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

January 13, 2011

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Contents

Introduction **3**

Comments Pertaining to the Entire Module **4**

Comments on the Technical Foundation of the Module 4

Comments on the Scope of the Module 6

Comments on the Relationship of the Module to Other Processes 7

Comments Pertaining to Limiting Factors and Threats **8**

General Comments on Limiting Factors and Threats 8

Comments Suggesting Factors That Should Receive More Attention 9

Comments Related to Categorization of Limiting Factors and Threats 11

Comments Related to Prioritization of Limiting Factors and Threats 11

Comments on Specific Limiting Factors 13

Comments Pertaining to Management Actions **14**

Comments on the Identification of Management Actions and Related Projects 14

Comments on Relationships between Actions 17

Comments on the Evaluation and Identification of Constraints to Actions 18

Comments on the Allocation of Benefits among Management Actions 20

Comments Pertaining to Survival improvement Targets **21**

Comments Pertaining to Cost Estimates **22**

Comments Pertaining to Research, Monitoring, and Evaluation **24**

REFERENCES CITED **25**

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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