, Mr. Olney is not correct in his assumption that the ERTG scoring process is bound to the survival targets in the Estuary Module and that NMFS therefore must address whether all of the other management actions in the Module such as removing piling and pile dikes, improving flow regulation, reducing the entrapment of sediment in reservoirs, reducing impacts from dredging and from fertilizer and pesticide sources upstream have been implemented to a reasonable degree in order to secure the 9% ocean-type and 6% stream-type survival improvements from the Action Agencies' habitat improvement program. [2014 Olney Decl. at ¶34]. Indeed, the science shows that some management actions such as pile dike removals would not provide the benefits that were originally assumed, and the Action Agencies' implementation plan has evolved to reflect that information.

37. **It is reasonable for NMFS to expect the Action Agencies to meet the BiOp's survival improvements for estuary habitat without implementing RPA action 38 (the piling and pile dike removal program).** Mr. Olney asserts that the Action Agencies cannot achieve the 9% survival improvement for ocean- and 6% for stream-type fish without implementing RPA

action 38 because that strategy would not be consistent with Table 5-5 in NMFS's Estuary Module. [2014 Olney Decl at ¶31-34]. However, NMFS stated in the Estuary Module that "if a certain action were implemented partially or not at all, the potential 20 percent gain in the number of wild, ESA-listed juveniles leaving the estuary and plume could not be achieved *unless other actions were implemented to a greater extent than envisioned in the module*, to compensate." (emphasis added) [2014 NOAA B296:31690]. NMFS understood that many of the actions in the module would not be implemented at all or that implementation would be at least constrained by social, political, or technical factors. However, NMFS also anticipated that some of the constraints to implementation incorporated into the survival targets in the Estuary Module might be reduced over time and thus "some actions may have greater potential for implementation than is represented in this recovery plan module." [2014 NOAA B296:31659]. "Actual improvements in survival will depend on which management actions are implemented, how fully they are implemented, and their efficacy – factors that at this point are open to interpretation and can be qualitatively estimated only." [2014 NOAA B296:31688]. NMFS reviewed the program in the 2014 BiOp and concluded that it was being implemented to a degree sufficient to meet the estuary survival improvement standards of 9% and 6% by 2018. [2014 BiOp, pg. 339].

38. **NMFS properly accounted for the negative effects of other ongoing and future human activities in the environmental baseline and cumulative effects sections of the 2014 BiOp.** Mr. Olney states that NMFS did not address whether there are negative effects of factors such as adverse flow effects, increased ship traffic, or increased agricultural runoff on the survival benefits of the estuary habitat program. [2014 Olney Dec. at ¶34]. NMFS addressed these as background conditions in the Environmental Baseline and Cumulative Effects sections

of the 2008 BiOp and the 2010 and 2014 Supplemental BiOps. The conditions affecting the environmental baseline across the life cycle for all species were presented in Section 5 of the 2008 BiOp (cross-referencing Section 5 in NMFS's 2008 Supplemental Comprehensive Analysis) [2008 BiOp, pg. 5-3 and 2008 SCA, pgs. 5-3 to 5-67, respectively], with more detailed discussions provided for each species (e.g., Section 8.3.3 for Snake River Spring/summer Chinook Salmon in 2008 BiOp, pgs. 8.3-9 to 8.3-17). The ongoing and future effects of non-Federal actions for each species were addressed as cumulative effects (e.g., Section 8.3.3.4 for Snake River Spring/summer Chinook in 2008 BiOp, pgs. 8.3-17 to 8.3-18). NMFS updated these analyses in the 2014 BiOp. [2014 BiOp, pgs. 183-220 and pg. 221].

39. As NMFS described in the environmental baseline section (Section 2.2.3) of the 2014 BiOp, two recent mapping exercises show the loss of floodplain habitat and forested uplands since the 1880s and during a more recent period. NMFS made the qualitative statement that these changes may be having ongoing negative effects on the condition of estuarine habitat. [2014 BiOp, pg. 192]. These issues are taken into consideration in the SBU scoring process: the project proponents describe the condition of adjacent lands in their project template and they and the ERTG discuss these types of upstream (i.e., within the local tributary watershed) effects on the likely success of a proposed estuary habitat project[17] during site visits. [2014 NOAA C33144:277424].

40. NMFS addressed the ongoing effects of state, tribal, local, and private activities such as ship traffic and stormwater runoff qualitatively in the cumulative effects section of the 2008 BiOp noting that "although NOAA Fisheries finds it likely that the cumulative effects of these activities will have adverse effects commensurate to those of similar past activities, it is not

[17] Certainty of Success is one of the ERTG's three scoring criteria. [2014 Corps 4:1155-1156].

possible to quantify these effects." [2008 BiOp, pgs. 8.3-17 to 8.3-18]. Thus, cumulative effects were considered qualitatively, but were not part of the quantitative estimates of the risk of extinction or likelihood of recovery under the RPA (i.e., the prospective case). NMFS reiterated this statement in the 2014 BiOp saying "NOAA Fisheries finds that the analysis of cumulative effects in the 2008 BiOp is still accurate for this Supplemental Opinion." [2014 BiOp, pg. 221].

41. **The ERTG accounts for the inundation effects of FCRPS flow management when it evaluates habitat improvement projects.** Mr. Olney claims that the ERTG does not consider how FCRPS flow management can limit the survival benefits of each habitat improvement project. This is incorrect—flow effects are taken into account in two ways. First, when the project proponents fill out the project template, they provide data that establish the upper limit elevation for inundation at their site under current flow management conditions. [2014 NOAA C33144:277423]. This information allows the Action Agencies to calculate the resulting wetted area based on either the two-year flood elevation[18] or extreme high water.[19] The ERTG chose these two water levels because they are ecologically relevant to juvenile salmonids, support access to the site by juvenile salmonids, support natural and relatively frequent processes of disturbance and wetting, and support the export of organic matter from the site to the broader ecosystem including materials that contribute to the food web for juvenile fish.[20] [2014 NOAA C32616:272554]. The wetted area expected to result from a proposed dike breach or other habitat improvement is calculated in a standardized manner and shown on a map in the project

[18] The "two-year flood elevation" is the maximum water level that would recur every other year, on average, based on a statistical analysis of conditions downstream of Bonneville Dam.
[19] Extreme high water is the highest elevation reached by the sea as recorded by a water level gauge during a given period. [2014 NOAA C32616:272554-5].
[20] Because the two-year flood elevation can overestimate the ecologically relevant area of a site, the ERTG gives its opinion, usually following a field trip to the site, on which of the two water levels should be used for calculating the SBU scores. [2014 NOAA C32616:272555].

template. For example, the 122.8-acre area that would be inundated after levee removal is shown in gray in the ERTG template for the "North Unit Phase I-Ruby Lake" project (Figure 3).

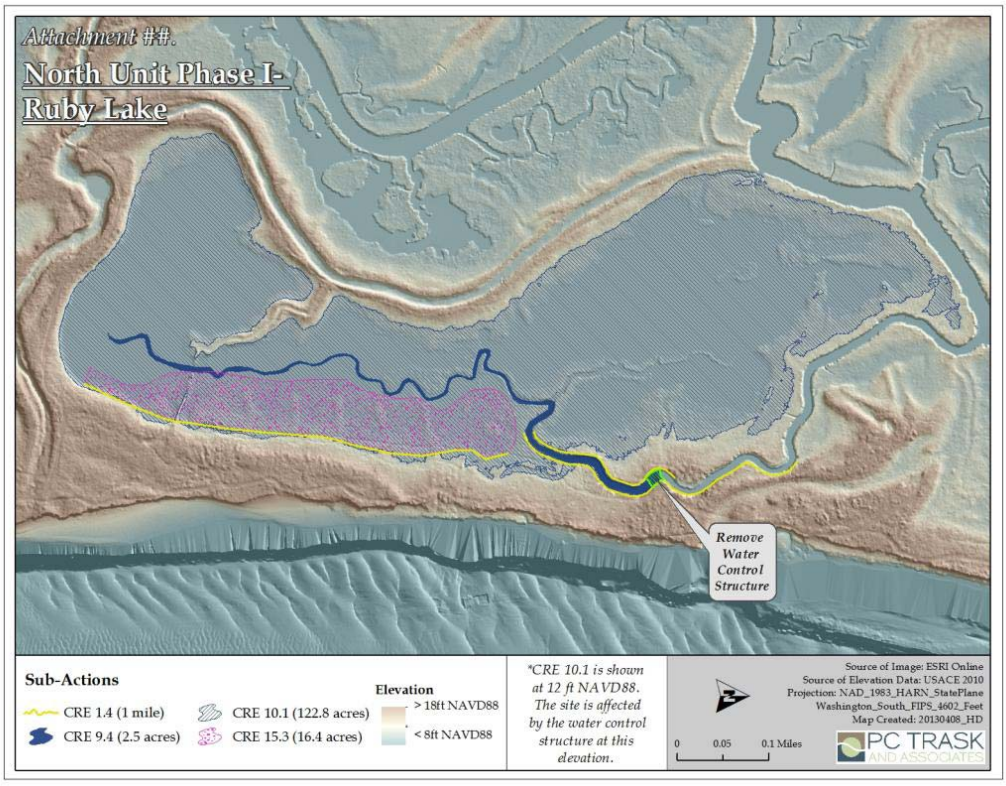


Figure 3. Project goal map for Phase 1 at Ruby Lake on the Sauvie Island Wildlife Area North Unit, owned and managed for aquatic species and wildlife by Oregon Department of Fish and Wildlife.

[2014 Corps 4:1170].

42. In a second step, the ERTG considers the likely frequency of inundation when it develops a score for "Habitat Access/Opportunity" for each project. Scores can range between 5 for "high connectivity" for most species, populations and life history types coming down river at most water level stages to a 1 for "low to no connectivity." [2014 Corps 4:1156]. A footnote in the ERTG template explains that connectivity may be seasonal and that a site where connectivity would occur only during occasional high flow conditions would receive a lower score than a site that would remain connected during low flows. Thus, FCRPS flow management is an important

consideration when the ERTG evaluates the likely change in habitat function and survival benefit units to be gained at each site.

43. **The Action Agencies facilitate passive habitat improvement by changing the permitted activities on land they purchase or protect through a conservation easement.** One of the concerns that Mr. Olney reiterates is that NMFS allows the Action Agencies to obtain a portion of the predicted survival improvements by protecting existing estuary habitat. Mr. Olney assumes that while protecting existing habitat can prevent degradation, it cannot increase the availability of habitat. [2014 Olney Decl. at ¶21]. Dr. Kratz addressed this concern by saying that it may be appropriate to assign survival benefits where an acquisition project results in a land use change such as removing or reducing grazing that improves ecological function without or before the active restoration activities such as breaching or lowering levees. This is called "passive restoration." [Kratz 2008 Reply Decl. at ¶39]. Knowing that this had been a point of contention, the Action Agencies described the passive restoration aspects of acquisition projects in their Comprehensive Evaluation. [2014 NOAA B47:3556-62]. Examples include Phase 1 for the Columbia Stock Ranch where land use is now transitioning away from agricultural (especially cattle grazing) to allow the natural plant communities (tidal marsh scrub shrub, forested wetlands, and upland forests) to return to the site. Water quality is expected to improve with reductions in cattle grazing (fewer suspended sediments and more stream bank vegetation and shading that will contribute to cooler water) and beavers are expected to recolonize the site creating conditions that maintain water on the property after local rainfall or inundation by high tides or mainstem flows. All of these factors will restore opportunities for juvenile salmonid rearing and refugia and the conditions that export organic material and prey to the mainstem migration channel. Over time, large stands of mature forests will provide shade for cooler water

and when these trees die, they will contribute large wood to the floodplain. [2014 NOAA B47:3562]. The Action Agencies expect to achieve 0.71 ocean-type and 0.27 stream-type SBUs from the acquisition of this 646-acre property next to the Columbia River near Rainier, Oregon. [2014 NOAA C33622: Row 63 on the tab labeled "Updated per CR(BPA)"]. NMFS found this expectation reasonable based on the best available scientific information, including the ERTG scoring criteria.

44. **The Action Agencies can achieve the RPA's required survival benefits without evenly distributing their projects throughout the lower river.** Mr. Olney criticizes the Action Agencies for relying on a few large projects in the "upper three of the six reaches"[21] to achieve many of the required survival benefits when "one assumption of the Estuary Module was that restoration actions would be balanced and distributed throughout all segments of the lower river in order to ensure their connectivity, rather than concentrated in one or a few segments." [2014 Olney Decl at ¶36]. Actually, this is not an assumption in the Estuary Module. Instead, Mr. Olney refers to a statement by a NMFS Scientist, Dr. Varanasi, who was responding to questions about the Action Agencies' proposed estuary program. At that time (2007), NMFS's scientists assumed that "to insure connectivity among the complex suite of habitats required by salmon it is important that the actions proposed be balanced and distributed throughout all segments of the lower river, rather than concentrated in one or a few segments." [2008 NOAA C680:3]. However, the ERTG has not made the same assumption—one of the ERTG's uncertainties is "What is the stock-specific residency and use of various reaches of the estuary?" [2014 NOAA B110:9167]. The scientific information that the Action Agencies have developed to respond to this question indicates that juvenile salmon and steelhead from the Interior Columbia basin are

[21] NMFS identified eight, not six reaches in the Columbia River estuary (see Figure 1-2 in the 2011 Estuary Module). [2014 NOAA B296:31593].

more likely to be found in the shallow water areas of the mid and upper reaches of the estuary than farther downstream. Thom et al. (2013), in their "*2012 Synthesis Memorandum for the Columbia Estuary Ecosystem Restoration Program*" state:

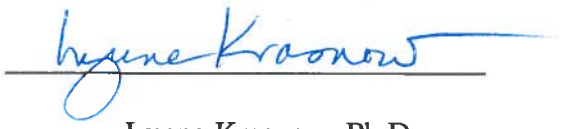
> *"Genetic results for a variety of time periods and estuary regions since 2002 suggest that stocks of Columbia River Chinook salmon are not distributed uniformly in space or time, but exhibit characteristic patterns of migration and habitat use. Samples from lower (Bottom et al. 2011; Roegner et al. 2012) and mid-estuary reaches (Sather et al. 2011) included contributions from the full diversity of stock groups (except for interior spring Chinook stocks), but were dominated by lower Columbia River fall Chinook salmon. In contrast, samples upriver near the confluence of the Sandy river delta included a greater representation of interior Columbia River and Willamette River stocks."*
>
> [2014 NOAA B404:40143-4].

45. Thus, although NMFS's scientists made the simplifying assumption in 2007 that survival benefits would best be achieved by distributing the Action Agencies' habitat improvement projects throughout all eight reaches of the lower river, the best available scientific information shows that juvenile salmon and steelhead may benefit more directly from projects in the mid and upper reaches. Thus, it is appropriate to target those areas with particular projects.

46. **Implementation of RPA estuary habitat program is evolving and improving in response to the latest science.** The estuary habitat program is built upon and responds to the best available scientific information. During the 2007 BiOp collaboration, it was envisioned as an opportunity for the Action Agencies to achieve a portion of the 20% survival improvement target for ocean- and stream-type fish in the estuary and plume by implementing some of the actions in the draft 2006 Estuary Module. Over time, the program has evolved to focus on reconnecting large tracts of the historical floodplain below Bonneville that have been segregated behind dikes and levees. Both previous and more recent research show that these are the types of actions that will most effectively restore lost habitat function below Bonneville Dam and contribute to improved growth, condition, and survival of juvenile salmon and steelhead. Fish

from ESA-listed Interior Columbia ESUs and DPSs benefit from this program whether they enter these sites directly or consume prey exported to the mainstem.

I declare under penalty of perjury that the foregoing is true and correct. Executed on March 4 2015, in Portland, Oregon.



Lynne Krasnow, Ph.D.

Lynne Krasnow - NOAA Federal <lynne.krasnow@noaa.gov>

RE: ERTG feedback questions

1 message

Catherine Corbett <ccorbett@estuarypartnership.org> Mon, Oct 27, 2014 at 9:23 AM
To: Greg Hood <ghood@skagitcoop.org>, "David.Price@dfw.wa.gov" <David.Price@dfw.wa.gov>, "Blaine.D.Ebberts@usace.army.mil" <Blaine.D.Ebberts@usace.army.mil>, "bbbde1@msn.com" <bbbde1@msn.com>, "smcewen@columbialandtrust.org" <smcewen@columbialandtrust.org>, "isinks@columbialandtrust.org" <isinks@columbialandtrust.org>, "rsalakory@cowlitz.org" <rsalakory@cowlitz.org>, "phil@pctrask.com" <phil@pctrask.com>, "mvaness@columbiaestuary.org" <mvaness@columbiaestuary.org>, "bdzelinsky@bpa.gov" <bdzelinsky@bpa.gov>, "Lynne.Krasnow@noaa.gov" <Lynne.Krasnow@noaa.gov>, Paul Kolp <pkolp@estuarypartnership.org>, Chris Collins <cCollins@estuarypartnership.org>
Cc: "kirk.krueger@dfw.wa.gov" <kirk.krueger@dfw.wa.gov>, Dan Bottom <Dan.Bottom@noaa.gov>, "ron.thom@pnnl.gov" <ron.thom@pnnl.gov>, "kim.jones@oregonstate.edu" <kim.jones@oregonstate.edu>, "Gary.Johnson@pnnl.gov" <Gary.Johnson@pnnl.gov>

Hi Greg – thanks for the opportunity to weigh in on these questions. I hope that by replying to all, if I misspeak or omit something important, others will provide feedback.

I'll take the easy question first. RE: #5, you will recall that we presented a draft study design in Dec 2013, comparing prey composition and availability and detrital flux for reed canarygrass dominated habitats versus native plants. ERTG members gave us a lot of great input, which we used for revising the design. Jeff Cordell's group at UW and PNNL are helping us with that study. I can send you the final design if interested.

RE:#1-4. It is pretty common that restoration practitioners learn the priorities or focus of funding entities when trying to secure funding for a project. They focus their applications to that entity based on what they think would make a competitive proposal, right? Thus, the actions that generate low SBUs scores (LWD, plantings, floodplain lakes) have been deprioritized for projects the AAs are being requested to fund. As examples, the Wapato Access project, which was erroneously categorized as a floodplain lake, and the USACE project at Post Office Lake are no longer being pursued under CEERP.

Additionally, as you are probably aware, BPA runs a cost per SBU analysis to determine if a project will be approved for funding. As a result, practitioners will either 1) aim the design

of the project to fit within that ratio, or 2) need to cobble together many funding sources to create a holistic project. While the latter is pretty standard with grants and restoration projects, some entities have more resources than others to spend on trying to secure the additional funding. Thus, in some cases, some aspects of projects, such as LWD placement or large scale planting, may not be included in the overall project if it is deemed to be outside the cost/SBU ratio and additional grants are unlikely.

Another result is that projects may not move forward if restoration practitioners cannot address ERTG concerns and raise the SBU score so they fit within that cost/SBU ratio. An example of this is the Clatskanie project which received a low preliminary SBU relative to its size, location and proposed actions (dike breaches - 10.1). Because it requires land acquisition, 408 permitting, and a lot of earth turning, it won't be cheap, and the score won't allow the project to move forward within the cost/SBU guidelines. In this case, BPA is supporting us in returning to the ERTG over the winter to provide a sediment budget, more background on hydrologic and physical processes in the immediate area, and a persuasive argument of what we think is a reasonable expected site recovery timeframe, in comparison to other restored sites in hopes that we can raise the score and keep the project moving forward. We have the resources to do these analyses, and make these arguments, whereas other restoration entities might not.

Projects are assigned scores in the design stage, rather than how well a project met performance standards or whether it met practitioner's objectives (i.e., assigning scores after a project is constructed and monitored). I think we all would appreciate being able to treat individual restoration projects like experiments, and be able to revisit and adaptively manage them over time to ensure they meet our intended targets.

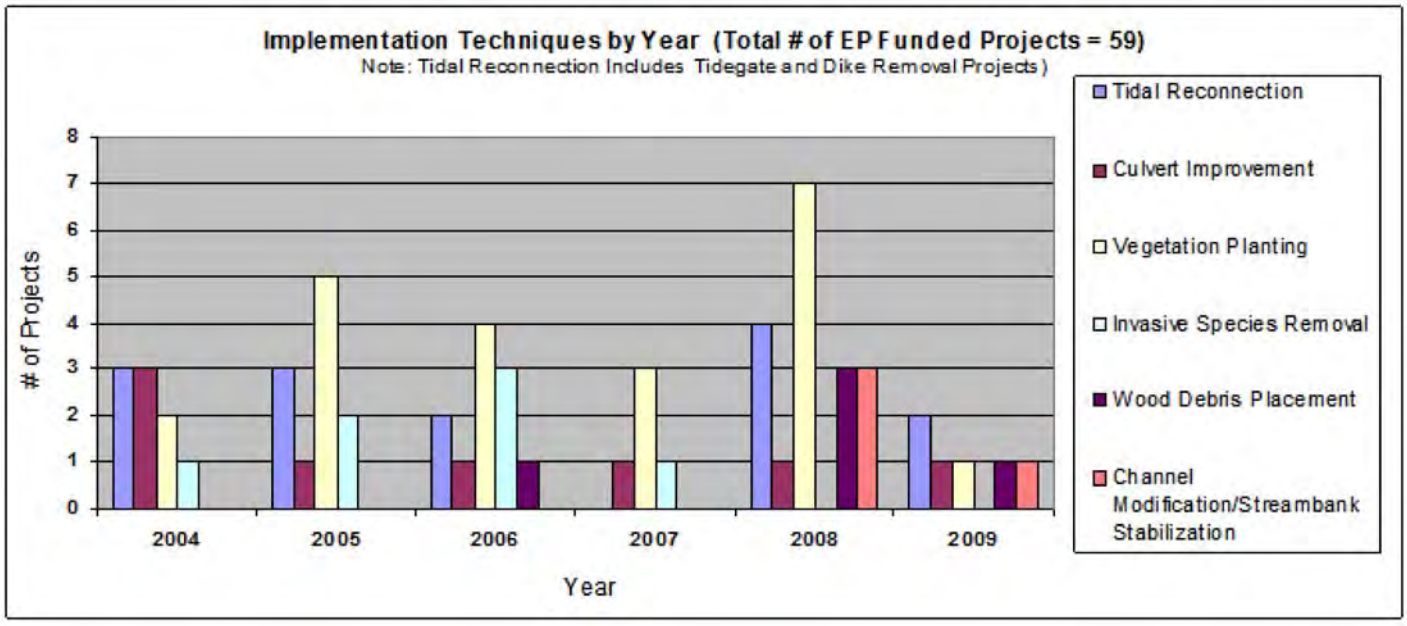
All standardized project evaluation processes have strengths and weaknesses, as well as unintentional consequences. A strength of this process is that priorities (large in size, close to the mainstem, intertidal reconnections) are pretty clear. However, scores still can be somewhat unpredictable because of emerging issues (e.g., subsidence, LWD, floodplain lakes at the time).

I think the restoration practitioners would appreciate more discussion on individual project scores as well as the overall concepts, concerns and uncertainties behind the scores, if possible. I am familiar with several instances where restoration practitioners have felt strongly that the ERTG misunderstood aspects of a project(s) and would have liked to get a chance to appeal comments, clarify misunderstandings, and at minimum understand the ERTG's scores better. I would appreciate the opportunity to help with this, if needed.

Finally, back in 2009, Keith and Chris ran some preliminary analyses on the types of restoration projects, the rate of implementation and cost for a couple presentations Chris and I gave at CREC and to the NPCC (see below). My recollection is that prior to 2009, the vast majority of projects were plantings, LWD, culvert replacements. Around 2009/2010, the region definitely started considering dike breaches and inter tidal reconnections essential for projects in order to get AA funding; the plantings and LWD are now considered "icing" to intertidal reconnections. Keith could update those analyses and provide graphs of types of projects then, and now...as well as rates of implementation for your manuscript if interested. Keep in mind that many of the restoration entities, like ourselves, CREST, Cowlitz, with stable BPA funding, have been able to increase our technical capacity and complete more complex projects than prior to this time…so it's not a true comparison.

Thanks again for the opportunity to provide input. I'm around today if you want to chat about any of these comments.

Thanks, Catherine



Catherine

-----Original Message-----
From: Greg Hood [mailto:ghood@skagitcoop.org]
Sent: Wednesday, October 22, 2014 5:45 PM
To: David.Price@dfw.wa.gov; Catherine Corbett; Blaine.D.Ebberts@usace.army.mil; bbbde1@msn.com; smcewen@columbialandtrust.org; isinks@columbialandtrust.org; rsalakory@cowlitz.org; phil@pctrask.com; mvaness@columbiaestuary.org; bdzelinsky@bpa.gov; Lynne.Krasnow@noaa.gov
Cc: kirk.krueger@dfw.wa.gov; Dan Bottom; ron.thom@pnnl.gov; kim.jones@oregonstate.edu; Gary.Johnson@pnnl.gov
Subject: ERTG feedback questions

Dear colleagues:

The ERTG has been asked by the ISAB to subject their process to peer review by publishing a description and analysis of the process in a journal. Thus, we are currently working on a manuscript to that end.

One of the themes that has come up in the course of writing the manuscript is that the ERTG process has been one of not only of evaluating restoration projects, but also one of communicating the conceptual models, ecological priorities, restoration philosophy, scientific rationales, and scientific uncertainties that underpin the ERTG process to the AAs and to the restoration practioners participating in the ERTG process. We have received anecdotal and informal comments from you that this has resulted in an alteration in the way that you prioritize restoration, design restoration projects, etc. from prior to formation of the ERTG, or since the earliest years of the ERTG, compared to the current day.

Examples of informal comments to this effect are: [1] The AAs try to "channel their inner ERTG" to anticipate ERTG scores and decide if a project is worth pursuing and taking to the ERTG or if it should be culled at an early stage, or if an improvement in its design should be considered; [2] Fewer projects focused primarily on riparian enhancements or on modest culvert improvements are being proposed and instead more projects involving dike breaches are being brought to the ERTG; [3] LWD placements are now de-emphasized in estuarine marsh restoration projects, though not completely eliminated; [4] Floodplain lakes are now a low priority; [5] Targeted research on the ecological function of reed canarygrass is now underway to determine if its control matters to juvenile salmon.

The ERTG is interested in this aspect of our work; how much communication and feedback (behavioral and verbal) is occurring between the three principal players in this process, the ERTG, the AAs, and restoration practitioners as a result of the ERTG's actions? Because we are not privy to the complete process of developing a restoration project and bringing it to the ERTG for review, we are not entirely aware of how we have been affecting this process, for better or worse. Thus, we would appreciate more formal comments from you about the degree to which the ERTG process has affected your approach to habitat restoration in the Columbia River Estuary, if at all. Are examples 1 to 5, above, true in your experience? How else have your approaches changed? Do you think these changes, if any, have been positive or negative, and why? Do you have any documentation (graphs, tables, reports, PowerPoint presentation slides) that support any changes that you believe have occurred (this is not necessary, but would be nice). Is there a question that I haven't asked and should have?

If you could respond by e-mail, the ERTG would highly value your feedback. If you prefer to respond over the phone, send me an e-mail with your phone number and a time when I should call.

On behalf of the ERTG, thank you,

Greg Hood, PhD

ERTG member

Senior Research Scientist

Skagit River System Cooperative

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Response to Public Comments Received regarding the Columbia River Estuary ESA Recovery Plan Module for Salmon and Steelhead

January 13, 2011

Prepared by
National Marine Fisheries Service
Northwest Region

Contents

Introduction

The *Columbia River Estuary ESA Recovery Plan Module for Salmon and Steelhead* (module) provides the basis for estuary recovery actions for Endangered Species Act (ESA)-listed salmon and steelhead in the Columbia River Basin. The National Marine Fisheries Service (NMFS) will incorporate the module by reference into ESA recovery plans for listed Columbia Basin salmon evolutionarily significant units (ESUs) and steelhead distinct population segments (DPSs), thus providing a unified set of Columbia River estuary recovery actions to address the needs of all listed Columbia Basin ESUs and DPSs. The module was prepared for NMFS by the Lower Columbia River Estuary Partnership (contractor) and PC Trask & Associates, Inc., (subcontractor) under contract to NMFS.

Preliminary drafts of the module went through multiple reviews and revisions in response to comments from NMFS Northwest Regional Office and Northwest Fisheries Science Center staff, entities expected to be closely involved in implementation (e.g., the U.S. Army Corps of Engineers, Bonneville Power Administration, and the Lower Columbia River Estuary Partnership), and other groups engaged in recovery planning in the Columbia River Basin (e.g., the Lower Columbia Fish Recovery Board, Oregon Lower Columbia Recovery Planning Stakeholder Team, Upper Willamette Stakeholder Team, and Oregon Mid-Columbia Sounding Board). In January 2008, NMFS made the draft module available for public review as a proposed ESA recovery plan module. The contractors, under guidance from NMFS, revised the proposed recovery plan module in response to public comments, including comments from the Independent Science Advisory Board as technical peer reviewers.

NMFS received nine comment letters by mail, fax, or email on the proposed recovery plan module from a variety of sources, including local, state, and Federal government entities, nonprofit organizations, and interested individuals. Public hearings were held on January 29 and 31, 2008, in Astoria, Oregon, and Vancouver, Washington.

NMFS reviewed all comments received for substantive issues and new information, and addresses as many of them as practicable in the following summary. The contractors, under guidance from NMFS, revised the recovery plan module as appropriate. For readers' convenience, we have assigned comments to major issue categories and, where possible, combined similar comments into single comments and responses. We received a number of very detailed comments, including editorial clarifications and minor corrections, requests to cite specific documents, and suggested changes in wording to clarify the document. These are not addressed here but were considered and acted upon as appropriate. The revised recovery plan module is now the final plan; the *Columbia River Estuary ESA Recovery Plan Module for Salmon and Steelhead* is available at the following website: *http://www.nwr.noaa.gov/Salmon-Recovery-Planning/ESA-Recovery-Plans/Estuary-Module.cfm*.

NMFS acknowledges the high quality of the comments and the great care with which individuals and organizations reviewed the recovery plan module. Salmon and steelhead

are important to the people of the Pacific Northwest, and NMFS recognizes that public participation is essential to the task of protecting this precious natural resource. Most commenters offered support for the recovery plan module and its implementation, along with thoughtful comments.

The recovery plan module is the product of long work by numerous individuals and entities, and NMFS now intends to move forward to the long-term collaboration that will be necessary to implement it. NMFS welcomes the participation of all interested parties as we move forward into this new and rewarding phase of work.

Comments Pertaining to the Entire Module

Comments pertaining to the entire module included comments pertaining to the technical foundation of the module, the scope of the module, and the relationship of the module to other processes.

Comments on the Technical Foundation of the Module

Comment: The process used to develop relationships between limiting factors and threats, score limiting factors and threats, and estimate possible survival gains is not adequately transparent. Provide more detail on the process and identify the experts who provided input. A formal expert process such as a Delphi panel might provide more insight into questions such as prioritization of limiting factors and threats and identification of actions and their benefits.

Response: The module was developed by the Lower Columbia River Estuary Partnership (Estuary Partnership) and a private consultant, PC Trask & Associates, Inc., in close coordination with NMFS Northwest Regional Office and Northwest Fisheries Science Center staff. PC Trask & Associates, Inc., was the primary author and developed products that were reviewed and refined by staff from the Estuary Partnership and NMFS and by other experts on a case-by-case basis. Conclusions regarding relationships between limiting factors and threats, prioritization of limiting factors and threats, and possible survival gains represent the professional judgment of the author (based upon the primary source documents used and other literature), as modified based on input primarily from staff at the Estuary Partnership and NMFS, as well as from other individuals consulted on a case-by-case basis. The contractors and NMFS staff also considered input from reviewers at other agencies and the public in finalizing these aspects of the document. We have clarified throughout the document (e.g., in Chapters 1, 3, 4, and 5) the ways in which experts were involved and how their input was used in reaching conclusions about limiting factors, survival gains, and other technical aspects of the document. In addition, we have added an acknowledgments page that identifies the experts who provided input to the document and the nature of their input. We agree that a formal Delphi process would be useful in the future as a way to build on this document and on our understanding of the estuary.

Comment: The document is in many respects a "review of reviews": it relies heavily on three internal agency documents rather than on primary literature and leans heavily

toward management tools rather than science. It should not be characterized as a scientific document.

Response: NMFS intended the module to be a planning and management document that tiered off a body of existing knowledge and that summarized and synthesized that knowledge in a more comprehensive way than had been done in the past. NMFS decided at the outset that the module should rely primarily on three source documents--two NOAA Technical Memoranda and one Northwest Power and Conservation Council document--because we believed that they were accurate, timely, and comprehensive summaries of existing science.[1] The module does also cite extensive references in addition to the three primary sources (see the 16-page Reference list at the end of the document). We have clarified (see Chapter 1) that the module was intended to be a planning document that was based on and that synthesized available science. Our intent was also to develop initial hypotheses regarding the relative impact of limiting factors and threats and the potential to improve conditions in the estuary and survival through the estuary. We feel the document has accomplished that intent and that it clearly describes the degree to which these conclusions are based on expert opinion in the absence of quantitative data. In addition, the importance of research, monitoring, and evaluation to test the document's hypotheses, and of adaptive management to adjust management actions as scientific understanding evolves, is clearly stated (see Chapter 6).

Comment: Clarify the assumptions made in the module regarding hatchery versus natural-origin fish. Is it correct then to assume that hatchery fish do not "count" toward recovery goals? If they do, then does this whole analysis have to be re-done using hatchery fish?

Response: NMFS determines ESA recovery based on evaluation of the status of naturally produced salmon and steelhead and the threats they face. Current scientific information on the effects of estuarine limiting factors does not differentiate between effects to hatchery and natural-origin salmon and steelhead or between effects to salmon and steelhead listed under the ESA and those that are not. Thus, the evaluation of limiting factors and threats in the module does not distinguish between hatchery and natural-origin or listed and non-listed fish. Similarly, the intent of the management actions in the module is to improve the survival of ESA-listed, natural-origin salmon and steelhead, but at this time it is not possible to differentiate the effects of estuary habitat actions on hatchery versus natural-origin or listed versus non-listed fish. (Actions in other components of ESA recovery plans deal with harvest and hatcheries and these actions do differentiate between hatchery and natural-origin fish.) Finally, while the survival improvement targets are expressed in terms of numbers of natural-origin, listed fish, doing so was a device to illustrate potential

[1] Bottom, D.L., C.A. Simenstad, J. Burke, A.M Baptista, D.A. Jay, K.K. Jones, E. Casillas, and M.H. Schiewe. 2005. *Salmon at River's End: The Role of the Estuary in Decline and Recovery of Columbia River Salmon.* NOAA technical memorandum, NMFS-NWFSC-68; Fresh, K.L., E. Casillas, L.L. Johnson, and D.L. Bottom. 2005. *Role of the Estuary in the Recovery of Columbia River Basin Salmon and Steelhead: An Evaluation of the Effects of Selected Factors on Salmonid Population Viability*. NOAA technical memorandum, NMFS-NWFSC-69; Northwest Power and Conservation Council. 2004. *Mainstem Lower Columbia River and Columbia River Estuary Subbasin Plan.* Portland, OR.

benefits of actions and not an analysis of differential benefits to natural origin or listed fish; what is important is the allocation of relative benefits among the management actions.

Comments on the Scope of the Module

Comment: Acknowledge the connection between tributary and estuary conditions and the fact that many threats identified in the module are partly the result of the cumulative effects of upriver actions that must be treated using systemic actions that will translate downstream to the estuary. Address how NMFS will ensure that plans for these upstream areas consider the impact of their management actions on estuary issues.

Response: We agree that some estuary threats and limiting factors are subject to the cumulative effects of upriver actions. The module acknowledges this linkage and specifies certain categories of actions that will need to occur in tributaries to fully address estuary limiting factors and threats (see Chapter 5, under *Other Recommended Management Actions*). While NMFS's domain-scale recovery plans do not explicitly evaluate the need for or incorporate tributary actions specifically to address estuary threats, it is likely that many of the tributary actions identified in domain recovery plans will contribute to addressing certain estuary threats. The module also incorporates actions related to the effects of the Federal Columbia River Power System on habitat conditions in the estuary and plume. The issue raised by the commenters also relates to the need for each ESU to have a comprehensive assessment of limiting factors and threats and an evaluation of the extent to which actions are being implemented to address that full scope of limiting factors and threats. This issue is one most appropriately addressed in future status reviews and through ESU and domain-level adaptive management plans.

Comment: Clarify the geographic extent of the estuary as defined in the module, and specify whether it includes the portion of the Lower Willamette River up to Willamette Falls, which is tidally influenced. Also, clarify where Lower Willamette mainstem actions fall.

Response: For purposes of the module, the estuary is broadly defined to include the entire continuum where tidal forces and river flows interact, regardless of the extent of saltwater intrusion. This includes the Columbia River upstream to Bonneville Dam and the Willamette River upstream to Willamette Falls. It also includes the Columbia River plume (see Chapter 1, under *Formation and Current Characteristics of the Estuary*). The module uses a system of Columbia River mainstem reaches developed by the Lower Columbia River Estuary Partnership to provide geographic specificity to priority areas for actions. We have clarified where Willamette mainstem actions fall within this reach system. To make this clarification, we have added a "Willamette Reach." (Because the Estuary Partnership's system covers only the Columbia River mainstem, we have not assigned a letter to this reach but refer to it simply as the "Willamette Reach.") We have also clarified in the descriptive text for reaches F and G the portions of the Willamette mainstem included in those reaches (see Chapter 1, under *Estuary Reaches*, and Appendix A, map for "Reach G and Willamette Reach"). Finally, we have ensured that priority reaches for actions as

identified in Table 5-6 (*Estimated Cost and Schedule*) reflect the Willamette Reach where appropriate.

Comments on the Relationship of the Module to Other Processes

Comment: Are impacts of the Federal Columbia River Power System (FCRPS) on estuarine habitat addressed in upriver recovery plans or is the module intended to address those impacts? What is the relationship of the module to the FCRPS Biological Opinion (BiOp)?

Response: Upriver recovery plans do not address impacts of the FCRPS on estuarine habitat. They do address impacts of the FCRPS on juvenile and adult passage survival through the FCRPS by incorporating the *Recovery Plan Module for Mainstem Columbia River Hydropower Projects for ESA-listed Columbia Basin* (NMFS 2008a; available at *http://www.nwr.noaa.gov/Salmon-Recovery-Planning/ESA-Recovery-Plans/Other-Documents.cfm*). Upriver recovery plans address estuarine habitat by incorporating this estuary module.

In terms of the relationship between this module and the FCRPS Biological Opinion, drafts of this module were available during the FCRPS BiOp remand collaborative process, which led to the 2008-2018 FCRPS Biological Opinion and Supplemental Comprehensive Analysis (NMFS 2008b). Among the provisions of the 2008-2018 FCRPS BiOp were requirements for the Federal action agencies to implement habitat improvement and predation control actions in the estuary. Estimates of the survival benefits that would be gained from those actions were included in the 2008-2018 BiOp, and those survival estimates were derived from the allocation of survival improvements among actions in this module.

In February 2010, NMFS issued the 2010 Supplemental BiOp for the FCRPS (NMFS 2010). This Supplemental BiOp integrated elements from the 2008 BiOp and the Adaptive Management Implementation Plan (AMIP). The AMIP included accelerated and enhanced actions to protect Columbia Basin salmon and steelhead, including commitments to additional estuary actions under a new agreement with the state of Washington and efforts to control native predators and invasive species. It also included enhanced research and monitoring and incorporated specific biological triggers for contingencies linked to unexpected declines in the abundance of listed fish.

The 2010 Supplemental BiOp retained the estimates of survival improvements from estuary habitat and predation control actions that had been incorporated into the 2008 BiOp and that were based on a draft version of this module. In addition, it summarized and assessed relevant new information that had become available since the 2008 BiOp was issued, including information on climate change, juvenile salmonid use of the estuary and plume, predation, toxics, and ecological interactions between hatchery- and natural-origin fish. The new information summarized in the 2010 Supplemental BiOp will be useful in informing implementation decisions regarding actions in the module.

Actions in the 2008 BiOp and its 2010 Supplement that relate to estuarine habitat, predation, and flow will contribute to the implementation of actions in this module. The

module, however, identifies habitat, predation, and flow actions that are larger in scope than the actions that will be implemented under the 2008 BiOp and its 2010 Supplement. NMFS projects that the 2008 BiOp actions related to estuarine habitat, flow, and predation will yield only a portion of the total survival improvements that this module hypothesizes are possible for actions in those categories. The intent of the estuary module was to lay out the full suite of limiting factors and threats affecting the estuary; to identify actions to address those limiting factors and threats; and to provide a basis for future discussions and societal decisions about recovery efforts in the Columbia River estuary.

Comments Pertaining to Limiting Factors and Threats

Generally, commenters noted that the module seemed to have identified the full range of limiting factors and threats. We received a few requests for more discussion of certain limiting factors and threats. In addition, we received requests for more detail on the method used for prioritizing limiting factors and threats, questions about how relationships between limiting factors and threats were defined, and some comments or requests for clarification on specific limiting factors or threats.

General Comments on Limiting Factors and Threats

Comment: The module does not use the term *limiting factors* to indicate conditions or processes that have been proven by scientific investigation to have actually influenced survival of salmonids in the estuary. There has been insufficient research in the Columbia River estuary, or indeed any estuary on the northeast Pacific, to identify limiting factors for salmonids. In many ways, the list of factors in the estuary module is a reflection of what has been studied, not a proven list of what has in fact limited salmon populations in the estuary. The term *potential limiting factors* is a possible alternative.

Response: We have clarified in the module that the term *limiting factors* is used to refer to the key habitat-related physical, chemical, or biological features that scientific literature and the professional opinion of the author and technical reviewers suggest are affecting the viability of salmon in the estuary. We have also clarified that we use the term to indicate the full range of factors believed to be affecting viability of salmon in the estuary and not to indicate the single factor that is most limiting to the viability of salmon in the estuary (see introductory text and corresponding footnote in Chapter 3).

Comment: It would be useful if an additional column were added on the right side of Table 3-1 (*Impact of Limiting Factors on Ocean- and Stream-Type Salmonids*) listing the specific primary references used by the author to identify each factor as a potentially limiting factor.

Response: Citations for each limiting factor are contained within the text of Chapter 3. If these citations were added to Table 3-1, they would be out of context compared to simply returning to the section in Chapter 3 that addresses the limiting factor of concern. We added text under the Chapter 3 subhead *Prioritization of Limiting Factors*, in which Table 3-

1 is introduced, to refer the reader back to the text discussion of individual limiting factors for specific source material on those topics.

Comment: The module should recognize the synergistic effects of limiting factors.

Response: The concept of synergistic and interrelated effects is woven throughout the module, although we have also attempted to balance conveying the complexity of the estuary with communicating essential information in a way that a broad audience can readily grasp. We have added discussion in Chapter 3 (under *Habitat Opportunity, Habitat Quality, and Synergistic Effects*) of the possibility that some limiting factors have synergistic effects, in which the cumulative negative impact of two or more limiting factors is greater than the sum of the impacts of the individual limiting factors. Although synergistic effects are difficult to identify and quantify, the module assumes that they exist and can also be taken advantage of to enhance the beneficial impacts of management actions in the estuary. The implications of potential synergistic effects of management actions are also addressed in Chapter 7, Perspectives on Implementation.

Comments Suggesting Factors That Should Receive More Attention

Comment: Climate change should receive more attention, including impacts on flow and water temperature.

Response: We have added additional discussion of climate change in Chapter 4 (under *Threat: Climate Cycles and Global Climate Change*). This added text acknowledges climate change impacts to flow-related issues and water temperature. We have updated the discussion with reference to work by the Intergovernmental Panel on Climate Change and the Independent Scientific Advisory Board.[2] We have also noted that detailed discussion of potential impacts of climate change is beyond the scope of the module. Specific impacts of climate change on salmon are identified as a critical uncertainty. In addition, the module notes that the 2010 Supplemental Biological Opinion for the Federal Columbia River Power System (NMFS 2010) summarized and assessed relevant new information on climate change, and that this information should inform implementation decisions regarding actions in the module.

Comment: Rearing capacity in the estuary, or density dependence, should receive more discussion.

Response: The focus of the module is on the effects of habitat conditions and processes in the estuary and plume, rather than on the effects of hatchery or harvest practices (see

[2] Intergovernmental Panel on Climate Change. 2007. *Climate Change 2007: Synthesis Report*. Contributions of Working Groups I, II, and III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, Pachauri, R.K and Reisinger, A. (eds.)]. IPCC, Geneva, Switzerland; Independent Scientific Advisory Board. 2007. *Climate Change Impacts on Columbia River Basin Fish and Wildlife*. ISAB Climate Change Report, ISAB 2007-2. Prepared by the Independent Scientific Advisory Board for the Northwest Power and Conservation Council, Columbia River Basin Indian Tribes, and National Marine Fisheries Service. May 11, 2007.

Chapter 3, under *Density-Dependent Mortality*). The question of rearing capacity, or density dependence, overlaps significantly with the topic of hatchery production and practices, which are beyond the scope of the module. We have reviewed the discussion of density-dependence in the module and believe it is up-to-date and treated in a manner consistent with the scope of the document. The module describes possible mechanisms of density-dependent mortality in the estuary, identifies the issue as a critical uncertainty, and points to the need to examine the cumulative effects of hatchery releases. In addition, the module indirectly addresses density dependence by identifying the need to improve habitat quality and quantity.

Comment: Provide additional information on toxics, including emerging research on the synergistic effects of toxics.

Response: The discussion of toxic contaminants as a limiting factor has been substantially updated to include more recent data that is specific to the estuary and to provide a fuller picture of the effects of toxics on salmonids. This expanded section discusses lethal and significant sublethal effects of toxics on salmonids, includes more recent information on specific contaminants in the estuary, discusses synergistic effects, and describes the pervasiveness of toxics in the estuary (see Chapter 3, under *Toxic Contaminants*).

Comment: Provide additional information on ship wake stranding and its significance as a limiting factor.

Response: We have added additional information on the extent and magnitude of ship wake stranding (see Chapter 4, under *Threat: Ship Wakes*). Impacts of ship wake stranding relative to other threats are reflected in the prioritization of threats (see Chapter 4, under *Prioritization of Threats*).

Comment: Include more discussion of habitat quality when discussing limiting factors such as reduced in-channel and off-channel habitat opportunity; pilings, dikes, and overwater structures; and riparian practices.

Response: We have added a section in Chapter 3 (*Limiting Factors*) that discusses the interplay between habitat quality and habitat quantity and how the various limiting factors identified in the module affect habitat quality and quantity generally (see under *Habitat Opportunity, Habitat Quality, and Synergistic Effects*).

Comment: The module focuses on ballast release but not intake, which can affect juvenile salmonids in the water column. Most ballast intakes are not screened to protect fish.

Response: We note in Chapter 4 (under *Ship Ballast Practices*) that this issue is an emerging source of concern. In addition, we have added ballast water intake to management action CRE-7 (Reduce entrainment and habitat effects resulting dredge activities and ship ballast intake).

Comment: It is not clear why the introduction of non-native species through ballast water discharge is not considered a greater threat. It is also not clear why there is not more discussion of the impacts to the food web of species introduced through ballast water and of the impacts of such introductions in other ecosystems.

Response: Rankings of threats are influenced by the limiting factor priority ratings (see Table 4-1, *Linkages Between Limiting Factors and Threats to Ocean- and Stream-Type Salmonids*). The associated limiting factor for this threat, introduced invertebrates, was ranked relatively low in priority among limiting factors (see Table 3-2, *Limiting Factor Prioritization*). In ranking the limiting factors, issues such as introduced invertebrates, which have a potential to have ecosystem effects but for which there is also a high degree of uncertainty regarding impacts on salmonids, tended to be ranked lower in priority. Should information emerge that clarifies these impacts, then we would expect this issue to gain a higher profile in implementation.

Comments Related to Categorization of Limiting Factors and Threats

Comment: A number of comments suggested changes to the way limiting factors and threats were categorized. For example, one commenter suggested categorizing *flow-related threats* as *hydrology-related threats* to characterize the interaction of flow with riparian area functions. The commenter thought this would also allow some management actions currently captured under *water-quality related threats*, such as CRE-23 (Implement stormwater best management practices), to fit under *hydrology-related threats*, where they would also be appropriate.

Response: These comments addressed the terminology used for and the categorization of limiting factors or threats as well as various ways of lumping and/or splitting the organization of limiting factors and threats. In part, the lumping and splitting in the module reflects the way limiting factors were organized and evaluated in two NOAA Technical Memoranda that were among the primary sources relied on for the module (Fresh et al. 2005 and Bottom et al. 2005). The important point is to ensure that all limiting factors and threats have been included, and we believe that they have. Where possible, we attempted to acknowledge specific points made in such comments. For example, in the case mentioned above, we have added reference to effects of flow on groundwater recharge, cold-water upwelling, flooding, off-channel habitat quality and quantity, and water quality in an effort to acknowledge the issue raised by the commenter (see Chapter 4, under *Flow-Related Threats*).

Comments Related to Prioritization of Limiting Factors and Threats

Comment: In the module, threats are prioritized across the entire estuary. Within each reach, threats might be prioritized differently. Refine the prioritization of limiting factors and threats by individual reach to allow more targeted management actions.

Response: At this time, we lack the assessment information and resources to do such a fine-scale prioritization. We have noted in the text that threats are prioritized across the entire estuary and that within each reach, threats could be prioritized differently. We have

also noted that information is not available at present to support prioritization by reach but that such an analysis would be useful in the future as information becomes available (see Chapter 4, under *Prioritization of Threats*). This is also an implementation and adaptive management consideration. The module identifies top tier priorities but does not imply they are all equal. Implementation should involve dialogue, additional evaluation, and response to evolving information. We have added language noting that the potential benefits of management actions varies from reach to reach, and that it is assumed that implementation will involve dialogue and additional evaluation at the reach scale to aid in prioritizing actions and focusing them where they will be most beneficial (see Chapter 7, under *Evaluation of Management Actions*).

Comment: Was a formal and structured method (e.g., a Delphi process) used in developing the prioritization of limiting factors?

Response: PC Trask & Associates, Inc., performed an initial prioritization of limiting factors, based on a synthesis of the three main literature sources (Bottom et al. 2005, Fresh et al. 2005, and Northwest Power and Conservation Council 2004), supplemented by additional literature. In prioritizing limiting factors, the author considered the following: (1) how the three main literature sources evaluated and/or prioritized limiting factors; (2) the magnitude or severity of limiting factors as described in the source documents; (3) estimates of mortality caused by a limiting factor (which were available only for predation-related limiting factors); and (4) the frequency with which a limiting factor was identified in the source documents. Staff from the Lower Columbia River Estuary Partnership, the NMFS Northwest Fisheries Science Center, NMFS Northwest Regional Office, and the Lower Columbia Fish Recovery Board reviewed and provided input on the prioritization (see Chapter 3, under *Prioritization of Limiting Factors*). We agree that in the future, a formal Delphi process would be useful as a way to build on this document and on our understanding of the estuary. We also believe that the document adequately describes uncertainties inherent in the limiting factor ranking process and provides rankings of sufficient credibility to provide the foundation for implementation supplemented by research and monitoring and based on adaptive management.

Comment: Without more specific information than is given in the document, it is not possible to clearly prioritize the limiting factors based on mortality. Instead, it might be more desirable to prioritize them based on which would be potentially limiting at which scale or over a certain range of values.

Response: Limiting factors were prioritized based on information in the literature. If the literature contained mortality estimates, PC Trask & Associates, Inc., considered them in developing the priority rankings. For many limiting factors, however, mortality estimates are lacking and the module author relied on professional judgment. While the approach suggested by the commenter could be useful, it could also introduce a false sense of certainty and precision because of existing limitations on data. We are confident that the module provides an adequate basis from which to begin implementation of recovery actions in concert with rigorous monitoring and adaptive management.

Comments on Specific Limiting Factors

Comment: Clarify that elimination of overbank flooding is largely a function of reduced peak freshet flows as a result of flow regulation and of increase in bankfull level as a result of dikes and levees.

Response: We have made the suggested clarification by adding the following language (see Chapter 3, under *Reduced Off-Channel Habitat Opportunity*): "The near elimination of overbank flooding is a function of both reductions in peak freshet flows (as a result of flow regulation for flood control, storage for irrigation and municipal use, and electricity generation) and increases in the bankfull level of the Columbia River (as a result of dikes and levees), among other factors."

Comment: Why is breaching dikes and levees important for stream-type Chinook in the estuary? References on the importance of off-channel habitats to stream type salmon and steelhead are needed.

Response: The rationale relates to the member/vagrant theory (Bottom et al. 2005), discussed in Chapter 2, which basically states that populations express a variety of life histories (e.g., stream-type populations exhibit ocean-type life histories and vice versa). We have added a reference to Bottom et al. 2005 in the discussion of benefits of off-channel habitats to stream-type juveniles (see Chapter 3, under *Reduced Off-Channel Habitat Opportunity*).

Comment: The discussion in Chapter 4 (*Threats to Salmonids*) of reservoir-related temperature changes could use clarification and elaboration.

Response: We have refined the discussion of water temperature as a limiting factor in Chapter 3 (under *Limiting Factor: Water Temperature*) and added information on the effects of high water temperatures on salmon as well as on the Independent Scientific Advisory Board's view on how global climate change will contribute to still higher water temperatures in the future (ISAB 2007). We have cross-referenced this discussion in Chapter 4, under *Threat: Reservoir-Related Temperature Changes*.

Comment: It is completely speculative whether there is a proportional relationship between flows and survival.

Response: Many studies show that if enough habitat is wetted frequently enough and for a long enough time, it is functional habitat. It is reasonable to assume that increasing such habitat would improve survival. The module does not imply that the increase in survival would be proportional to the increase in flow. It simply assumes that incremental changes in flow would increase the amount, frequency, and duration of wetted habitat and provide some survival benefit for juvenile salmonids present when flows were increased.

Comments Pertaining to Management Actions

Comments pertaining to management actions included comments related to whether we had identified a comprehensive and appropriate set of management actions and comments on specific actions, including requests for clarification or for minor changes in wording or the component projects of an action. In addition, we received comments on relationships between management actions, comments on the identification and evaluation of constraints to implementation of management actions, and comments on the allocation of survival benefits among actions.

Comments on the Identification of Management Actions and Their Related Projects

Generally commenters appeared to think that we had identified actions that addressed the full range of limiting factors and threats. We did not receive requests to incorporate any additional management actions beyond the 23 identified in the proposed plan. We did receive numerous specific suggestions to adjust the wording of actions slightly to clarify their scope and intent. While we have not responded to each of these comments in detail below, in almost every case, we either accepted the suggestions verbatim or made slight modifications to the suggested wording to capture what we believed was the commenter's intent in a manner more consistent with the tone of the module. One exception was comments suggesting that we add hatchery fish to the management actions dealing with predation on salmon by fish (CRE-13) and with competition between shad and salmon (CRE-18). Because actions related to hatchery fish are beyond the scope of the module, we did not incorporate those suggestions.

We also received some specific suggestions to add projects that would contribute to implementing actions. While we have not discussed each such instance below, we did evaluate and respond appropriately to all such comments. We also received requests for clarification of specific actions, requests to add additional reaches to the priority reaches for certain actions, and requests to include specific entities in the list of "potential implementers" for each management action. Again, while we have not described and responded to each of these specific comments below, in most cases we agreed with the comment and accommodated the requests.

Comment: Some commenters suggested alternative ways of lumping and/or splitting actions and their associated limiting factors and threats—e.g., a commenter suggested that in Table 5-2 (*Constraints to Implementation of Management Actions*) we should include water quality as a function and associated limiting factor addressed by CRE-1 (protect and restore riparian areas) and by CRE-3 (establish minimum instream flows).

Response: These comments addressed terminology used for limiting factors or threats and various ways of lumping and/or splitting the organization of limiting factors and threats. The important point is to ensure that all limiting factors and threats have been included and addressed by management actions, and we believe they have. Water quality is not identified as a limiting factor per se in the module. Instead, individual aspects of water quality are included as limiting factors--water temperature, toxics, and sediment and

nutrient-related habitat changes in the estuary and plume--and each of these limiting factors is addressed by management actions.

Comment: Education and outreach should be a part of all management actions.

Response: Education and outreach seem particularly relevant to certain actions, such as protecting and restoring riparian areas (CRE-1), protecting off-channel habitat (CRE-9), controlling invasive plants (CRE-15), and reducing pollutants entering the estuary (CRE-20 and CRE-21), for which successful implementation will depend on the combined efforts of many individual landowners. For these actions we have included education as a specific component of implementation, although we have also noted the need to combine these efforts where possible for efficiency and maximum impact with the public. In addition, we agree with the commenter that education is one way of garnering support for implementation of all the management actions in the face of social and political obstacles, and that education about stewardship and the ecosystem benefits that implementation would provide is an essential component of all management actions in the module. We have noted this in Chapter 7 (*Perspectives on Implementation*), along with an additional reminder that, to the extent possible, these education efforts should be coordinated to create efficiencies.

Comment: Many actions include some type of planning or assessment as an initial step in implementation. In addition, some actions or projects are worded to imply that new forums must be created to conduct this planning or assessment. We should rely on existing forums wherever possible. We should not create multiple new forums.

Response: The commenter is correct that in some cases, the module has identified additional planning tasks as first steps in implementation of actions. The state of knowledge regarding exactly how best to address some estuarine threats is such that additional assessment or evaluation of the feasibility of various approaches is needed before direct action can be supported. We agree with the commenter that we should not create multiple new forums and should rely on existing processes wherever possible. Accordingly, we have modified the wording of some actions and projects so as not to imply that we are suggesting the creation of a new forum. We have also added text in Table 5-6 (*Estimated Cost and Schedule*) that describes existing efforts related to implementing each action. The summaries of existing efforts are not exhaustive but are intended to emphasize that opportunities exist to build on existing programs to improve salmon and steelhead survival in the estuary. In addition, we have added general language in Chapter 7 (*Perspectives on Implementation*) regarding the need for efficiencies in implementation and the need to rely on existing processes wherever possible. In many cases, there is not an existing process targeted directly at an action. In such cases, we expect those involved in implementation to look for ways that existing processes can be modified to more directly target actions in the module.

Comment: Many actions or projects are closely related (e.g., CRE-1.1, Educate landowners about ecosystem benefits of intact riparian areas, and CRE-9.1, Educate landowners about

the ecosystem benefits of protecting…off-channel areas). We need to demonstrate efficiencies for similar actions.

Response: We agree with the general need to look for efficiencies and to emphasize the importance of doing so. We have addressed this concept generally in Chapter 7 (*Perspectives on Implementation*). In addition, in Table 5-6 (*Estimated Cost and Schedule*), in some cases we explicitly identified linkages between projects or actions through footnotes and by adding text that summarizes existing efforts related to implementing each action. (The summaries of existing efforts are not exhaustive and are intended to emphasize that opportunities exist to build on existing programs to improve salmon and steelhead survival in the estuary.)

Comment: The connection between some actions and habitat access and habitat quality is not clear enough, either in discussions of limiting factors or in management actions. Include more discussion of habitat access and habitat quality in certain actions.

Response: Habitat access and habitat quality per se are not identified as limiting factors. These concepts are captured in the module under the various flow- and sediment/nutrient-related limiting factors and are addressed in a number of management actions (see Table 4-1, *Linkages Between Limiting Factors and Threats to Ocean- and Stream-Type Salmonids* and Table 5-1, *Management Actions to Address Threats*). We have added a section in Chapter 3 (under *Habitat Opportunity, Habitat Quality, and Synergistic Effects*) that discusses the interplay between habitat opportunity and habitat quality and various limiting factors in the estuary at a summary level. In addition, we have also changed the wording of some actions to make their linkages to habitat access and habitat quality more explicit.

Comment: The largest proportional benefit for stream-type juveniles comes from redistributing terns and cormorants. This strategy may not be effective because it may shift the problem upstream; in addition, the success of relocation has not been demonstrated, so the magnitude of results is speculative.

Response: Action CRE-17 (disperse double-crested cormorants) is given a constraint rating of 4, so the module is highlighting that there are significant difficulties involved in implementation. For this action and for action CRE-16 (redistribute Caspian tern population), implementation efforts will need to continue to consider the impacts of relocation.

Comment: The module assumes that pikeminnow are a greater threat to salmonids than are bass, walleye, and channel catfish. Active efforts should be made to significantly reduce all warmwater, non-native fishes.

Response: The module does address other warmwater, non-native fishes. Action CRE-13 is to "manage pikeminnow and other piscivorous fish, including introduced species, to reduce predation on salmons." We have also noted, in Chapter 4 (under *Threat: Altered*

Predator-Prey Relationships), that other exotic fish species such as introduced walleye and catfish have also altered food web dynamics through predation and competition for food. We believe that pikeminnow are a greater threat at this time because their numbers are believed to be greater. We have clarified this assumption in Table 5-2 (*Constraints to Implementation of Management Actions*). Research is being conducted through the FCRPS BiOp to better assess potential impacts of non-native fish species within the mainstem migration corridor. Information from these studies should be pertinent to potential management actions in the estuary.

Comment: There is no intent to reduce the rate of maintenance dredging in the lower Columbia River, so it is unclear what will actually be done to reduce continued loss of wetlands. Impacts of maintenance dredging need to be scrutinized.

Response: We agree that the impacts of maintenance dredging need to be evaluated and addressed. The module notes the magnitude of the recent Columbia River Channel Deepening Project (see Chapter 4, under *Threat: Dredging*). In addition, action CRE-6 is directed toward beneficial use of dredged materials. As noted in the "existing efforts" for that action (see Table 5-6, *Estimated Cost and Schedule*), work is underway to address wetlands loss as a result of dredging: for example, the Lower Columbia Solutions Group is working on a sediment plan for the Lower Columbia River and looking for ways to avoid further impacts to wetlands and restore some that have been degraded.

Comment: Action CRE-9 (Protect remaining high-quality off-channel habitat from degradation) should be broadened to explicitly incorporate restoration as well as protection.

Response: Our thinking initially was that habitat restoration would be covered largely under other actions, such as CRE-1 (protect and restore riparian areas), CRE-8 (remove or modify pilings), and CRE-10 (breach or lower dikes). Upon consideration of this comment, however, we agree and have made the requested change so that CRE-9 now reads "Protect remaining off-channel habitat from degradation and restore degraded areas with high intrinsic potential for high-quality habitat." In addition, we have added a project to this action that addresses habitat restoration (see Project CRE-4.4 in Table 5-6, *Estimated Cost and Schedule*). Changing the scope of action CRE-9 also necessitated a change in the survival improvement targets allocated to that action. Accordingly, we have adjusted the survival improvement target for CRE-9 from 14 percent to 16 percent for ocean-type juveniles and from 6 percent to 9 percent for stream-type juveniles (see Table 5-5, *Survival Improvement Targets Allocated to Management Actions*).

Comments on Relationships between Actions

Comment: The module has described the relative benefits of the 23 management actions in terms of their potential contribution to survival improvements in the estuary. Some actions, however, would have interrelated effects, synergistic effects, or cumulative effects among actions. Some actions may not reap their full potential unless their implementation is coupled with implementation of other, related actions. The module should more clearly

explain how certain actions are interrelated (e.g., the extent to which flow is addressed will influence the effectiveness of actions to breach and lower dikes, protect off-channel habitat, and reduce reservoir heating) and should note that recovery may depend on the summed or synergistic effects of several actions.

Response: The concept of synergistic or interrelated effects is woven throughout the module, although we have also attempted to balance conveying the complexity of the estuary with communicating essential information in a way that a broad audience can readily grasp. In addition, information to predict and describe synergistic and cumulative effects is limited. In response to the comments received, we have addressed the issue of interrelated, synergistic, and cumulative effects of implementation of management actions in Chapter 7. We have added language emphasizing that the benefits of certain actions will be enhanced if implemented in concert with other actions, and we have noted the importance of considering these cumulative and synergistic effects in implementation. It is impossible to identify every specific instance in which synergistic or cumulative effects will be realized in implementation, but because several comments in this category specifically mentioned flow in this regard, we have specifically noted that effects of certain actions will be enhanced if combined with adjustments in flow (see Chapter 7, under *Improving Ecosystem Health*). However, it is also important to bear in mind that each action will provide some benefit individually, and this is what the module has attempted to analyze (i.e., the module analyzes each action individually and does not attempt to analyze the synergistic effects of actions).

Comments on the Evaluation and Identification of Constraints to Actions

In addition to general comments on the evaluation of constraints to implementation of management actions, we received several specific comments with regard to the constraint ratings of specific actions. A few, but not all, of the specific comments are discussed here for illustrative purposes. In all cases, we reviewed the comments and responded appropriately.

Comment: The evaluation of constraints in Chapter 5 should be transparent, objective, and consistent across the threats and actions. Describe in greater detail the analysis used to identify and rank the constraints to implementation as well as the benefits in this regard. One alternative approach to evaluating constraints would be to identify scenarios projecting benefits if 25 percent of the actions were implemented, if 50 percent of the actions were implemented, if 75 percent of the actions are implemented, and if there were no constraints.

Response: PC Trask & Associates, Inc., performed an initial rating of management action constraints by qualitatively estimating the degree of difficulty in implementing each action, taking into account social, political, and technical factors, including the probable cost of implementation. Staff at the Lower Columbia River Estuary Partnership, NMFS Northwest Fisheries Science Center, NMFS Northwest Regional Office, and Lower Columbia Fish Recovery Board provided input into this process. PC Trask & Associates, Inc., and NMFS also revised some constraint scores in response to the *Federal Register* public comment

process. Because the scientific literature generally falls short of prescribing discrete actions to address threats and is even less robust when it comes to evaluating constraints to implementation, the reader should view specific ratings as a qualitative estimate only, but one that is useful in comparing relative implementation constraints across the 23 management actions.

We have added this clarification to Chapter 5 under the subhead *Evaluation of Management Actions: Constraints to Implementation*. In Chapter 7 (under *How can implementation of the management actions gain traction?*), we have also added text regarding the need to further evaluate and address constraints in implementation. Regarding the suggestion to analyze the effects of percentages of actions implemented, we believe this would assume a precision that we do not have, and would also assume that implementation and benefits would be somewhat linear. These assumptions might not be accurate, especially given the discussions in the module regarding synergistic effects of actions.

Comment: Despite the key importance of flow adjustment and its interrelatedness with the effectiveness of other actions, it is given a very high constraint level.

Response: The point of the constraint ratings is to evaluate objectively the implementation constraints regardless of the biological benefits an action might have. This entire suite of information will be useful in implementation--for instance, a decision could be made to focus on reducing constraints to actions with potential for very high biological benefit. Alternatively, a realistic evaluation of constraints for certain actions could lead to decisions to focus on more complete implementation of other actions with fewer constraints. We feel that the constraint rating on this action is appropriate.

Comment: The constraint rating for CRE-19 (which deals with introductions of aquatic invertebrates, primarily through ballast water) is too high, given that stricter regulations are being debated at the Federal level.

Response: After considering the comment, we decreased the implementation constraint on CRE-19 from 5 to 4 (see Table 5-2, *Constraints to Implementation of Management Actions*).

Comment: The constraint ratings for the various actions dealing with flow and reservoir heating are different but they should be consistent with one another.

Response: We agree and have changed the constraint ratings for the management actions dealing with flow and reservoir heating to be consistent with each other. CRE-2 (deal with effects of reservoir surface heating), CRE-3 (establish minimum instream flows), and CRE-4 (adjust timing, magnitude, and frequency of flows) now all have constraint ratings of 5 (see Table 5-2, *Constraints to Implementation of Management Actions*).

Comments on the Allocation of Benefits among Management Actions

Comment: Explain the relationship between the potential benefits scores in Table 5-2 (*Constraints to Implementation of Management Actions*) and the allocation of survival improvement targets to management actions (Table 5-5). Are they the same or different estimates of benefits?

Response: The tables have different purposes. The primary intent of Table 5-2 (*Constraints to Implementation of Management Actions*) was to contrast the benefits that might be achieved with unconstrained implementation of an action with the benefits that might be achieved under a more likely scenario of constrained implementation. In Table 5-6 (*Survival Improvement Targets Allocated to Management Actions*), the intent was to compare potential benefits across actions. There is not a mechanistic relationship between the two tables, but there is a rough correlation between the potential benefits with constrained implementation in Table 5-2 and where an action falls in the relative rankings in Table 5-5. We have added clarification in the text.

Comment: The effects of management actions CRE 20 through 23 (implement pesticide and fertilizer best management practices, identify and reduce pollutants, restore or mitigate for contaminated sites, and implement stormwater best management practices) would be higher in Reach G than in other reaches, and the potential benefits of actions are higher in Reach G than Table 5-2 (*Constraints to Implementation of Management Actions*) indicates for the entire estuary.

Response: This comment is essentially asking for an allocation of benefits at the reach scale. At this time, we lack the assessment information to do such a fine scale allocation. We have so noted in the module with new text clarifying that information is not available at present to support prioritization by reach but that such an analysis would be useful in the future, as information becomes available (see, e.g., Chapter 4, under *Prioritization of Threats*). We also believe that this is an implementation consideration. The module identifies top tier priorities but does not imply they are all equal. Implementation should involve dialogue, additional evaluation, and response to evolving information. We have added language (see Chapter 5, under *Evaluation of Constraints*) noting that the severity of individual threats and limiting factors, along with potential benefits of management actions, varies from reach to reach, and that we assume that implementation will involve dialogue and additional evaluation at the reach scale to aid in prioritizing actions and focusing them where they will be most beneficial.

Comment: Action CRE-4 (adjust timing, magnitude, and frequency of flows) should account for more than 10 percent of the total benefits hypothesized to be achievable in the estuary.

Response: We agree that adjusting the timing, magnitude, and frequency of flows is potentially a highly beneficial action. For example, in Table 5-2 (*Constraints to Implementation of Management Actions*), the action is assigned the highest score possible for potential benefits with unconstrained implementation. However this action is also

assigned the highest score possible for constraints, indicating that constraints to implementation are significant. Consequently, the potential benefits of the action with constrained implementation would be significantly lower, as also indicated in Table 5-2. Since the allocation of benefits is based on constrained implementation of management actions, we feel that the allocation of benefits to this action is appropriate.

Comment: The success and outcome of implementation of the management actions is unclear. The allocation of benefits is based on many actions that are still speculative.

Response: The commenter is correct that there are many uncertainties regarding the outcome of implementing any single management action or various combinations of management actions. This is true of all recovery plans. The module, including the allocation of benefits among the management actions, is based on best available science and uncertainties are duly noted. Also noted is the need for continued dialogue in the implementation process to discuss all available information and implementation considerations, and the need for ongoing monitoring, research, and evaluation within an adaptive management framework so that we can continue to refine our understanding and assumptions regarding action effectiveness and outcomes.

Comments Pertaining to Survival improvement Targets

Comment: The module should document the basis for the 20 percent survival improvement target and how it will be measured. Because of the multiyear life history of salmon, it will take 20 years or more to see if the survival improvement targets are achieved. Evaluating whether the 20 percent survival improvement target has been attained is not straightforward because the target populations will be responding to the aggregate effects of recovery actions implemented throughout the estuary and upstream of the estuary and to background or cumulative effects from all other sources.

Response: Several pages of text in the module describe how the survival improvement targets were developed (see Chapter 5, under *Establishing Survival Improvement Targets*). As described there, the improvement target is hypothetical, not based on quantitative information. We have been explicit that the document rests more on the allocation of the 20 percent survival improvement target among the 23 management actions than it does on the 20 percent number itself (see Chapter 5, under *Use of the Survival Improvement Targets*, and Chapter 7, under *Management Actions Offering the Greatest Survival Benefits* and *Cost-Effectiveness of Management Actions*). We have also been explicit that the targets are not being set as a predictive tool for how many fish will actually be produced as a result of implementing actions (see Chapter 5, under *Uses of the Survival Improvement Targets*). In addition, we have identified the need for research and monitoring to test the assumptions regarding allocation of benefits among the actions so that we have a better sense of which actions provide the greatest benefit, and we have noted the need for more research to evaluate the bounds of what is possible in improving conditions and fish survival in the estuary (see Chapter 6, under *Critical Uncertainties Research*).

Comment: The survival improvement targets should be viewed as planning tools only.

Response: We agree and have noted so explicitly in several places in the module (see Chapter 5, under *Establishing Survival Improvement Targets*, *Assigning Survival Improvement Targets to Recovery Actions*, and *Use of the Survival Improvement Targets*).

Comment: Distributing the 20 percent survival improvement target across the various management actions is overly simplistic because it does not account for compounding effects (i.e., improvement of survival from addressing a potential limiting factor in an upper estuary habitat would not be successful for the whole life cycle if a potential limiting factor in the lower estuary was not done at the same time).

Response: We agree that distributing the 20 percent survival improvement target across the various management actions does not account for compounding or synergistic effects. The concept of interrelated effects is woven throughout the module and is addressed specifically in Chapter 7. We have added language emphasizing that the benefits of certain actions may be enhanced if combined with other actions (see, e.g., Chapter 7, under *Will management actions have synergistic effects?*), and that it is important to consider such synergistic and cumulative effects in implementation. It may be that combining actions, e.g., flow management and dike breaching, would yield greater improvement than what the module shows for an individual action. However, each action will provide some benefit individually, and this is what the module has attempted to analyze (i.e., the module analyzes each action individually and does not attempt to analyze the synergistic effects of actions).

Comments Pertaining to Cost Estimates

Comments related to cost estimates included both general inquiries regarding methods and level of certainty and questions regarding the cost estimates for specific actions or projects.

Comment: Were any economists involved in preparation of the cost estimates? Were hydropower system operators, for example, involved in determining the costs of decreased hydropower revenues identified in CRE-4 (adjust timing, magnitude, and frequency of flows), footnote 1? The cost effectiveness of specific actions also seems uncertain.

Response: Costs estimates in the module were developed consistent with NMFS guidance (Plummer 2006a and 2006b). The cost estimates in Table 5-6 (*Estimated Cost and Schedule*) were developed by PC Trask & Associates, Inc., and reviewed by staff at the Lower Columbia Fish Recovery Board, the Lower Columbia River Estuary Partnership, and the NMFS Northwest Regional Office. An economist at the NMFS Northwest Fisheries Science Center also reviewed Chapter 5 and provided comments but not a detailed evaluation of the costs. Lower Columbia River Estuary Partnership staff contributed substantively to cost estimates for actions for which the Estuary Partnership has some history of implementation. For example, the Estuary Partnership has funded multiple dike breaches (CRE-10), riparian protection projects (CRE-1), and off-channel protection/restoration projects (CRE-9). In other cases, the module author sought input on

cost estimates from experts with knowledge of implementing particular actions. For example, a NMFS Northwest Regional Office staff person was consulted regarding costs for managing pinnipeds (CRE-14). We have added additional information to Chapter 5 (see under *Evaluation of Management Actions: Cost and Schedule*) to describe how cost estimates were developed and some of the associated uncertainties.

Regarding the costs identified in CRE-4 (adjust timing, magnitude, and frequency of flows), footnote 1, the estimated $1.5 million per year cost of foregone power generation is included primarily as an indicator that even with minor changes in the flow regime there would be some foregone revenues. As implementers develop and evaluate specific scenarios for modifying flows, we expect they will also develop and discuss more rigorous cost analyses.

We agree that there are uncertainties in the cost-effectiveness analysis and believe that they are duly noted in Chapter 7 of the document. The cost-effectiveness analysis is intended to provide a starting point for further discussion and evaluation during implementation.

Comment: For some actions there is an initial project that describes inventory and assessment (e.g., CRE-8.1, inventory, assess, and evaluate in-channel pile dikes . . . . [and] develop working hypotheses for removal or modification), which is followed by a project (e.g., CRE-8.2, implement demonstration projects designed to test working hypotheses) that describes carrying out the action. This makes it appear we are drawing conclusions about what an action will be before we have the data. Is it possible to stage the cost schedule so we do not build in these presumptions?

Response: We have added language in Chapter 5 (under *Evaluation of Management Actions: Cost and Schedule*) clarifying that in some cases the extent of on-the-ground actions cannot be determined until additional scientific or technical questions have been answered more definitively through studies or information gathering. In such cases, costs of any assessment or technical work were estimated, and then a coarse-scale, placeholder cost estimate was developed based on assumptions about the magnitude of subsequent actions. We expect that such cost estimates will be refined as more specific projects are defined in implementation.

Comment: We received a number of comments regarding specific cost estimates. In almost every case these seemed to be based on the commenter's impression that a cost estimate was either too high or too low, without supporting documentation or other justification.

Response: In each case we revisited our cost estimates and consulted with knowledgeable implementers where possible. In some cases, we adjusted our cost estimates slightly; in other cases, we left them the same.

Comments Pertaining to Research, Monitoring, and Evaluation

Comment: The module should include discussion of adaptive management, action effectiveness monitoring, and the need for coordination in monitoring activities.

Response: The Research, Monitoring, and Evaluation chapter (Chapter 6) of the module has been substantially expanded and includes more extensive discussion of adaptive management, action effectiveness monitoring, and coordination needs.

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ERTG -- Project SBU Report

Name: Shillapoo
Id. No.: 2014-08
Report Date: 6/10/2014
Prepared By: GEJ
SBU Status: PRELIMINARY
Report Status: FINAL

Total Project SBUs

Ocean-type:	3.617
Stream-type:	1.125

Scores	Subaction	Project Goal	Certainty of Success	Access Benefit	Capacity Benefit	SBU Ocean	SBU Stream
Shillapoo	9.4	10	3.10	3.00	2.78	0.03448	0.02299
	10.1	785	3.00	3.00	3.61	3.316	1.020
	10.1 FPL	644.4	3.00	3.00	3.51	0.2668	0.08208

Comments

Discussion Prior to Scoring – comments on the Shillapoo part; see comments for Buckmire (2014-07)

• Note: ERTG understands that the restoration could entail Buckmire only or Shillapoo+Buckmire, but not Shillapoo only. The ERTG scored Buckmire separately (see 2014-07). For Shillapoo+Buckmire, the ERTG scored the total project by scoring and calculating SBUs for each part separately, then summing the SBUs for the total project. Separate scoring made sense because the landforms dominating each area are different; bar/scroll in Buckmire and lake/fringing wetland in Shillapoo. The ERTG assessed potential for synergies across the Buckmire and Shillapoo parts and incorporated these considerations into scores for Shillapoo.

• Scores for other projects might benefit from consideration of synergies across the entire project, which could result in higher scores. That is, piecemeal scoring of projects and components could result in lower scores because synergies would not necessarily be taken into account.

• Subactions – Appropriate.

• Acreages/mileages – Reasonable.

• Overall impressions

o The sponsor's delineation of the wetland from the floodplain lake was creative.

o As with Buckmire, the project has good location and project size.

o Engineering work for the restoration (not moving the pipelines) seems reasonable for the acreage affected.

o Biggest uncertainties have to do with the area being an FPL. Relatively low dynamism. Jury still out on interactions between juvenile salmon and non-native species.

o Lake level directly affected by Col R. Hyporheic functions may be important here.

o The template was well done and the site visit was invaluable.

o Dedicated land management is a strong point.

o The subaction map (Fig.1) does not need to include the in-holding element.

• FPL situation -- The breakout of subaction 10.1 wetland and 10.1 FPL makes sense because the perimeter of a lake typically has emergent vegetation. Therefore, separating out the different habitats makes sense ecologically. One uncertainty is how accurate the prediction of the delineation will be. However, the ERTG provided the same scores for the 10.1 and the 10.1 FPL because conceptually it was difficult to separate

predicted effects of each because of the seasonality in fringing and FPL habitats.

Scoring Comments -- Shillapoo

Subaction 9.4

• Certainty of Success – This has a reasonable chance of being maintained because of the changing volume of the lake and resultant channel flow. On the other hand, the channels are relatively small. Historic flood regime would have caused greater flushing than contemporary flow.

• Access Benefits – Limited access from the Col R (2 locations), although similar to the historic plus one connection. Col R stock access from the Lake R side has low probability, because Shillapoo is ~10 miles from Columbia via Lake River.

• Capacity Benefits – Concerned about invasive species. Also, the size is relatively small. Most of the capacity benefits for salmon should come from the channels connected to the Col R.

Subaction 10.1 (fringe and FPL)

• Certainty of Success – Scored down for exotic species. Risks seem moderate. Self-maintenance should be acceptable. Controlling point for success is the number of access points.

• Access Benefits – Overall connectivity is less than Buckmire. Relatively few access points, as noted above.

• Capacity Benefits – Good sized area with relatively high level of primary and secondary production, especially during seasonal flooding over the fringing wetland. However, organic matter export to the main stem Col R may be inhibited due to the number and locations of connections to the Col R. Concern that the area might become a "reservoir" for warm water fishes.

Subaction 10.1 FPL

• Certainty of Success -- see 10.1 comments above.

• Access Benefits -- see 10.1 comments above.

• Capacity Benefits -- see 10.1 comments above.

Concluding Comments -- Shillapoo

• Synergies – Not much synergy is expected, especially for fish, because Buckmire and Shillapoo have different landforms and there are few direct connections between the two. Groundwater connections likely exist, but we don't enough of about how these function and might affect habitat capacity to incorporate them in the ERTG process.

• Strengths – The sponsors are designing to connect a FPL to the main stem (Invert El. 7 ft) so the system will be more dynamic. Experimentally this will be a good project to build. Removal of culverts and restoring remnant channels is a strength. Setting the elevation of the inverts to get more frequent water exchange than in other FPLs is a strength.

• Weaknesses – Relatively few number of reconnections to the main stem Col R.

• Uncertainties – See the uncertainties that have been listed for FPL-type areas.

• Landscape perspective – The Shillapoo component increases habitat diversity. It restores a FPL in an landscape of floodplain lakes.

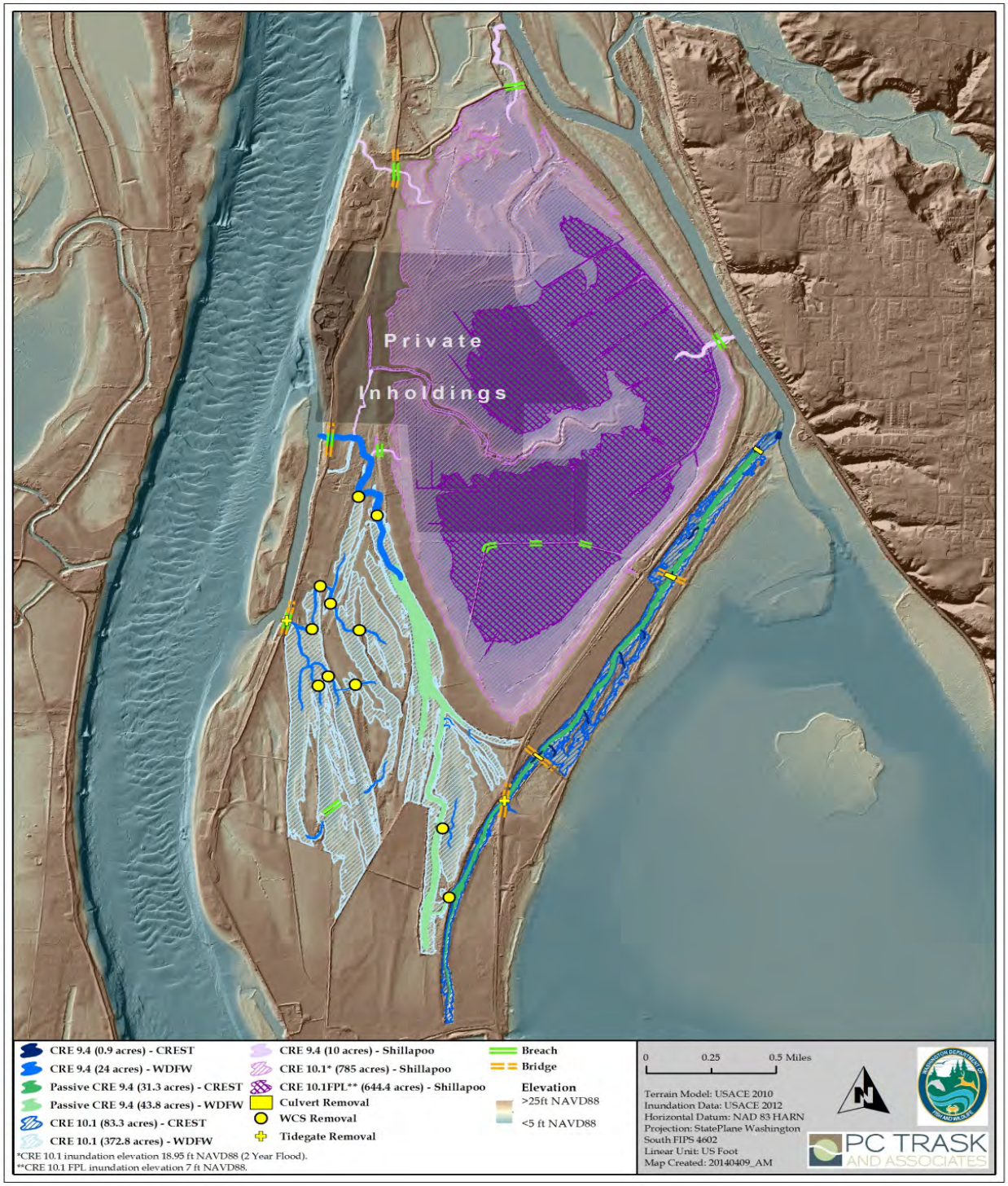
• Monitoring – The ERTG encourages pre- vs post-restoration monitoring, including fish sampling. Perhaps consider including fish sampling infrastructure in the design, e.g., PIT array structure. Consider stratified fish and production sampling by habitat (fringe wetland vs FPL) in Shillapoo Lake. Certainly perform basic Level 3 AEMR. Design sampling around hypotheses based on the restoration objectives.

• Monitoring Continued – Simultaneous monitoring at Shillapoo and Buckmire of water and fish could make a useful comparison of FPL and bar-scroll habitat types.

• Other – This site is a great opportunity to address uncertainties in the FPL restoration concept and assessing reconnection restoration in a system whose hydrology is controlled by a hydrosystem.

• The wildlife area manager is very knowledgeable and actively manages the area for water levels, waterfowl and other birds, native plants, etc. He will be actively engaged in the restoration and a key element for success of the project.

MAP


Private
Inholdings
CRE 9.4 (0.9 acres) - CREST
CRE 9.4 (24 acres) - WDFW
Passive CRE 9.4 (31.3 acres) - CREST
Passive CRE 9.4 (43.8 acres) - WDFW
CRE 10.1 (83.3 acres) - CREST
CRE 10.1 (372.8 acres) - WDFW
CRE 9.4 (10 acres) - Shillapoo
CRE 10.1* (785 acres) - Shillapoo
CRE 10.1FPL** (644.4 acres) - Shillapoo
Culvert Removal
WCS Removal
Tidegate Removal
Breach
Bridge
Elevation
>25ft NAVD88
<5 ft NAVD88
*CRE 10.1 inundation elevation 18.95 ft NAVD88 (2 Year Flood).
**CRE 10.1 FPL inundation elevation 7 ft NAVD88.
0 0.25 0.5 Miles
Terrain Model: USACE 2010
Inundation Data: USACE 2012
Horizontal Datum: NAD 83 HARN
Projection: StatePlane Washington South FIPS 4602
Linear Unit: US Foot
Map Created: 20140409_AM
PC TRASK AND ASSOCIATES

Lynne Krasnow - NOAA Federal <lynne.krasnow@noaa.gov>

ERTG -- Feedback on Landscape Planning Framework

1 message

Johnson, Gary E <Gary.Johnson@pnnl.gov> Wed, Aug 20, 2014 at 4:03 PM
To: "bdzelinsky@bpa.gov" <bdzelinsky@bpa.gov>, "blaine.d.ebberts@usace.army.mil" <blaine.d.ebberts@usace.army.mil>, "Chris Read (clread@bpa.gov)" <clread@bpa.gov>, "Creason,Anne M - KEWR-4" <amcreason@bpa.gov>, "Doumbia,Julie A - KEWR-4" <jadoumbia@bpa.gov>, "Karnezis,Jason P - KEWU-4" <jpkarnezis@bpa.gov>, Lynne Krasnow <Lynne.Krasnow@noaa.gov>, "Phil Trask (phil@pctrask.com)" <phil@pctrask.com>, Robert C Anderson <robert.c.anderson@noaa.gov>, "Robert Rose (robert.e.rose@usace.army.mil)" <robert.e.rose@usace.army.mil>, "Roberts,David A (BPA) - KEWL-4" <daroberts@bpa.gov>, "Studebaker, Cynthia A NWP" <Cynthia.A.Studebaker@usace.army.mil>
Cc: "simenstd@u.washington.edu" <simenstd@u.washington.edu>, Dan Bottom <Dan.Bottom@noaa.gov>, "Greg Hood (ghood@skagitcoop.org)" <ghood@skagitcoop.org>, "Kim Jones (kim.jones@oregonstate.edu)" <kim.jones@oregonstate.edu>, "Kirk Krueger (kirk.krueger@dfw.wa.gov)" <kirk.krueger@dfw.wa.gov>, "Thom, Ronald M" <ron.thom@pnnl.gov>

ERTG Steering Comm – Here's some draft feedback from the ERTG on the Landscape Planning Framework. Let's discuss during the next SC call (9/2/14). Thx, Gary

Gary E. Johnson

Research Scientist

Coastal Ecosystem Research Group

Marine Sciences Laboratory

Pacific Northwest National Laboratory

Work. 503-417-7567

Mobile. 360-808-2901

ERTG Feedback to SC re LPF_082014.docx
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ERTG Reply to Steering Committee RE: Landscape Planning Framework

August 20, 2014 DRAFT

Feedback to Steering Committee

The Landscape Planning Framework (LPF) is being developed to support the Columbia Estuary Ecosystem Restoration Program (CCERP). As stated by the LPF developers, "The underlying purpose of LPF was to develop a salmon-based application for the Columbia River Estuary Ecosystem Classification…that provides a landscape-scale platform for identifying and evaluating protection and restoration projects…"

The ERTG Steering Committee requested that the ERTG review the LPF and provide comments on its scientific foundation and possible application in the ERTG process. To learn about the LPF and respond to the Steering Committee's request, the ERTG received presentations from and held discussions with S. Simenstad and others on February 19 and June 18 2014, discussed the LPF during internal meetings on March 20 and July 23, 2014, and reviewed the following materials: powerpoint files of the presentations, spreadsheets of metrics for the Kerry Island project, and *The Landscape Planning Framework for Juvenile Salmonids: Science Foundation and Vetting Report* (PC Trask and S Simenstad, July 7, 2014). In addition, ERTG members D Bottom and G Hood participated as science advisors on the LPF Expert Panel.

The purpose of this communication is to provide overarching comments on the LPF relative to CEERP and ERTG processes, *not* to present a formal technical review of the LPF. The ERTG has the following comments on the LPF:

- The conceptual foundation for the LPF is strong and the LPF provides a useful theoretical framework of potential fish use. However, the relationship of LPF habitat metrics to juvenile salmon ecology in the LCRE is a weakness, but this is the state of the science, as the developers know. A valuable element of the framework is that it acknowledges these uncertainties as implicit assumptions in the LPF.
- Excessive jargon makes the LPF hard to understand, e.g., "fish habitat catena" is really a tidal channel.
- To provide landscape context for a proposed restoration project, it would be useful to develop a comprehensive distribution of selected LPF metrics at a landscape scale. Then one could take a proposed project and see where it lands on the distribution. The value of the LPF will increase as more sites are analyzed in a landscape.
- The LPF's original purpose was to provide a prioritization of areas to pursue restoration, i.e., define high priority restoration areas proactively *a priori*, not reactively or opportunistically. It would be good to return to this purpose.
- The Steering Committee might request participation of restoration sponsors in a meeting or workshop to apply the LPF to help prioritize restoration in a "strategic" manner. This would allow

practitioners to provide feedback and buy-in for the LPF. The ERTG could be involved, perhaps to review the results, but not to conduct the prioritization.

- A map of priority areas for restoration based on the LPF could be very useful during the CEERP's project development process. BPA/Corps could use the map in their decision-making. This would be consistent with LPF's original purpose.
- The prioritization map and comprehensive metric distributions could provide useful information on access and opportunity for the ERTG to consider when they score projects.

APPENDIX: Notes from Previous ERTG Discussions

June 18, 2014

- Need to provide feedback to SC on the usefulness of the LPF to the ERTG process.
- ERTG to study the materials and discuss during July call.
- GH: Could use the LPF at multiple scales.
- Need to understand the work that's been done so far and how it could be applied at various parts of the process and the players: BPA/Corps, sponsors, and ERTG. Need to account for the different perspectives.
- Might eventually need an "application" handbook for the LPF.
- Will definitely need a write up of the metrics and what they mean.
- Two part write up: 1) science: metrics and what they mean biologically, 2) applications: uses in the CEERP and ERTG process.
- How to include in the ERTG templates? calculator?
- Path forward: recommend part 1 gets done, then work session w/ Si/ERTG on part 2.
- Sponsors could use the LPF to say why a site is important in the landscape. Also, LPF useful to BPA/Corps in terms of prioritization.

March 20, 2014 -- Landscape Planning Framework [comments from ERTG? Considerations for application in ERTG process?] Scaling issue must be resolved. However, good potential here to provide information useful to the ERTG process; information concerning the geomorphic context and landscape perspective for a given project. Needs more work, though. Perhaps apply the landscape framework (habitat classification) to stratify fish sampling. If it's applied, need to prioritize the myriad of metrics to those most useful to the ERTG, and maybe even incorporate them into the ERTG Template. Revisit this during the April ERTG event.

March 3, 2014 -- Will discuss the LPF further in March. **TODO** get the LPF 11x17 sheets in electronic form and send to ERTG.

February 19, 2014 -- Presentation on Kerry Island+Landscape Planning Framework

Lynne Krasnow - NOAA Federal <lynne.krasnow@noaa.gov>

ERTG -- Outline for ERTG Process Paper

1 message

Johnson, Gary E <Gary.Johnson@pnnl.gov> Thu, Feb 19, 2015 at 5:42 PM
To: "bdzelinsky@bpa.gov" <bdzelinsky@bpa.gov>, "blaine.d.ebberts@usace.army.mil" <blaine.d.ebberts@usace.army.mil>, "Chris Read (clread@bpa.gov)" <clread@bpa.gov>, "Creason,Anne M - KEWR-4" <amcreason@bpa.gov>, "Karnezis,Jason P - KEWU-4" <jpkarnezis@bpa.gov>, Lynne Krasnow <Lynne.Krasnow@noaa.gov>, "Phil Trask (phil@pctrask.com)" <phil@pctrask.com>, Robert C Anderson <robert.c.anderson@noaa.gov>, "Robert Rose (robert.e.rose@usace.army.mil)" <robert.e.rose@usace.army.mil>, "Roberts,David A (BPA) - KEWL-4" <daroberts@bpa.gov>, "Studebaker, Cynthia A NWP" <Cynthia.A.Studebaker@usace.army.mil>
Cc: Dan Bottom <Dan.Bottom@noaa.gov>, "Greg Hood (ghood@skagitcoop.org)" <ghood@skagitcoop.org>, "Kim Jones (kim.jones@oregonstate.edu)" <kim.jones@oregonstate.edu>, "Kirk Krueger (kirk.krueger@dfw.wa.gov)" <kirk.krueger@dfw.wa.gov>, "Thom, Ronald M" <ron.thom@pnnl.gov>

Hello SC – Per Wednesday's ERTG+SC meeting, here is the outline for the ERTG process paper. Please call or write w/ questions.

Gary E. Johnson
Research Scientist
Coastal Ecosystem Research Group
Marine Sciences Laboratory
Pacific Northwest National Laboratory
Work. 503-417-7567
Mobile. 360-808-2901

ERTG process paper_Outline_Jan 2015.docx
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An Expert Panel Process to Evaluate Ecological Restoration Actions for Juvenile Salmon in the Lower Columbia River and Estuary

Outline Version: January 21, 2015