This is not a final federal agency product. Rather, it is a pre-decisional document prepared by the Action Agencies that reflects present understandings of currently available information and analyses, and of the progression of discussions with the sovereigns in the collaborative process. Revisions and refinements are to be expected based on further discussions with the sovereigns over new and modified proposed federal actions upon which the action agencies will ultimately consult. Finally, the information in this product does not constitute an analysis of whether the identified measures would or would not jeopardize the continued existence of a listed species or result in the destruction or adverse modification of designated critical habitat. Furthermore, this document does not in any way interpret or apply the regulatory definitions of the statutory phrases "jeopardize the continued existence of" and "destruction or adverse modification."

Habitat Proposed Action Summary

Habitat Action Objective for All ESUs: Protect and improve tributary and estuary habitat to improve fish survival.

Habitat Strategy 1: Protect and improve tributary habitat based on biological needs and prioritized actions that address limiting factors identified for each ESU.

Performance Standard: Implementation of identified projects in 3 year implementation cycles selected to achieve the targeted improvement in habitat quality.

Funding Source(s): BPA direct funding, Reclamation congressional appropriations for Columbia/Snake Salmon Recovery.

Rationale: Degradation of tributary habitat is a limiting factor for almost all listed fish, although the nature and magnitude of this impact varies by location. Protection and improvement of tributary habitat by acquiring water for instream flows, by restoring riparian habitat, improving water quality, screening diversions and providing passage, and improving mainstem and side-channel habitat are proven ways to enhance fish survival, depending on location. Priority locations for habitat actions are based on biological needs and potential for benefits.

What's New: BPA funding commitments have been increased from approximately $21 million per year to approximately $35 million per year for habitat actions for all ESUs between 2007 and 2009. This is about a 66% increase over the 2000 BiOp program. In addition, actions beyond those selected in the '07-'09 Fish and Wildlife Program decision have been identified for implementation in 2008 and 2009 based on the Action Agencies' lifecycle biological analysis and Remand collaboration input. Budgets for these additional actions total up to $11.6 million for the two year period. The Bureau's funding commitments are approximately $ 4-6 million per year, and are subject to annual appropriations. Starting in 2010, BPA will further increase its funding commitment for all ESUs to $40-45 million per year for 2010-2017. This increase will be allocated according to "gaps" in biological performance of populations where tributary habitat is a limiting factor and habitat potential exists. Specific projects will be identified based on biological priorities and criteria in 3 year cycles.

Tributary Habitat Protection and Improvement

As described in more detail below, the Action Agencies will implement an expanded and better defined tributary habitat program to achieve commitment to improvement in habitat quality by addressing limiting factors impairing spawning and rearing habitat for ESUs affected by the FCRPS, with particular focus on populations with highest biological need (low productivity) and where habitat potential exists. An inventory of possible habitat projects have been identified in draft recovery plans and subbasin plans has been compiled in the remand collaboration, providing a menu of projects to select from. The primary types of actions that will be implemented include:

- Increase streamflow through water acquisitions
- Address entrainment through screening
- Provide fish passage and access
- Improve mainstem and side channel habitat conditions
- Protect and enhance riparian conditions
- Improve water quality

Initial Actions: For **2007-2009,** the Action Agencies, working through the remand collaboration, have refined identification of ESUs and populations with greatest biological need based on most current science. For these 3 years, **s**pecific habitat projects were identified and funded with a broadened geographic scope consistent with scope of 2000 BiOp. Costs are approximately $31.5 million annual average. This includes earmarking 70% of the Columbia Basin Water Transactions Program to secure water acquisitions and riparian easements to address key limiting factors to make progress toward meeting habitat quality improvement targets for ESA-listed anadromous fish.

Additional Actions: In response to the Action Agencies' biological analyses and collaboration input after the 2007-2009 project selection decision was made, a further suite of actions beyond those funded in the '07-'09 Program decision focused on priority populations have been identified for implementation and BPA funding in '08 and '09. The estimated increase for the two year period for these additional tributary habitat actions in 2008 and 2009 is up to $11.6 million.

Future Implementation: The Action Agencies will implement a further expansion of the 2007-2009 tributary habitat program to achieve commitments to improvement in habitat quality. This expansion will be targeted to populations with low productivity where habitat potential exists (those with highest biological need). For other populations, the Action Agencies will maintain a broad habitat program to achieve targeted habitat quality improvements specified in the Proposed Action. To support this expansion, BPA's funding commitment would be increased to $40-45 million average annual for 2010-2017 for the habitat program (including estuary). Project selection will be based on criteria to prioritize actions for populations with greatest biological need and ensure consistency with recovery plan implementation through coordination with recovery plan and Northwest Power and Conservation Council processes. Specific actions will be identified in 3 years cycles, and "sample scenarios" to guide the selection of these projects are provided. The scenarios were developed using information provided through the remand collaboration process by the participating sovereigns. Tributary habitat potential varies within geographic areas. The scenario approach, combined with a commitment of funds, allows the Agencies to define a commitment to action while maintaining the obvious flexibility that is required to identify and implement the best projects to benefit the ESUs over this time period.

The Proposed Action identifies the following priority populations:

Snake River Spring/Summer Chinook: *Grande Ronde Imnaha MPG*	Target % Habitat Quality Improvement
Upper Grande Ronde	7
Catherine Creek	14
Snake River Steelhead	
Clearwater MPG	
Lolo Creek	12
Lochsa River	18
Selway River	2
South Fork	14
Salmon River MPG	
Secesh River	6
South Fork Salmon	6
Lower Middle Fork Tributaries	7
Upper Columbia Steelhead	
Wenatchee	4
Methow	4
Entiat	8
Okanogan	14

Targets for improvement in habitat quality for other populations within the ESUs affected by the FCRPS that are not included within the priority population designation are specified in the proposed action. Habitat actions will be delivered through the broad based habitat program. For these populations, the Action Agencies may adjust actions to focus on other populations within a major population group of an ESU *provided that* the biological benefit to the major population group remains equivalent.

The Action Agencies will report annually on project implementation, noting populations benefited and limiting factors addressed. If a project becomes infeasible to implement, the Action Agencies will implement a comparable replacement project to maintain estimated biological benefits. At the end of 2012, the Action Agencies will review cumulative implementation and make adjustments necessary to ensure that habitat actions achieve the targeted habitat quality improvement by 2017.

Habitat Strategy 2: Protect and Increase the Distribution of High Quality Estuary Habitat for all ESUs.

Performance Standards: Implementation of identified projects in 3 year implementation cycles to achieve the targeted biological benefit.

Funding Source(s): Corps of Engineers (Section 536 of WRDA 2000 or other authorities, as appropriate). BPA – direct funding.

Rationale: Degradation of estuary habitat is a limiting factor affecting all listed fish to some extent, although the nature and magnitude of this impact varies by life history type. Recent studies indicate that protection and improvement of estuary habitat enhances fish survival. In particular, estuary projects that provide an increase in shallow water habitat would benefit all listed ESUs, with the greatest habitat benefit to those ESUs that use the estuarine environment for longer periods of time (ocean- type fish).

What's New: Additional actions benefiting all ESUs and increased funding (more than doubling the 2000-2006 level).

Habitat Protection and Improvement in the Estuary

As described in more detail below, the Action Agencies will implement an expanded estuary habitat program to address limiting factors involved in passage and rearing in the estuary for ESUs affected by the FCRPS. An inventory of possible habitat projects have been identified in draft recovery plans and subbasin plans has been compiled in the remand collaboration, providing a menu of projects to select from. Project selection criteria have been developed in collaboration with the Lower Columbia Estuary Program (LCREP) and other regional parties.

Action Agency estuary habitat projects will provide an increase in juvenile salmonid shallow water habitat that would benefit all listed ESUs, with the greatest habitat benefit to those ESUs expressing ocean type life histories that use the estuarine environment for longer periods of time. Types of actions that will be implemented include:

- Acquire, protect and restore off-channel habitat
- Restore tidal influence and improve hydrologic flushing
- Restore floodplain reconnection by removing or breaching dikes or installing fish friendly tide gates
- Remove invasive plants and weeds; replant native vegetation
- Protect and restore emergent wetland habitat and riparian forest habitat
- Restore channel structure and function

Initial Actions: For **2007-2009,** 35specific habitat projects are identified and funded by the Action Agencies, with funding of approximately $4 million a year. Through its 2007-2009 Fish and Wildlife Program decision, BPA will fund approximately $2 million per year, more than doubling the 2000-2006 funding of approximately $600,000 per year for estuary projects. The Corps expects to continue funding estuary habitat projects similar to current approximately $2 million annual levels subject to Congressional appropriations. In addition, the Corps is seeking funding for a general investigation (GI) study to identify further ecosystem opportunities in the

lower Columbia River (estuary). If funded this study could lead to additional authorities and funding for habitat work in the estuary.

Additional Actions for 2008 and 2009: In response to the Action Agencies' biological analyses and collaboration input after BPA's 2007-2009 project selection decision was made, actions beyond those funded in the '07-'09 Program decision were identified for the estuary to benefit all ESUs for '08 and '09. The additional budgeted amount for these actions is $1.5 million annually and is focused on an expansion of the types of habitat projects in the 2007-2009 original suite of projects to provide an important additional benefit to all ESUs.

Future Implementation: For **2010-2017**, the Action Agencies will implement continued actions based on biological criteria and limiting factors. BPA's funding commitment would remain at the increased level of $3.5 million average annual for 2010-2017. The Corps expects to continue funding estuary habitat projects similar to the 2007-2009 level of approximately $2 million annually subject to Congressional appropriations. BPA project selection will be based on criteria to prioritize actions for populations with greatest biological need and ensure consistency with recovery plan implementation through coordination with recovery plan and Northwest Power and Conservation Council processes. Specific actions will be identified in 3 years cycles. The Corps will consider limiting factors and the recovery plan in working with potential local sponsors under its authorities. Specific projects will be selected based on biological effectiveness criteria consistent with the Willamette/Lower River Recovery Plan (Recovery Plan).

The Action Agencies will report annually on project implementation, noting ESUs benefited and limiting factors addressed. If a project becomes infeasible to implement, they will implement a comparable replacement project to maintain estimated biological benefits.

At the end of 2012, the Action Agencies will review cumulative implementation and make adjustments necessary to ensure that habitat actions achieve the overall estimated benefits by 2017.

This is not a final federal agency product. Rather, it is a pre-decisional document prepared by the Action Agencies that reflects present understandings of currently available information and analyses, and of the progression of discussions with the sovereigns in the collaborative process. Revisions and refinements are to be expected based on further discussions with the sovereigns over new and modified proposed federal actions upon which the action agencies will ultimately consult. Finally, the information in this product does not constitute an analysis of whether the identified measures would or would not jeopardize the continued existence of a listed species or result in the destruction or adverse modification of designated critical habitat. Furthermore, this document does not in any way interpret or apply the regulatory definitions of the statutory phrases "jeopardize the continued existence of" and "destruction or adverse modification."

Tributary Habitat Proposed Action

Global Objectives and Strategies for all ESUs

Habitat Objectives: Protect and improve mainstem tributary and side-channel tributary habitat for migration, spawning and rearing and restore floodplain function.

Habitat Strategy: Protect and improve tributary habitat based on biological needs and prioritized actions that address primary limiting factors identified for each ESU.

Action: Implement expanded tributary habitat program with particular (but not exclusive) focus on populations with greatest biological need (productivity less than 1) and where there is potential for improvement in tributary habitat. Proposed actions address key limiting factors to:

- Increase streamflow through water acquisitions
- Address entrainment through screening
- Provide fish passage and access
- Improve mainstem and side channel habitat conditions
- Protect and enhance riparian conditions.
- Improve water quality

Projects funded will address limiting factors identified by the BiOp Remand Collaboration Habitat Workgroup (CHW) and ESA recovery plans and will be consistent with subbasin plans. These tributary habitat actions have been, and will continue to be, implemented in partnership with States, Tribes, and others with funding and/or technical assistance from the Action Agencies.

Introduction

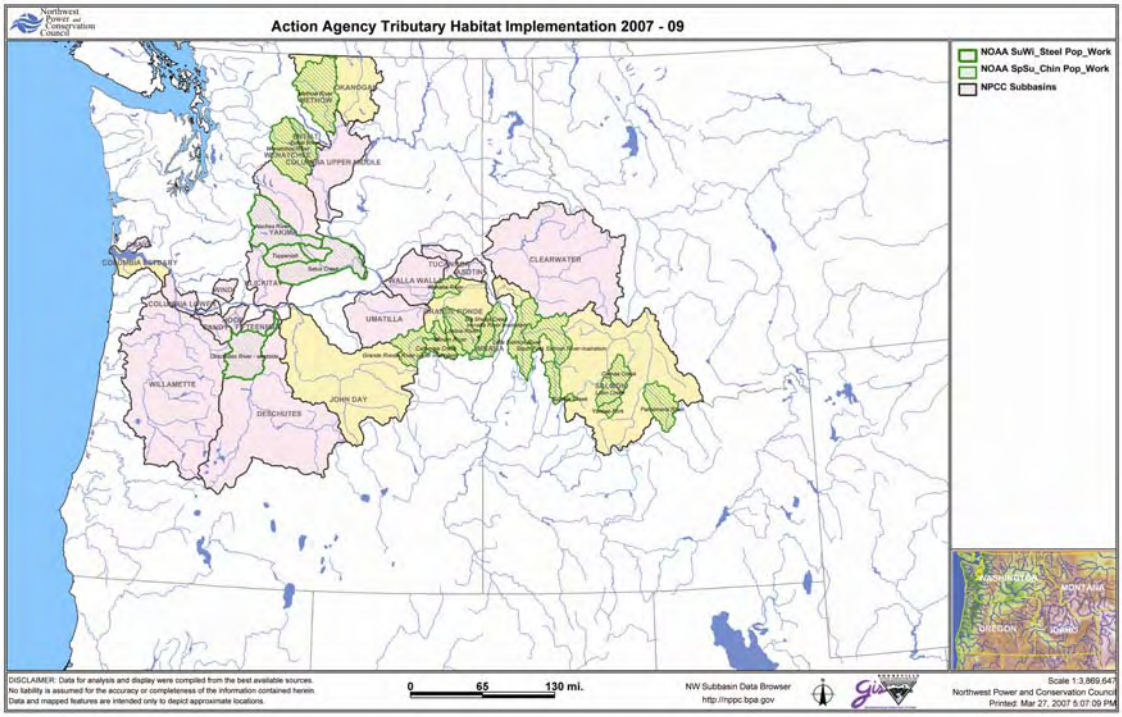
Experts agree that implementation of actions to improve conditions for survival in tributary habitats is one important element of salmon and steelhead recovery efforts (MacDonald et al. 2006). Although measuring the biological benefits of these efforts is difficult to quantify, it is generally accepted that protecting and restoring natural migration, spawning, and rearing habitat conditions in tributary subbasins is important to salmon recovery. Methods for assessing biological benefits from habitat actions to improve habitat quality have been developed by a variety of experts and have been a particular focus of the BiOp Remand Collaboration Habitat Workgroup. The Action Agencies are using a method for associating change in habitat quality with change in survival developed in the Habitat Workgroup. A description of this method is appended to the *Tributary Habitat Benefits* document submitted with this Proposed Action (PA).

The PA uses the products (assembly of tables of potential recovery actions and methods for assessing their benefits) developed by the CHW. The action draws from and is consistent with Northwest Power Planning and Conservation Council (NPCC) Subbasin Plans and NOAA and State Recovery Planning efforts and builds on the progress made under the 2000/2004 FCRPS BiOps.

Since 2000, the Action Agencies have spent over $100 million to protect and restore more than 1,000 miles of riparian habitat, screen 85 diversions, restore passage to 1,280 miles of stream, and acquire 530 cfs of water for instream flow (FCRPS 2005 Progress Report, June 2006, p. 9). BPA also provided an additional $15 million to support development of subbasin assessments and plans. These accomplishments have been implemented through partnerships and cost-sharing with States, Tribes, and local parties. The Action Agencies have learned from experience that tributary habitat actions require the cooperation of local stakeholders and take one to four years to progress from planning to construction and implementation.

In this PA, BPA proposes to increase the rate of effort to implement tributary habitat actions to benefit listed ESUs compared to that in 2000-2006. The map below shows the geographic scope

of the current action, which is considerably broader than was used in the 2004 BiOp and is consistent with the scope of the 2000 BiOp RPA.



BPA funding commitments were increased from approximately $20 million per year (average between 2000 and 2006) to approximately $31.5 million per year for tributary habitat actions to benefit listed ESUs during 2007-2009, about a 58% increase over the 2000 and 2004 BiOp programs in the recently issued BPA decision on ’07 – ’09 Fish and Wildlife Program funding.[1] This increase is largely directed toward areas where listed populations are experiencing low productivity. In addition, the Columbia Basin Water Transactions Program (a water and land brokerage established under the 2000 BiOp) and the NPCC’s 2000 Fish and Wildlife Program has been effective in acquiring instream flows and riparian easements to benefit ESA-listed and other anadromous and resident fish species affected by the FCRPS. BPA will direct 70% of the funding for that program ($3.5 million annually) to prioritize actions for listed salmon and steelhead. In addition, as described below, in response to draft biological analyses prepared by the Action Agencies subsequent to BPA’s ’07 – ’09 funding decision and to input from the PWG in response to the draft analyses, additional actions have been added for ’08 and ’09 to address

[1] The $31.5M annual tributary habitat budget includes 70% of the $5M annual budget of the Columbia Basin Water Transactions Program targeted toward ESA-listed salmon and steelhead.

low productivity populations. The estimated annual average increase for these additional tributary habitat actions in ’08 and ’09 is up to $5.8 million. Reclamation’s funding commitments are approximately $4-6 million per year and are subject to annual Congressional appropriations. In order to support implementation of a further expansion of the habitat program, BPA will increase its funding commitment to $40 - $45 million per year for 2010 – 2017 to achieve the improvement in habitat quality specified in the PA and to fund actions to benefit all ESUs in the estuary and actions for Lower River ESUs. These increases will be allocated according to “gaps” in biological performance of populations where tributary habitat is a limiting factor and potential for habitat quality improvement exists.

Description of the Tributary Habitat Proposed Action

The Action Agencies are committing to implement “on-the-ground” actions to address biological priorities and key limiting factors identified for tributary habitat for Columbia and Snake River ESUs. These actions are designed to improve function of the limiting factors and achieve an improvement in habitat quality. Specific habitat quality improvement targets (% change) for ESUs are presented by major population groups and specific populations in Appendix A. This habitat program will be implemented in 3 year increments. For the 2007-2009 timeframe, specific locations and actions are identified. These actions represent a substantial expansion from the 2000-2006 implementation of the 2000 and 2004 BiOps. For the 2010 – 2017 period, the Action Agencies have committed increased funding and specific project selection on a 3 year basis based on biological priorities, analysis of limiting factors, and improvements in habitat quality. Projects funded to implement this action will be consistent with Recovery Plans.

Initial Actions

The first phase of implementation of these commitments is 2007-2009. The Action Agencies will complete the habitat actions initiated under the 2000 and 2004 BiOps and will substantially expand the level of implementation with particular focus on areas with greatest biological need. For this period, specific projects were identified and funding decisions made by BPA through the

Fish and Wildlife Program ’07-’09 project selection process (See Appendices B1 – B3). Selection of actions was based on priority for populations with low productivity. These priority areas included the Entiat, Okanogan, Methow, Wenatchee, Grande Ronde, Salmon and John Day subbasins. Outside of these priority areas, the Action Agencies are also implementing a broad habitat program to benefit all ESUs based on recommendations from the four-state Northwest Power and Conservation Council.[2]

This suite of actions for 2007-2009 includes a number of enhancements to the 2000-2006 program. Highlights include:

- **Better Biological Focus:** Refined identification of ESUs and populations with greatest biological needs to allow for more effective habitat actions, generally focused on areas with listed ESU populations with low productivity.
- **Expanded Actions:** Expanded actions specifically identified through the NPCC Fish and Wildlife Program process, with a significant increase in funding for habitat actions to benefit listed salmon and steelhead above the 2000 – 2006 period. The selected projects have also successfully undergone independent science review.
- **Additional Opportunity:** Additional priority water acquisitions and riparian easements to address key limiting factors as opportunities arise using the funds earmarked ($3.5M annually) for the Columbia Basin Water Transactions Program which allows the Action Agencies to pursue other habitat action opportunities that may arise in 2007-2009.
- **Further Action Expansion in Response to Biological Analysis and PWG input:** Based on biological needs identified in the recent lifecycle biological analyses and input from the remand collaboration process, a suite of further actions beyond those funded in the ’07 – ’09 Fish and Wildlife Program decision have been identified for implementation in ’08 and ’09. Projects and estimated changes in habitat quality were identified through

[2] In the recently completed 2007-2009 Fish and Wildlife Program solicitation process, BPA made a decision to fund implementation of all proposed “high priority” projects (with on-the–ground habitat benefits and positive independent scientific review for the identified low productivity areas) in addition to maintaining a significant habitat program for other populations within listed ESUs throughout the Basin. Priority subbasins were identified in the 2000 and 2004 Biological Opinions based on ESUs with biological need and habitat potential where addressing flow, passage and screening problems could produce immediate or short-term benefits. It was in those areas where **all** proposed projects with on-the-ground habitat benefits were selected for funding

meetings with a subset of collaboration parties active in these geographic areas.[3] The estimated annual average budgets for these additional actions in ’08 and ’09 are up to an additional $5.8 million beyond the ’07-’09 Fish and Wildlife Program decision. Actions will benefit certain populations of **Snake River Spring/Summer Chinook** (*Catherine Creek, Upper Grande Ronde, Lostine, Big Creek and Secesh);* **Snake River Steelhead** *(Grande Ronde Upper Mainstem, Lochsa River, Lolo Creek, Selway River, South Fork Clearwater, Secesh River, South Fork Salmon, and Lower Middle Fork Salmon);* and **Upper Columbia Steelhead** *(Okanogan).*[4] Projects will proceed to implementation following issuance of a FCRPS BiOp and will undergo independent science review (if they have not already received review) and coordination with the BPA/NPCC process. In addition, in order to better facilitate development of tributary projects in the Grande Ronde for Snake River Spring/Summer Chinook and Snake River Steelhead, Reclamation will shift resources to assign a full time liaison to the area.

More detail on specific proposed habitat actions can be found in Appendices B1-B4.
Appendix B1 addresses Upper Columbia ESUs;
Appendix B2 addresses Mid-Columbia ESU; and
Appendix B3 addresses Snake River ESUs.

Each table includes a description of projects, limiting factors addressed by MPG and population, reporting metrics and budgets.

Appendix B4 contains available information on additional projects identified for funding in ’08 and ’09.

Reclamation contributes technical assistance for numerous tributary habitat actions listed in Appendices B1 – B3. Appendix B-5 displays Reclamation’s technical assistance for tributary habitat actions that supplement those shown in B1-B3.

[3] Future project review and selection will involve a broader group of entities as described in the section on “Future Implementation.”
[4] Projects were selected to benefit populations of low productivity and in a limited number of cases, high extinction risk. Many of the selected projects had dual benefits also benefiting populations of another ESU/DPS. Those populations are also noted .

The habitat program described above is weighted toward listed ESUs in upriver and middle river areas since these incur the greatest impact from the FCRPS. However Lower River ESUs are also included in the proposed action. BPA is funding projects in the Wind River that will benefit chum, and the estuary habitat program (Estuary Habitat Proposed Action) provides benefits to all ESUs and addresses Lower Columbia/Willamette ESUs (Chinook, steelhead, coho, and chum). 2007-2009 habitat projects selected for implementation in the Lower River to benefit Lower River ESUs are displayed in Appendix B-6[5].

Snake River fall Chinook and Sockeye are not included in the tributary habitat PA because fall Chinook are mainstem spawners and Sockeye are currently maintained through a safety-net hatchery program. However, as the significant increase in Sockeye smolt production (see Hatchery Proposed Action) is implemented, the safety net program will become a conservation program and complementary habitat actions will be developed to support the conservation function of the production increase to assist in recovery.

Future Implementation

For each subsequent phase of implementation of the tributary habitat PA, the Action Agencies will solicit projects based on biological priorities, key limiting factors, and habitat quality improvements to make progress toward meeting the targeted change in habitat quality specified in Appendix A. The Action Agencies will expand the level of implementation from the 2007-2009 period for specific priority populations while maintaining a broad based program for other ESUs. To support this expansion, BPA will increase its funding commitment to $40 million - $45 million per year for 2010-2017 for its habitat program to achieve the remaining portion of the targeted habitat quality improvements after implementation in the ’07 – ’09 period.[6] For priority populations (productivity below 1 where habitat potential exists), the Action Agencies will meet the population-specific change in habitat quality in Appendix A. For other ESUs, the

[5] The annual average 2007-2009 budget for habitat actions in the Lower River is $1.5 million.
[6] As noted above, BPA’s habitat program includes actions in the estuary to benefit all ESUs and actions in the Lower River.

Action Agencies may select actions to change habitat quality for various populations within the same MPG as long as demonstrated benefit to the MPG is equivalent to that presented in Appendix A.

Future projects will be selected by the Action Agencies based on the following criteria which will be applied in coordination with local recovery plan and NPCC processes. The Action Agencies will coordinate with NOAA, NPCC, States, Tribes, project sponsors and others to further refine and advance these criteria for use in developing and implementing projects for 2010-2017.

- Projects must address limiting factors identified in recovery plans (the Collaboration Habitat Workgroup tables have assembled the current information from recovery plans and subbasin plans);
- Priority will be given to actions for populations with low productivity;
- Priority will also be given to:
    - projects that address the most important population-specific limiting factor/s (key limiting factors);
    - projects that benefit more than one population or more than one ESU;
    - projects that address more than one limiting factor; and
    - projects with more immediate benefits
- Consideration of Viable Salmonid Populations (VSP) characteristics in addition to productivity (abundance, geographic distribution and genetic diversity)

Before projects are selected for implementation, the Action Agencies will (in coordination with the NPCC and recovery planning processes) meet with local experts to estimate change in habitat quality associated with project proposals. All proposals considered for funding will display the estimated change in habitat quality resulting from this process. The amount of habitat quality change associated with different projects will be a criterion in project selection.

The Action Agencies will continue the ’07-’09 level of effort throughout the 2010-2017 period in treating limiting factors **for most populations** unless habitat potential has been met. The Action

Agencies may adjust actions to focus on other populations within the MPG provided that the biological benefit to the ESU remains equivalent to that presented in Appendix A. As noted above, all VSP parameters will be considered when selecting projects to treat limiting factors in this broad program of actions.

For populations that still have productivity gaps under the biological analyses and where habitat potential exists, the Action Agencies propose to further increase effort to address limiting factors. Although the Action Agencies cannot identify a final suite of specific habitat projects for priority areas for 2010-2017, the Agencies have developed "habitat project scenarios" to demonstrate commitments to actions. The scenarios are based on the '07-09 specific projects plus the collaboration work products. The scenarios indicate the types of actions likely to be implemented, what limiting factors these actions would address, and how much habitat quality improvement (and associated survival improvement) is estimated to be gained from such actions. The Action Agencies' intent is to commit to an identified change in habitat quality including a clear and definite commitment of resources to implement the actions needed to effect this change in habitat quality. The change in habitat quality then translates to an associated improvement in fish survival. A change in habitat quality can result from a variety of different combinations of actions that address the primary limiting factors. Progress toward treatment of limiting factors and change in habitat quality displayed in the scenarios will be made in '07—09 through implementing the actions in Appendix B.

The habitat project scenarios show the Action Agencies' commitments to focus the action on: a) areas of high biological need and good habitat potential; b) specific limiting factors; and c) ground-level feasibility as assessed by input from local habitat specialists from states, tribes and project sponsors. This scenario approach, combined with a commitment of funds, allows the Action Agencies to define a commitment to action while simultaneously maintaining the obvious flexibility that is required to identify and implement the best projects to benefit the ESUs over this time period.

To develop the scenarios, the Action Agencies began with the Collaboration Habitat Workgroup's tables of limiting factors and actions and the '07-09 specific lists of projects

(Appendix B). Other references were also consulted, such as tables developed by the Nez Perce Tribe to augment the State tables and the Okanogan Initiative submitted by the Colville Tribes. Using these tables as a base, the Action Agencies explored possibilities with local specialists, looked at agency capabilities, and then attempted to predict different combinations of actions that would result in changes in habitat condition from which changes in survival could be calculated. In several cases, follow up meetings were held with local parties to refine information. Specificity of action descriptions underlying the scenarios varies based on the information provided through the collaboration process. In 3 year implementation cycles, specific projects will be solicited and implemented based on the habitat quality and estimated survival change displayed in the scenarios. If projects become infeasible, substitute projects will be sought for implementation to maintain a similar level of benefit. Implementation will be documented in the Action Agencies' performance and progress reporting.

Benefits of actions continue past 2017: Many of the actions that compose the scenarios (such as floodplain, channel complexity, and riparian protection and enhancement) accrue sometimes significantly greater habitat quality and associated survival improvements after 2017 than before 2017. Participants in the collaboration process have, in some cases, provided estimates of 25 year benefits associated with implementing actions in the 2007-2017 period. This information on post-2017 effects is displayed in Appendix A. Benefits continuing to accrue from actions taken in 2007-2017 will be carried forward to subsequent FCRPS consultations.

Habitat Project Scenarios:

Based on current biological analyses, priorities for future habitat actions will be focused on the following populations with low productivity and positive habitat potential. We share below our latest thinking on the kinds of actions that could be implemented in these areas during the BiOp period to achieve the targeted improvement in habitat quality.[7]

a. Snake River Spring/Summer Chinook:

[7] Percent change in habitat quality and percent change in survival are equivalent here (i.e. changes in juvenile survival are directly proportional to changes in habitat condition). Methodology for this analysis is presented in Appendix A and the *Tributary Habitat Benefits* document.

Grande Ronde/Imnaha MPG

Upper Grande Ronde chinook scenarios represent the combination of actions funded by BPA through the 07-09 NPCC solicitation plus additional 07-17 actions identified in a follow-up meeting with a subset of the collaboration parties active in the geographic area. Scenario 1 represents the proportion of actions identified at that follow-up meeting within the full habitat potential for the limiting factors shown. Scenarios 2 and 3 represent different combinations of actions treating limiting factors to arrive at the same projected habitat quality and survival change.

The performance target for habitat quality change for this population results in a 7% survival improvement over the period of the BiOp. These scenarios represent the best information available today for projecting actions during the BiOp period that meet that performance target.

The specific actions funded for the 2007-2009 period are listed in Appendix B-3b. Additional actions identified for funding in ’08 and ’09 are listed in Appendix B-4. Subsequent actions are realistic, known example actions suggested by collaborators that result in total in the habitat quality change and associated survival improvement. In time, specific projects would emerge from the scenarios; these specific projects will be identified in 3 year cycles.

Upper Grand Ronde Chinook	**Action Type**	**Percentage of potential habitat function addressed for each limiting factor**		
Limiting Factor Addressed		Scenario 1	Scenario 2	Scenario 3
In-channel characteristics	in-steam enhancement, LWD, modify/enhance channel	26%	20%	10%
Riparian / Floodplain	livestock exclusion/reveg/weed control/expand streamside buffers/levee or road mod/restore meadows	10%	23%	50%
Sediment	all above actions contribute	26%	20%	10%
Water Quality/temp	all above actions contribute	23%	23%	10%
Fish Passage	culverts/irrigation diversion improvements	100%	25%	10%
Flow Quantity	water conservation/water right acquisition	25%	25%	10%
Estimated Habitat Quality Change		7%	7%	7%

Appendix C-1 details the actions and changes in habitat quality underlying these scenarios.

As noted above, many of these actions result in habitat quality changes that do not fully accrue until after the BiOp period (e.g., riparian projects). Post-2017, another estimated 26% habitat quality and survival improvement is expected as a result of implementing suites of actions as represented by the above scenarios (Appendix A).

Catherine Creek chinook scenarios represent the combination of actions funded by BPA through the 07-09 NPCC solicitation plus additional 07-17 actions identified in a follow-up meeting with a subset of the collaboration parties active in the geographic area. Scenario 1 represents the proportion of actions identified at that follow-up meeting within the full habitat potential for the limiting factors shown. Scenarios 2 and 3 represent different combinations of actions treating limiting factors to arrive at the same projected habitat quality and survival change.

The performance target for habitat quality change for this population results in a 14% survival improvement over the period of the BiOp. These scenarios represent the best information available today for projecting actions during the BiOp period that meet that performance target.

The specific actions funded for the 2007-2009 period are listed in Appendix B-3b. Additional actions identified for funding in ’08 and ’09 are listed in Appendix B-4. Subsequent actions are realistic, known example actions suggested by collaborators that result in total in the habitat quality change and associated survival improvement. In time, specific projects would emerge from the scenarios; these specific projects will be identified in 3 year cycles.

Catherine Creek Chinook	**Action Type**	**Percentage of potential habitat function addressed for each limiting factor**		
Limiting Factor Addressed		Scenario 1	Scenario 2	Scenario 3
In-channel characteristics	in-steam enhancement, LWD, modify/enhance channel	44%	60%	30%
Riparian / Floodplain	livestock exclusion/reveg/weed control/expand streamside buffers/levee or road mod/restore meadows	50%	25%	75%
Water Quality/temp	all above actions contribute	22%	22%	22%

Catherine Creek Chinook	**Action Type**	**Percentage of potential habitat function addressed for each limiting factor**		
Limiting Factor Addressed		Scenario 1	Scenario 2	Scenario 3
Fish Passage	culverts/irrigation diversion improvements	60%	25%	75%
Flow Quantity	water conservation/water right acquisition	13%	13%	13%
Estimated Habitat Quality Change		14%	14%	14%

Appendix C-2 details the actions and changes in habitat quality underlying these scenarios.

As noted above, many of these actions result in habitat quality changes that do not fully accrue until after the BiOp period (e.g., riparian projects). Post-2017, another estimated 24% habitat quality and survival improvement is expected as a result of implementing suites of actions as represented by the above scenarios (Appendix A).

b. Snake River Steelhead

Full habitat project scenarios have not yet been developed for these populations. Habitat quality change targets are derived from collaboration workgroup materials and represent an extensive program of habitat implementation over the 2007-2017 period. Scenarios will be developed based on these target changes in habitat quality through collaboration with remand Parties. The specific actions funded for the 2007-2009 period are listed in Appendix B-3a. Additional actions identified for funding in ’08 and ’09 are listed in Appendix B-4.

Tables displaying collaboration workgroup input detailing potential habitat actions to address limiting factors and associated habitat quality change for these populations are presented in Appendices C-3 through C- 10.

Clearwater River MPG

Population	**Target % Habitat Quality Improvement (10 year)**
Lolo Creek	12
Lochsa River	18
Selway River	2
South Fork	14

Salmon River MPG

Population	**Target % Habitat Quality Improvement (10 year)**

Secesh River	6
South Fork Salmon	6
Lower Middle Fork Tributaries	7

Many of the actions that will be implemented to benefit Snake River Steelhead will result in habitat quality changes that do not fully accrue until after the BiOp period (e.g., riparian projects). Appendix A displays the expected post-2017 habitat quality and survival improvements associated with level/type of action presented in Appendices C-3 – C-9 for these specific populations.

c. Upper Columbia Steelhead -

The Action Agencies propose the following tributary habitat conceptual scenarios for the Upper Columbia steelhead populations. Progress toward meeting this habitat quality change is underway with actions to be completed under the 2004 BiOp and actions funded under the 07-09 Fish and Wildlife Program funding decision. The Action Agencies calculated the scenarios using methods described the footnote below and as shown in Appendices C-10-13.[8]

Wenatchee Upper Columbia River steelhead scenarios represent the combination of actions funded by BPA through the '07-'09 NPCC solicitation plus representative mixes of actions that address the limiting factors as identified in the Habitat Collaboration Workgroup tables. The performance target for habitat quality change for this population results in a 4% survival improvement over the period of the BiOp.

The specific actions funded for the 2007-2009 period are listed in Appendix B-1a. Subsequent actions are realistic, known example actions suggested by collaborators to result in the habitat quality change and associated survival improvement. In time, specific projects will emerge from the scenarios; these specific projects will be identified in 3 year cycles.

Wenatchee Steelhead	Percentage of potential habitat function addressed for each limiting factor by 2007-2017 actions

[8] Habitat function change values were estimated from conversations with local Reclamation tributary habitat practitioners. These individuals provided general information about the feasibility for implementing action types for each limiting factor. The maximum habitat function change was set to 50 percent, and action types associated with limiting factors with less feasibility were assigned commensurately lower percentages in the tables below.
The percentages were multiplied by the difference between the maximum 2017 habitat function potential (provided in the Habitat Collaboration Workgroup tables) and the potential obtained by implementation of the 2007-09 actions (obtained from local biologists and recovery planners). The Hybrid Method was used to integrate these habitat function changes to calculate the estimated survival change values depicted in the tables below for each scenario.

Limiting Factor Addressed	Action type	Scenario 1	Scenario 2	Scenario 3
High Stream temperature	(Addressed through riparian and floodplain function)	40%	50%	60%
Low streamflow	Water purchase, lease, transfer	5%	10%	5%
	Increase irrigation delivery and use efficiency			
In-channel habitat quantity	Reconnect side channels	25%	15%	10%
	Pool-forming structures			
	Large wood structures			
Barriers to passage or access	Culvert replacement	50%	40%	75%
Riparian and floodplain function	Plantings	40%	50%	60%
	Livestock fencing			
Nutrients	Add nutrients	0%	10%	5%
Estimated Habitat Quality Change		4%	4%	4%

Many habitat actions will result in benefits well past 2017. Post-2017 benefits for the above scenarios are estimated to result in another 1% habitat quality and survival improvement (Appendix A).

Appendix C-10 details the actions and changes in habitat quality underlying these scenarios.

Methow Upper Columbia River steelhead scenarios represent the combination of actions funded by BPA through the ’07-’09 NPCC solicitation plus representative mixes of actions that address the limiting factors as identified in the Habitat Collaboration Workgroup tables. The performance target for habitat quality change for this population results in a 4% survival improvement over the period of the BiOp.

The specific actions funded for the 2007-2009 period are listed in Appendix B-1a. Subsequent actions are realistic, known example actions suggested by collaborators to result in the habitat

quality change and associated survival improvement. In time, specific projects will emerge from the scenarios; these specific projects will be identified in 3 year cycles.

Methow Steelhead		Percentage of potential habitat function addressed for each limiting factor by 2007-2017 actions		
Limiting Factor Addressed	Action type	Scenario 1	Scenario 2	Scenario 3
Low streamflow	Water purchase, lease, transfer	10%	5%	20%
	Increase irrigation delivery and use efficiency			
In-channel habitat quantity	Dike removal and channel reconnections	75%	90%	60%
Barriers to passage or access	Culvert replacement	15%	10%	10%
Riparian and floodplain function	Plantings	75%	70%	90%
	Riparian/Floodplain protection			
	Riparian,floodplain,sidechannel, Large Woody Debris, and in-stream structure restoration			
	Livestock fencing			
High Stream Temperature	See riparian and floodplain function action types	75%	70%	90%
Fine sediment	Road management	0%	0%	0%
Estimated Habitat Quality Change		4%	4%	4%

Many habitat actions will result in benefits well past 2017. Post-2017 benefits for the above scenarios are estimated to result in another 1% habitat quality and survival improvement (Appendix A).

Appendix C-11 details the actions and changes in habitat quality underlying these scenarios.

Entiat Upper Columbia River steelhead scenarios represent the combination of actions funded by BPA through the '07-'09 NPCC solicitation plus representative mixes of actions that address the limiting factors as identified in the Habitat Collaboration Workgroup tables. The performance target for habitat quality change for this population results in a 4% survival improvement over the period of the BiOp.

The specific actions funded for the 2007-2009 period are listed in Appendix B-1a. Subsequent actions are realistic, known example actions suggested by collaborators to result in the habitat quality change and associated survival improvement. In time, specific projects will emerge from the scenarios; these specific projects will be identified in 3 year cycles.

Entiat Steelhead		Percentage of potential habitat function addressed for each limiting factor by 2007-2017 actions		
Limiting Factor Addressed	Action type	Scenario 1	Scenario 2	Scenario 3
Low streamflow	Convert surface water diversion to wells	10	5	0
Riparian condition	Riparian plantings	75	50	25
	Conservation easements	5	5	10
Floodplain and side-channel connectivity	Side channel alternatives	25	50	25
Habitat diversity and quantity	Pool-forming structures	85	90	95
	LWD treatments			
Estimated Habitat Quality change		8%	8%	8%

Many habitat actions will result in benefits well past 2017. Post-2017 benefits for the above scenarios are estimated to result in another 3% habitat quality and survival improvement (Appendix A).

Appendix C-12 details the actions and changes in habitat quality underlying these scenarios.

Okanogan Upper Columbia steelhead scenarios represent the combination of actions funded by BPA through the 07-09 NPCC solicitation plus additional 07-17 actions identified by the Colville Tribes. Scenario 1 represents the proportion of actions identified by the Colville Tribes within the full habitat potential for the limiting factors shown. Scenarios 2 and 3 represent different combinations of actions treating limiting factors to arrive at the same projected habitat quality and survival change.

The performance target for habitat quality change for this population results in a 14% survival improvement over the period of the BiOp. These scenarios represent the best information available today for projecting actions during the BiOp period that meet that performance target.

The specific actions funded for the 2007-2009 period are listed in Appendix B-1a. Additional actions identified for funding in ’08 and ’09 are listed in Appendix B-4. Subsequent actions are realistic, known example actions suggested by collaborators that result in total in the habitat quality change and associated survival improvement. In time, specific projects will emerge from the scenarios; these specific projects will be identified in 3 year cycles.

Okanogan Steelhead		Percent of potential function addressed from 2010-2017		
Limiting Factor Addressed	**Action type**	**Scenario 1**	**Scenario 2**	**Scenario 3**
Low stream flow	improve water management	25%	13%	25%
	Protect existing flows			
	water conservation			
	improve water management			
	water acquisition			
Riparian and floodplain function	water conservation	31%	31%	50%
	improve water management			
	water acquisition			
	improve habitat diversity			
	improve habitat quality			
In-channel habitat quantity	improve habitat diversity	37%	67%	67%
	improve habitat quality			
In-channel habitat quality	improve water management	50%	75%	38%
	Protect existing flows			
	water conservation			
	improve water management			
	improve habitat diversity			
	improve habitat quality			
Passage- flow barrier in lower reach	provide passage at barriers	18%	18%	18%
Estimated Habitat Quality Change		14%	14%	14%

Many habitat actions will result in benefits well past 2017. Post-2017 benefits for the above scenarios are estimated to result in another 3% habitat quality and survival improvement (Appendix A).

Appendix C-13 details the actions and changes in habitat quality underlying these scenarios.

The Action Agencies will review cumulative implementation at the end of 2012 and make adjustments necessary to ensure that habitat actions achieve the overall estimated benefits.

Biological Benefits of the Tributary Habitat Proposed Action

Methods associated with determining the biological benefits for the tributary habitat proposed actions are described in a separate document entitled *Tributary Habitat Benefits*.

Research, Monitoring, and Effectiveness

Tributary habitat actions will be coordinated with Research, Monitoring, and Evaluation (RM&E) efforts currently being developed consistent with broader regional RM&E goals. The Action Agencies will continue to use results from RM&E activities to adjust tributary habitat program priorities with a goal of attaining the greatest biological effectiveness from implementing tributary habitat actions.

Performance Target and Performance Standard

Performance Target: The Action Agencies' performance target for the tributary habitat proposed action is the change in habitat quality specified in Appendix A.

Performance Standard: The Action Agencies performance standard for the tributary habitat proposed action is the implementation of projects selected to achieve change in habitat quality specified in Appendix A.

Reporting Metrics: The Action Agencies will use the following performance metrics to track their progress in implementation over the term of the BiOp. These metrics are consistent with those developed by the Federal Habitat Team and PNAMP and used to track implementation of the PSCSRF program.

Action	Performance Measure
Flow	Cubic feet per second or acre-feet of increased instream flow acquired (months of year/duration (e.g. permanent, annual, seasonal)
Screen	Number of screens
Access	Miles of access
Complexity	Miles of complexity restored
Riparian protection and enhancement	Miles or acres of riparian habitat protected or enhanced

For 2007-2009 these performance metrics will be tracked for actions identified in Appendix B or for comparable actions where there is a substitution. Successful implementation will be determined by completion or initiation of substantially all of these projects by the end of 2009.

For 2010-2017 these performances metrics will be tracked for two timeframes – 2010-2013 and 2014-2017. Successful implementation will be determined by completion or initiation of suites of projects based on the sample scenarios for the purpose of achieving the targeted change in habitat quality.

Accomplishment Reporting

The Action Agencies will produce an annual accomplishment report to report performance metrics for completed tributary habitat actions.

Appendix A - Tributary Habitat – Habitat Quality Improvement

Appendix B – Tributary Habitat Actions

B-1. 2007-2009 Tributary Habitat Actions, Upper Columbia River Spring Chinook salmon and Steelhead.

B-2. 2007-2009 Tributary Habitat Actions, Mid Columbia River Steelhead.

B-3. 2007-2009 Tributary Habitat Actions, Snake River Spring/Summer Chinook salmon and Steelhead.

B-4. Additional 2008 – 2009 Tributary Habitat Actions

B-5. Reclamation Technical Assistance (Additional to B1-B3)

B-6. 2007-2009 Habitat Actions for Lower River ESUs.

Appendix C – Scenario Worksheets

C-1 Scenario– Snake River Spring/Summer Chinook – Upper Grande Ronde

C-2 Scenario– Snake River Spring/Summer Chinook – Catherine Creek

C-3 Information for Scenario – Snake River Steelhead – Lolo Creek

C-4 Information for Scenario – Snake River Steelhead – Lochsa River

C-5 Information for Scenario – Snake River Steelhead – Selway River

C-6 Information for Scenario – Snake River Steelhead – South Fork (*Clearwater MPG)*

C-7 Information for Scenario – Snake River Steelhead – Secesh River

C-8 - Information for Scenario – Snake River Steelhead – South Fork Salmon

C-9 Information for Scenario – Snake River Steelhead – Lower Middle Fork Tributaries *(Salmon River MPG)*

C-10 Scenario – Upper Columbia Steelhead – Wenatchee

C-11 Scenario – Upper Columbia Steelhead – Methow

C-12 Scenario – Upper Columbia Steelhead – Entiat

C-13 Scenario – Upper Columbia Steelhead - Okanogan

References

MacDonald, Dan D. E., Eric Knudsen, and Cleveland R. Steward. Salmon in the 21st Century: Managing Human Activities to Achieve Long-Term sustainability of Pacific Salmon and Steelhead Populations. Pp 393-409 In: Salmon 2100, The Future of Wild Pacific Salmon. Lackey, Robert T, Denise H. Lach, and Sally L. Duncan. 2006. p. 398.

This is not a final federal agency product. Rather, it is a pre-decisional document prepared by the Action Agencies that reflects present understandings of currently available information and analyses, and of the progression of discussions with the sovereigns in the collaborative process. Revisions and refinements are to be expected based on further discussions with the sovereigns over new and modified proposed federal actions upon which the action agencies will ultimately consult. Finally, the information in this product does not constitute an analysis of whether the identified measures would or would not jeopardize the continued existence of a listed species or result in the destruction or adverse modification of designated critical habitat. Furthermore, this document does not in any way interpret or apply the regulatory definitions of the statutory phrases "jeopardize the continued existence of" and "destruction or adverse modification."

Appendix A. Estimated habitat quality improvement for actions to be funded from 2007-2017. Improvements are shown for time periods through 2017 and after 2017. Shaded populations were estimated using the Hybrid method. Unshaded populations were estimated using the Appendix E method with exceptions to both methods indicated by footnotes. Although improvements are to be expected, no estimated improvements were made after 2017 (within 25 years) for populations where the Appendix E method was used. BPA commits to fund additional tributary habitat actions for shaded and hachured focus populations to obtain the indicated survival improvements in 10 and 25 years to fill or help fill the survival gaps for those populations identified by the biological analysis. Blank cells indicate that estimates are not available. Percent change in habitat quality and percent change in survival are equivalent here (i.e., changes in juvenile survival are directly proportional to changes in habitat condition). The information we actually received from the collaborators was related to habitat condition, the actions we are undertaking will improve habitat condition, and therefore we report habitat quality change here instead of juvenile salmon survival. See explanation at the end of this table (Methods for Estimating Overall Habitat Conditions).

			Estimated Percentage Habitat Quality Improvement	
ESA-listed ESU	**MPG**	**Population**	**Benefits of 2007-2017 Actions accrued by 2017 (within 10 years)**	**Benefits of 2007-2017 Actions accrued after 2017 (within 25 years)**
Snake River Spring/Summer Chinook	Grande	**Catherine**	**14**[1]	**24**

[1] Estimates derived from additional actions identified through collaboration with parties in the Grande Ronde subbasin

	Ronde / Imnaha	**Creek**		
		Lostine/Wallowa River	**18[2,3]**	**9**
		Minam River		
		Grande Ronde River upper mainstem	**7[1]**	**26**
		Wenaha River		
		Big Sheep Creek		
		Imnaha River mainstem	**<1[4]**	
	Middle Fork Salmon River	Bear Valley Creek		
		Big Creek	**7[2]**	**2**
		Camas Creek		
		Loon Creek		
		Marsh Creek		
		Sulphur Creek		
		Middle Fork Salmon River above Indian Creek		
		Chamberlain Creek		
		Middle Fork Salmon River below Indian Creek		

[2] Estimates derived from additional actions identified through collaboration with the Nez Perce Tribe. Estimates provided by Nez Perce Tribe
[3] Represents estimated percentage habitat quality improvements associated with approximately 54% of actions identified by the Nez Perce Tribe
[4] Low estimates are constrained by low habitat potential values which were initially provided by Oregon to the Remand Collaboration Habitat Workgroup but are now being reviewed with the collaboration parties

	South Fork Salmon River	East Fork South Fork Salmon River		
		Little Salmon River	**12**[2]	**3**
		Secesh River	**6**[2]	**5**
		South Fork Salmon River mainstem	**6**[2]	**3**
	Lower Snake	Asotin Creek	**14**	**10**
		Tucannon River	**17**	**13**
	Upper Salmon River	East Fork Salmon River	**3**	[5]
		Lemhi River	**21**	[5]
		North Fork Salmon River		
		Pahsimeroi River	**43**[6]	[5]
		Salmon River lower mainstem below Redfish Lake	**3**	[5]
		Salmon River upper mainstem above Redfish Lake	**42**	[5]
		Valley Creek	**3**	[5]
		Yankee Fork	**30**	**32**
Upper Columbia Spring Chinook	Upper Columbia - Below Chief Joseph	Entiat River	**22**	**2**
		Methow River	**6**	**1**
		Wenatchee River	**3**	[5]
Middle Columbia Steelhead	Cascades	Deschutes	**3**[4]	

[5] Estimates are not currently available, but will be developed when 2010-2017 actions are refined
[6] Represents estimated percentage habitat quality improvements targeted by the action agencies

	Eastern Slope Tributaries	River - eastside		
		Deschutes River - westside	**1**[4]	
		Fifteenmile Creek (winter run)	**<1**[4]	
		Klickitat River	**12**	
		Rock Creek		
	John Day River	John Day River lower mainstem tributaries	**1**[4]	
		John Day River upper mainstem	**1**[4]	
		Middle Fork John Day River	**1**[4]	
		North Fork John Day River	**1**[4]	
		South Fork John Day River	**2**[4]	
	Umatilla and Walla Walla River	Touchet River	**12**	
		Umatilla River	**12**	
		Walla Walla River	**12**	
	Yakima River Group	Naches River	**12**	
		Satus Creek	**12**	
		Toppenish	**12**	
		Yakima River upper mainstem	**12**	

Snake River Steelhead	Clearwater River	Clearwater River lower mainstem	**4**	**1**
		Lochsa River	**18[2]**	**7**
		Lolo Creek	**12[2]**	**6**
		Selway River	**2[2]**	**2**
		South Fork Clearwater River	**14[2]**	**12**
	Grande Ronde River	Grande Ronde River lower mainstem tributaries	**<1[4]**	
		Grande Ronde River upper mainstem	**9[1]**	**25**
		Joseph Creek (OR)	**<1[4]**	
		Joseph Creek (WA)	**12**	
		Wallowa River	**27[2]**	**16**
	Hells Canyon	Hells Canyon		
	Imnaha River	Imnaha River	**<1[4]**	
	Lower Snake	Asotin Creek	**12**	**8**
		Tucannon River	**11**	**8**

	Salmon River	**Lower Middle Fork mainstem and tribs (Big**, Camas, and Loon **Creek**s)	**7**[2]	**2**
		Chamberlain Creek		
		East Fork Salmon River	**6**	**1**
		Lemhi River	**9**	[5]
		Little Salmon and Rapid River	**10**[2]	**3**
		Upper Middle Fork mainstem and tribs		
		North Fork Salmon River		
		Pahsimeroi River	**27**	[5]
		Panther Creek		
		Salmon River upper mainstem	**18**	**15**
		Secesh River	**6**[2]	**5**
		South Fork Salmon River	**6**[2]	**3**
Upper Columbia Steelhead	Upper Columbia River - Below Chief Joseph	**Entiat River**	**8**	**3**
		Methow River	**4**	**1**
		Okanogan River	**14**[7]	**3**
		Wenatchee River	**4**	**1**

[7] Estimates derived from additional actions identified through collaboration with the Colville Tribes. Estimates do not reflect any limiting factor constraints for Loup Loup Creek assessment unit

Methods for Estimating Overall Habitat Conditions

The approach used to estimate overall habitat condition varied depending on the type of information provided by the local biologists. In some cases, local biologists provided information on the current and potential conditions of limiting factors within tributary streams. In other cases, they not only provided current and potential conditions of limiting factors, but also included the relative importance (weight) of each factor in contributing to juvenile survival. Finally, where local biologists were unable to provide habitat information, the effects of habitat actions were estimated using the Appendix E approach in the 2004 BiOp. Below we identify the three methods used to estimate overall habitat condition (or changes in habitat condition) associated with the type of information provided by the local biologists.

The first and simplest approach followed the methods used in Appendix E in the 2004 BiOp. This approach assumed that any change in juvenile survival was proportion to the change in overall habitat condition. This approach comports well with the habitat-survival relationships developed by the Remand Habitat Workgroup that show a direct relationship between survival change and change in overall habitat condition. Thus, if proposed tributary habitat actions improve overall habitat condition from a low to low-medium (1-4%), then egg-smolt survival should improve from a low to low-medium (1-4%). This approach assumed that there were no factors currently at levels or concentrations that would be lethal to fish and that all non-lethal factors have an equal effect on overall habitat condition.

The second approach followed methods developed by the Remand Habitat Workgroup. This method included a two-pronged approach. First, if no lethal factors were identified by the local biologists, an overall composite habitat score was estimated by averaging individual habitat scores for each limiting factor within an assessment unit or population. This approach assumed that good habitat conditions on one variable could compensate for poor conditions on other variables. On the other hand, if a limiting factor was considered lethal (i.e., its current level or concentration was such that it killed fish), the overall habitat quality was based only on the condition of that lethal factor. These overall habitat scores were then translated into survival changes based on the habitat-survival functions developed by the Remand Habitat Workgroup.

The last approach used to estimate overall habitat condition was based on a modification of the method recommended by the Remand Habitat Workgroup. Unlike the Habitat Workgroup approach, which assumed that non-lethal limiting factors affect overall habitat condition equally, this modified approach assumed that some limiting factors have a greater effect on overall habitat quality than other limiting factors. Under this approach, local biologists provided both individual habitat scores and their respective weighting factors. The weighting factors indicated the relative importance of a given limiting factor on juvenile survival. For example, if the habitat in a given assessment unit or population was limited by four factors and each factor equally influenced juvenile survival, each limiting factor was assigned a weight of 0.25 (the sum of the weights must equal 1.0). On the other hand, if one of the four factors was

considered lethal, it was given a weight of 1.0 and all other limiting factors were given weights of 0.0. Thus, in this case, the modified approach is similar to the Habitat Workgroup approach. Overall habitat condition was estimated as the arithmetic mean of the individual habitat scores times their respective weights. Overall habitat scores were then translated into survival changes based on the habitat-survival functions developed by the Remand Habitat Workgroup.

This is not a final federal agency product. Rather, it is a pre-decisional document prepared by the Action Agencies that reflects present understandings of currently available information and analyses, and of the progression of discussions with the sovereigns in the collaborative process. Revisions and refinements are to be expected based on further discussions with the sovereigns over new and modified proposed federal actions upon which the action agencies will ultimately consult. Finally, the information in this product does not constitute an analysis of whether the identified measures would or would not jeopardize the continued existence of a listed species or result in the destruction or adverse modification of designated critical habitat. Furthermore, this document does not in any way interpret or apply the regulatory definitions of the statutory phrases "jeopardize the continued existence of" and "destruction or adverse modification."

Upper Columbia Steelhead							
MPG	**Populations**	**Tributary Habitat Limiting Factors** (FCRPS BiOp Remand Habitat Workgroup products)	**BPA Project Nbr**	**Average annual planning budget**	**Project Title & Short Description**	**Action Description**	**Reporting Metric**
Eastern Cascades	Wenatchee River	Floodplain Connectivity and Function- degraded floodplain connectivity and function Channel Structure and Complexity- habitat diversity, in-channel habitat quantity Riparian Areas and LWD Recruitment- degraded riparian function Stream Flow- low stream flow Water Quality- High stream temperature Fish Passage- barriers to passage or access	200201301	$ 3,500,000	Water Entity (Rpa 151) Nwppc Fund water right transactions that restore streamflows and focused riparian easements on criticial fish-bearing Columbia Basin tributaries. Implemented as the Columbia Basin Water Transactions Program (CBWTP) in a partnership between BPA and NFWF	Land Purchase	# of HU's protected by land purchase or easement
							* # of acres of new purchase/easement
							* # of riparian miles protected
						Install Flow Measuring Device	* Is the measuring device portable or fixed?
						Acquire Water Instream	
						Develop and Negotiate Water Right Transaction	
			200704200	$ 156,600	UPA Wenatchee Passage Program To replace 9 barrier culverts in Alder Creek, Clear Creek and Beaver Creek with fish-friendly structures to provide 4.0 miles of spawning and rearing habitat for ESA listed Upper Columbia steelhead.	Install Fish Passage Structure	
						Remove/Modify Dam	
			200708500	$ 216,667	UPA Nason Creek Oxbow Reconnection Project Project proposes to install two bottomless arch culverts in SR 207 to successfully reconnect 0.64 miles of historic oxbow habitat to the mainchannel Nason Creek. This project will increase Spring Chinook salmonid abundance by 25-50% in the Nason A.U.	Install Fish Passage Structure	* # of miles of habitat accessed
			200708600	$ 100,000	UPA Wenatchee Subbasin Riparian Enhancement Proposal The Wenatchee Riparian proposal will involve planting native vegetation and fencing to establish a properly functioning riparian buffer in the Wenatchee Assessment Units. This project will benefit Upper Columbia steelhead, spring Chinook and bull trout.	Install Fence	
						Plant Vegetation	* # of riparian miles treated
						Maintain Vegetation	

Upper Columbia Steelhead							
MPG	**Populations**	**Tributary Habitat Limiting Factors** (FCRPS BiOp Remand Habitat Workgroup products)	**BPA Project Nbr**	**Average annual planning budget**	**Project Title & Short Description**	**Action Description**	**Reporting Metric**
			200728300	$ 766,667	UPA Wenatchee Subbasin Access Proposal Forty three (43) potential fish passage barrier structures are being proposed for funding to benefit Upper Columbia spring Chinook, steelhead and bull trout. Emphasis is on replacing the Mill Creek	Install Fish Passage Structure	
Eastern Cascades (con't)	Wenatchee River (con't)		200732500	$ 700,000	UPA Wenatchee Subbasin Complexity Proposal Five potential complexity projects are being proposed for funding to benefit Upper Columbia spring Chinook, steelhead and bull trout. Funds are also requested for unidentified potential complexity projects to assist in meeting UPA metric goals.	Realign, Connect, and/or Create Channel	
			200703400	$ 308,000	Columbia Cascade Pump Screen Correction This project proposes to start a voluntary compliance pump screen correction program in the Methow, Entiat, and Wenatchee River basins in order to reduce juvenile fish losses due to entrapment in water diversions as called for in the most recent FCRPS BiO	Install Fish Screen	
	Entiat River	Floodplain Connectivity and Function- impaired floodplain and side-channel connectivity Channel Structure and Complexity- in-channel habitat quantity, habitat diversity Riparian Areas and LWD Recruitment- degraded riparian condition Stream Flow- Low stream flow Fish Passage- obstructions to passage and access Stream Substrate- excess fine sediment	200705500	$ 20,000	Entiat River - UPA - Lower Entiat River Off-Channel Restoration Project The Lower Entiat River Off-Channel enhancement project will provide 0.28 miles of off-channel habitat to benefit Upper Columbia ESA listed steelhead, spring Chinook, and bull trout. An irrigation channel will be enhanced for rearing and spawning habitat.	Develop Pond	
						Increase Instream Habitat Complexity	* # of stream miles treated
							* # of structures installed
						Plant Vegetation	
						Install Fish Passage Structure	* # of miles of habitat accessed
			200723100	$ 83,333	UPA Entiat Subbasin Riparian Enhancement Program Riparian projects are being proposed in the Entiat subbasin to benefit Upper Columbia spring Chinook, steelhead and bull trout. Funding is requested for Tillicum Creek Fence and programmatic riparian projects.	Install Fence	
						Plant Vegetation	
						Maintain Vegetation	
			200731800	$ 125,000	Entiat River - UPA - Knapp-Wham Hanan Detwiler Irrigation System Consolidation Project Consolidation of the Knapp-Wham and	Develop Alternative Water Source	
						Increase Instream Habitat Complexity	* # of stream miles treated

Upper Columbia Steelhead							
MPG	**Populations**	**Tributary Habitat Limiting Factors** (FCRPS BiOp Remand Habitat Workgroup products)	**BPA Project Nbr**	**Average annual planning budget**	**Project Title & Short Description**	**Action Description**	**Reporting Metric**
					Hanan Detwiler irrigation systems will eliminate partial fish passage barriers associated with 2 surface water diversions, add instream habitat within the lower Entiat River, and enhance instream flows via water saved		* # of structures installed
						Remove/Install Diversion	* # of miles of habitat accessed
						Install Well	* Amount of unprotected water flow returned to the stream by conservation in cfs
							* Estimated # of miles of primary stream reach improvement
Eastern Cascades (con't)	Entiat River (con't)		200201301	$ 3,500,000	Water Entity (Rpa 151) Nwppc Fund water right transactions that restore streamflows and focused riparian easements on criticial fish-bearing Columbia Basin tributaries. Implemented as the Columbia Basin Water Transactions Program (CBWTP) in a partnership between BPA and NFWF	Land Purchase	# of HU's protected by land purchase or easement
							* # of acres of new purchase/easement
							* # of riparian miles protected
						Install Flow Measuring Device	* Is the measuring device portable or fixed?
						Acquire Water Instream	
						Develop and Negotiate Water Right Transaction	
			200703400	$ 308,000	Columbia Cascade Pump Screen Correction This project proposes to start a voluntary compliance pump screen correction program in the Methow, Entiat, and Wenatchee River basins in order to reduce juvenile fish losses due to entrapment in water diversions as called for in the most recent FCRPS BiO	Install Fish Screen	
	Methow River	Floodplain Connectivity and Function- impaired floodplain connectivity and function, impaired side-channel connectivity Channel Structure and Complexity- habitat diversity, in-channel habitat quality Riparian Areas and LWD Recruitment- impaired riparian function Stream Flow- Low stream flow Water Quality- High stream temperature Fish Passage- passage: thermal, screens, culverts and flow barriers in lower reach Other- Ecologic conditions-disease	200703500	$ 202,880	UPA Project - Methow Basin Riparian Enhancement MSRF proposes to partner with Bureau of	Install Fence	* # of miles of fence
						Plant Vegetation	* # of riparian miles treated
			200717200	$ 90,193	UPA Project - MVID West Canal Diversion and Headworks Move POD 175' upstream by installing new concrete diversion headworks, realign 150' of West Canal intake and build new access road to connect new headworks, construct permanent channel-spanning natural rock	Plant Vegetation	
						Operate and Maintain Habitat/Passage	
						Install Fish Passage Structure	* # of miles of habitat accessed
						Remove/Install Diversion	* # of miles of habitat accessed
			200721400	$ 41,832	UPA Project - Fender Mill Floodplain Restoration - Phase 1	Create, Restore, and/or Enhance Wetland	* # of acres treated

Upper Columbia Steelhead							
MPG	**Populations**	**Tributary Habitat Limiting Factors** (FCRPS BiOp Remand Habitat Workgroup products)	**BPA Project Nbr**	**Average annual planning budget**	**Project Title & Short Description**	**Action Description**	**Reporting Metric**
					Restore natural channel process, reestablish side channel rearing habitat, restore-improve riparian forest habitat, add wood complexes in main stem, install rock structure to keep majority of flow in main	Increase Instream Habitat Complexity	* # of stream miles treated
						Plant Vegetation	* # of acres of planted
						Operate and Maintain Habitat/Passage	
			200703400	$ 308,000	Columbia Cascade Pump Screen Correction This project proposes to start a voluntary compliance pump screen correction program in the Methow, Entiat, and Wenatchee River basins in order to reduce juvenile fish losses due to entrapment in water diversions as called for in the most recent FCRPS BiO	Install Fish Screen	
Eastern Cascades (con't)	Methow River (con't)		200723700	$ 45,120	UPA Project - Elbow Coulee Floodplain Restoration This project would eliminate a dike; open an existing side channel and floodplain; reconnect a wetland; and use large woody debris and boulders to split flows. These would increase habitat complexity and create more dynamic habitats for listed salmonids.	Create, Restore, and/or Enhance Wetland	* # of acres treated
						Enhance Floodplain	* # of acres treated
						Increase Instream Habitat Complexity	* # of structures installed
						Plant Vegetation	* # of acres of planted
						Realign, Connect, and/or Create Channel	* # of stream miles treated, including off-channels, after realignment
						Upland Erosion and Sedimentation Control	* # of acres treated
						Operate and Maintain Habitat/Passage	
			200725100	$ 164,640	UPA Project - Methow Valley Irrigation District East Diversion Dam Replacement This project will remove the present channel spanning irrigation diversion dam and replace it with a reinforced earth and rock wing dam parallel to the thalweg. This project will also re-open 1/4 mile of side channel habitat blocked by a pushup berm.	Plant Vegetation	* # of acres of planted
						Realign, Connect, and/or Create Channel	* # of stream miles treated, including off-channels, after realignment
						Operate and Maintain Habitat/Passage	
						Remove/Install Diversion	* # of miles of habitat accessed
			200726400	$ 333,333	UPA Project - Programmatic Habitat Complexity Projects in the Methow River Subbasin These projects would eliminate dikes, open side channels, and enhance floodplain connectivity at various sites in the Methow subbasin. Identification and ranking to be based on MIHRP study.	Realign, Connect, and/or Create Channel	* # of stream miles treated, including off-channels, after realignment

Upper Columbia Steelhead							
MPG	**Populations**	**Tributary Habitat Limiting Factors** (FCRPS BiOp Remand Habitat Workgroup products)	**BPA Project Nbr**	**Average annual planning budget**	**Project Title & Short Description**	**Action Description**	**Reporting Metric**
			200201301	$ 3,500,000	Water Entity (Rpa 151) Nwppc Fund water right transactions that restore streamflows and focused riparian easements on criticial fish-bearing Columbia Basin tributaries. Implemented as the Columbia Basin Water Transactions Program (CBWTP) in a partnership between BPA and NFWF	Land Purchase	# of HU's protected by land purchase or easement
							* # of acres of new purchase/easement
							* # of riparian miles protected
						Install Flow Measuring Device	* Is the measuring device portable or fixed?
						Acquire Water Instream	
						Develop and Negotiate Water Right Transaction	
Eastern Cascades (con't)	Okanogan River	Floodplain Connectivity and Function- impaired floodplain connectivity and function, impaired side-channel connectivity Channel Structure and Complexity- habitat diversity, in-channel habitat quality Riparian Areas and LWD Recruitment- impaired riparian f	199604200	$ 621,420	Restore and Enhance Anadromous Fish Populations and Habitat in Salmon Creek This project is directed at reconnecting a productive tributary of the Okanogan River, Salmon Creek. This project involves a water lease with the Okanogan Irrigation District and construction of a low flow channel within the lower reach.	Realign, Connect, and/or Create Channel	* # of stream miles treated, including off-channels, after realignment
						Install Well	
						Acquire Water Instream	
						Develop and Negotiate Water Right Transaction	
			200000100	$ 206,999	Anadromous Fish Habitat & Passage The Tribe proposes continuing habitat rehabilitation efforts to decrease sediment	Develop Alternative Water Source	
						Install Fence	* # of miles of fence
			200714500	$ 40,763	Okanogan Livestock and Water Provide a cost share program to assist producers in developing offsite water for livestock and provide assistanc fencing	Develop Alternative Water Source	
						Install Fence	* # of miles of fence
						Plant Vegetation	
			200722400	$ 480,453	Implementation of the Okanogan Subbasin Plan. Initiate a Programmatic and Sequenced set of Key Habitat Restoration and Protection Actions The integration of science into management, decision-making and recommended actions is an essential task for resource managers. This phased and programmatic plan is the centerpiece for mitigation, recovery and conservation in the Okanogan R & the Province	Enhance Floodplain	* # of acres treated
						Plant Vegetation	* # of acres of planted
							* # of riparian miles treated
						Realign, Connect, and/or Create Channel	* # of stream miles treated, including off-channels, after realignment
						Upland Erosion and Sedimentation Control	* # of acres treated
						Acquire Water Instream	* # of acres treated

Upper Columbia Steelhead							
MPG	**Populations**	**Tributary Habitat Limiting Factors** (FCRPS BiOp Remand Habitat Workgroup products)	**BPA Project Nbr**	**Average annual planning budget**	**Project Title & Short Description**	**Action Description**	**Reporting Metric**
							* # of miles of total stream reach improvement, including primary and secondary reaches
							* Amount of water secured
Eastern Cascades (con't)	Okanogan River (con't)		200201301	$ 3,500,000	Water Entity (Rpa 151) Nwppc Fund water right transactions that restore streamflows and focused riparian easements on criticial fish-bearing Columbia Basin tributaries. Implemented as the Columbia Basin Water Transactions Program (CBWTP) in a partnership between BPA and NFWF	Land Purchase	# of HU's protected by land purchase or easement
							* # of acres of new purchase/easement
							* # of riparian miles protected
						Install Flow Measuring Device	* Is the measuring device portable or fixed?
						Acquire Water Instream	
						Develop and Negotiate Water Right Transaction	

This is not a final federal agency product. Rather, it is a pre-decisional document prepared by the Action Agencies that reflects present understandings of currently available information and analyses, and of the progression of discussions with the sovereigns in the collaborative process. Revisions and refinements are to be expected based on further discussions with the sovereigns over new and modified proposed federal actions upon which the action agencies will ultimately consult. Finally, the information in this product does not constitute an analysis of whether the identified measures would or would not jeopardize the continued existence of a listed species or result in the destruction or adverse modification of designated critical habitat. Furthermore, this document does not in any way interpret or apply the regulatory definitions of the statutory phrases "jeopardize the continued existence of" and "destruction or adverse modification."

Upper Columbia Spring Chinook Salmon							
MPG	**Populations**	**Tributary Habitat Limiting Factors** (FCRPS BiOp Remand Habitat Workgroup products)	**BPA Project Nbr**	**Average annual planning budget**	**Project Title & Short Description**	**Action Description**	**Reporting Metric**
Eastern Cascades	**Wenatchee River**	Floodplain Connectivity and Function- impaired floodplain connectivity and function Channel Structure and Complexity- reduced in-channel habitat quantity Riparian Areas and LWD Recruitment- reduced riparian function Stream Flow- low stream flow Water Quality- high stream temperature Fish Passage- barriers to passage or access	200704200	$ 156,600	UPA Wenatchee Passage Program To replace 9 barrier culverts in Alder Creek, Clear Creek and Beaver Creek with fish-friendly structures to provide 4.0 miles of spawning and rearing habitat for ESA listed Upper Columbia steelhead.	Install Fish Passage Structure	
						Remove/Modify Dam	
			200703400	$ 308,000	Columbia Cascade Pump Screen Correction This project proposes to start a voluntary compliance pump screen correction program in the Methow, Entiat, and Wenatchee River basins in order to reduce juvenile fish losses due to entrapment in water diversions as called for in the most recent FCRPS BiO	Install Fish Screen	
			200708500	$ 216,667	UPA Nason Creek Oxbow Reconnection Project Project proposes to install two bottomless arch culverts in SR 207 to successfully reconnect 0.64 miles of historic oxbow habitat to the mainchannel Nason Creek. This project will increase Spring Chinook salmonid abundance by 25-50% in the Nason A.U.	Install Fish Passage Structure	* # of miles of habitat accessed
			200708600	$ 100,000	UPA Wenatchee Subbasin Riparian Enhancement Proposal The Wenatchee Riparian proposal will involve planting native vegetation and fencing to establish a properly functioning riparian buffer in the Wenatchee Assessment Units. This project will benefit Upper Columbia steelhead, spring Chinook and bull trout.	Install Fence	
						Plant Vegetation	* # of riparian miles treated
						Maintain Vegetation	
			200728300	$ 766,667	UPA Wenatchee Subbasin Access Proposal Forty three (43) potential fish passage barrier structures are being proposed for funding to benefit Upper Columbia spring Chinook, steelhead and bull trout. Emphasis is on replacing the Mill Creek Culvert near the mouth of Peshastin Creek.	Install Fish Passage Structure	

Upper Columbia Spring Chinook Salmon							
MPG	**Populations**	**Tributary Habitat Limiting Factors** (FCRPS BiOp Remand Habitat Workgroup products)	**BPA Project Nbr**	**Average annual planning budget**	**Project Title & Short Description**	**Action Description**	**Reporting Metric**
			200732500	$ 700,000	UPA Wenatchee Subbasin Complexity Proposal Five potential complexity projects are being proposed for funding to benefit Upper Columbia spring Chinook, steelhead and bull trout. Funds are also requested for unidentified potential complexity projects to assist in meeting UPA metric goals.	Realign, Connect, and/or Create Channel	
Eastern Cascades (con't)	**Wenatchee River (con't)**		200201301	$ 3,500,000	Water Entity (Rpa 151) Nwppc Fund water right transactions that restore streamflows and focused riparian easements on criticial fish-bearing Columbia Basin tributaries. Implemented as the Columbia Basin Water Transactions Program (CBWTP) in a partnership between BPA and NFWF	Acquire Water Instream	
						Develop and Negotiate Water Right Transaction	
	Entiat River	Floodplain Connectivity and Function- impaired floodplain connectivity and function, impaired side-channel connectivity Channel Structure and Complexity- reduced habitat diversity, in-channel habitat quantity Riparian Areas and LWD Recruitment- impaired riparian condition and function Stream Flow- low stream flow	200705500	$ 20,000	Entiat River - UPA - Lower Entiat River Off-Channel Restoration Project The Lower Entiat River Off-Channel enhancement project will provide 0.28 miles of off-channel habitat to benefit Upper Columbia ESA listed steelhead, spring Chinook, and bull trout. An irrigation channel will be enhanced for rearing and spawning habitat.	Develop Pond	
						Increase Instream Habitat Complexity	* # of stream miles treated
							* # of structures installed
						Plant Vegetation	
						Install Fish Passage Structure	* # of miles of habitat accessed
			200703400	$ 308,000	Columbia Cascade Pump Screen Correction This project proposes to start a voluntary compliance pump screen correction program in the Methow, Entiat, and Wenatchee River basins in order to reduce juvenile fish losses due to entrapment in water diversions as called for in the most recent FCRPS BiO	Install Fish Screen	
			200723100	$ 83,333	UPA Entiat Subbasin Riparian Enhancement Program Riparian projects are being proposed in the Entiat subbasin to benefit Upper Columbia spring Chinook, steelhead and bull trout. Funding is requested for Tillicum Creek Fence and programmatic riparian projects.	Install Fence	
						Plant Vegetation	
						Maintain Vegetation	
			200731800	$ 125,000	Entiat River - UPA - Knapp-Wham Hanan Detwiler Irrigation System Consolidation Project Consolidation of the Knapp-Wham and Hanan Detwiler irrigation systems will eliminate partial fish passage barriers	Develop Alternative Water Source	
						Increase Instream Habitat Complexity	* # of stream miles treated
							* # of structures installed

Upper Columbia Spring Chinook Salmon							
MPG	**Populations**	**Tributary Habitat Limiting Factors** (FCRPS BiOp Remand Habitat Workgroup products)	**BPA Project Nbr**	**Average annual planning budget**	**Project Title & Short Description**	**Action Description**	**Reporting Metric**
					associated with 2 surface water diversions, add instream habitat within the lower Entiat River, and enhance instream flows via water saved	Remove/Install Diversion	* # of miles of habitat accessed
						Install Well	* Amount of unprotected water flow returned to the stream by conservation in cfs
							* Estimated # of miles of primary stream reach improvement
Eastern Cascades (con't)	**Entiat River (con't)**		200201301	$ 3,500,000	Water Entity (Rpa 151) Nwppc Fund water right transactions that restore streamflows and focused riparian easements on criticial fish-bearing Columbia Basin tributaries. Implemented as the Columbia Basin Water Transactions Program (CBWTP) in a partnership between BPA and NFWF	Acquire Water Instream	
						Develop and Negotiate Water Right Transaction	
	Methow River	Floodplain Connectivity and Function- impaired floodplain connectivity and function Channel Structure and Complexity- reduced habitat diversity, in-channel habitat quantity, side-channel connectivity Riparian Areas and LWD Recruitment- reduced riparian condition Stream Flow- low stream flow Water Quality- high water temperature Stream Substrate- excess fine sediment (ChewuchR., Beaver Ck) Fish Passage- obstructions to passage and access	200703500	$ 202,880	UPA Project - Methow Basin Riparian Enhancement MSRF proposes to partner with Bureau of Reclamation and Methow Conservancy to identify and prioritize riparian enhancement projects that will add value to passage, access and conservation projects. All projects will focus on TES species and habitat.	Install Fence	* # of miles of fence
						Plant Vegetation	* # of riparian miles treated
			200703400	$ 308,000	Columbia Cascade Pump Screen Correction This project proposes to start a voluntary compliance pump screen correction program in the Methow, Entiat, and Wenatchee River basins in order to reduce juvenile fish losses due to entrapment in water diversions as called for in the most recent FCRPS BiO	Install Fish Screen	
			200717200	$ 90,193	UPA Project - MVID West Canal Diversion and Headworks Move POD 175' upstream by installing new concrete diversion headworks, realign 150' of West Canal intake and build new access road to connect new headworks, construct permanent channel-spanning natural rock	Plant Vegetation	
						Operate and Maintain Habitat/Passage	
						Install Fish Passage Structure	* # of miles of habitat accessed
						Remove/Install Diversion	* # of miles of habitat accessed
			200721400	$ 41,832	UPA Project - Fender Mill Floodplain Restoration - Phase 1 Restore natural channel process, reestablish side channel rearing habitat, restore-improve riparian forest habitat, add	Create, Restore, and/or Enhance Wetland	* # of acres treated
						Increase Instream Habitat Complexity	* # of stream miles treated
						Plant Vegetation	* # of acres of planted

Upper Columbia Spring Chinook Salmon							
MPG	**Populations**	**Tributary Habitat Limiting Factors** (FCRPS BiOp Remand Habitat Workgroup products)	**BPA Project Nbr**	**Average annual planning budget**	**Project Title & Short Description**	**Action Description**	**Reporting Metric**
					wood complexes in main stem, install rock structure to keep majority of flow in main stem, breach existing levee, connect side channels	Realign, Connect, and/or Create Channel	* # of stream miles before treatment
						Operate and Maintain Habitat/Passage	
Eastern Cascades (con't)	**Methow River (con't)**		200723700	$ 45,120	UPA Project - Elbow Coulee Floodplain Restoration This project would eliminate a dike; open an existing side channel and floodplain; reconnect a wetland; and use large woody debris and boulders to split flows. These would increase habitat complexity and create more dynamic habitats for listed salmonids.	Create, Restore, and/or Enhance Wetland	* # of acres treated
						Enhance Floodplain	* # of acres treated
						Increase Instream Habitat Complexity	* # of structures installed
						Plant Vegetation	* # of acres of planted
						Realign, Connect, and/or Create Channel	* # of stream miles before treatment
						Realign, Connect, and/or Create Channel	* # of stream miles treated, including off-channels, after realignment
						Upland Erosion and Sedimentation Control	* # of acres treated
						Operate and Maintain Habitat/Passage	
			200725100	$ 164,640	UPA Project - Methow Valley Irrigation District East Diversion Dam Replacement This project will remove the present channel spanning irrigation diversion dam and replace it with a reinforced earth and rock wing dam parallel to the thalweg. This project will also re-open 1/4 mile of side channel habitat blocked by a pushup berm.	Plant Vegetation	* # of acres of planted
						Realign, Connect, and/or Create Channel	* # of stream miles treated, including off-channels, after realignment
						Operate and Maintain Habitat/Passage	
						Remove/Install Diversion	* # of miles of habitat accessed
			200726400	$ 333,333	UPA Project - Programmatic Habitat Complexity Projects in the Methow River Subbasin This project will remove the present channel spanning irrigation diversion dam and replace it with a reinforced earth and rock wing dam parallel to the thalweg. This project will also re-open 1/4 mile of side channel habitat blocked by a pushup berm.	Realign, Connect, and/or Create Channel	* # of stream miles treated, including off-channels, after realignment
			200201301	$ 3,500,000	Water Entity (Rpa 151) Nwppc Fund water right transactions that restore streamflows and focused riparian easements on criticial fish-bearing Columbia Basin tributaries. Implemented as the Columbia Basin Water Transactions Program (CBWTP) in a partnership between BPA and NFWF	Acquire Water Instream	
						Develop and Negotiate Water Right Transaction	

Upper Columbia Spring Chinook Salmon							
MPG	**Populations**	**Tributary Habitat Limiting Factors** (FCRPS BiOp Remand Habitat Workgroup products)	**BPA Project Nbr**	**Average annual planning budget**	**Project Title & Short Description**	**Action Description**	**Reporting Metric**
Eastern Cascades (con't)	**Okanogan River (extirpated)**	Floodplain Connectivity and Function- impaired floodplain connectivity and function Channel Structure and Complexity- reduced habitat diversity, in-channel habitat quantity, side-channel connectivity Riparian Areas and LWD Recruitment- reduced riparian condition Stream Flow- low stream flow Water Quality- high water temperature Stream Substrate- excess fine sediment (ChewuchR., Beaver Ck) Fish Passage- obstructions to passage and access	199604200	$ 621,420	Restore and Enhance Anadromous Fish Populations and Habitat in Salmon Creek This project is directed at reconnecting a productive tributary of the Okanogan River, Salmon Creek. This project involves a water lease with the Okanogan Irrigation District and construction of a low flow channel within the lower reach.	Realign, Connect, and/or Create Channel	* # of stream miles treated, including off-channels, after realignment
						Install Well	
						Acquire Water Instream	
						Develop and Negotiate Water Right Transaction	
			200000100	$ 206,999	Anadromous Fish Habitat & Passage The Tribe proposes continuing habitat rehabilitation efforts to decrease sediment loads and improve passage for anadromous steelhead and salmon. In addition, monitoring and evaluation efforts will assess effectiveness of ongoing activities.	Develop Alternative Water Source	
						Install Fence	* # of miles of fence
			200714500	$ 40,763	Okanogan Livestock and Water Provide a cost share program to assist producers in developing offsite water for livestock and provide assistanc fencing riparian areas. Allowing producers to respond to and prevent complaints	Develop Alternative Water Source	
						Install Fence	* # of miles of fence
						Plant Vegetation	
			200722400	$ 480,453	Implementation of the Okanogan Subbasin Plan. Initiate a Programmatic and Sequenced set of Key Habitat Restoration and Protection Actions The integration of science into management, decision-making and recommended actions is an essential task for resource managers. This phased and programmatic plan is the centerpiece for mitigation, recovery and conservation in the Okanogan R & the Province	Enhance Floodplain	* # of acres treated
						Plant Vegetation	* # of acres of planted
						Realign, Connect, and/or Create Channel	* # of riparian miles treated
							* # of stream miles treated, including off-channels, after realignment
						Upland Erosion and Sedimentation Control	* # of acres treated
						Acquire Water Instream	* # of acres treated
							* # of miles of total stream reach improvement, including primary and secondary reaches
							* Amount of water secured
			200201301	$ 3,500,000	Water Entity (Rpa 151) Nwppc Fund water right transactions that restore streamflows and focused riparian easements on criticial fish-bearing Columbia Basin tributaries. Implemented	Acquire Water Instream	
						Develop and Negotiate Water Right Transaction	

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Mid Columbia Steelhead							
MPG	**Populations**	**Tributary Habitat Limiting Factors** (FCRPS BiOp Remand Habitat Workgroup products)	**BPA Project Nbr**	**Average annual planning budget**	**Project Title**	**Action Description**	**Reporting Metric**
Eastern Cascades	Klickitat River (above BON)	Floodplain Connectivity and Function- disconnected floodplain Stream Flow- altered high and low flows, low summer stream flow, flow effects of groundwater use Fish Passage- improperly screened diversions, road culvert passage obstructions, passage at mouth of tributaries (passage barrier at Bowman Creek) Channel Structure and Complexity- limited key in-channel habitat quantity, stability and diversity, loss of key habitat, unstable channel, loss of habitat diversity Riparian Areas and LWD Recruitment- reduced LWD Stream Substrate- Excess fine sediment load from roads, tilled land, bank erosion, cropping & livestock Water Quality- high water temp (lack of shade), availability of food/nutrients, low dissolved oxygen, pathogens Other - Harassment/poaching, competition with hatchery fish, predation - lack of cover	199705600 2007 Interim Ops Agreement	$ 261,000 (FY07)	Klickitat Watershed Enhancement This project (KWEP) restores, enhances, and protects watershed health to aid recovery of native salmonid stocks in the Klickitat subbasin. Implemented by the Yakama Nation Fisheries Program and funded by BPA, KWEP addresses FWP goals and objectives.	Create, Restore, and/or Enhance Wetland	
						Decommission Road	
						Develop Alternative Water Source	
						Enhance Floodplain	
						Enhance Nutrients Instream	
						Improve/Relocate Road	
						Increase Instream Habitat Complexity	
						Install Fence	
						Plant Vegetation	
						Realign, Connect, and/or Create Channel	
						Remove vegetation	
						Upland Erosion and Sedimentation Control	
						Maintain Vegetation	
						Operate and Maintain Habitat/Passage	
						Remove Debris	
						Install Fish Passage Structure	
						Install Flow Measuring Device	
			198812035	$ 461,666	YKFP Klickitat Management, Data, and Habitat Proposal provides for all YN management functions associated with the Yakima/Klickitat Fisheries Project including project planning, O&M, research, data management, and habitat improvement and acquisition actions in the Klickitat Subbasin.	Habitat improvement	
						Lease Land	
			200102100	$ 86,168	15 Mile Creek Riparian Buffers This proposal develops riparian buffer systems on streams in the Fifteenmile Subbasin and other direct tributaries to the	Riparian Enhancement	# acres affected

Mid Columbia Steelhead							
MPG	**Populations**	**Tributary Habitat Limiting Factors** (FCRPS BiOp Remand Habitat Workgroup products)	**BPA Project Nbr**	**Average annual planning budget**	**Project Title**	**Action Description**	**Reporting Metric**
					Columbia River in northern Wasco County. Implementation of buffer plans developed under this proposal are fully funded by USDA		# riparian miles enhanced
Eastern Cascades (con't)	Fifteen Mile Creek (above TDA)	Stream Flow- low flows Channel Structure and Complextiy- habitat quality, diversity	199304000	$ 323,685	Fifteenmile Creek Habitat Restoration and Monitoring Project Provide continued operation and maintenance on previously installed fencing and instream habitat, monitor the success of all restoration efforts, and begin implementation to improve instream habitat complexity within the Fifteenmile Creek Subbasin.	Develop Alternative Water Source	
						Increase Instream Habitat Complexity	
						Install Fence	* # of miles of fence
						Maintain Vegetation	
						Operate and Maintain Habitat/Passage	
			200201301	$ 3,500,000	Water Entity (Rpa 151) Nwppc Fund water right transactions that restore streamflows and focused riparian easements on criticial fish-bearing Columbia Basin tributaries. Implemented as the Columbia Basin Water Transactions Program (CBWTP) in a partnership between BPA and NFWF	Acquire Water Instream	
						Develop and Negotiate Water Right Transaction	
	Westside Deschutes (above TDA)	Fish Passage- physical barriers Stream Flow- hydrologic barriers Floodplain Connectivity and Function- floodplain condition Channel Structure and Complexity- habitat diversity Water Quality- water chemistry, toxics/pollutants	No actions proposed for this population				
	Eastside Deschutes (above TDA)	Stream Flow- low flows Channel Structure and Complexity- habitat quality, quantity and diversity Water Quality- water chemistry	199404200	$ 383,662	Trout Creek Fish Habitat Restoration Project Construction, O&M, and M&E of numerous new and existing instream and riparian habitat restoration projects; Monitoring and Evaluation of summer steelhead smolt production and adult return. M&E of instream and riparian habitat restoration	Develop Alternative Water Source	
						Enhance Floodplain	* # of acres treated
						Realign, Connect, and/or Create Channel	* # of stream miles treated, including off-channels, after realignment
						Maintain Vegetation	
			199802800	$ 165,000	Trout Creek Watershed Restoration Project Implementation of numerous riparian and upland habitat improvement projects on private lands in the Trout Creek watershed, Deshutes basin. Monitoring and evaluation of current and past projects.	Enhance Floodplain	* # of acres treated
						Plant Vegetation	* # of acres of planted
							* # of riparian miles treated
						Realign, Connect, and/or Create Channel	* # of stream miles treated, including off-channels, after realignment

Mid Columbia Steelhead							
MPG	**Populations**	**Tributary Habitat Limiting Factors** (FCRPS BiOp Remand Habitat Workgroup products)	**BPA Project Nbr**	**Average annual planning budget**	**Project Title**	**Action Description**	**Reporting Metric**
						Remove/Install Diversion	* # of miles of habitat accessed
Eastern Cascades (con't)	Eastside Deschutes (above TDA) (con't)		199802800 (con't)			Install Pipeline	* Amount of unprotected water flow returned to the stream by conservation in acre-feet
			200201900	$ 70,160	Wasco Riparian Buffers This proposal develops riparian buffer systems in southern Wasco County in the	Riparian Enhancement	# acres affected # riparian miles enhanced
	Crooked River (Historic population)		No projects for this population				
	Rock Creek (above JDA)	Riparian Areas and Condition- riparian condition, lack of LWD Stream Flow- excessive high flows, low flows Floodplain Connectivity and Function- floodplain connectivity, loss of side channel habitat Channel Structure and Complexity- degraded habitat quality/diversity Stream Substrate- excessive sediment load Water Quality- high water temperature	No projects for this population				
John Day River (All of the projects listed for the John Day River MPG are located in the NPCC John Day subbasin and benefit at least 1 of the populations in this MPG	Lower Main Stem Tributaries John Day (above JDA)	Riparian Areas and LWD Recruitment-riparian conditions Water Quality- high water temperatures Stream Flow- low flows Fish Passage- migration barriers	198402100	$ 518,000	Mainstem, Middle Fork, John Day Rivers Fish Habitat Enhancement Project This project was initiated on July 1, 1984, (BPA) contract number DE A179-84 BP17460 and allows for initial landowner contacts, agreement development, project design, budgeting, and implementation for anadromous fish habitat on private lands.	Develop Alternative Water Source	
	North Fork John Day (above JDA)	Riparian Areas and LWD Recruitment- riparian conditions Water Quality- high water temperatures, water chemistry Channel Structure and Complexity- habitat diversity Stream Flow- low flows				Increase Instream Habitat Complexity	* # of stream miles treated
	Mid Fork John Day (above JDA)	Water Quality- high water temperature, water chemistry				Install Fence	* # of miles of fence
	South Fork John Day (above JDA)	Floodplain Connectivity and Function- floodplain connectivity				Plant Vegetation	* # of acres of planted
	Upper Main Stem John Day (above JDA)	Riparian Areas and LWD Recruitment- riparian conditions Stream Substrate- sedimentation Water Quality- high water temperatures Stream Flow- low flow				Remove vegetation	* # of acres treated
						Operate and Maintain Habitat/Passage	
			199306600	$ 1,042,700	Oregon Fish Screens Project The project provides immediate and long-	Operate and Maintain Habitat/Passage	

Mid Columbia Steelhead							
MPG	**Populations**	**Tributary Habitat Limiting Factors** (FCRPS BiOp Remand Habitat Workgroup products)	**BPA Project Nbr**	**Average annual planning budget**	**Project Title**	**Action Description**	**Reporting Metric**
					term protection for anadromous and resident fish species in the John Day,	Install Fish Passage Structure	* # of miles of habitat accessed
John Day River (con't) All of the projects listed for the John Day River MPG are located in the NPCC John Day subbasin and benefit at least 1 of the populations in this MPG			199306600 (con't)			Install Fish Screen	* Flow rate at the screen diversion allowed by the water right
						Install Fish Screen	* Quantity of water protected by screening, as determined by what is stated in the water right or calculated based on flow rate
						Remove/Install Diversion	* # of miles of habitat accessed
			199801800	$ 1,728,011	John Day Watershed Restoration Continue implementation of protection and restoration actions, planned under the John Day Subbasin Plan, to improve water quality, water quantity, and riparian habitat, and to eliminate passage barriers for anadromous and resident fish.	Develop Alternative Water Source	
						Increase Instream Habitat Complexity	* # of stream miles treated
						Plant Vegetation	* # of riparian miles treated
						Remove vegetation	* # of acres treated
						Maintain Vegetation	
						Install Fish Passage Structure	* # of miles of habitat accessed
						Remove/Install Diversion	* # of miles of habitat accessed
						Install Pipeline	* Amount of unprotected water flow returned to the stream by conservation in cfs
			199901000	$ 18,887	Pine Hollow/Jackknife Habitat Implement practices to reduce erosion, flooding, and protect critical areas in the stream corridor which will allow natural recovery of riparian vegetation and channel stability in the Pine Hollow and Jackknife watersheds.	Develop Alternative Water Source	
						Install Fence	
						Plant Vegetation	* # of acres of planted
						Remove vegetation	* # of acres treated

Mid Columbia Steelhead							
MPG	**Populations**	**Tributary Habitat Limiting Factors** (FCRPS BiOp Remand Habitat Workgroup products)	**BPA Project Nbr**	**Average annual planning budget**	**Project Title**	**Action Description**	**Reporting Metric**
						Upland Erosion and Sedimentation Control	
John Day River (con't) All of the projects listed for the John Day River MPG are located in the NPCC John Day subbasin and benefit at least 1 of the populations in this MPG			200001500	$ 200,070	Oxbow Conservation Area Management The 1,022-acre Oxbow Conservation Area project is a mitigation property acquired by the CTWSRO through BPA funding. This proposal aims to continue the O&M, M&E, and habitat improvement projects on this valuable anadromous fish property.	Conduct Controlled Burn	
						Increase Instream Habitat Complexity	* # of stream miles treated
							* # of structures installed
						Install Fence	* # of miles of fence
						Plant Vegetation	* # of riparian miles treated
						Realign, Connect, and/or Create Channel	* # of stream miles treated, including off-channels, after realignment
						Remove vegetation	* # of acres treated
						Maintain Vegetation	
						Operate and Maintain Habitat/Passage	
						Install Fish Passage Structure	* # of miles of habitat accessed
						Install Fish Screen	* Flow rate at the screen diversion allowed by the water right
							* Quantity of water protected by screening, as determined by what is stated in the water right or calculated based on flow rate
						Develop and Negotiate Water Right Transaction	
			200003100	$ 216,333	North Fork John Day Basin Anadromous Fish Habitat Enhancement Project Increase habitat for Chinook salmon and steelhead on private and public-owned lands via implementing fencing, off-stream water development, revegetation, culvert replacement, pool development, mine tailing removal and large wood placement projects.	Enhance Floodplain	* # of acres treated
						Increase Instream Habitat Complexity	* # of stream miles treated
						Install Fence	* # of miles of fence
						Plant Vegetation	* # of acres of planted
							* # of riparian miles treated
						Remove Mine Tailings	* # of acres treated
						Maintain Vegetation	
						Install Fish Passage Structure	* # of miles of habitat accessed
						Lease Land	* # of riparian miles protected

Mid Columbia Steelhead							
MPG	**Populations**	**Tributary Habitat Limiting Factors** (FCRPS BiOp Remand Habitat Workgroup products)	**BPA Project Nbr**	**Average annual planning budget**	**Project Title**	**Action Description**	**Reporting Metric**
John Day River (con't) All of the projects listed for the John Day River MPG are located in the NPCC John Day subbasin and benefit at least 1 of the populations in this MPG			200104101	$ 206,635	Forrest Conservation Area Management The Forrest Conservation Area consists of 4,232 acres and contains 8.5 miles of critical fish habitat in the Upper Mainstem and Middle Fork John Day River systems. Management prioritizes protection of fish, wildlife and their associated habitats.	Conduct Controlled Burn	
						Increase Instream Habitat Complexity	* # of stream miles treated
							* # of structures installed
						Plant Vegetation	* # of riparian miles treated
						Remove vegetation	* # of acres treated
						Investigate Trespass	
						Maintain Vegetation	
						Operate and Maintain Habitat/Passage	
						Install Fish Passage Structure	* # of miles of habitat accessed
						Install Fish Screen	* Flow rate at the screen diversion allowed by the water right
						Develop and Negotiate Water Right Transaction	
			200201301	$ 3,500,000	Water Entity (Rpa 151) Nwppc Fund water right transactions that restore streamflows and focused riparian easements on criticial fish-bearing Columbia Basin tributaries. Implemented as the Columbia Basin Water Transactions Program (CBWTP) in a partnership between BPA and NFWF	Acquire Water Instream	
						Develop and Negotiate Water Right Transaction	
			200201900	$ 70,160	Wasco Riparian Buffers This proposal develops riparian buffer systems in southern Wasco County in the lower Deschutes and lower John Day subbasins of the Columbia Plateau Province. Implementation of buffer plans developed under this proposal is fully funded by USDA.	Riparian Enhancement	# acres affected
							# riparian miles enhanced

Mid Columbia Steelhead							
MPG	**Populations**	**Tributary Habitat Limiting Factors** (FCRPS BiOp Remand Habitat Workgroup products)	**BPA Project Nbr**	**Average annual planning budget**	**Project Title**	**Action Description**	**Reporting Metric**
John Day River (con't) All of the projects listed for the John Day River MPG are located in the NPCC John Day subbasin and benefit at least 1 of the populations in this MPG			200201500	$ 68,337	Provide Coordination and Technical Assistance to Watershed Councils and Individuals in Sherman County, Oregon	Riparian Enhancement	# acres affected # riparian miles enhanced
			200203400	$ 74,305	Wheeler Co Riparian Buffers This proposal will provide technical support and planning needed to implement riparian buffer contracts (CREP) on streams within Wheeler County. Ripairan buffers address many of the limiting factors identified in the John Day Sub-basin Plan	Riparian Enhancement	# acres affected # riparian miles enhanced
			200203500	$ 68,498	Gilliam Co Riparian Buffers We seek BPA funding to continue our riparian buffer position. This job entails making 10-15 year contracts with private landowners to establish riparian areas. Non BPA monies are then leveraged to develop, maintain and enhance fish and wildlife resources	Riparian Enhancement	# acres affected # riparian miles enhanced
Walla Walla and Umatilla Rivers	Umatilla River (above JDA)	Riparian Areas and LWD Recruitment- reduced LWD Stream Substrate- excessive sediment load, reduced channel bed load stability Stream Flow- low flows; Water Quality- high water temperature Fish Passage- physical barriers, irrigation diversions, loss to unscreened diversions Channel Structure and Complexity- reduced habitat quality-diversity, pools, riffles	198343600	$ 467,785	Umatilla Passage O&M Westland Irrigation District, as contractor to Bonneville Power Administration, and West Extension Irrigation District, as subcontractor to Westland, provide labor, equipment, and material necessary for the operation, care, and maintenance of fish facilities	Operate and Maintain Habitat/Passage	

Mid Columbia Steelhead							
MPG	**Populations**	**Tributary Habitat Limiting Factors** (FCRPS BiOp Remand Habitat Workgroup products)	**BPA Project Nbr**	**Average annual planning budget**	**Project Title**	**Action Description**	**Reporting Metric**
Walla Walla and Umatilla Rivers (con't)	Umatilla River (above JDA) con't		198710001	$ 326,000	Umatilla Anad Fish Hab - Ctuir Instream and riparian habitat restoration for fisheries and wildlife in the Umatilla River Basin	Develop Alternative Water Source	
						Increase Instream Habitat Complexity	* # of structures installed
						Install Fence	* # of miles of fence
						Plant Vegetation	* # of acres of planted
						Remove vegetation	* # of acres treated
						Maintain Vegetation	
						Operate and Maintain Habitat/Passage	
						Remove/Modify Dam	* # of miles of habitat accessed
						Lease Land	* # of acres of new lease
							* # of riparian miles protected
			198710002	$ 280,264	Umatilla Subbasin Fish Habitat Improvement Project The ongoing Umatilla Subbasin Fish Habitat Improvement Project (19871-100-02) is aimed at protecting (where possible) and enhancing/rehabilitating (where required), degraded fish habitat on private lands using passive and active restoration techniques.	Develop Alternative Water Source	
						Improve/Relocate Road	* # of road miles improved, upgraded, or restored
						Increase Instream Habitat Complexity	* # of stream miles treated
						Install Fence	* # of miles of fence
						Plant Vegetation	* # of riparian miles treated
						Realign, Connect, and/or Create Channel	* # of stream miles treated, including off-channels, after realignment
						Remove vegetation	* # of acres treated
						Maintain Vegetation	
						Operate and Maintain Habitat/Passage	
						Remove/Modify Dam	* # of miles of habitat accessed
						Lease Land	* # of acres of new lease
						Develop and Negotiate Water Right Transaction	

Mid Columbia Steelhead							
MPG	**Populations**	**Tributary Habitat Limiting Factors** (FCRPS BiOp Remand Habitat Workgroup products)	**BPA Project Nbr**	**Average annual planning budget**	**Project Title**	**Action Description**	**Reporting Metric**
Walla Walla and Umatilla Rivers (con't)	Umatilla River (above JDA) con't		198802200	$ 362,164	Umatilla Fish Passage Operations Increase survival of migrating juvenile and adult salmon and steelhead in the Umatilla Basin by operating passage facilities, flow enhancement measures, trapping facilities,	Operate and Maintain Habitat/Passage Trap and Haul	
			198902700	$ 1,150,000	Power Repay Umatilla Basin Project Provide reimbursement of power costs to Umatilla Electric Coopeative and Pacific Powr & Light Company for the Umatilla Basin Project pumping plants that provide Columbia River water to irrigators in exchange for Umatilla River water left instream	Acquire Water Instream	
	Walla Walla River (above MCN)	Riparian Areas and LWD Recruitment- riparian degradation, reduced LWD Stream Substrate- sediment load, channel stability; Stream Flow- low flows Water Quality- high water temperature, turbidity Fish Passage- barriers and screens Floodplain Connectivity and Function- floodplain confinement Channel Structure and Complexity- in-stream habitat quality-quantity-diversity, pools, riffles, channelization	199601100	$ 878,667	Walla Walla Juvenile and Adult Passage Improvements Provide safe passage for migrating juvenile and adult salmonids in the Walla Walla Subbasin by constructing and maintaining passage facilities at irrigation diversion dams and canals and other passage barriers.	Install Fish Screen	* Flow rate at the screen diversion allowed by the water right * Quantity of water protected by screening, as determined by what is stated in the water right or calculated based on flow rate
			199604601	$ 337,710	Walla Walla River Basin Fish Habitat Enhancement The proposed project is a continued effort by the CTUIR to protect and restore habitat critical to the recovery of salmonid fish populations in the Walla Walla River Basin.	Increase Instream Habitat Complexity Plant Vegetation Maintain Vegetation	
			200003300	$ 89,000	Walla Walla River Fish Passage Operations Increase survival of migrating salmonids in the Walla Walla Basin by coordinating the overall passage program including monitoring passage conditions and operation of passage facilities and transport equipment to provide adequate passage conditions.	Operate and Maintain Habitat/Passage Trap and Haul	
			200203600	$ 447,000	Restore Walla Walla River Flow Irrigation efficiency and shallow aquifer recharge will improve Walla Walla River flows on flow -impaired priority restoration reaches at times of the year that are critical for steelhead, spring Chinook, and bull trout passage and habitat use.	Install Pipeline	* Amount of unprotected water flow returned to the stream by conservation in cfs

Mid Columbia Steelhead							
MPG	**Populations**	**Tributary Habitat Limiting Factors** (FCRPS BiOp Remand Habitat Workgroup products)	**BPA Project Nbr**	**Average annual planning budget**	**Project Title**	**Action Description**	**Reporting Metric**
Walla Walla and Umatilla Rivers (con't)	Walla Walla River (above MCN) con't		200203600 con't			Install Sprinkler	* Amount of unprotected water flow returned to the stream by conservation in cfs
						Develop and Negotiate Water Right Transaction	
			200721700	$ 182,725	Operation and Maintenance for Walla Walla Basin Passage Projects Operation and maintenance of BPA-Constructed fish passage facilities in the Walla Walla Sub-basin.	Operate and Maintain Habitat/Passage	
			200201301	$ 3,500,000	Water Entity (Rpa 151) Nwppc Fund water right transactions that restore streamflows and focused riparian easements on criticial fish-bearing Columbia Basin tributaries. Implemented as the Columbia Basin Water Transactions Program (CBWTP) in a partnership between BPA and NFWF	Acquire Water Instream	
						Develop and Negotiate Water Right Transaction	
	Touchet River (above MCN)	Riparian Areas and LWD Recruitment- riparian condition, riparian degradation, reduce LWD Stream Substrate- excessive sediment load, reduced channel bedload stability Stream Flow- low flows Water Quality- high water temperatures, elevated turbidity Fish Passage- barriers and screens Floodplain Connectivity and Function- floodplain confinement, floodplain condition Channel Structure and Complexity- habitat quality, diversity, reduced pool abundance	Projects in the NPCC Walla Walla subbasin may implement actions that benefit the Touchet River population				
Yakima River Group	Satus Creek (above MCN)	Floodplain Connectivity and Function- degraded/disconnected floodplain, loss of side channels and side channel thermal refugia Stream Flow- higher/lower flow from loss of natural storage Stream Substrate- elevated sediment loads from return flows Water Quality- high water temperature Fish Passage- entrainment in diversion structures, passage obstructions due to false attraction at	199206200 2007 Interim Ops Agreement	$ 725,000 (FY07)	Yakama Nation - Riparian/Wetlands Restoration Continue implementation on YN Wetlands/Riparian Restoration Project by protecting and restoring native floodplain habitats along anadromous fish-bearing waterways in the agricultural area of the Yakama Reservation (~2,000 acres per year).	Plant Vegetation	* # of acres of planted
	Toppenish Creek (above MCN)					Maintain Vegetation	
	Naches River (above MCN)					Operate and Maintain Habitat/Passage	
	Upper Mainstem Yakima (above MCN)					Remove Debris	
						Lease Land	* # of acres of new lease

Mid Columbia Steelhead							
MPG	**Populations**	**Tributary Habitat Limiting Factors** (FCRPS BiOp Remand Habitat Workgroup products)	**BPA Project Nbr**	**Average annual planning budget**	**Project Title**	**Action Description**	**Reporting Metric**
Yakima River Group (con't) All of the projects listed for the Yakima River Group MPG are located in the NPCC Yakima subbasin and benefit at least 1 of the populations in this MPG			199603501 2007 Interim Ops Agreement	$ 420,000 (FY07)	Yakama Reservation Watersheds Project The YRWP works to restore natural function to the Satus, Toppenish and Ahtanum Watersheds. Our restoration and monitoring efforts take a comprehensive approach to the restoration of habitat for fisheries resources including steelhead and bull trout.	Enhance Floodplain	* # of acres treated
						Increase Instream Habitat Complexity	* # of stream miles treated
							* # of structures installed
						Install Fence	* # of miles of fence
						Plant Vegetation	* # of acres of planted
							* # of riparian miles treated
						Realign, Connect, and/or Create Channel	* # of stream miles treated, including off-channels, after realignment
						Lease Land	* # of acres of renewed lease
			198812025	$ 151,333	Ykfp Management, Data, Habitat Proposal provides for all YN management functions associated with the Yakima/Klickitat Fisheries Project including project planning, O&M, research, data management, and habitat improvement and acquisition actions in the Yakima Subbasin.	Increase Instream Habitat Complexity	
						Plant Vegetation	
			199200900	$ 161,500	Yakima Phase II/Huntsville Screen Operation & Maintenance Continue to provide operation and maintenance to BPA's Phase II Fish Screen Facilities to ensure they provide maximum protection to all species and life stages of fish. This O&M function will include the addition of the Manastash basin facilities	Operate and Maintain Habitat/Passage	
			199503300	$ 91,200	O&M Yakima Basin Fish Screens This proposal provides for continuation of funding for the existing comprehensive operation & maintenance program by the USBR of BPA owned Yakima Phase II fish screening and trapping facilities.	Operate and Maintain Habitat/Passage	

Mid Columbia Steelhead							
MPG	**Populations**	**Tributary Habitat Limiting Factors** (FCRPS BiOp Remand Habitat Workgroup products)	**BPA Project Nbr**	**Average annual planning budget**	**Project Title**	**Action Description**	**Reporting Metric**
Yakima River Group (con't) All of the projects listed for the Yakima River Group MPG are located in the NPCC Yakima subbasin and benefit at least 1 of the populations in this MPG			200202501	$ 879,987	Yakima Tributary Access & Habitat Program The Yakima Tributary Access and Habitat Program intends to: a) screen diversion structures; b) provide for fish passage at man-made barriers; c) assist landowners improve stream habitat; and, d) coordinate the acquisition of riparian buffer easements.	Create, Restore, and/or Enhance Wetland	* # of acres treated
						Develop Alternative Water Source	
						Enhance Floodplain	* # of acres treated
						Increase Instream Habitat Complexity	* # of stream miles treated
						Install Fence	* # of miles of fence
						Plant Vegetation	* # of riparian miles treated
						Realign, Connect, and/or Create Channel	* # of stream miles treated, including off-channels, after realignment
						Maintain Vegetation	
						Install Fish Passage Structure	* # of miles of habitat accessed
						Install Fish Screen	* Flow rate at the screen diversion allowed by the water right
							* Quantity of water protected by screening, as determined by what is stated in the water right or calculated based on flow rate
						Remove/Install Diversion	* # of miles of habitat accessed
						Install Pipeline	* Amount of unprotected water flow returned to the stream by conservation in cfs
						Install Well	* Amount of unprotected water flow returned to the stream by conservation in cfs

Mid Columbia Steelhead							
MPG	**Populations**	**Tributary Habitat Limiting Factors** (FCRPS BiOp Remand Habitat Workgroup products)	**BPA Project Nbr**	**Average annual planning budget**	**Project Title**	**Action Description**	**Reporting Metric**
Yakima River Group (con't) All of the projects listed for the Yakima River Group MPG are located in the NPCC Yakima subbasin and benefit at least 1 of the populations in this MPG			200300100	$ 823,477	Manastash Crk Passage & Screening The Manastash Creek Project will provide fish passage, diversion screening and seek instream flow to support fish recovery in the Yakima Basin. This proposal is for Phase 1: screening/passage. Phase 2: instream flow will be a second proposal.	Plant Vegetation	* # of acres of planted
							* # of riparian miles treated
						Maintain Vegetation	
						Operate and Maintain Habitat/Passage	
						Install Fish Passage Structure	* # of miles of habitat accessed
						Install Fish Screen	* Flow rate at the screen diversion allowed by the water right
							* Quantity of water protected by screening, as determined by what is stated in the water right or calculated based on flow rate
						Remove/Modify Dam	* # of miles of habitat accessed
						Install Pipeline	
			200702000	$ 297,666	Manastash Instream Flow Enhancement This proposal seeks to enhance instream flow by working with water users to implement irrigation conveyance and onfarm water use efficiency projects, to trust water to the creek and investigate diversion timing to assist steelhead migration.	Install Pipeline	* Amount of unprotected water flow returned to the stream by conservation in acre-feet
							* Amount of unprotected water flow returned to the stream by conservation in cfs
							* Estimated # of miles of primary stream reach improvement
							* Estimated # of miles of total stream reach improvement
						Install Sprinkler	* Amount of unprotected water flow returned to the stream by conservation in acre-feet
							* Amount of unprotected water flow returned to the stream by conservation in cfs

Mid Columbia Steelhead							
MPG	**Populations**	**Tributary Habitat Limiting Factors** (FCRPS BiOp Remand Habitat Workgroup products)	**BPA Project Nbr**	**Average annual planning budget**	**Project Title**	**Action Description**	**Reporting Metric**
Yakima River Group (con't) All of the projects listed for the Yakima River Group MPG are located in the NPCC Yakima subbasin and benefit at least 1 of the populations in this MPG			200702000 con't			Install Sprinkler	* Estimated # of miles of primary stream reach improvement
							* Estimated # of miles of total stream reach improvement
						Install Well	
						Acquire Water Instream	* # of miles of primary stream reach improvement
							* Amount of water secured
							* Flow of water returned to the stream as prescribed in the water acquisition
						Develop and Negotiate Water Right Transaction	
			200711200	$ 340,000	Teanaway Watershed - Protect critical habitat from development, reduce water temperatures and increase instream flows, restore habitat forming processes in the floodplain. Teanaway watershed supports viable salmonid populations with complex spatial structure and diversity. Maximizing abundance and productivity of focal species requires protecting critical habitat, augmenting instream flows, & restoring floodplain functions	Increase Instream Habitat Complexity	* # of stream miles treated
							* # of structures installed
						Install Fence	* # of miles of fence
						Plant Vegetation	* # of acres of planted
							* # of riparian miles treated
						Maintain Vegetation	
						Operate and Maintain Habitat/Passage	
						Acquire Water Instream	* # of miles of primary stream reach improvement
							* # of miles of total stream reach improvement, including primary and secondary reaches
							* Amount of water secured
							* Flow of water returned to the stream as prescribed in the water acquisition
						Develop and Negotiate Water Right Transaction	

Mid Columbia Steelhead							
MPG	**Populations**	**Tributary Habitat Limiting Factors** (FCRPS BiOp Remand Habitat Workgroup products)	**BPA Project Nbr**	**Average annual planning budget**	**Project Title**	**Action Description**	**Reporting Metric**
Yakima River Group (con't) All of the projects listed for the Yakima River Group MPG are located in the NPCC Yakima subbasin and benefit at least 1 of the populations in this MPG			200711300	$ 100,000	Cowiche Restoration and Protection Project (Easement/Fee Simple Acquisition) The goal of this project is to protect stream and riparian habitat, and floodplain functions along the Cowiche Creek. The project will acquire conservation easements protecting more than five miles of critical, high quality, steelhead and coho habitat.	Lease Land	* # of riparian miles protected
			200719400	$ 183,333	Oak Flats Acquisition and Habitat Enhancement Acquire a 357 acre multi-parcel site on the Naches River to protect from rural development and enhance 3.0 miles of streamside riparian habitat. Site supports Chinook salmon and Federally threatened mid-Columbia summer steelhead and bull trout.	Enhance Floodplain	* # of acres treated
						Plant Vegetation	* # of riparian miles treated
						Remove Debris	
						Remove/Modify Dam	* # of miles of habitat accessed
						Acquire Water Instream	* # of miles of primary stream reach improvement
			200201301	$ 3,500,000	Water Entity (Rpa 151) Nwppc Fund water right transactions that restore streamflows and focused riparian easements on criticial fish-bearing Columbia Basin tributaries. Implemented	Acquire Water Instream	
						Develop and Negotiate Water Right Transaction	
			199705100	$ 500,000	Yakima Basin Side Channels We will replace problematic irrigation diversions and culverts in the Lower North Fork and Mid-mainstem John Day Watersheds with fish-friendly structures that ensure fish passage and improve riparian habitat while efficiently meeting landmanagers' needs.	Land Purchase	* # of acres of new purchase/easement

This is not a final federal agency product. Rather, it is a pre-decisional document prepared by the Action Agencies that reflects present understandings of currently available information and analyses, and of the progression of discussions with the sovereigns in the collaborative process. Revisions and refinements are to be expected based on further discussions with the sovereigns over new and modified proposed federal actions upon which the action agencies will ultimately consult. Finally, the information in this product does not constitute an analysis of whether the identified measures would or would not jeopardize the continued existence of a listed species or result in the destruction or adverse modification of designated critical habitat. Furthermore, this document does not in any way interpret or apply the regulatory definitions of the statutory phrases "jeopardize the continued existence of" and "destruction or adverse modification."

Snake River Steelhead							
MPG	**Populations**	**Tributary Habitat Limiting Factors** (FCRPS BiOp Remand Habitat Workgroup products)	**Project Nbr**	**Average annual planning budget**	**Project Title & Short Description**	**Action Description**	**Reporting Metric**
Lower Snake	**Tucannon River**	Tucannon, Pataha & Deadman AUs: Floodplain Connectivity and Function- floodplain confinement Channel Structure and Complexity- reduced habitat diversity (LWD) Riparian Areas and LWD Recruitment- riparian degradation Stream Flow- low stream flow Water Quality-high water temperature & turbidity Fish Passage-barriers & screens	199401806	$ 331,333	Tucannon Stream and Riparian Protection, Enhancement, and Restoration Implement habitat protection, enhancement, and recovery strategies to support Subbasin Plan identified ESA focal, cultural significant and species of interest recovery within the Tucannon Subbasin.	Increase Instream Habitat Complexity	* # of stream miles treated
							* # of structures installed
						Lease Land	* # of acres of new lease
							* # of riparian miles protected
			199401807	$ 64,333	Improve Habitat For Fall Chinook, Steelhead in the Lower Snake and Tucannon Sub basins To obtain funding to continue with the districts effort to reduce soil erosion on the uplands and along the streams of Garfield County to improve water quality and fish habitat.	Develop Alternative Water Source	
						Install Fence	
						Plant Vegetation	* # of acres of planted
						Practice No-till and Conservation Tillage Systems	
						Remove vegetation	* # of acres treated
						Upland Erosion and Sedimentation Control	* # of acres treated
	Asotin Creek (extirpated)	Asotin, Alpowa & George Creek AUs: Floodplain Connectivity and Function- floodplain confinement Channel Structure and Complexity- reduced habitat diversity (LWD) Riparian Areas and LWD Recruitment- riparian degradation Stream Flow- low stream flow Water Quality - high water temperature & turbidity	199401805	$ 267,000	Continued Implementation of Prioritized Asotin Creek Watershed Habitat Projects On-going project for prioritizing & implementing on-the-ground habitat projects for wild steelhead & Chinook salmon in Asotin watershed. Bull trout also benefit from this ridge-top-to-ridge-top approach with match from private landowners & other grants.	Develop Alternative Water Source	
						Install Fence	* # of miles of fence
						Plant Vegetation	* # of riparian miles treated
						Practice No-till and Conservation Tillage Systems	* # of acres treated
						Operate and Maintain Habitat/Passage	
			200205000	$ 233,333	Continued Riparian Buffer Projects on Couse/Tenmile and other Salmonid Bearing Streams in Asotin County On-going project to continue implementation of prioritized habitat protection on private property for ESA listed steelhead, Chinook salmon and bull trout as identified in the Asotin Subbasin Plan. Cost share provided by private landowners & other sources	Develop Alternative Water Source	
						Install Fence	* # of miles of fence
						Plant Vegetation	* # of riparian miles treated
						Practice No-till and Conservation Tillage Systems	* # of acres treated
						Upland Erosion and Sedimentation Control	* # of acres treated

Snake River Steelhead							
MPG	**Populations**	**Tributary Habitat Limiting Factors** (FCRPS BiOp Remand Habitat Workgroup products)	**Project Nbr**	**Average annual planning budget**	**Project Title & Short Description**	**Action Description**	**Reporting Metric**
Grande Ronde The projects listed for the Grande Ronde MPG are located in the NPCC Grande Ronde subbasin and will benefit at least 1 of the populations in this MPG.	**Upper MS Grande Ronde**	Channel Structure and Complexity- reduced habitat quality, diversity, LWD Riparian Areas and LWD Recruitment- impaired riparian condition Water Quality- high water temperature, impaired water chemistry Floodplain Connectivity and Function- impaired floodplain condition Stream Flow- low flows Fish Passage- physical passage barriers	198402500	$ 365,000	ODFW Blue Mountain Oregon Fish Habitat Improvement This project works with landowners, and other government and quasi-governmental agencies to protect and enhance habitat for federal ESA listed fish in the Blue Mountain Province of Oregon.	Create, Restore, and/or Enhance Wetland	* # of acres treated
	Wallowa River	Channel Structure and Complexity- reduced habitat quality, diversity, LWD Riparian Areas and LWD Recruitment- impaired riparian condition Water Quality- high water temperature, water chemistry Floodplain Connectivity and Function- impaired floodplain condition Stream Flow- low flows Fish Passage- physical barriers				Develop Alternative Water Source	
	Lower Grande Ronde	Channel Structure and Complexity- reduced habitat quality – diversity, LWD Riparian Areas and LWD Recruitment- impaired riparian condition Floodplain Connectivity and Function- impaired floodplain condition Fish Passage- Physical barriers				Increase Instream Habitat Complexity	* # of stream miles treated
	Joseph Creek	Channel Structure and Complexity- reduced habitat diversity, quality, LWD Riparian Areas and LWD Recruitment- riparian degradation Water Quality- high water temperature, water chemistry, turbidity (WA only) Floodplain Connectivity and Function- floodplain condition and confinement Stream Flow - low flow (WA only) Fish Passage - barriers and screens				Install Fence	* # of miles of fence
						Plant Vegetation	* # of acres of planted
						Realign, Connect, and/or Create Channel	* # of stream miles treated, including off-channels, after
						Maintain Vegetation	
						Operate and Maintain Habitat/Passage	

Snake River Steelhead							
MPG	**Populations**	**Tributary Habitat Limiting Factors** (FCRPS BiOp Remand Habitat Workgroup products)	**Project Nbr**	**Average annual planning budget**	**Project Title & Short Description**	**Action Description**	**Reporting Metric**
Grande Ronde (con't) The projects listed for the Grande Ronde MPG are located in the NPCC Grande Ronde subbasin and will benefit at least 1 of the populations in this MPG.			199202601	$ 2,183,849	Grand Ronde Model Watershed Program Habitat Restoration - Planning, Coordination and Implementation The project coordinates BPA funded restoration activities in the Grande Ronde and Imnaha Subbasins working with tribes, agencies and landowners. The project annually implements 10-20 habitat restoration projects. Project also to consider including habitat actions proposed in Wallowa, Lostine, & Joseph Cr. watersheds (200710500, 200711600,	Develop Alternative Water Source	
						Increase Instream Habitat Complexity	* # of stream miles treated
						Install Fence	* # of miles of fence
						Plant Vegetation	* # of acres of planted
						Realign, Connect, and/or Create Channel	* # of stream miles treated, including off-channels, after realignment
						Install Fish Passage Structure	* # of miles of habitat accessed
			199608300	$ 190,000	CTUIR Grande Ronde Subbasin Restoration Project The CTUIR Grande Ronde Subbasin Restoration Project plans, designs, implements, maintains, and monitors habitat enhancement and restoration projects in the Grande Ronde Subbasin. Planned FY 2007-09 projects include Meadow Cr, End Cr, Ladd Cr, and main GR	Create, Restore, and/or Enhance Wetland	* # of acres treated
						Develop Alternative Water Source	
						Install Fence	* # of miles of fence
						Plant Vegetation	* # of riparian miles treated
						Realign, Connect, and/or Create Channel	* # of stream miles treated, including off-channels, after realignment
						Maintain Vegetation	
			200201301	$ 3,500,000	Water Entity (Rpa 151) Nwppc Fund water right transactions that restore streamflows and focused riparian easements on criticial fish-bearing Columbia Basin tributaries. Implemented as the Columbia Basin Water Transactions Program (CBWTP) in a partnership between BPA and NFWF	Acquire Water Instream	# of miles of primary stream reach improvement
							# of miles of total stream reach improvement
							Amount of water secured in acre-feet/year
			200739300	$ 176,500	NPT Protect and Restore NE OR Funding for Coordination, Planning, Design, Implementation. Initially the funds were placed under 200724500. Established a new project for the Wallowa and Imnaha watersheds	Install Fish Passage Structure	* # of miles of habitat accessed

Snake River Steelhead							
MPG	**Populations**	**Tributary Habitat Limiting Factors** (FCRPS BiOp Remand Habitat Workgroup products)	**Project Nbr**	**Average annual planning budget**	**Project Title & Short Description**	**Action Description**	**Reporting Metric**
Clearwater River The projects listed for the Clearwater River MPG are located in the NPCC Clearwater subbasin and will benefit at least 1 of the populations in this MPG.	**Lower M S Clearwater**	Riparian Areas and LWD Recruitment- impaired riparian condition and function Stream Substrate- elevated stream bed instability, elevated sediment Floodplain Connectivity and Function- reduced floodplain connectivity, altered floodplain Channel Structure a	199607702	$ 260,722	Protect and Restore Lolo Creek Watershed Protect and restore the Lolo Creek Watershed to provide quality habitat for anadromous and resident fish. This will be accomplished by watershed resotration projects such as culvert replacement, road obliteration, and streambank stabilization.	Decommission Road	* # of road miles decommissioned
	North Fork Clearwater (blocked)					Increase Instream Habitat Complexity	* # of acres treated
	Lolo Creek	Riparian Areas and LWD Recruitment- loss of riparian function Stream Substrate- sediment from roads and historic mining, sediment from upstream sources Floodplain Connectivity and Function- reduced floodplain connectivity and function from grazing and flo				Plant Vegetation	* # of riparian miles treated
	Lochsa River	Riparian Areas and LWD Recruitment				Remove vegetation	* # of acres treated
	Selway River					Upland Erosion and Sedimentation Control	* # of acres treated
	South Fork Clearwater	Floodplain Connectivity and Function Channel Structure and Complexity, Riparian Areas and LWD Recruitment Stream Substrate					* # of miles of habitat accessed
						Maintain Vegetation	
						Install Fish Passage Structure	* # of miles of habitat accessed
			199607703	$ 122,614	Protect and Restore Waw'aalamnime to 'Imnamatnoon Creek Analysis Area This project will protect, restore, and return critical spawning and rearing habitat to the Analysis Area using a holistic approach to restoration. Projects will be coordinated with the USFS.	Decommission Road	* # of road miles decommissioned
						Improve/Relocate Road	* # of road miles improved, upgraded, or restored
						Plant Vegetation	
						Remove vegetation	* # of acres treated
						Upland Erosion and Sedimentation Control	
						Remove/Modify Dam	

Snake River Steelhead							
MPG	**Populations**	**Tributary Habitat Limiting Factors** (FCRPS BiOp Remand Habitat Workgroup products)	**Project Nbr**	**Average annual planning budget**	**Project Title & Short Description**	**Action Description**	**Reporting Metric**
Clearwater River (con't) The projects listed for the Clearwater River MPG are located in the NPCC Clearwater subbasin and will benefit at least 1 of the populations in this MPG.			199607705	$ 331,259	Restore McComas Meadows/ Meadow Creek Watershed Protect, restore, and enhance the Meadow Creek Watershed to provide quality habitat for anadromous and resident fish. This will be accomplished by watershed resotration projects such as culvert replacement, road obliteration, and streambank stabilization.	Decommission Road	* # of road miles decommissioned
						Increase Instream Habitat Complexity	* # of stream miles treated
						Plant Vegetation	* # of acres of planted * # of riparian miles treated
						Remove vegetation	* # of acres treated
						Maintain Vegetation	
						Install Fish Passage Structure	* # of miles of habitat accessed
			199901600	$ 165,000	Protect & Restore the Big Canyon Creek Watershed This project is to protect, restore, and return critical spawning and reareing habitat using a ridgetop to ridge top approach, based on a complete watershed assessment and following the Clearwater Subbasin Management Plan.	Create, Restore, and/or Enhance Wetland	* # of acres treated
						Decommission Road	* # of road miles decommissioned
						Develop Alternative Water Source	
						Improve/Relocate Road	* # of road miles improved, upgraded, or restored
						Install Fence	* # of miles of fence
						Plant Vegetation	* # of acres of planted
						Remove vegetation	* # of acres treated
						Upland Erosion and Sedimentation Control	* # of acres treated
						Maintain Vegetation	
						Operate and Maintain Habitat/Passage	
						Lease Land	* # of acres of new lease
			199901700	$ 389,765	Protect and Restore Lapwai Creek Watershed This project will protect, restore and return critical spawning and rearing fish habitat using a ridge top to ridge top approach, based on a complete watershed assessment.	Create, Restore, and/or Enhance Wetland	* # of acres treated
						Decommission Road	* # of road miles decommissioned
						Develop Alternative Water Source	
						Improve/Relocate Road	* # of road miles improved, upgraded, or restored
						Install Fence	* # of miles of fence
						Plant Vegetation	* # of acres of planted
						Remove vegetation	* # of acres treated
						Upland Erosion and Sedimentation Control	* # of acres treated
						Maintain Vegetation	

Snake River Steelhead							
MPG	**Populations**	**Tributary Habitat Limiting Factors** (FCRPS BiOp Remand Habitat Workgroup products)	**Project Nbr**	**Average annual planning budget**	**Project Title & Short Description**	**Action Description**	**Reporting Metric**
						Operate and Maintain Habitat/Passage	
						Install Fish Passage Structure	* # of miles of habitat accessed
						Lease Land	* # of acres of new lease
Clearwater River (con't) The projects listed for the Clearwater River MPG are located in the NPCC Clearwater subbasin and will benefit at least 1 of the populations in this MPG.			200003500	$ 317,474	Rehabilitate Newsome Creek - S Protect and restore Newsome Creek Watershed for the benefit of both anadromous and resident fish using an overall watershed approach. This project is a cooperative effort between the Nez Perce Tribe and the Nez Perce National Forest.	Decommission Road	* # of road miles decommissioned
						Enhance Floodplain	* # of acres treated
						Improve/Relocate Road	* # of road miles improved, upgraded, or restored
						Increase Instream Habitat Complexity	* # of stream miles treated
						Plant Vegetation	* # of acres of planted * # of riparian miles treated
						Realign, Connect, and/or Create Channel	* # of stream miles treated, including off-channels, after realignment
						Remove Mine Tailings	* # of miles of habitat accessed
						Remove vegetation	* # of acres treated
						Upland Erosion and Sedimentation Control	* # of acres treated
						Remove/Modify Dam	* # of miles of habitat accessed
			200003600	$ 150,000	Protect And Restore Mill Creek Protect, restore, and enhance the Mill Creek Watershed to provide quality habitat for anadromous and resident fish. This will be accomplished by watershed resotration projects such as culvert replacement and	Plant Vegetation	* # of riparian miles treated
						Remove vegetation	* # of acres treated
						Maintain Vegetation	
						Install Fish Passage Structure	* # of miles of habitat accessed
			200206100	$ 397,486	Restore Potlatch R Watershed Implementation stage for the Potlatch River Watershed Management Plan with focus on restoration of A-run steelhead spawning and rearing habitat through the implementation of best management practices on private agricultural, forest and range lands.	Develop Alternative Water Source	
						Increase Instream Habitat Complexity	* # of stream miles treated
						Install Fence	* # of miles of fence
						Practice No-till and Conservation Tillage Systems	* # of acres treated
						Upland Erosion and Sedimentation Control	* # of acres treated
			200207000	$ 43,333	Lapwai Cr Anadromous Habitat This project restores, protects and	Create, Restore, and/or Enhance Wetland	* # of acres treated

Snake River Steelhead							
MPG	**Populations**	**Tributary Habitat Limiting Factors** (FCRPS BiOp Remand Habitat Workgroup products)	**Project Nbr**	**Average annual planning budget**	**Project Title & Short Description**	**Action Description**	**Reporting Metric**
					enhances steelhead spawing and rearing habitat in the Lapwai Creek Watershed. Information is collected to fill data gaps and BMPs are installed on agricultural and forestlands to achieve biological objectives.	Develop Alternative Water Source	
						Improve/Relocate Road	* # of road miles improved, upgraded, or restored
						Increase Instream Habitat Complexity	* # of stream miles treated
						Install Fence	* # of miles of fence
						Plant Vegetation	* # of acres of planted
							* # of riparian miles treated
						Remove vegetation	* # of acres treated
Clearwater River (con't) The projects listed for the Clearwater River MPG are located in the NPCC Clearwater subbasin and will benefit at least 1 of the populations in this MPG.			200207000 (con't)			Upland Erosion and Sedimentation Control	* # of acres treated
						Maintain Vegetation	
						Operate and Maintain Habitat/Passage	
						Remove/Install Diversion	
						Remove/Modify Dam	* # of miles of habitat accessed
			200207200	$ 393,118	<u>Protect & Restore Red River Watershed</u> Protect and restore the Red River Watershed for the benefit of both anadromous and resident fish using an overall watershed approach. This project is a cooperative effort between the Nez Perce Tribe and the Nez Perce National Forest.	Decommission Road	* # of road miles decommissioned
						Improve/Relocate Road	* # of road miles improved, upgraded, or restored
						Increase Instream Habitat Complexity	* # of stream miles treated
						Plant Vegetation	* # of acres of planted
						Realign, Connect, and/or Create Channel	* # of stream miles treated, including off-channels, after realignment
						Remove vegetation	* # of acres treated
						Upland Erosion and Sedimentation Control	* # of acres treated
						Remove/Modify Dam	* # of miles of habitat accessed
			200207400	$ 76,041	<u>Protect and Restore Crooked Fork to Colt Killed Analysis Area</u> This project will protect, restore, and return critical spawning and rearing habitat to the Analysis Area using a holistic approach to restoration. Projects will be coordinated with the Clearwater National Forest.	Decommission Road	* # of road miles decommissioned
						Improve/Relocate Road	* # of road miles improved, upgraded, or restored
						Plant Vegetation	* # of acres of planted * # of riparian miles treated

Snake River Steelhead							
MPG	**Populations**	**Tributary Habitat Limiting Factors** (FCRPS BiOp Remand Habitat Workgroup products)	**Project Nbr**	**Average annual planning budget**	**Project Title & Short Description**	**Action Description**	**Reporting Metric**
						Remove vegetation	* # of acres treated
						Upland Erosion and Sedimentation Control	
						Remove/Modify Dam	* # of miles of habitat accessed
Salmon River The projects listed for the Salmon River MPG are located in the NPCC Salmon subbasin and will benefit at least 1 of the populations in this MPG.	**Little Salmon**	Channel Structure and Complexity- altered Mainstem structure Riparian Areas and LWD Recruitment- impaired riparian condition Stream Substrate- increased sediment Stream Flow- low flows Water Quality- elevated temperature, elevated nutrient concentrations	199401500	$ 1,443,333	Idaho Fish Screening and Passage Improvements This project will protect, restore, and return critical spawning and rearing habitat to the Analysis Area using a holistic approach to restoration. Projects will be coordinated with the Clearwater National Forest.	Operate and Maintain Habitat/Passage	
	Chamberlain Creek					Install Fish Screen	* Flow rate at the screen diversion allowed by the water right
	South Fork Salmon River	Sediment, water quality in EFSF (Stibnite mine site)					
	Secesh River	Sediment				Remove/Install Diversion	* # of miles of habitat accessed
	Panther Creek	Riparian Areas and LWD Recruitment- loss of floodplain connectivity and function as result of road encroachment Stream Substrate- elevated sediment levels Floodplain Connectivity and Function- loss of floodplain connectivity and function as result of road					
	Upper Mid Fork Salmon River					Install Pipeline	* Amount of unprotected water flow returned to the stream by conservation in cfs * Estimated # of miles of primary stream reach improvement
	North Fork Salmon River	Channel Structure and Complexity- channelized and relocated channels Floodplain Connectivity and Function- floodplain connectivity and function impaired from development and encroachment Riparian Areas and LWD Recruitment- riparian condition impaired from					

Snake River Steelhead							
MPG	**Populations**	**Tributary Habitat Limiting Factors** (FCRPS BiOp Remand Habitat Workgroup products)	**Project Nbr**	**Average annual planning budget**	**Project Title & Short Description**	**Action Description**	**Reporting Metric**
	Lower Mid Fork Salmon River	Floodplain Connectivity and Function- impaired connectivity to floodplain Riparian Areas and LWD Recruitment- reduced riparian function as a result of development and encroachment Stream Substrate- elevated sediment loading Stream Flow- low flow Fish Pass				Install Sprinkler	* Amount of unprotected water flow returned to the stream by conservation in cfs
	Lemhi River	Stream Substrate- high sediment loading Stream Flow- Reduced streamflow Water Quality- elevated temperature Fish Passage- passage barriers, entrainment in irrigation diversions	199901900	$ 384,236	Restore Salmon River (Challis, Idaho) Passive restoration by securing easements will assist restoration efforts via the Corps 206 Program. The development of side channels will help create a more naturally functioning floodplain, provide a wide array of environmental and ecological benefit.	Investigate Trespass	
Salmon River (con't)	**Pahsimeroi River**	Riparian Areas and LWD Recruitment- poor riparian conditions Stream Substrate- elevated sediment loading Stream Flow- low flows Water Quality- excess nutrients, elevated temperature Fish Passage- passage barriers	200205900	$ 116,667	Yankee Fork Salmon River Dredge Tailings Restoration Project Reconnect the Yankee Fork River to its floodplain and restore natural channel characteristics and processes in a segment impacted by dredge-mining. Integrate biological and physical data with project experiences to develop future restoration alternatives.	Plant Vegetation	
	Upper East Fork Salmon River	Irrigation Withdrawals Floodplain Connectivity and Function- reduced connectivity and function from development and road encroachment Riparian Areas and LWD Recruitment- impaired status and function as a result of development and road encroachment Stream				Remove Mine Tailings	
	Upper Main Stem Salmon	Migration barriers, water temperature, sediment, streamflow. (For tributaries with significant water withdrawals: previous factors plus entrainment in irrigation diversions)	200706400	$ 106,791	Protect and Restore Slate Creek Restore and protect the Slate Creek Watershed for the benefit of both resident and anadromous fish using an overall watershed approach. Restoration and protection efforts will be done cooperatively	Decommission Road	* # of road miles decommissioned
						Plant Vegetation	* # of acres of planted
						Remove vegetation	* # of acres treated
						Upland Erosion and Sedimentation Control	* # of acres treated
			200706500	$ 21,667	Coordinate and implement tributary habitat restoration in the Little Salmon River and lower Salmon River Idaho Implement fish habitat restoration on private lands dominated by agricultural practices using cost sharing by Bonneville, Idaho Pacific Coast Salmon Recovery Funds, Idaho Water Quality Program for	Develop Alternative Water Source	
						Install Fence	* # of miles of fence
						Plant Vegetation	* # of acres of planted
						Remove vegetation	* # of acres treated
						Maintain Vegetation	
						Remove/Install Diversion	* # of miles of habitat accessed

Snake River Steelhead							
MPG	**Populations**	**Tributary Habitat Limiting Factors** (FCRPS BiOp Remand Habitat Workgroup products)	**Project Nbr**	**Average annual planning budget**	**Project Title & Short Description**	**Action Description**	**Reporting Metric**
					Agriculture, and landowner participation.	Install Flow Measuring Device	
			200712700	$ 305,867	Reestablish Connectivity and Restore Fish Habitat in the East Fork of the South Fork Salmon River Watershed This project will reestablish fish passage through a 30-foot tall cascade using natural channel design and rehabilitate one mile of fish habitat through an anthropogenically degraded reach of the upper mainstem East	Enhance Floodplain	* # of acres treated
						Increase Instream Habitat Complexity	* # of stream miles treated
						Plant Vegetation	* # of riparian miles treated
						Trap and Haul	* # of fish
						Install Fish Passage Structure	* # of miles of habitat accessed
			200726800	$ 250,000	Idaho Watershed Habitat Restoration Project via Custer Soil and Water Conservation District The project scope is to implement high priority action items to maintain, enhance and restore fish habitat and fish passage in the priority stream segments of the Upper Salmon Basin area within the administrative boundaries of the Custer SWCD.	Install Fence	* # of miles of fence
						Operate and Maintain Habitat/Passage	
						Remove/Install Diversion	* # of miles of habitat accessed
						Remove/Modify Dam	* # of miles of habitat accessed
						Install Pipeline	* Estimated # of miles of primary stream reach improvement
Salmon River (con't) The projects listed for the Salmon River MPG are located in the NPCC Salmon subbasin and will benefit at least 1 of the populations in this MPG.			200201301	$ 3,500,000	Water Entity (Rpa 151) Nwppc Fund water right transactions that restore streamflows and focused riparian easements on criticial fish-bearing Columbia Basin tributaries. Implemented as the Columbia Basin Water Transactions Program (CBWTP) in a partnership between BPA and NFWF	Acquire Water Instream	# of miles of primary stream reach improvement
							# of miles of total stream reach improvement
							Amount of water secured in acre-feet/year
			200739400	$ 250,000	Idaho Watershed Habitat Restoration Lemhi County Move funds for coordination, planning, design and implementation from 1992-026-03, Upper Salmon Basin Watershed Project.	Install Fence	* # of miles of fence
						Install Fish Passage Structure	* # of miles of habitat accessed
						Install Fish Screen	* Flow rate at the screen diversion allowed by the water right
						Acquire Water Instream	# of miles of primary stream reach improvement
Imnaha River	**Imnaha River**	Channel Structure and Complexity- reduced habitat quality, diversity, LWD Floodplain Connectivity and Function- impaired floodplain condition iparian Areas and LWD Recruitment- impaired riparian condition Fish Passage- physical barriers	199202601	$ 2,183,849	Grand Ronde Model Watershed Program Habitat Restoration - Planning, Coordination and Implementation The project coordinates BPA funded restoration activities in the Grande Ronde and Imnaha Subbasins working with tribes, agencies and landowners. The project annually implements 10-20 habitat restoration projects. Project also to consider including habitat actions proposed	Develop Alternative Water Source	
						Increase Instream Habitat Complexity	* # of stream miles treated
						Install Fence	* # of miles of fence
						Plant Vegetation	* # of acres of planted
						Realign, Connect, and/or Create Channel	* # of stream miles treated, including off-channels, after realignment

Snake River Steelhead							
MPG	**Populations**	**Tributary Habitat Limiting Factors** (FCRPS BiOp Remand Habitat Workgroup products)	**Project Nbr**	**Average annual planning budget**	**Project Title & Short Description**	**Action Description**	**Reporting Metric**
					in Wallowa, Lostine, & Joseph Cr. watersheds (200710500, 200711600, 200724500).	Install Fish Passage Structure	* # of miles of habitat accessed
			200739300	$ 176,500	NPT Protect and Restore NE OR Funding for Coordination, Planning, Design, Implementation. Initially the funds were placed under 200724500. Established a new project for the Wallowa and Imnaha watersheds	Install Fish Passage Structure	* # of miles of habitat accessed

This is not a final federal agency product. Rather, it is a pre-decisional document prepared by the Action Agencies that reflects present understandings of currently available information and analyses, and of the progression of discussions with the sovereigns in the collaborative process. Revisions and refinements are to be expected based on further discussions with the sovereigns over new and modified proposed federal actions upon which the action agencies will ultimately consult. Finally, the information in this product does not constitute an analysis of whether the identified measures would or would not jeopardize the continued existence of a listed species or result in the destruction or adverse modification of designated critical habitat. Furthermore, this document does not in any way interpret or apply the regulatory definitions of the statutory phrases "jeopardize the continued existence of" and "destruction or adverse modification."

Snake River Spring Summer Chinook							
MPG	**Populations**	**Tributary Habitat Limiting Factors** (FCRPS BiOp Remand Habitat Workgroup products)	**Project Nbr**	**Average annual planning budget**	**Project Title & Short Description**	**Action Description**	**Reporting Metric**
Lower Snake: Main Stem Tributaries	Tucannon River	Floodplain Connectivity and Function - Floodplain confinement Channel Structure and Complexity - Habitat diversity, reduced LWD Riparian Areas and LWD Recruitment - riparian degradation Stream Flow- low stream flow Water Quality - high water temperature, high water turbidity Fish Passage - barriers and screens	199401806	$ 331,333	Tucannon Stream and Riparian Protection, Enhancement, and Restoration Implement habitat protection, enhancement, and recovery strategies to support Subbasin Plan identified ESA focal, cultural significant and species of interest recovery within the Tucannon Subbasin.	Increase Instream Habitat Complexity	* # of stream miles treated
							* # of structures installed
						Lease Land	* # of acres of new lease
							* # of riparian miles protected
			199401807	$ 64,333	Improve Habitat For Fall Chinook, Steelhead in the Lower Snake and Tucannon Sub basins To obtain funding to continue with the districts effort to reduce soil erosion on the uplands and along the streams of Garfield County to improve water quality and fish habitat.	Plant Vegetation	* # of acres of planted
						Remove vegetation	* # of acres treated
						Upland Erosion and Sedimentation Control	* # of acres treated
			200201301	$ 3,500,000	Water Entity (Rpa 151) Nwppc Fund water right transactions that restore streamflows and focused riparian easements on criticial fish-bearing Columbia Basin tributaries. Implemented as the Columbia Basin Water Transactions Program (CBWTP) in a partnership between BPA and NFWF	Acquire Water Instream	* flow of water returned to the stream as prescribed in the water acquisition in cfs
	Asotin Creek (extirpated)	Floodplain Connectivity and Function - Floodplain confinement Channel Structure and Complexity - Habitat diversity, reduced LWD Riparian Areas and LWD Recruitment - riparian degradation Stream Flow- low stream flow Water Quality - high water temperature, high water turbidity Fish Passage - barriers and screens	199401805	$ 267,000	Continued Implementation of Prioritized Asotin Creek Watershed Habitat Projects On-going project for prioritizing & implementing on-the-ground habitat projects for wild steelhead & Chinook salmon in Asotin watershed. Bull trout also benefit from this ridge-top-to-ridge-top approach with match from private landowners & other grants.	Install Fence	* # of miles of fence
						Plant Vegetation	* # of riparian miles treated
						Practice No-till and Conservation Tillage Systems	* # of acres treated

Snake River Spring Summer Chinook							
MPG	**Populations**	**Tributary Habitat Limiting Factors** (FCRPS BiOp Remand Habitat Workgroup products)	**Project Nbr**	**Average annual planning budget**	**Project Title & Short Description**	**Action Description**	**Reporting Metric**
			200205000	$ 233,333	Continued Riparian Buffer Projects on Couse/Tenmile and other Salmonid Bearing Streams in Asotin County On-going project to continue implementation of prioritized habitat protection on private property for ESA listed steelhead, Chinook salmon and bull trout as identified in the Asotin Subbasin Plan. Cost share provided by private landowners & other sources	Install Fence	* # of miles of fence
						Plant Vegetation	* # of riparian miles treated
						Practice No-till and Conservation Tillage Systems	* # of acres treated
						Upland Erosion and Sedimentation Control	* # of acres treated
Grande Ronde / Imnaha The projects listed for the Grande Ronde MPG are located in the NPCC Grande Ronde or Imnaha subbasins and will benefit at least 1 of the populations in this MPG.	Wenaha River	Floodplain Connectivity and Function- Floodplain confinement and condition Channel Structure and Complexity- Habitat diversity, reduced LWD Riparian Areas and LWD Recruitment- Riparian degradation and condition Stream Flow- low stream flow Water Quality- high water temperature, high water turbidity Fish Passage- barriers and screens	198402500	$ 365,000	ODFW Blue Mountain Oregon Fish Habitat Improvement This project works with landowners, and other government and quasi-governmental agencies to protect and enhance habitat for federal ESA listed fish in the Blue Mountain Province of Oregon.	Create, Restore, and/or Enhance Wetland	* # of acres treated
						Increase Instream Habitat Complexity	* # of stream miles treated
	Lostine River / Wollowa					Install Fence	* # of miles of fence
						Plant Vegetation	* # of acres of planted
	Catherine Creek					Realign, Connect, and/or Create Channel	* # of stream miles treated, including off-channels, after realignment
			199202601	$ 2,183,849	Grand Ronde Model Watershed Program Habitat Restoration - Planning, Coordination and Implementation The project coordinates BPA funded restoration activities in the Grande Ronde and Imnaha Subbasins working with tribes, agencies and landowners. The project annually implements 10-20 habitat restoration projects. Project also to consider including habitat actions proposed in Wallowa, Lostine, & Joseph Cr. watersheds (200710500, 200711600, 200724500).	Increase Instream Habitat Complexity	* # of stream miles treated
	Upper Mainstem Grand Ronde					Install Fence	* # of miles of fence
	Imnaha Mainstem					Plant Vegetation	* # of acres of planted

Snake River Spring Summer Chinook							
MPG	**Populations**	**Tributary Habitat Limiting Factors** (FCRPS BiOp Remand Habitat Workgroup products)	**Project Nbr**	**Average annual planning budget**	**Project Title & Short Description**	**Action Description**	**Reporting Metric**
	Minam River	No limiting factors identified for this population				Realign, Connect, and/or Create Channel	* # of stream miles treated, including off-channels, after realignment
						Install Fish Passage Structure	* # of miles of habitat accessed
			199608300	$ 190,000	CTUIR Grande Ronde Subbasin Restoration Project The CTUIR Grande Ronde Subbasin Restoration Project plans, designs, implements, maintains, and monitors habitat enhancement and restoration projects in the Grande Ronde Subbasin. Planned FY 2007-09 projects include Meadow Cr, End Cr, Ladd Cr, and main GR	Create, Restore, and/or Enhance Wetland	* # of acres treated
						Install Fence	* # of miles of fence
						Plant Vegetation	* # of riparian miles treated
						Realign, Connect, and/or Create Channel	* # of stream miles treated, including off-channels, after realignment
Grande Ronde / Imnaha (con't) The projects listed for the Grande Ronde MPG are located in the NPCC Grande Ronde or Imnaha subbasins and will			200739300	$ 176,500	NPT Protect and Restore NE OR Funding for Coordination, Planning, Design, Implementation. Initially the funds were placed under 200724500. Established a new project for the Wallowa and Imnaha watersheds	Decommission Road	* # of road miles decommissioned
						Enhance Floodplain	* # of acres treated
						Increase Instream Habitat Complexity	* # of structures installed
						Install Fence	* # of miles of fence
						Install Fish Passage Structure	* # of miles of habitat accessed
						Maintain Vegetation	
						Plant Vegetation	* # of acres of planted
						Realign, Connect, and/or Create Channel	* # of stream miles treated, including off-channels, after realignment
						Remove vegetation	

Snake River Spring Summer Chinook							
MPG	**Populations**	**Tributary Habitat Limiting Factors** (FCRPS BiOp Remand Habitat Workgroup products)	**Project Nbr**	**Average annual planning budget**	**Project Title & Short Description**	**Action Description**	**Reporting Metric**
benefit at least 1 of the populations in this MPG.			200201301	$ 3,500,000	Water Entity (Rpa 151) Nwppc Fund water right transactions that restore streamflows and focused riparian easements on criticial fish-bearing Columbia Basin tributaries. Implemented as the Columbia Basin Water Transactions Program (CBWTP) in a partnership between BPA and NFWF	Acquire Water Instream	* flow of water returned to the stream as prescribed in the water acquisition in cfs
South Fork Salmon River The projects listed for the South Fork, Middle Fork, or Upper Salmon MPGs are located in the NPCC Salmon subbasin and will benefit at least 1 of the populations in those MPGs	Little Salmon River	Channel Structure and Complexity- altered channels Stream Substrate- sediment Riparian Areas and LWD Recruitment- riparian condition Stream Flow- low flows Water Quality- temperature, nutrients	199401500	$ 1,443,333	Idaho Fish Screening and Passage Improvements The project protects anadromous fish and improves fish passage in Idaho's anadromous fish corridors by consolidation and elimination of irrigation diversions, conservation of water, and screening fish from gravity and pump water withdrawal systems.	Install Fish Screen	* Flow rate at the screen diversion allowed by the water right
	East Fork South Fork Salmon River / Johnson Creek	Channel Morphology (App E)				Remove/Install Diversion	* # of miles of habitat accessed
	Secesh River	Channel Morphology - floodplain loss (App E)	200706400	$ 106,791	Protect and Restore Slate Creek Restore and protect the Slate Creek Watershed for the benefit of both resident and anadromous fish using an overall watershed approach. Restoration and protection efforts will be done cooperatively with the Nez Perce National Forest.	Decommission Road	* # of road miles decommissioned
	Main Stem South Fork Salmon River	Channel Morphology (App E)				Plant Vegetation	* # of acres of planted
Middle Fork Salmon River The projects listed for the South Fork, Middle Fork, or Upper Salmon MPGs are located in the NPCC Salmon subbasin and will benefit at least 1 of the populations in	Chamberlain Creek	No limiting factors identified for this population	200706400 (con't)			Remove vegetation	* # of acres treated
	Lower Mid Fork Salmon	No limiting factors identified for this population				Upland Erosion and Sedimentation Control	* # of acres treated
	Big Creek	Channel Morphology (App E)	200706500	$ 21,667	Coordinate and implement tributary habitat restoration in the Little Salmon River and lower Salmon River Idaho Implement fish habitat restoration on private lands dominated by agricultural practices using cost sharing by Bonneville, Idaho Pacific Coast Salmon Recovery Funds, Idaho Water Quality Program for Agriculture, and landowner participation.	Install Fence	* # of miles of fence
	Camas Creek	Flow (App E)				Plant Vegetation	* # of acres of planted
	Loon Creek	No limiting factors identified for this population				Remove vegetation	* # of acres treated

Snake River Spring Summer Chinook							
MPG	**Populations**	**Tributary Habitat Limiting Factors** (FCRPS BiOp Remand Habitat Workgroup products)	**Project Nbr**	**Average annual planning budget**	**Project Title & Short Description**	**Action Description**	**Reporting Metric**
those MPGs	Upper Mid Fork Salmon	No limiting factors identified for this population				Remove/Install Diversion	* # of miles of habitat accessed
	Sulpher Creek	Flow (App E)	200712700	$ 305,867	Reestablish Connectivity and Restore Fish Habitat in the East Fork of the South Fork Salmon River Watershed This project will reestablish fish passage through a 30-foot tall cascade using natural channel design and rehabilitate one mile of fish habitat through an anthropogenically degraded reach of the upper mainstem East Fork of the South Fork Salmon River.	Enhance Floodplain	* # of acres treated
	Bear Valley Creek	No limiting factors identified for this population				Increase Instream Habitat Complexity	* # of stream miles treated
	Marsh Creek	Channel Morphology (App E)				Plant Vegetation	* # of riparian miles treated
Upper Salmon River The projects listed for the South Fork, Middle Fork, or Upper Salmon MPGs are located in the NPCC Salmon subbasin and will benefit at least 1 of the populations in those MPGs	Lemhi	Stream Flow- low flow Water Quality- water temperature Fish Passage- migration barriers, entrainment in irrigation diversions	200712700 (con't)			Install Fish Passage Structure	* # of miles of habitat accessed
			200726800	$ 250,000	Idaho Watershed Habitat Restoration Project via Custer Soil and Water Conservation District The project scope is to implement high priority action items to maintain, enhance and restore fish habitat and fish passage in the priority stream segments of the Upper Salmon Basin area within the administrative boundaries of the Custer SWCD.	Install Fence	* # of miles of fence
	Lower Mainstem Upper Salmon River	Channel Structure and Complexity- degraded bank stability Riparian Areas and LWD Recruitment- degraded and altered riparian function Stream Flow- altered hydrology, dewatering, degraded hydrologic connection to Mainstem Stream Substrate- elevated sediment Water Quality- water temperature (elevated in summer and severely reduced in winter) Fish Passage- passage barriers, entrainment in irrigation diversions				Remove/Install Diversion	* # of miles of habitat accessed
	Pahsimeroi	Stream Flow- low flow Water Quality- water temperature Fish Passage- migration barriers, entrainment in irrigation diversions				Remove/Modify Dam	* # of miles of habitat accessed

Snake River Spring Summer Chinook							
MPG	**Populations**	**Tributary Habitat Limiting Factors** (FCRPS BiOp Remand Habitat Workgroup products)	**Project Nbr**	**Average annual planning budget**	**Project Title & Short Description**	**Action Description**	**Reporting Metric**
	East Fork Upper Salmon River	Riparian Areas and LWD Recruitment- Altered Riparian Community, riparian condition Stream Flow- Altered Hydrology, low flow Water Quality- water temperature, nutrients Stream Substrate- sediment Fish Passage- migration barriers	200201301	$ 3,500,000	Water Entity (Rpa 151) Nwppc Fund water right transactions that restore streamflows and focused riparian easements on criticial fish-bearing Columbia Basin tributaries. Implemented as the Columbia Basin Water Transactions Program (CBWTP) in a partnership between BPA and NFWF	Acquire Water Instream	* flow of water returned to the stream as prescribed in the water acquisition in cfs
Upper Salmon River (con't)	Main Stem Upper Salmon River	Stream Flow- low flow Water Quality- water temperature Stream Substrate- sediment Fish Passage- migration barriers, entrainment in irrigation diversions	200739400	$ 250,000	Idaho Watershed Habitat Restoration Lemhi County Move funds for coordination, planning, design and implementation from 1992-026-03, Upper Salmon Basin Watershed Project.	Install Fence	* # of miles of fence
	Valley Creek	Channel Structure and Complexity- channel alteration Riparian Areas and LWD Recruitment- impaired riparian condition Stream Flow- low flow Water Quality- water temperature Stream Substrate- elevated sediment Fish Passage- migration barriers Other- Exotic Species (Brook Trout)				Install Fish Passage Structure	* # of miles of habitat accessed
	Yankee Fork	Water Quality - siltation, mining (legacy and recent), road and development encroachment, logging, grazing, wetlands fill and draining Fish Passage Floodplain Connectivity and Function Channel Structure and Complexity - streambank degradation, stream channel alteration Riparian Areas and LWD Recruitment Stream Substrate Stream Flow				Install Fish Screen	* Flow rate at the screen diversion allowed by the water right
	Panther (extirpated)	No limiting factors identified for this population				Acquire Water Instream	# of miles of primary stream reach improvement
	North Fork Upper Salmon River	Floodplain Connectivity and Function- connectivity to floodplain, wetlands fill and draining; Channel Structure and Complexity- stream bank degradation Riparian Areas and LWD Recruitment- degraded riparian function, road and development encroachment Stream Flow- altered hydrology, low flows Water Quality- pollutants, legacy mining Stream Substrate- sediment Fish Passage- passage barriers	199901900	$ 384,236	Restore Salmon River (Challis, Idaho) Passive restoration by securing easements will assist restoration efforts via the Corps 206 Program. The development of side channels will help create a more naturally functioning floodplain, provide a wide array of environmental and ecological benefit.	Investigate Trespass	
			200205900	$ 116,667	Yankee Fork Salmon River Dredge Tailings Restoration Project Reconnect the Yankee Fork River to its floodplain and restore natural channel characteristics and processes in a segment	Plant Vegetation	

Snake River Spring Summer Chinook							
MPG	**Populations**	**Tributary Habitat Limiting Factors** (FCRPS BiOp Remand Habitat Workgroup products)	**Project Nbr**	**Average annual planning budget**	**Project Title & Short Description**	**Action Description**	**Reporting Metric**
					impacted by dredge-mining. Integrate biological and physical data with project experiences to develop future restoration alternatives.	Remove Mine Tailings	

Appendix B-4a - 2008-2009 Additional Tributary Habitat Actions

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Snake River Spring and Summer Chinook						
MPG	**Population**	**Assessment Unit (AU)**	**Primary Limiting Factor(s) (PLF) by AU**	**Action Description**	**Cost Above BPA 2007-09 Planning Budget**	**Reporting Metric** *(tbd)*
Grande Ronde	Catherine Creek	Catherine Creek	In-channel characteristics	In-steam enhancement, LWD, modify/enhance channel	$150,000	
				Opportunistic channel enhancement	$2,100	7 mi
			Riparian / Floodplain	livestock exclusion/reveg/weed control/expand streamside buffers/levee or road mod/restore meadows	$295,000	
				wetland project development	$50,000	
				riparian fencing (FS)	$60,000	4 mi
				road obliteration/sediment reduction (FS)	$55,000	2 mi
			Fish Passage	culverts/irrigation diversion improvements	$300,000	
				Catherine Creek State Diversion Fish Passage	$83,000	4 mi
			Fish Passage	Catherine Creek Diversion Townley-Dobin	$140,000	25
				Catherine Creek Davis Dams Fish Passage (design)	$100,000	
				Scout Creek Culvert Replacement (design)	$6,000	
	Upper Grande Ronde	Mid Grande Ronde River and Tribs	In-channel characteristics	End Creek Restoration - Phase IV	$33,000	
				Willow Ck channel improvement /wetland restoration (new)	$600,000	4
				Indian Ck channel enhancement and wetland restoration	$500,000	4 mi
			Riparian / Floodplain	Indian/Little Indian riparian fencing/water development- start in 09, continue through 15 (FS)	$1,000	.5 mi
			Passage	culverts/irrigation diversion improvements	$100,000	5

Snake River Spring and Summer Chinook						
MPG	**Population**	**Assessment Unit (AU)**	**Primary Limiting Factor(s) (PLF) by AU**	**Action Description**	**Cost Above BPA 2007-09 Planning Budget**	**Reporting Metric** *(tbd)*
Grande Ronde (con't)	Upper Grande Ronde (con't)	Upper Grande Ronde and Tribs	In-channel characteristics	Upper GR River mine tailings (FS)	$300,000	2 mi
				Fly Ck (FS)	$275,000	6 mi
				UGR/Fly/Sheep Ck riparian fencing + water development- 2009 (FS)	$129,000	9 mi
				Camp Carson erosion control 2008 (FS)	$45,000	1 mi
	Lostine	Lostine River	Lack of passage - Lack of access to diversity of habitats,	Fish Passage Improvements	$542,400	
Middle Fork Salmon	Big Creek	Entire Big Creek Watershed	Sediment effects on rearing and spawning success - lack of intersticial space, reduced pool volume, reduced spawning success	Road Decommissioning, Road Improvement, Culvert Removal / Replacement, Riparian Restoration near Mining Sites, Weed Management, Silvacultural BMPs	$590,000	
			Migration Barriers associated with roads and mining activities	Assess stream crossings and anthropogenic migration barriers to determine actions necessary for salmonid passage. Provide for salmonid passage at identified passage barriers (e.g., culvert replacement)		
South Fork Salmon River	South Fork Salmon River mainstem	EFSF Salmon and tribs	Sediment effects on rearing and spawning success - lack of intersticial space, reduced pool volume, reduced spawning success	Road Decommissioning, Road Improvement, Culvert Removal / Replacement, Riparian Restoration, Mine rehabilitation	$162,800	
			Migration Barriers	Assess stream crossings and anthropogenic migration barriers to determine actions necessary for salmonid passage. Provide for salmonid passage at identified passage barriers. The Stibnite-Glory Hole passage project is a priority.		
	Secesh River	Entire Secesh Basin	Sediment effects on rearing and spawning success - lack of intersticial space, reduced pool volume, reduced spawning success	Road Decommissioning, Road Improvement, Culvert Removal / Replacement, Weed Management, Silvacultural BMPs	Included in EFSF Salmon above	
				2008-09 Total	***$4,519,300***	

Appendix B-4b - 2008-2009 Additional Tributary Habitat Actions

This is not a final federal agency product. Rather, it is a pre-decisional document prepared by the Action Agencies that reflects present understandings of currently available information and analyses, and of the progression of discussions with the sovereigns in the collaborative process. Revisions and refinements are to be expected based on further discussions with the sovereigns over new and modified proposed federal actions upon which the action agencies will ultimately consult. Finally, the information in this product does not constitute an analysis of whether the identified measures would or would not jeopardize the continued existence of a listed species or result in the destruction or adverse modification of designated critical habitat. Furthermore, this document does not in any way interpret or apply the regulatory definitions of the statutory phrases "jeopardize the continued existence of" and "destruction or adverse modification."

Snake River Steelhead						
MPG	**Population**	**Assessment Unit (AU)**	**Primary Limiting Factor(s) (PLF) by AU**	**Action Description**	**Cost Above BPA 2007-09 Planning Budget**	**Reporting Metric** *(tbd)*
Grande Ronde	Upper Grande Ronde	Mid Grande Ronde River and Tribs	In-channel characteristics	End Creek Restoration - Phase IV	$33,000	
				Willow Ck channel improvement /wetland restoration (new)	$600,000	4
				Indian Ck channel enhancement and wetland restoration	$500,000	4 mi
			Riparian / Floodplain	Indian/Little Indian Riparian fencing/water development 2009 start (FS)	$1,000	5
		Upper Grande Ronde and Tribs	In-channel characteristics	Upper GR River mine tailings (FS)	$300,000	2 mi
				Fly Ck (FS)	$275,000	6 mi
			Sediment	Camp Carson erosion control (FS)	$45,000	1 mi
		Catherine Creek	In-channel characteristics	In-steam enhancement, LWD, modify/enhance channel	$150,000	
			Riparian / Floodplain	livestock exclusion/reveg/weed control/expand streamside buffers/levee or road mod/restore meadows	$295,000	
				wetland project development	$50,000	
				Catherine Ck road obliteration/sediment reduction 2009 start (FS)	$55,000	2 mi
			Fish Passage	culverts/irrigation diversion improvements	$300,000	
				Catherine Creek State Diversion Fish Passage	$83,000	4 mi
				Catherine Creek Diversion Townley-Dobin	$140,000	25

Snake River Steelhead						
MPG	**Population**	**Assessment Unit (AU)**	**Primary Limiting Factor(s) (PLF) by AU**	**Action Description**	**Cost Above BPA 2007-09 Planning Budget**	**Reporting Metric** *(tbd)*
				Catherine Creek Davis Dams Fish Passage (design)	$100,000	
				Scout Creek Culvert Replacement (design)	$6,000	
Clearwater River	Lochsa	Crooked Fork	Connectivity - Lack of access to diversity of habitats	Culvert Replacement or Removal	$500,000	
			Sediment effects on rearing and spawning success - lack of intersticial space, reduced pool volume, reduced spawning success	Road Removal and Improvement/ Land Acquisition		
			Temperature and Instream Habitat-poor quality pools and structure	Revegetation to allow for woody debris recruitment and riparian area cover. Land Acquisition		
		Middle Lochsa North Face Tribs (from Post Office to Bald Mountain)	Loss of riparian vegetation and complexity, lack of shade, loss of nutrients	Riparian Rehabilitation	$212,544	
			Lack of passage - Lack of access to diversity of habitats,	Culvert Replacement or Removal		
			Sediment effects on rearing and spawning success - lack of intersticial space, reduced pool volume, reduced spawning success	Road Decommissioning,Culvert Removal / Replacement, Noxious Weed Control		
			Temperature	Road Removal, Riparian Rehabilitation		
		Lower Lochsa (Fish Creek to Pete King Creek)	Loss of riparian vegetation and complexity, lack of shade, loss of nutrients	Riparian Rehabilitation	$800,000	
			Lack of passage - Lack of access to diversity of habitats	Culvert Replacement or Removal, Remove engineered instream structures		
			Temperature	Road Removal, Riparian Rehabilitation		
			Sediment effects on rearing and spawning success - lack of intersticial space, reduced pool volume, reduced spawning success	Road Decommissioning,Culvert Removal / Replacement, Noxious Weed Control		

Snake River Steelhead						
MPG	**Population**	**Assessment Unit (AU)**	**Primary Limiting Factor(s) (PLF) by AU**	**Action Description**	**Cost Above BPA 2007-09 Planning Budget**	**Reporting Metric** *(tbd)*
	Lolo Creek	Musselshell Creek	Sediment from roads, timber harvest, cattle grazing, and historic mining - effects on rearing and spawning success, intersticial space and pool volume.	Road Decommissioning and road drainage improvements, Weed Control	$140,000	
		Musselshell Creek (con't)	Loss of riparian vegetation and complexity - lack of stream shading resulting in elevated temperatures	Riparian Rehabilitation & Large Woody Debris		
			Lack of passage - Lack of access to diversity of habitats,	Musselshell Tunnel/ Stream Relocation, Culvert Replacement		
Clearwater River (con't)	Lolo Creek (con't)	Yoosa Creek	Sediment from roads, timber harvest, cattle grazing, and historic mining - effects on rearing and spawning success, intersticial space and pool volume.	Road Decommissioning and road drainage improvements, Weed Control	$200,000	
		Lolo Creek	Sediment from roads, timber harvest, cattle grazing,- effects on rearing and spawning success, intersticial space and pool volume	Road obliteration and road drainage improvements	$200,000	
			Reduced channel complexity from streamside roads, reduced LWD & historic dredge mining	Riparian Rehabilitation & Large Woody Debris		
			Loss of riparian vegetation and complexity - lack of stream shading resulting in elevated temperatures	Riparian planting		
			Lack of passage - Lack of access to diversity of habitats.	Culvert Replacement, Eldorado Falls Adjustment		
	Selway River	O'Hara Creek	Sediment from roads, timber harvest, cattle grazing - effects on rearing and spawning success, intersticial space and pool volume.	Road Decommissioning and road drainage improvements, Weed Control	$50,000	
			Loss of riparian vegetation and complexity - lack of stream shading resulting in elevated temperatures	Riparian Rehabilitation & Large Woody Debris		
		Lower Selway River	Sediment from roads - effects on rearing and spawning success, intersticial space and pool volume.	Riparian Rehabilitation & Sediment Filters	$350,000	

Snake River Steelhead						
MPG	**Population**	**Assessment Unit (AU)**	**Primary Limiting Factor(s) (PLF) by AU**	**Action Description**	**Cost Above BPA 2007-09 Planning Budget**	**Reporting Metric** *(tbd)*
		River	Lack of passage - Lack of access to diversity of habitats,	Culvert Replacement		
	South Fork Clearwater River	Newsome Creek	Channel Morphology - Channel straightened, lack of pools, lack of pool depth, lack of complexity, lack of cover	Channel / Riparian Rehabilitation	$643,200	
			Loss of riparian vegetation and complexity - dredge mine effects, lack of shade, loss of nutrients	Channel / Riparian Rehabilitation		
			Lack of passage - Lack of access to diversity of habitats,	Culvert Replacement		
			Sediment effects on rearing and spawning success - lack of intersticial space, reduced pool volume, reduced spawning success	Road Decommissioning, Road Improvement, Culvert Removal / Repalcement		
Clearwater River (con't)	South Fork Clearwater River (con't)	Meadow Creek	Sediment effects on rearing and spawning success - lack of intersticial space, reduced pool volume, reduced spawning success	Road Decommissioning, Soil Restoration, Culvert Removal / Replacement, Weed Control	$400,000	
			Lack of passage - Lack of access to diversity of habitats,	Culvert Replacement		
			Loss of riparian vegetation and complexity - lack of large woody debris recruitment resulting in lack of habitat complexity	Riparian Rehabilitation		
			Loss of riparian vegetation and complexity - lack of stream shading resulting in elevated temperatures	Riparian Rehabilitation		
		Mill Creek	Lack of passage - Lack of access to diversity of habitats,	Culvert Replacement	$300,000	
			Loss of riparian vegetation and complexity - lack of large woody debris recruitment resulting in lack of habitat complexity	Riparian Rehabilitation		
			Loss of riparian vegetation and complexity - lack of stream shading resulting in elevated temperatures	Riparian Rehabilitation		

Snake River Steelhead						
MPG	**Population**	**Assessment Unit (AU)**	**Primary Limiting Factor(s) (PLF) by AU**	**Action Description**	**Cost Above BPA 2007-09 Planning Budget**	**Reporting Metric** *(tbd)*
		American River	Channel Morphology - Channel straightened, lack of pools, lack of pool depth, lack of complexity, lack of cover	Channel / Riparian Rehabilitation on Telephone, Whitaker, & Queen Creeks. BLM proposed restoration of American River.	$683,000	
			Loss of riparian vegetation and complexity - dredge mine effects, lack of shade, loss of nutrients	Channel / Riparian Rehabilitation on Telephone, Whitaker, & Queen Creeks		
			Lack of passage - Lack of access to diversity of habitats	Culvert Replacement		
			Sediment effects on rearing and spawning success - lack of intersticial space, reduced pool volume, reduced spawning success	Road Decommissioning, Road Improvement, Culvert Removal / Replacement, Weed Control		
			Riparian and channel alteration from floodplain/riparian development	Maines Estate Land Acquisition / Conservation Easements		
Clearwater River (con't)	South Fork Clearwater River (con't)	Crooked River	Channel Morphology - Channel straightened, lack of pools, lack of pool depth, lack of complexity, lack of cover	Channel / Riparian Rehabilitation, includes both BPA proposals and FS Stewardship actions	$770,800	
			Loss of riparian vegetation and complexity - dredge mine effects, lack of shade, loss of nutrients	Channel / Riparian Rehabilitation, includes both BPA proposals and FS Stewardship actions		
			Lack of passage - Lack of access to diversity of habitats	Culvert Replacement		
			Sediment effects on rearing and spawning success - lack of intersticial space, reduced pool volume, reduced spawning success	Road Decommissioning, Road Improvement, Culvert Removal / Replacement, Weed Control		
		Red River	Channel Morphology - Channel straightened, lack of pools, lack of pool depth, lack of complexity, lack of cover	Channel / Riparian Rehabilitation	$397,400	
			Loss of riparian vegetation and complexity - dredge mine effects, lack of shade, loss of nutrients	Channel / Riparian Rehabilitation		
			Lack of passage - Lack of access to diversity of habitats,	Culvert Replacement		

Snake River Steelhead						
MPG	**Population**	**Assessment Unit (AU)**	**Primary Limiting Factor(s) (PLF) by AU**	**Action Description**	**Cost Above BPA 2007-09 Planning Budget**	**Reporting Metric** *(tbd)*
			Sediment effects on rearing and spawning success - lack of intersticial space, reduced pool volume, reduced spawning success	Road Decommissioning, Road Improvement, Culvert Removal / Replacement, Weed Control		
			Riparian and channel alteration from floodplain/riparian development.	Red River Meadows Land Acquisition / Conservation Easements		
Salmon River	Big Creek	Entire Big Creek Watershed	Chemical Pollution From Mining Activities	Mine Rehabilitation and Riparian Restoration	$590,000	
			Sediment effects on rearing and spawning success - lack of intersticial space, reduced pool volume, reduced spawning success	Road Decommissioning, Road Improvement, Culvert Removal / Replacement, Riparian Restoration near Mining Sites, Weed Management, Silvacultural BMPs		
			Migration Barriers associated with roads and mining activities	Assess stream crossings and anthropogenic migration barriers to determine actions necessary for salmonid passage. Provide for salmonid passage at identified passage barriers (e.g., culvert replacement)		
Salmon River (con't)	Secesh River	Entire Secesh Basin	Sediment effects on rearing and spawning success - lack of intersticial space, reduced pool volume, reduced spawning success	Road Decommissioning, Road Improvement, Culvert Removal / Replacement, Weed Management, Silvacultural BMPs	$162,800	
	South Fork Salmon		Sediment effects on rearing and spawning success - lack of intersticial space, reduced pool volume, reduced spawning success	Road Decommissioning, Road Improvement, Culvert Removal / Replacement, Riparian Restoration, Mine rehabilitation		

Snake River Steelhead						
MPG	**Population**	**Assessment Unit (AU)**	**Primary Limiting Factor(s) (PLF) by AU**	**Action Description**	**Cost Above BPA 2007-09 Planning Budget**	**Reporting Metric** *(tbd)*
		EFSF Salmon and tribs	Migration Barriers	Assess stream crossings and anthropogenic migration barriers to determine actions necessary for salmonid passage. Provide for salmonid passage at identified passage barriers. The Stibnite-Glory Hole passage project is a priority.	Included in Secesh	
			Heavy Metal Contamination	Mine oversight and management to protect and restore water quality and fish habitat. Riparian, floodplain, and wetland restoration.		
				2008-09 Total	***$9,332,744***	

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Upper Columbia River Steelhead

MPG	Population	Assessment Unit (AU)	Primary Limiting Factor(s) (PLF) by AU	Action Description	Cost Above BPA 2007-09 Planning Budget	Reporting Metric *(tbd)*
Upper Columbia River - Below Chief Joseph	Okanogan River	Omak Creek MSA	Passage-culverts	provide passage at barriers	$ 545,000	20 mi
		Small Trib Creeks Combined mSA	Riparian and floodplain function	land acquisition	$ 350,000	7.9 ac .5 mi
		Salmon Creek	Low stream flow	water acquisition		700 +AF
			In-channel habitat quantity*	Salmon Creek Project funded under 2007-09 F&W Pgm Funding Decision. Potential to fund water acquisition through the WaterEntity/CBWTP.	$ 251,000	4.3 mi
			Passage-flow barrier in lower reach	improve water management/channel reconstruction		11 mi
		Loup Loup Creek	Low stream flow	improve water management	$ 24,000	1.5 cfs
			Riparian and floodplain function	water conservation	$ 3,000	0.2 mi
			Passage- flow barrier in lower reach	provide passage at barriers	$ 255,000	2.2 mi
				2008-09 Total	***$ 1,428,000***	

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Reclamation technical assistance in Appendix B-5 supplements technical assistance associated with projects listed in Appendices B-1, B-2, and B3.

Upper Columbia Steelhead

Limiting Factor	Project Title	Subbasin	Short Description
Habitat - Channel Complexity	Bridge to Bridge Resoration, Phases 2 and 3	Entiat	Phases II and III will reconnect off-channel habitat, reconnect floodplain connectivity and off-channel habitat, restore mainstem large pool habitat for adult resting and restore cover and restore streambank stability and riparian vegetation.
Habitat - Channel Complexity	Stillwater Complexity Project	Entiat	The intended impacts of this measure are to increase LWD density and habitat diversity, as well as the amount of backwater pool and tool tail-out habitat.
Habitat - Channel Access	Jones Shotwell Ditch	Wenatchee	This project would bring the Jones Shotwell Ditch Company's fish screen into compliance with NOAA Fisheries criteria.
Habitat - Channel Access	Three Mission Creek Projects: Miller, Turnbull and Jurgins	Wenatchee	Miller and Turnbull- Repair and installation of low stage log weirs to re-establish plunge pool habitat and thalweg, and increase complexity. Jurgins- Install a low stage rock weir with large woody debris to provide plunge pool habitat, control bank erosion, increase complexity, and re-establish thalweg.
Habitat - Channel Complexity	Wenatchee Watershed Fluvial Habitat Resoration Plan	Wenatchee	The deliverable of this RFP will be a Wenatchee Watershed Fluvial Habitat Restoration Plan Scope of Work . A draft of the plan will be required by May 31, 2007
Habitat - Barrier Removal	Red Shirt Diversion Renovation	Methow	This project will remove the last irrigation-related passage barrier in Beaver Creek - a major tributary of the Methow River
Habitat - Barrier Removal	Poorman Creek Road Culvert Replacement	Methow	This project will replace a barrier culvert on a County Road
Habitat - Channel Complexity	Heath Floodplain Restoration	Methow	This project will create passage into 2 spring- fed ponds that are currently blocked by dams and road embankments. It will also bridge two streams that are currently crossed by vehicles using unimproved fords which has degraded the streams in the vicinity
Habitat - Channel Complexity	Lower Eightmile Floodplain Restoration	Methow	This project will create passage into 2 spring- fed ponds that are currently blocked by dams and road embankments. It will also bridge two streams that are currently crossed by vehicles using unimproved fords which has degraded the streams in the vicinity
Habitat - Channel Complexity	Fender Mill Floodplain Restoration	Methow	This project will remove the remnants of an old lumber mill pond and irrigation causing stranding after high flows from the floodplain. It will also reconnect a side channel blocked by the remains of the dams headworks.

Reclamation technical assistance is provided for several projects listed in Appendix B-1.

Limiting Factor	Project Title	Subbasin	Short Description
Upper Columbia Spring Chinook			
Habitat - Channel Complexity	Bridge to Bridge Resoration, Phases 2 and 3	Entiat	Phases II and III will reconnect off-channel habitat, reconnect floodplain connectivity and off-channel habitat, restore mainstem large pool habitat for adult resting and restore cover and restore streambank stability and riparian vegetation.
Habitat - Channel Complexity	Stillwater Complexity Project	Entiat	The intended impacts of this measure are to increase LWD density and habitat diversity, as well as the amount of backwater pool and tool tail-out habitat.
Habitat - Channel Access	Jones Shotwell Ditch	Wenatchee	This project would bring the Jones Shotwell Ditch Company's fish screen into compliance with NOAA Fisheries criteria.
Habitat - Channel Access	Three Mission Creek Projects: Miller, Turnbull and Jurgins	Wenatchee	Miller and Turnbull- Repair and installation of low stage log weirs to re-establish plunge pool habitat and thalweg, and increase complexity. Jurgins- Install a low stage rock weir with large woody debris to provide plunge pool habitat, control bank erosion, increase complexity, and re-establish thalweg.
Habitat - Channel Complexity	Wenatchee Watershed Fluvial Habitat Resoration Plan	Wenatchee	The deliverable of this RFP will be a Wenatchee Watershed Fluvial Habitat Restoration Plan Scope of Work . A draft of the plan will be required by May 31, 2007
Habitat - Channel Complexity	Fender Mill Floodplain Restoration	Methow	This project will remove the remnants of an old lumber mill pond and irrigation causing stranding after high flows from the floodplain. It will also reconnect a side channel blocked by the remains of the dams headworks.
Habitat - Channel Complexity	Heath Floodplain Restoration	Methow	This project will create passage into 2 spring- fed ponds that are currently blocked by dams and road embankments. It will also bridge two streams that are currently crossed by vehicles using unimproved fords which has degraded the streams in the vicinity
Habitat - Channel Complexity	Lower Eightmile Floodplain Restoration	Methow	This project will create passage into 2 spring- fed ponds that are currently blocked by dams and road embankments. It will also bridge two streams that are currently crossed by vehicles using unimproved fords which has degraded the streams in the vicinity

Reclamation provides technical assistance for several projects listed in Appendix B-1.

Snake River Spring/Summer Chinook

Reclamation provides technical assistance for habitat projects to improve survival of Snake River spring/summer chinook populations in the Grande Ronde, Lemhi, Upper Salmon (including Salmon River upstream and downstream from Redfish Lake, Valley Creek, East Fork Salmon River spring/summer chinook populations, and upper mainstem Salmon River and East Fork Salmon River steelhead populations), and Little Salmon subbasins. These projects are covered in Appendix B-3.

Snake River Steelhead

Reclamation provides technical assistance for habitat projects to improve survival of Snake River steelhead populations in the Grande Ronde, Lemhi, Upper Salmon (including Salmon River upstream and downstream from Redfish Lake, Valley Creek, East Fork Salmon River spring/summer chinook populations, and upper mainstem Salmon River and East Fork Salmon River steelhead populations), and Little Salmon subbasins. These projects are covered in the Appendix B-3.

Mid-Columbia Steelhead

Reclamation provides techncial assistance for several projects listed in Appendix B-2. Technical assistance is provided for the North Fork, Middle Fork, Upper Main, and South Fork John Day River subbasins.

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Grande Ronde Chinook Habitat/Survival Changes

Assessment Unit (AU)	Primary Limiting Factor(s) (PLF) by AU	Habitat condition by limiting factor (%)						Habitat condition by Assessment Unit (%)					
		Current	07-09 Actions	10-17 (S1) Actions	10-17 (S2) Actions	10-17 (S3) Actions	Max	Current	07-09 Actions	10-17 (S1) Actions	10-17 (S2) Actions	10-17 (S3) Actions	Max
Mid Grande Ronde River and Tribs	In-channel characteristics	25%	25%	26%	28%	27%	48%	29%	29%	30%	31%	30%	37%
	Riparian / Floodplain	35%	35%	36%	36%	38%	48%						
	Sediment	25%	25%	26%	28%	27%	24%						
	Water Quality	25%	25%	26%	26%	26%	27%						
	passage	89%	89%	90%	89%	89%	27%						
	Flow Quantity	20%	21%	22%	22%	21%	45%						
Upper Grande Ronde and Tribs	In-channel characteristics	35%	36%	40%	38%	37%	45%	35%	36%	38%	38%	38%	44%
	Riparian / Floodplain	35%	36%	36%	38%	41%	45%						
	Sediment	35%	36%	40%	38%	37%	45%						
	Water Quality	35%	36%	37%	37%	36%	40%						
			Survival Changes						1.02	1.07	1.07	1.07	1.09

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ESU – Snake River Chinook MPG - Grande Ronde/Imnaha Population - Upper Grande Ronde

FCRPS BiOP Remand Potential Habitat Actions and Benefits

Assessment Unit (AU)	AU Relative Size (AU % of pop. area)	Primary Limiting Factor(s) (PLF) by AU	Current % Function of each listed PLF in AU	PLF Weighted Effect on Survival	Current % Function of Average Habitat at AU	07-09 funded Actions	Resulting % Function of Limiting Factor		Resulting % Function of Habitat at AU scale		2007-2009 Actions (by 2017)	2007-2009 Actions (After 2017)	Near-term (<= 10 years)	Long-term (> 10 years)	Resulting % Function of Limiting Factor for 2010-2017 Actions		Resulting % Function of Habitat at AU scale		Potential increase available after 07-09 actions (by limiting factor)	Fraction of the potential increase remaining after 07-09 actions that can be implemented in 2010-2017			Resulting % Function of Limiting Factor (10-17 Actions)			Resulting % Function of Habitat at AU Scale (10-17 Actions)		
							10 Years	25 Years	10 Years	25 Years					10 Years	25 Years	10 Years	25 Years		Scenario 1	Scenario 2	Scenario 3	Scenario 1	Scenario 2	Scenario 3	Scenario 1	Scenario 2	Scenario 3
Mid Grande Ronde River and Tribs	47.0%	In-channel characteristics	25%	20%	29%	In-steam enhancement, LWD, modify/enhance channel	40%	80%	37%	76%	25%	25%	29%	29%	26%	27%	30%	31%	15%	0.06666667	0.2	0.1	26%	28%	27%	30%	31%	30%
						Willow ck channel/wetland projects																						
		Riparian / Floodplain	35%	20%		livestock exclusion/reveg/weed control/expand streamside buffers/levee or road mod/restore meadows	40%	80%			35%	35%			36%	37%			5%	0.2	0.2	0.5	36%	36%	38%			
						Willow ck channel/wetland projects																						
		Sediment	25%	10%			40%	80%			25%	25%			26%	27%			15%	0.06666667	0.2	0.1	26%	28%	27%			
		Water Quality	25%	15%		all above	30%	70%			25%	25%			26%	27%			5%	0.2	0.2	0.1	26%	26%	26%			
		passage	89%	5%		culverts/irrigation diversion improvements	90%	90%			89%	89%			90%	90%			1%	1	0.25	0.1	90%	89%	89%			
		Flow Quantity	20%	30%		water conservation/water right acquisition	25%	70%			21%	21%			22%	23%			4%	0.25	0.25	0.1	22%	22%	21%			
Upper Grande Ronde and Tribs	53.0%	In-channel characteristics	35%	30%	35%	In-steam enhancement, LWD, modify/enhance channel/land acquisition	45%	70%	44%	67%	36%	37%	36%	37%	40%	65%	39%	59%	9%	0.44444444	0.2	0.1	40%	38%	37%	38%	38%	38%
						Upper GR channel enhancement (1 mi)																						
						Meadow channel restoration (1 mi)																						
		Riparian / Floodplain	35%	30%		livestock exclusion/reveg/weed control/expand streamside buffers/levee or road mod/restore meadows/land acquisition	45%	70%			36%	37%			40%	65%			9%	0	0.25	0.5	36%	38%	41%			
						Upper GR + Meadow wetland/restoration																						
						Upper GR levy removal 1/2 mi																						
		Sediment	35%	10%		benefits from above	45%	70%			36%	37%			40%	65%			9%	0.44444444	0.2	0.1	40%	38%	37%			
		Water Quality	35%	30%		all above	40%	60%			36%	37%			37%	45%			4%	0.25	0.25	0.1	37%	37%	36%			

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Calculation of CHS Egg-Smolt Survival Change:

Assumes a maximum egg-smolt survival of under "optimal" conditions of: **18%**

	Current			
AU	**Weight**	**Hab (%)**	**SI**	**Totals**
Middle GR	0.470	29	0.052	0.024
Upper GR	0.530	35	0.063	0.033
Sum:	**1.00**			**0.058**

2007-2009 Actions						
Survival changes by 2017				Survival changes After 2017		
Hab (%)	**SI**	**Totals**		**Hab (%)**	**SI**	**Totals**
29	0.052	0.025		29	0.052	0.025
36	0.065	0.034		37	0.067	0.035
		0.059				**0.060**
Survival Change:		**1.02**		**Survival Change:**		**1.04**

Additional 2007-2017 Actions						
Survival changes by 2017				Survival changes After 2017		
Hab (%)	**SI**	**Totals**		**Hab (%)**	**SI**	**Totals**
30	0.054	0.025		31	0.056	0.026
39	0.070	0.037		59	0.106	0.056
		0.063				**0.082**
Survival Change:		**1.09**		**Survival Change:**		**1.43**

	Potential by 2017			
AU	**Weight**	**Hab (%)**	**SI**	**Totals**
Middle GR	0.470	37	0.066	0.031
Upper GR	0.530	44	0.078	0.041
Sum:	**1.00**			**0.072**
		Survival Change:		**1.26**

	Potential after 2017			
AU	**Weight**	**Hab (%)**	**SI**	**Totals**
Middle GR	0.470	76	0.137	0.064
Upper GR	0.530	67	0.121	0.064
Sum:	**1.00**			**0.128**
		Survival Change:		**2.22**

SCENARIO ANALYSES

Scenario 1		
Survival changes by 2017		
Hab (%)	**SI**	**Totals**
30	0.054	0.025
38	0.068	0.036
		0.062
Survival Change:		**1.07**

Scenario 2		
Survival changes by 2017		
Hab (%)	**SI**	**Totals**
31	0.055	0.026
38	0.068	0.036
		0.062
Survival Change:		**1.07**

Scenario 3		
Survival changes by 2017		
Hab (%)	**SI**	**Totals**
30	0.054	0.026
38	0.068	0.036
		0.062
Survival Change:		**1.07**

Note: Vey Meadows limiting factor
That changed Max 25 yr potential f
change of 26 (33-7)

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Catherine Creek Chinook Habitat/Survival Changes

Assessment Unit (AU)	Primary Limiting Factor(s) (PLF) by AU	Habitat condition by limiting factor (%)						Habitat condition by Assessment Unit (%)					
		Current	07-09 Actions	10-17 (S1) Actions	10-17 (S2) Actions	10-17 (S3) Actions	Max	Current	07-09 Actions	10-17 (S1) Actions	10-17 (S2) Actions	10-17 (S3) Actions	Max
Catherine Creek	In-channel characteristics	40%	42%	50%	53%	47%	60%	43%	29%	49%	49%	49%	56%
	Riparian / Floodplain	40%	42%	46%	44%	48%	50%						
	Water Quality	40%	41%	43%	43%	43%	50%						
	Passage	70%	75%	78%	76%	79%	80%						
	Flow Quantity	40%	42%	43%	43%	43%	50%						
			Survival Changes						1.05	1.14	1.14	1.14	1.14

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ESU – Snake River Chinook MPG - Grande Ronde/Imnaha Population - Catherine Creek

FCRPS BiOP Remand Potential Habitat Actions and Benefits

Assessment Unit (AU)	AU Relative Size (AU % of pop. area)	Primary Limiting Factor(s) (PLF) by AU	Current % Function of each listed PLF in AU	PLF Weighted Effect on Survival	Current % Function of Average Habitat at AU	Actions	Resulting % Function of Limiting Factor		Resulting % Function of Habitat at AU scale		2007-2009 Actions (by 2017)	2007-2009 Actions (After 2017)	Near-term (<= 10 years)	Long-term (> 10 years)	Resulting % Function of Limiting Factor for 2010-2017 Actions		Resulting % Function of Habitat at AU scale		Potential increase available after 07-09 actions (by limiting factor)	Fraction of the potential increase remaining after 07-09 actions that can be implemented in 2010-2017			Resulting % Function of Limiting Factor (10-17 Actions)			Resulting % Function of Habitat at AU Scale (10-17 Actions)		
							10 Years	25 Years	10 Years	25 Years					10 Years	25 Years	10 Years	25 Years		Scenario 1	Scenario 2	Scenario 3	Scenario 1	Scenario 2	Scenario 3	Scenario 1	Scenario 2	Scenario 3
Catherine Creek	100.0%	In-channel characteristics	40%	25%	43%	In-steam enhancement, LWD, modify/enhance channel	60%	80%	56%	73%	42%	50%	45%	49%	50%	70%	49%	60%	18%	0.44444444	0.6	0.3	50%	53%	47%	49%	49%	49%
		Riparian / Floodplain	40%	25%		livestock exclusion/reveg/weed control/expand streamside buffers/levee or road mod/restore meadows	50%	70%			42%	47%			46%	60%			8%	0.5	0.25	0.75	46%	44%	48%			
		Water Quality/temp	40%	20%		all above	50%	70%			41%	45%			43%	50%			9%	0.22222222	0.22	0.22	43%	43%	43%			
		Fish Passage	70%	10%		culverts/irrigation diversion improvements	80%	90%			75%	75%			78%	82%			5%	0.6	0.25	0.75	78%	76%	79%			
		Flow Quantity	40%	20%		water conservation/water right acquisition	50%	60%			42%	43%			43%	44%			8%	0.125	0.125	0.125	43%	43%	43%			

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Calculation of CHS Egg-Smolt Survival Change:

Assumes a maximum egg-smolt survival of under "optimal" conditions of: **18%**

	Current			
AU	**Weight**	**Hab (%)**	**SI**	**Totals**
Catherine Ck	1.000	43	0.077	0.077
Sum:	**1.00**			**0.077**

2007-2009 Actions						
Survival changes by 2017				Survival changes After 2017		
Hab (%)	SI	Totals		Hab (%)	SI	Totals
45	0.081	0.081		49.35	0.089	0.089
		0.081				**0.089**
Survival Change:		**1.05**		**Survival Change:**		**1.15**

Additional 2007-2017 Actions						
Survival changes by 2017				Survival changes After 2017		
Hab (%)	SI	Totals		Hab (%)	SI	Totals
49	0.088	0.088		60	0.107	0.107
		0.088				**0.107**
Survival Change:		**1.14**		**Survival Change:**		**1.38**

	Potential by 2017			
AU	**Weight**	**Hab (%)**	**SI**	**Totals**
Middle GR	1.000	56	0.100	0.100
Sum:	**1.00**			**0.100**
		Survival Change:		**1.29**

	Potential after 2017			
AU	**Weight**	**Hab (%)**	**SI**	**Totals**
Middle GR	1.000	73	0.131	0.131
Sum:	**1.00**			**0.131**
		Survival Change:		**1.69**

SCENARIO ANALYSES

Scenario 1		
Survival changes by 2017		
Hab (%)	SI	Totals
49	0.088	0.088
		0.088
Survival Change:		**1.14**

Scenario 2		
Survival changes by 2017		
Hab (%)	SI	Totals
49	0.088	0.088
		0.088
Survival Change:		**1.14**

Scenario 3		
Survival changes by 2017		
Hab (%)	SI	Totals
49	0.088	0.088
		0.088
Survival Change:		**1.14**

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ESU – Snake River Steelhead MPG - Clearwater River Population - Lolo Creek

Nez Perce Tribe DFRM Watershed Division

FCRPS BiOP Remand Potential Habitat Actions and Benefits

Col 4	Col 5[1]	Col 6	Col 7		Col 8b	Col 9	Col 10A	Col 10B	Col 11B(1)	Col 11B(2)	PA % of Action			PA % Function at AU scale						
Assessment Unit (AU)	AU Relative Size (AU % of pop. area)	Primary Limiting Factor(s) (PLF) by AU	Current % Function of each listed PLF in AU	PLF Weighted Effect on Survival	Current % Function of Average Habitat at AU	Actions	Resulting % Function of Limiting Factor		Resulting % Function of Habitat at AU scale		Completed (<=10 years)	Near-term (<= 10 years)	Long-term (> 10 years)	Completed (<=10 years)	Near-term (<= 10 years)	Long-term (> 10 years)	Resulting % Function of Limiting Factor		Resulting % Function of Habitat at AU scale	
							10 Years	25 Years	10 Years	25 Years							10 Years	25 Years	10 Years	25 Years
Musselshell Creek	7%	Sediment from roads, timber harvest, cattle grazing, and historic mining - effects on rearing and spawning success, intersticial space and pool volume.	40%	50%	38%	Road Decommissioning and road drainage improvements, Weed Control	55%	70%	71%	81%	40%	45%	45%	38%	41%	42%	45%	50%	65%	70%
		Loss of riparian vegetation and complexity - lack of stream shading resulting in elevated temperatures	60%	10%		Riparian Rehabilitation & Large Woody Debris	70%	75%			60%	65%	70%				65%	68%		
		Lack of passage - Lack of access to diversity of habitats,	30%	40%		Musselshell Tunnel/ Stream Relocation, Culvert Replacement	90%	95%			30%	30%	30%				90%	95%		
Yoosa Creek	12%	Sediment from roads, timber harvest, cattle grazing, and historic mining - effects on rearing and spawning success, intersticial space and pool volume.	55%	50%	60%	Road Decommissioning and road drainage improvements, Weed Control	65%	75%	69%	79%	55%	55%	55%	60%	60%	60%	58%	60%	61%	64%
		Loss of riparian vegetation and complexity -	60%	40%		Riparian Rehabilitation & Large Woody Debris	70%	80%			60%	60%	60%				60%	65%		
		Lack of passage - Lack of access to diversity of habitats	80%	10%		Culvert Replacement	85%	90%			80%	80%	80%				81%	82%		

Eldorado Creek	2%	Sediment from roads, timber harvest, cattle grazing,- effects on rearing and spawning success, intersticial space and pool volume.	40%	30%	49%	Road Decommissioning and road drainage improvements, Weed Control	55%	65%	68%	78%	38%	40%	40%	48%	54%	55%	45%	50%	57%	61%
		Loss of riparian vegetation and complexity - lack of stream shading resulting in elevated temperatures	60%	20%		Riparian Rehabilitation & Large Woody Debris	70%	80%			58%	62%	64%				65%	67%		
		Lack of passage - Lack of access to diversity of habitats.	50%	50%		Culvert Replacement, Eldorado Falls Adjustment	75%	85%			50%	60%	60%				60%	65%		
Lolo Creek	72%	Sediment from roads, timber harvest, cattle grazing,- effects on rearing and spawning success, intersticial space and pool volume	50%	40%	58%	Road obliteration and road drainage improvements	65%	75%	71%	80%	45%	55%	58%	54%	63%	64%	58%	60%	64%	67%
		Reduced channel complexity from streamside roads, reduced LWD & historic dredge mining	60%	10%		Riparian Rehabilitation & Large Woody Debris	65%	75%			60%	60%	60%				60%	62%		
		Loss of riparian vegetation and complexity - lack of stream shading resulting in elevated temperatures	60%	10%		Riparian planting	80%	85%			58%	65%	70%				72%	75%		
		Lack of passage - Lack of access to diversity of habitats.	65%	40%		Culvert Replacement, Eldorado Falls Adjustment	75%	85%			60%	70%	70%				70%	72%		
Jim Brown Creek/ Non-Federal Land	7%	Sediment from upstream sources	60%	30%	53%	Road obliteration and road drainage improvements	70%	80%	64%	77%	58%	60%	60%	48%	56%	57%	60%	65%	58%	60%
		High summer water temperature	50%	30%		Riparian fencing, planting, levee setbacks	60%	75%			45%	55%	57%				57%	58%		
		Loss of riparian function from grazing and floodplain development	40%	20%		Riparian fencing, planting, streambank bioengineering	50%	65%			37%	43%	46%				46%	47%		
		Lack of passage - Lack of access to diversity of habitats,	60%	20%		Culvert Replacement	75%	85%			50%	65%	65%				68%	70%		

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Calculation of Steelhead Egg-Smolt Survival Change:

Assumes a maximum egg-smolt survival of 4% under "optimal" conditions.

For Completed Actions up to Year 2000

AU	Current				Potential			
	Hab (%)	SI	Weight	Totals	Hab (%)	SI	Weight	Totals
Musselshell	38	0.01520	0.07	0.00106	38	0.01520	0.07	0.00106
Yoosa	60	0.02400	0.12	0.00288	60	0.02400	0.12	0.00288
Eldorado	49	0.01960	0.02	0.00039	48	0.01920	0.02	0.00038
Lolo Creek	58	0.02320	0.72	0.01670	54	0.02160	0.72	0.01555
Jim Brown Creek/Non-federal	53	0.02120	0.07	0.00148	48	0.01920	0.07	0.00134
Sum:			**1.00**	**0.023**			**1.00**	**0.021**

Survival Change: 0.94

10-Year Survival For All Actions Possible (no funding limits) Completed within the next 10 Years

AU	Current				Potential			
	Hab (%)	SI	Weight	Totals	Hab (%)	SI	Weight	Totals
Musselshell	38	0.01520	0.07	0.00106	71	0.02840	0.07	0.00199
Yoosa	60	0.02400	0.12	0.00288	69	0.02760	0.12	0.00331
Eldorado	49	0.01960	0.02	0.00039	68	0.02720	0.02	0.00054
Lolo Creek	58	0.02320	0.72	0.01670	71	0.02840	0.72	0.02045
Jim Brown Creek/Non-federal	53	0.02120	0.07	0.00148	64	0.02560	0.07	0.00179
Sum:			**1.00**	**0.023**			**1.00**	**0.028**

Survival Change: 1.25

Calculation of Steelhead Egg-Smolt Survival Change:

Assumes a maximum egg-smolt survival of 4% under "optimal" conditions.

For Near-Term Actions (07-09 BPA funding level only) for the next 10 years

AU	Current				Potential			
	Hab (%)	SI	Weight	Totals	Hab (%)	SI	Weight	Totals
Musselshell	38	0.01520	0.07	0.00106	41	0.01640	0.07	0.00115
Yoosa	60	0.02400	0.12	0.00288	60	0.02400	0.12	0.00288
Eldorado	49	0.01960	0.02	0.00039	54	0.02160	0.02	0.00043
Lolo Creek	58	0.02320	0.72	0.01670	63	0.02520	0.72	0.01814
Jim Brown Creek/Non-federal	53	0.02120	0.07	0.00148	56	0.02240	0.07	0.00157
Sum:			**1.00**	**0.023**			**1.00**	**0.024**

Survival Change: 1.07

25-Year Survival For All Actions Possible (no funding limits) Completed within the next 10 Years

AU	Current				Potential			
	Hab (%)	SI	Weight	Totals	Hab (%)	SI	Weight	Totals
Musselshell	38	0.01520	0.07	0.00106	81	0.03240	0.07	0.00227
Yoosa	60	0.02400	0.12	0.00288	79	0.03160	0.12	0.00379
Eldorado	49	0.01960	0.02	0.00039	78	0.03120	0.02	0.00062
Lolo Creek	58	0.02320	0.72	0.01670	80	0.03200	0.72	0.02304
Jim Brown Creek/Non-federal	53	0.02120	0.07	0.00148	77	0.03080	0.07	0.00216
Sum:			**1.00**	**0.023**			**1.00**	**0.032**

Survival Change: 1.42

Calculation of Steelhead Egg-Smolt Survival Change:

Assumes a maximum egg-smolt survival of 4% under "optimal" conditions.

For completed and near-term actions (with 07-09 BPA funding level only) after 10 years

AU	Current				Potential			
	Hab (%)	SI	Weight	Totals	Hab (%)	SI	Weight	Totals
Musselshell	38	0.01520	0.07	0.00106	42	0.01680	0.07	0.00118
Yoosa	60	0.02400	0.12	0.00288	60	0.02400	0.12	0.00288
Eldorado	49	0.01960	0.02	0.00039	55	0.02200	0.02	0.00044
Lolo Creek	58	0.02320	0.72	0.01670	64	0.02560	0.72	0.01843
Jim Brown Creek/Non-federal	53	0.02120	0.07	0.00148	57	0.02280	0.07	0.00160
Sum:			**1.00**	**0.023**			**1.00**	**0.025**

Survival Change: 1.09

INCLUDING BIOP PROJECTS, 07-09 AND 2010-2016

10-Year Survival For All Actions Completed within the next 10 Years

AU	Current				Potential			
	Hab (%)	SI	Weight	Totals	Hab (%)	SI	Weight	Totals
Musselshell	38	0.01520	0.07	0.00106	65	0.02600	0.07	0.00182
Yoosa	60	0.02400	0.12	0.00288	61	0.02440	0.12	0.00293
Eldorado	49	0.01960	0.02	0.00039	57	0.02280	0.02	0.00046
Lolo Creek	58	0.02320	0.72	0.01670	64	0.02560	0.72	0.01843
Jim Brown Creek/Non-federal	53	0.02120	0.07	0.00148	58	0.02320	0.07	0.00162
Sum:			**1.00**	**0.023**			**1.00**	**0.025**

Survival Change: 1.12

25-Year Survival For All Actions Completed within the next 10 Years

AU	Current				Potential			
	Hab (%)	SI	Weight	Totals	Hab (%)	SI	Weight	Totals
Musselshell	38	0.01520	0.07	0.00106	70	0.02800	0.07	0.00196
Yoosa	60	0.02400	0.12	0.00288	64	0.02560	0.12	0.00307
Eldorado	49	0.01960	0.02	0.00039	61	0.02440	0.02	0.00049
Lolo Creek	58	0.02320	0.72	0.01670	67	0.02680	0.72	0.01930
Jim Brown Creek/Non-federal	53	0.02120	0.07	0.00148	60	0.02400	0.07	0.00168
Sum:			**1.00**	**0.023**			**1.00**	**0.026**

Survival Change: 1.18

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ESU – Snake River Steelhead MPG - Clearwater River Population - Lochsa

Nez Perce Tribe DFRM Watershed Division

FCRPS BiOP Remand Potential Habitat Actions and Benefits

Col 4	Col 5[1]	Col 6	Col 7	Col 8b	Col 9	Col 10A	Col 10B	Col 11B(1)	Col 11B(2)	PA % of Action			PA % Function at AU scale						
Assessment Unit (AU)	AU Relative Size (AU % of pop. area)	Primary Limiting Factor(s (PLF) by AU	Current % Function of each listed PLF in AU	Current % Function of Average Habitat at AU	Actions	Resulting % Function of Limiting Factor		Resulting % Function of Habitat at AU scale		PA % Action	Near Term (with Council Approved	Long Term	Completed (<=10 years)	Near-term (<= 10 years)	Long-term (> 10 years)	Resulting % Function of Limiting Factor		Resulting % Function of Habitat at AU scale	
						10 Years	25 Years	10 Years	25 Years	2000-2005	2017	25+ years				10 Years	25 Years	10 Years	25 Years
Crooked Fork	16.4	Connectivity - Lack of access to diversity of habitats	60	38	Culvert Replacement or Removal/ Land Acquistion	80	90	60	82	40	65	65	35	50	52	90	90	77	82
		Sediment effects on rearing and spawning success - lack of intersticial space, reduced pool volume, reduced spawning success	30		Road Removal and Improvement/ Land Acquisition	50	80			40	60	65				70	80		
		Temperature and Instream Habitat-poor quality pools and structure	25		Revegetation to allow for woody debris recruitment and riparian area cover. Land Acquisition	50	75			25	25	25				70	75		
Colt Killed Creek	11.4	Sediment effects on rearing and spawning success - lack of intersticial space, reduced pool volume, reduced spawning success	60	60	Road Decommissioning,Culvert Removal / Replacement, Noxious Weed Control	70	85	67	75	60	65	70	60	62	63	70	80	67	73
		Instream Habitat-poor quality pools and structure	60		Riparian Rehabilitation	65	70			60	60	60				65	70		
		Temperature	60		Riparian Rehabilitation	65	70			60	60	60				65	70		
		Loss of riparian vegetation and complexity, lack of shade, loss of nutrients	60%		Riparian Rehabilitation	70	75			40	60	60							

Badger-Wendover	1%	Lack of passage - Lack of access to diversity of habitats,	70%	60%	Culvert Replacement or Removal	75	80	68	77	30	70	70	30	63	68			63	68
		Sediment effects on rearing and spawning success - lack of intersticial space, reduced pool volume, reduced spawning success	50%		Road Decommissioning,Culvert Removal / Replacement, Noxious Weed Control	60	75			20	60	75							
Legendary Bear (Papoose)	2.1	Loss of riparian vegetation and complexity, lack of shade, loss of nutrients	50	45	Riparian Rehabilitation	60	75	60	78	50	50	50	33	55	68			55	68
		Lack of passage - Lack of access to diversity of habitats,	50		Culvert Replacement or Removal	70	90			20	70	90							
		Temperature	50		Road Removal, Riparian Rehabilitation	60	70			40	60	70							
		Sediment effects on rearing and spawning success - lack of intersticial space, reduced pool volume, reduced spawning success	30		Road Decommissioning,Culvert Removal / Replacement, Noxious Weed Control, Mine Reclamation	50	75			20	40	60							
Fishing Creek (formerly Squaw)	2.5	Loss of riparian vegetation and complexity, lack of shade, loss of nutrients	50	56	Riparian Rehabilitation	60	75	68	79	50	50	50	35	60	66			60	66
		Lack of passage - Lack of access to diversity of habitats	65		Culvert Replacement or Removal	80	90			20	70	75							
		Temperature	60		Road Removal, Riparian Rehabilitation	65	75			40	65	75							
		Sediment effects on rearing and spawning success - lack of intersticial space, reduced pool volume, reduced spawning success	50		Road Decommissioning,Culvert Removal / Replacement, Noxious Weed Control	65	75			30	55	65							
Middle Lochsa North Face Tribs (from Post Office to Bald Mountain)	2.1	Loss of riparian vegetation and complexity, lack of shade, loss of nutrients	50	50	Riparian Rehabilitation	60	70	64	75							60	70	64	75
		Lack of passage - Lack of access to diversity of habitats,	40		Culvert Replacement or Removal	60	80									60	80		
		Sediment effects on rearing and spawning success - lack of intersticial space, reduced pool volume, reduced spawning success	45		Road Decommissioning,Culvert Removal / Replacement, Noxious Weed Control	65	75									65	75		
		Temperature	65		Road Removal, Riparian Rehabilitation	70	75									70	75		

South Lochsa Roadless Face	16.1	Channel Slope	90	90	No actions recommended only resource protection from deleterious future management	90	90	90	90										
Lower Lochsa (Fish Creek to Pete King Creek)	10.6	Loss of riparian vegetation and complexity, lack of shade, loss of nutrients	45	48	Riparian Rehabilitation	50	65	63	76							50	65	63	76
		Lack of passage - Lack of access to diversity of habitats	50		Culvert Replacement or Removal, Remove engineered instream structures	70	90									70	90		
		Temperature	50		Road Removal, Riparian Rehabilitation	60	70									60	70		
		Sediment effects on rearing and spawning success - lack of intersticial space, reduced pool volume, reduced spawning success	45		Road Decommissioning,Culvert Removal / Replacement, Noxious Weed Control	70	80									70	80		
Lochsa Mainstem	36.8	Temperature	50	40	No specific actions in the mainstem actions in the tributaries will improve mainstem habitat-riparian rehabilitation, reduction of sedimentation from roads and areas infested with noxious weeds.	60	70	53	73										
		Sediment effects on rearing and spawning success - lack of intersticial space, reduced pool volume, reduced spawning success	30		No specific actions in the mainstem actions in the tributaries will improve mainstem habitat-riparian rehabilitation, reduction of sedimentation from roads and areas infested with noxious weeds.	45	75												

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Assumes a maximum egg-smolt survival of 4% under "optimal" conditions.

Completed Projects

	Past Condition				Current			
AU	Hab (%)	SI	Weight	Totals	Hab (%)	SI	Weight	Totals
1-Crooked Fork	35	0.014	0.16	0.002	38	0.015	0.16	0.002
2-Colt Killed	60	0.024	0.11	0.003	60	0.024	0.11	0.003
3-Badger-Wendover	30	0.012	0.01	0.000	60	0.024	0.01	0.000
4-Legendary Bear	37	0.015	0.02	0.000	45	0.018	0.02	0.000
5-Fishing	47	0.019	0.03	0.000	56	0.022	0.03	0.001
6-Middle Lochsa North Face	50	0.020	0.02	0.000	50	0.020	0.02	0.000
7-South Lochsa Roadless Face	90	0.036	0.16	0.006	90	0.036	0.16	0.006
8-Lower Lochsa	48	0.019	0.11	0.002	48	0.019	0.11	0.002
9-Lochsa Mainstem	40	0.016	0.37	0.006	40	0.016	0.37	0.006
Sum:			**0.99**	**0.020**			**0.99**	**0.021**

Survival Change: 1.02

Assumes a maximum egg-smolt survival of 4% under "optimal" conditions.

Near Term Projects

	Current				10 Year Potential			
AU	Hab (%)	SI	Weight	Totals	Hab (%)	SI	Weight	Totals
1-Crooked Fork	38	0.015	0.16	0.002	50	0.020	0.16	0.003
2-Colt Killed	60	0.024	0.11	0.003	67	0.027	0.11	0.003
3-Badger-Wendover	60	0.024	0.01	0.000	63	0.025	0.01	0.000
4-Legendary Bear	45	0.018	0.02	0.000	55	0.022	0.02	0.000
5-Fishing	56	0.022	0.03	0.001	60	0.024	0.03	0.001
6-Middle Lochsa North Face	50	0.020	0.02	0.000	50	0.020	0.02	0.000
7-South Lochsa Roadless Face	90	0.036	0.16	0.006	90	0.036	0.16	0.006
8-Lower Lochsa	48	0.019	0.11	0.002	48	0.019	0.11	0.002
9-Lochsa Mainstem	40	0.016	0.37	0.006	40	0.016	0.37	0.006
Sum:			**0.99**	**0.021**			**0.99**	**0.022**

Survival Change: 1.06

Assumes a maximum egg-smolt survival of 4% under "optimal" conditions.

Long term effect of Near Term Projects

	Current				>10 Year Potential			
AU	Hab (%)	SI	Weight	Totals	Hab (%)	SI	Weight	Totals
1-Crooked Fork	38	0.015	0.16	0.002	52	0.021	0.16	0.003
2-Colt Killed	60	0.024	0.11	0.003	75	0.030	0.11	0.003
3-Badger-Wendover	60	0.024	0.01	0.000	68	0.027	0.01	0.000
4-Legendary Bear	45	0.018	0.02	0.000	70	0.028	0.02	0.001
5-Fishing	56	0.022	0.03	0.001	66	0.027	0.03	0.001
6-Middle Lochsa North Face	50	0.020	0.02	0.000	50	0.020	0.02	0.000
7-South Lochsa Roadless Face	90	0.036	0.16	0.006	90	0.036	0.16	0.006
8-Lower Lochsa	48	0.019	0.11	0.002	48	0.019	0.11	0.002
9-Lochsa Mainstem	40	0.016	0.37	0.006	40	0.016	0.37	0.006
Sum:			**0.99**	**0.021**			**0.99**	**0.022**

Survival Change: 1.09

10-Year Survival For All Actions Completed within the next 10 Years

	Current				>10 Year Potential			
AU	Hab (%)	SI	Weight	Totals	Hab (%)	SI	Weight	Totals
1-Crooked Fork	38	0.015	0.16	0.002	60	0.024	0.16	0.004
2-Colt Killed	50	0.020	0.11	0.002	67	0.027	0.11	0.003
3-Badger-Wendover	60	0.024	0.01	0.000	68	0.027	0.01	0.000
4-Legendary Bear	45	0.018	0.02	0.000	60	0.024	0.02	0.001
5-Fishing	56	0.022	0.03	0.001	68	0.027	0.03	0.001
6-Middle Lochsa North Face	50	0.020	0.02	0.000	64	0.026	0.02	0.001
7-South Lochsa Roadless Face	90	0.036	0.16	0.006	90	0.036	0.16	0.006
8-Lower Lochsa	48	0.019	0.11	0.002	63	0.025	0.11	0.003
9-Lochsa Mainstem	40	0.016	0.37	0.006	53	0.021	0.37	0.008
Sum:			**0.99**	**0.020**			**0.99**	**0.025**

Survival Change: 1.25

Calculation of Steelhead Egg-Smolt Survival Change:

Assumes a maximum egg-smolt survival of 4% under "optimal" conditions.

INCLUDING BIOP PROJECTS, 07-09 AND 2010-2016

10-Year Survival For All Actions Completed within the next 10 Years

	Current				Potential			
AU	Hab (%)	SI	Weight	Totals	Hab (%)	SI	Weight	Totals
1-Crooked Fork	38	0.015	0.16	0.002	75	0.030	0.16	0.005
2-Colt Killed	60	0.024	0.11	0.003	67	0.027	0.11	0.003
3-Badger-Wendover	60	0.024	0.01	0.000	63	0.025	0.01	0.000
4-Legendary Bear	45	0.018	0.02	0.000	55	0.022	0.02	0.000
5-Fishing	56	0.022	0.03	0.001	60	0.024	0.03	0.001
6-Middle Lochsa North Face	50	0.020	0.02	0.000	64	0.026	0.02	0.001
7-South Lochsa Roadless Face	90	0.036	0.16	0.006	90	0.036	0.16	0.006
8-Lower Lochsa	48	0.019	0.11	0.002	63	0.025	0.11	0.003
9-Lochsa Mainstem	40	0.016	0.37	0.006	40	0.016	0.37	0.006
Sum:			**0.99**	**0.021**			**0.99**	**0.024**

Survival Change: 1.18

Calculation of Steelhead Egg-Smolt Survival Change:

Assumes a maximum egg-smolt survival of 4% under "optimal" conditions.

25-Year Survival For All Actions Completed within the next 10 Years

	Current				Potential			
AU	Hab (%)	SI	Weight	Totals	Hab (%)	SI	Weight	Totals
1-Crooked Fork	38	0.015	0.16	0.002	81.3	0.033	0.16	0.005
2-Colt Killed	60	0.024	0.11	0.003	73	0.029	0.11	0.003
3-Badger-Wendover	60	0.024	0.01	0.000	68	0.027	0.01	0.000
4-Legendary Bear	45	0.018	0.02	0.000	68	0.027	0.02	0.001
5-Fishing	56	0.022	0.03	0.001	66	0.026	0.03	0.001
6-Middle Lochsa North Face	50	0.020	0.02	0.000	75	0.030	0.02	0.001
7-South Lochsa Roadless Face	90	0.036	0.16	0.006	90	0.036	0.16	0.006
8-Lower Lochsa	48	0.019	0.11	0.002	76	0.030	0.11	0.003
9-Lochsa Mainstem	40	0.016	0.37	0.006	40	0.016	0.37	0.006
Sum:			**0.99**	**0.021**			**0.99**	**0.026**

Survival Change: 1.25

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ESU – Snake River Steelhead MPG - Clearwater River Population - Selway

Nez Perce Tribe DFRM Watershed Division

FCRPS BiOP Remand Potential Habitat Actions and Benefits

Col 4	Col 5[1]	Col 6	Col 7		Col 8b	Col 9	Col 10A	Col 10A	Col 11B(1)	Col 11B(2)	PA % of Action			PA % Function at AU scale						
Assessment Unit (AU)	AU Relative Size (AU % of pop. area)	Primary Limiting Factor(s) (PLF) by AU	Current % Function of each listed PLF in AU	PLF Weighted Effect on Survival	Current % Function of Average Habitat at AU	Actions	Resulting % Function of Limiting Factor		Resulting % Function of Habitat at AU scale		Completed (<=10 years)	Near-term (<= 10 years)	Long-term (> 10 years)	Completed (<=10 years)	Near-term (<= 10 years)	Long-term (> 10 years)	Resulting % Function of Limiting Factor		Resulting % Function of Habitat at AU scale	
							10 Years	25 Years	10 Years	25 Years							10 Years	25 Years	10 Years	25 Years
O'Hara Creek	2%	Sediment from roads, timber harvest, cattle grazing - effects on rearing and spawning success, intersticial space and pool volume.	50%	70%	53%	Road Decommissioning and road drainage improvements, Weed Control	65%	75%	67%	75%	50%	50%	50%	53%	53%	53%	50%	50%	55%	55%
		Loss of riparian vegetation and complexity - lack of stream shading resulting in elevated temperatures	60%	30%		Riparian Rehabilitation & Large Woody Debris	70%	75%			60%	60%	60%				66%	68%		
Lower Selway River	4%	Sediment from roads - effects on rearing and spawning success, intersticial space and pool volume.	55%	70%	61%	Riparian Rehabilitation & Sediment Filters	65%	75%	73%	81%	55%	55%	55%	61%	61%	61%	55%	55%	63%	64%
		Lack of passage - Lack of access to diversity of habitats,	75%	30%		Culvert Replacement	90%	95%			75%	75%	75%				80%	85%		
Meadow Creek	17%	Sediment from trails- effects on rearing and spawning success, intersticial space and pool volume.	78%	100%	78%	Trail improvements	80%	85%	80%	85%	78%	78%	78%	78%	78%	78%	79%	84%	79%	84%
Wilderness Area (Moose Creek, Upper Selway River, etc.)	79%	Sediment from trails,- effects on rearing and spawning success, intersticial space and pool volume.	85%	100%	85%	Trail improvements	88%	90%	88%	90%	85%	85%	85%	85%	85%	85%	87%	89%	87%	89%

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Calculation of Steelhead Egg-Smolt Survival Change:

Assumes a maximum egg-smolt survival of 4% under "optimal" conditions.

For Completed Actions up to Year 2000

	Current				Potential			
AU	**Hab (%)**	**SI**	**Weight**	**Totals**	**Hab (%)**	**SI**	**Weight**	**Totals**
O'Hara Creek	53	0.02120	0.015	0.00032	53	0.02120	0.02	0.00032
Lower Selway River	61	0.02440	0.035	0.00085	61	0.02440	0.04	0.00085
Meadow Creek	78	0.03120	0.165	0.00515	78	0.03120	0.17	0.00515
Wilderness Area (Moose Creek, Upper Selway River, etc.)	85	0.03400	0.785	0.02669	85	0.03400	0.79	0.02669
Sum:			**1.000**	**0.033**			**1.00**	**0.033**

Survival Change: 1.00

10-Year Survival For All Actions Possible (no funding limits) Completed within the next 10 Years

	Current				Potential			
AU	**Hab (%)**	**SI**	**Weight**	**Totals**	**Hab (%)**	**SI**	**Weight**	**Totals**
O'Hara Creek	53	0.02120	0.015	0.00032	67	0.02680	0.02	0.00040
Lower Selway River	61	0.02440	0.035	0.00085	73	0.02920	0.04	0.00102
Meadow Creek	78	0.03120	0.165	0.00515	80	0.03200	0.17	0.00528
Wilderness Area (Moose Creek, Upper Selway River, etc.)	85	0.03400	0.785	0.02669	88	0.03520	0.79	0.02763
Sum:			**1.000**	**0.033**			**1.00**	**0.034**

Survival Change: 1.04

25-Year Survival For All Actions Possible (no funding limits) Completed within the next 10 Years

	Current				Potential			
AU	**Hab (%)**	**SI**	**Weight**	**Totals**	**Hab (%)**	**SI**	**Weight**	**Totals**
O'Hara Creek	53	0.02120	0.015	0.00032	75	0.03000	0.02	0.00045
Lower Selway River	61	0.02440	0.035	0.00085	81	0.03240	0.04	0.00113
Meadow Creek	78	0.03120	0.165	0.00515	85	0.03400	0.17	0.00561
Wilderness Area (Moose Creek, Upper Selway River, etc.)	85	0.03400	0.785	0.02669	90	0.03600	0.79	0.02826
Sum:			**1.000**	**0.033**			**1.00**	**0.035**

Survival Change: 1.07

INCLUDING BIOP PROJECTS, 07-09 AND 2010-2016

10-Year Survival For All Actions Completed within the next 10 Years

	Current				Potential			
AU	**Hab (%)**	**SI**	**Weight**	**Totals**	**Hab (%)**	**SI**	**Weight**	**Totals**
O'Hara Creek	53	0.02120	0.015	0.00032	55	0.02200	0.02	0.00033
Lower Selway River	61	0.02440	0.035	0.00085	63	0.02520	0.04	0.00088
Meadow Creek	78	0.03120	0.165	0.00515	79	0.03160	0.17	0.00521
Wilderness Area (Moose Creek, Upper Selway River, etc.)	85	0.03400	0.785	0.02669	87	0.03480	0.79	0.02732
Sum:			**1.000**	**0.033**			**1.00**	**0.034**

Survival Change: 1.02

25-Year Survival For All Actions Completed within the next 10 Years

	Current				Potential			
AU	**Hab (%)**	**SI**	**Weight**	**Totals**	**Hab (%)**	**SI**	**Weight**	**Totals**
O'Hara	53	0.02120	0.015	0.00032	55	0.02200	0.02	0.00033
Lower Selway	61	0.02440	0.035	0.00085	64	0.02560	0.04	0.00090
Creek	78	0.03120	0.165	0.00515	84	0.03360	0.17	0.00554
Wilderness Area (Moose Creek, Upper Selway	85	0.03400	0.785	0.02669	88	0.03520	0.79	0.02763
Sum:			**1.000**	**0.033**			**1.00**	**0.034**

Survival Change: 1.04

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ESU – Snake River Steelhead MPG - Clearwater River Population - S.F. Clearwater

Nez Perce Tribe DFRM Watershed Division

FCRPS BiOP Remand Potential Habitat Actions and Benefits

Col 4	Col 5	Col 6	Col 7		Col 8b	Col 9	Col 10A	Col 10A	Col 11B(1)	Col 11B(2)	PA % of Action			PA % Function at AU scale						
Assessment Unit (AU)	AU Relative Size (AU % of pop. area)	Primary Limiting Factor(s) (PLF) by AU	Current % Function of each listed PLF in AU	PLF Weighted Effect on Survival	Current % Function of Average Habitat at AU	Actions	Resulting % Function of Limiting Factor		Resulting % Function of Habitat at AU scale		Completed (<=10 years)	Near-term (<= 10 years)	Long-term (> 10 years)	Completed (<=10 years)	Near-term (<= 10 years)	Long-term (> 10 years)	Resulting % Function of Limiting Factor		Resulting % Function of Habitat at AU scale	
							10 Years	25 Years	10 Years	25 Years							10 Years	25 Years	10 Years	25 Years
Newsome Creek	12%	Channel Morphology - Channel straightened, lack of pools, lack of pool depth, lack of complexity, lack of cover	40%	60%	38%	Channel / Riparian Rehabilitation	65%	80%	58%	75%	40%	40%	40%	38%	38%	38%	55%	65%	50%	61%
		Loss of riparian vegetation and complexity - dredge mine effects, lack of shade, loss of nutrients	20%	20%		Channel / Riparian Rehabilitation	30%	55%			20%	20%	20%				25%	40%		
		Lack of passage - Lack of access to diversity of habitats,	80%	5%		Culvert Replacement	85%	90%			80%	80%	80%				83%	85%		
		Sediment effects on rearing and spawning success - lack of intersticial space, reduced pool volume, reduced spawning success	40%	15%		Road Decommissioning, Road Improvement, Culvert Removal / Repalcement	60%	75%			40%	40%	40%				50%	65%		
Meadow Creek	5%	Sediment effects on rearing and spawning success - lack of intersticial space, reduced pool volume, reduced spawning success	30%	35%	46%	Road Decommissioning, Soil Restoration, Culvert Removal / Replacement, Weed Control	60%	75%	67%	78%	28%	37%	45%	40%	49%	54%	50%	60%	58%	63%
		Lack of passage - Lack of access to diversity of habitats,	65%	15%		Culvert Replacement	80%	90%			60%	65%	65%				70%	75%		
		Loss of riparian vegetation and complexity - lack of large woody debris recruitment resulting in lack of habitat complexity	55%	20%		Riparian Rehabilitation	70%	80%			45%	55%	60%				62%	65%		
		Loss of riparian vegetation and complexity - lack of stream shading resulting in elevated temperatures	50%	30%		Riparian Rehabilitation	65%	75%			42%	50%	55%				58%	60%		
Mill Creek	2.50%	Lack of passage - Lack of access to diversity of habitats,	75%	20%	60%	Culvert Replacement	85%	90%	73%	81%	65%	85%	85%	56%	64%	65%	78%	81%	66%	69%
		Loss of riparian vegetation and complexity - lack of large woody debris recruitment resulting in lack of habitat complexity	50%	20%		Riparian Rehabilitation	65%	80%			45%	55%	58%				60%	65%		
		Loss of riparian vegetation and complexity - lack of stream shading resulting in elevated temperatures	55%	20%		Riparian Rehabilitation	65%	75%			50%	58%	60%				60%	65%		

		Sediment effets on rearing and spawning success - lack of intersticial space, reduced pool volume, reduced spawning success	60%	40%		Road Improvement, Weed Control	75%	80%			60%	60%	60%				65%	68%		
Ten Mile Creek	5%	Sediment effets on rearing and spawning success - lack of intersticial space, reduced pool volume, reduced spawning success	80%	100%	80%	Road Improvement, Road Decommissioning, Weed Control	85%	90%	85%	90%	80%	80%	80%	80%	80%	80%	80%	80%	80%	80%
John's Creek	3.50%	Loss of riparian vegetation and complexity - lack of large woody debris recruitment resulting in lack of habitat complexity	80%	100%	80%	Riparian Rehabilitation	85%	90%	85%	90%	80%	80%	80%	80%	80%	80%	80%	80%	80%	80%
American River	11	Channel Morphology - Channel straightened, lack of pools, lack of pool depth, lack of complexity, lack of cover	50%	20%	41%	Channel / Riparian Rehabilitation on Telephone, Whitaker, & Queen Creeks. BLM proposed restoration of American River.	60%	70%	49%	60%	50%	50%	50%	51%	51%	51%	55%	65%	56%	64%
		Loss of riparian vegetation and complexity - dredge mine effects, lack of shade, loss of nutrients	35%	20%		Channel / Riparian Rehabilitation on Telephone, Whitaker, & Queen Creeks	40%	65%			35%	35%	35%				38%	45%		
		Lack of passage - Lack of access to diversity of habitats	80%	20%		Culvert Replacement	85%	90%			80%	80%	80%				83%	85%		
		Sediment effects on rearing and spawning success - lack of intersticial space, reduced pool volume, reduced spawning success	40%	20%		Road Decommissioning, Road Improvement, Culvert Removal / Replacement, Weed Control	60%	75%			40%	40%	40%				50%	65%		
		Riparian and channel alteration from floodplain/riparian development	50%	20%		Maines Estate Land Acquisition / Conservation Easements	60%	65%			50%	50%	50%				55%	60%		
Crooked River	7%	Channel Morphology - Channel straightened, lack of pools, lack of pool depth, lack of complexity, lack of cover	30%	40%	39%	Channel / Riparian Rehabilitation, includes both BPA proposals and FS Stewardship actions	50%	70%	53%	68%	30%	30%	30%	39%	39%	39%	40%	55%	46%	57%
		Loss of riparian vegetation and complexity - dredge mine effects, lack of shade, loss of nutrients	25%	30%		Channel / Riparian Rehabilitation, includes both BPA proposals and FS Stewardship actions	35%	50%			25%	25%	25%				30%	40%		
		Lack of passage - Lack of access to diversity of habitats	75%	10%		Culvert Replacement	80%	85%			75%	75%	75%				77%	83%		
		Sediment effects on rearing and spawning success - lack of intersticial space, reduced pool volume, reduced spawning success	60%	20%		Road Decommissioning, Road Improvement, Culvert Removal / Replacement, Weed Control	70%	80%			60%	60%	60%				65%	75%		
Red River	21%	Channel Morphology - Channel straightened, lack of pools, lack of pool depth, lack of complexity, lack of cover	40%	25%	44%	Channel / Riparian Rehabilitation	75%	80%	67%	77%	40%	40%	40%	44%	44%	44%	55%	70%	56%	68%
		Loss of riparian vegetation and complexity - dredge mine effects, lack of shade, loss of nutrients	45%	10%		Channel / Riparian Rehabilitation	60%	70%			45%	45%	45%				53%	60%		
		Lack of passage - Lack of access to diversity of habitats,	50%	25%		Culvert Replacement	70%	80%			50%	50%	50%				60%	70%		
		Sediment effects on rearing and spawning success - lack of intersticial space, reduced pool volume, reduced spawning success	35%	30%		Road Decommissioning, Road Improvement, Culvert Removal / Replacement, Weed Control	60%	75%			35%	35%	35%				50%	65%		
		Riparian and channel alteration from floodplain/riparian development.	60%	10%		Red River Meadows Land Acquisition / Conservation Easements	70%	75%			60%	60%	60%				65%	70%		
SF Mainstem	28%	Sediment effects on rearing and spawning success - lack of intersticial space, reduced pool volume, reduced spawning success	60%	50%	55%	Primarily actions in tributaries (listed above) reducing sediment inputs into mainstem, some coop work with IDOT along Highway 14.	70%	75%	65%	73%	60%	60%	60%	55%	55%	55%	60%	60%	55%	55%

		Temperature effects on rearing and migration	50%	50%		Actions (listed above) in tributaries improving temp conditions in mainistem.	60%	70%			50%	50%	50%				50%	50%		
Misc Other Tributaries	3%	Sediment effects on rearing and spawning success - lack of intersticial space, reduced pool volume, reduced spawning success	50%	30%	53%	Road Decommissioning, Road Improvement, Culvert Removal / Replacement, Weed Control	60%	70%	63%	73%	50%	50%	50%	53%	53%	53%	50%	50%	53%	53%
		Lack of passage - Lack of access to diversity of habitats	50%	40%		Culvert Replacement	60%	70%			50%	50%	50%				50%	50%		
		Loss of riparian vegetation and complexity - dredge mine effects, lack of shade, loss of nutrients	60%	30%		Riparian Rehabilitation	70%	80%			60%	60%	60%				60%	60%		

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Calculation of Steelhead Egg-Smolt Survival Change:

Assumes a maximum egg-smolt survival of 4% under "optimal" conditions.

For Completed Actions up to Year 2000

	Current				Potential			
AU	Hab (%)	SI	Weight	Totals	Hab (%)	SI	Weight	Totals
1-Newsome	38	0.015	0.12	0.002	38	0.015	0.12	0.002
2-Meadow	46	0.018	0.05	0.001	40	0.016	0.05	0.001
3-Mill	60	0.024	0.03	0.001	56	0.022	0.03	0.001
4-Ten Mile	80	0.032	0.05	0.002	80	0.032	0.05	0.002
5- John's	80	0.032	0.04	0.001	80	0.032	0.04	0.001
6-American	41	0.016	0.11	0.002	51	0.020	0.11	0.002
7-Crooked	39	0.016	0.08	0.001	39	0.016	0.08	0.001
8-Red River	44	0.018	0.22	0.004	44	0.018	0.22	0.004
9-SF Mainstem	55	0.022	0.28	0.006	55	0.022	0.28	0.006
10-Misc Other	53	0.021	0.03	0.001	53	0.021	0.03	0.001
Sum:			**1.00**	**0.020**			**1.00**	**0.020**

Survival Change: 1.01

Calculation of Steelhead Egg-Smolt Survival Change:

Assumes a maximum egg-smolt survival of 4% under "optimal" conditions.

For Near-Term Actions (07-09 BPA funding level only) for the next 10 years

	Current				Potential			
AU	Hab (%)	SI	Weight	Totals	Hab (%)	SI	Weight	Totals
1-Newsome	38	0.015	0.12	0.002	38	0.015	0.12	0.002
2-Meadow	46	0.018	0.05	0.001	49	0.020	0.05	0.001
3-Mill	60	0.024	0.03	0.001	64	0.026	0.03	0.001
4-Ten Mile	80	0.032	0.05	0.002	80	0.032	0.05	0.002
5- John's	80	0.032	0.04	0.001	80	0.032	0.04	0.001
6-American	41	0.016	0.11	0.002	51	0.020	0.11	0.002
7-Crooked	39	0.016	0.08	0.001	39	0.016	0.08	0.001
8-Red River	44	0.018	0.22	0.004	44	0.018	0.22	0.004
9-SF Mainstem	55	0.022	0.28	0.006	55	0.022	0.28	0.006
10-Misc Other	53	0.021	0.03	0.001	53	0.021	0.03	0.001
Sum:			**1.00**	**0.020**			**1.00**	**0.020**

Survival Change: 1.03

Calculation of Steelhead Egg-Smolt Survival Change:

Assumes a maximum egg-smolt survival of 4% under "optimal" conditions.

For completed and near-term actions (with 07-09 BPA funding level only) after 10 years

	Current				Potential			
AU	Hab (%)	SI	Weight	Totals	Hab (%)	SI	Weight	Totals
1-Newsome	38	0.015	0.12	0.002	38	0.015	0.12	0.002
2-Meadow	46	0.018	0.05	0.001	54	0.022	0.05	0.001
3-Mill	60	0.024	0.03	0.001	65	0.026	0.03	0.001
4-Ten Mile	80	0.032	0.05	0.002	80	0.032	0.05	0.002
5- John's	80	0.032	0.04	0.001	80	0.032	0.04	0.001
6-American	41	0.016	0.11	0.002	51	0.020	0.11	0.002
7-Crooked	39	0.016	0.08	0.001	39	0.016	0.08	0.001
8-Red River	44	0.018	0.22	0.004	44	0.018	0.22	0.004
9-SF Mainstem	55	0.022	0.28	0.006	55	0.022	0.28	0.006
10-Misc Other	53	0.021	0.03	0.001	53	0.021	0.03	0.001
Sum:			**1.00**	**0.020**			**1.00**	**0.020**

Survival Change: 1.03

10-Year Survival For All Actions Possible (no funding limits) Completed within the next 10 Years

	Current				Potential			
AU	Hab (%)	SI	Weight	Totals	Hab (%)	SI	Weight	Totals
1-Newsome	38	0.015	0.12	0.002	58	0.023	0.12	0.003
2-Meadow	46	0.018	0.05	0.001	67	0.027	0.05	0.001
3-Mill	60	0.024	0.03	0.001	73	0.029	0.03	0.001
4-Ten Mile	80	0.032	0.05	0.002	85	0.034	0.05	0.002
5- John's	80	0.032	0.04	0.001	85	0.034	0.04	0.001
6-American	41	0.016	0.11	0.002	49	0.020	0.11	0.002
7-Crooked	39	0.016	0.08	0.001	53	0.021	0.08	0.002
8-Red River	44	0.018	0.22	0.004	67	0.027	0.22	0.006
9-SF Mainstem	55	0.022	0.28	0.006	65	0.026	0.28	0.007
10-Misc Other	53	0.021	0.03	0.001	63	0.025	0.03	0.001
Sum:			**1.00**	**0.020**			**1.00**	**0.026**

Survival Change: 1.29

25-Year Survival For All Actions Possible (no funding limits) Completed within the next 10 Years

	Current				Potential			
AU	Hab (%)	SI	Weight	Totals	Hab (%)	SI	Weight	Totals
1-Newsome	38	0.015	0.12	0.002	75	0.030	0.12	0.004
2-Meadow	46	0.018	0.05	0.001	78	0.031	0.05	0.002
3-Mill	60	0.024	0.03	0.001	81	0.032	0.03	0.001
4-Ten Mile	80	0.032	0.05	0.002	90	0.036	0.05	0.002
5- John's	80	0.032	0.04	0.001	90	0.036	0.04	0.001
6-American	41	0.016	0.11	0.002	60	0.024	0.11	0.003
7-Crooked	39	0.016	0.08	0.001	68	0.027	0.08	0.002
8-Red River	44	0.018	0.22	0.004	77	0.031	0.22	0.007
9-SF Mainstem	55	0.022	0.28	0.006	73	0.029	0.28	0.008
10-Misc Other	53	0.021	0.03	0.001	73	0.029	0.03	0.001
Sum:			**1.00**	**0.020**			**1.00**	**0.030**

Survival Change: 1.50

INCLUDING BIOP PROJECTS, 07-09 AND 2010-2016

10-Year Survival For All Actions Completed within the next 10 Years

	Current				Potential			
AU	Hab (%)	SI	Weight	Totals	Hab (%)	SI	Weight	Totals
1-Newsome	38	0.015	0.12	0.002	50	0.020	0.12	0.002
2-Meadow	46	0.018	0.05	0.001	58	0.023	0.05	0.001
3-Mill	60	0.024	0.03	0.001	66	0.026	0.03	0.001
4-Ten Mile	80	0.032	0.05	0.002	80	0.032	0.05	0.002
5- John's	80	0.032	0.04	0.001	80	0.032	0.04	0.001
6-American	41	0.016	0.11	0.002	56	0.022	0.11	0.002
7-Crooked	39	0.016	0.08	0.001	46	0.018	0.08	0.001
8-Red River	44	0.018	0.22	0.004	56	0.022	0.22	0.005
9-SF Mainstem	55	0.022	0.28	0.006	55	0.022	0.28	0.006
10-Misc Other	53	0.021	0.03	0.001	53	0.021	0.03	0.001
Sum:			**1.00**	**0.020**			**1.00**	**0.023**

Survival Change: 1.14

25-Year Survival For All Actions Completed within the next 10 Years

	Current				Potential			
AU	Hab (%)	SI	Weight	Totals	Hab (%)	SI	Weight	Totals
1-Newsome	38	0.015	0.12	0.002	61	0.024	0.12	0.003
2-Meadow	46	0.018	0.05	0.001	63	0.025	0.05	0.001
3-Mill	60	0.024	0.03	0.001	69	0.028	0.03	0.001
4-Ten Mile	80	0.032	0.05	0.002	80	0.032	0.05	0.002
5- John's	80	0.032	0.04	0.001	80	0.032	0.04	0.001
6-American	41	0.016	0.11	0.002	64	0.026	0.11	0.003
7-Crooked	39	0.016	0.08	0.001	57	0.023	0.08	0.002
8-Red River	44	0.018	0.22	0.004	68	0.027	0.22	0.006
9-SF Mainstem	55	0.022	0.28	0.006	55	0.022	0.28	0.006
10-Misc Other	53	0.021	0.03	0.001	53	0.021	0.03	0.001
Sum:			**1.00**	**0.020**			**1.00**	**0.025**

Survival Change: 1.26

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ESU – Snake River Steelhead MPG - Salmon River Population - Secesh

Nez Perce Tribe DFRM Watershed Division

FCRPS BiOP Remand Potential Habitat Actions and Benefits

Col 4	Col 5	Col 6	Col 7		Col 8b	Col 9	Col 10A	Col 10B	Col 11B(1)	Col 11B(2)	PA % of Action						
Assessment Unit (AU)	AU Relative Size (AU % of pop. area)	Primary Limiting Factor(s) (PLF) by AU	Current % Function of each listed PLF in AU	PLF Weighted Effect on Survival	Current % Function of Average Habitat at AU Scale	Actions	Resulting % Function of Limiting Factor		Resulting % Function of Habitat at AU scale		habitat function without past actions	Near-term (<= 10 years)	Long-term (> 10 years)	Resulting % Function of Limiting Factor		Resulting % Function of Habitat at AU scale	
							10 Years	25 Years	10 Years	25 Years				10 Years	25 Years	10 Years	25 Years
Entire Secesh Basin	100.0%	Sediment effects on rearing and spawning success - lack of intersticial space, reduced pool volume, reduced spawning success	83%	100%	83%	Road Decommissioning, Road Improvement, Culvert Removal / Replacement, Weed Management, Silvacultural BMPs	92%	94%	92%	94%	83%	83%	83%	88%	92%	88%	92%

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Calculation of Steelhead Egg-Smolt Survival Change:

Assumes a maximum egg-smolt survival of 4% under "optimal" conditions.

Original NOAA Table

	Current					Potential			
AU	Hab (%)	SI	Weight	Totals		Hab (%)	SI	Weight	Totals
Secesh Basin	83%	0.00033	1.00	0.00033		94%	0.00038	1.00	0.00038
Sum:			**1.00**	**0.00033**				**1.00**	**0.00038**

Survival Change: 1.13

INCLUDING BIOP PROJECTS, 07-09 AND 2010-2016

10-Year Survival For All Actions Completed within the next 10 Years

	Current					Potential			
AU	Hab (%)	SI	Weight	Totals		Hab (%)	SI	Weight	Totals
Secesh Basin	83%	0.00033	1.00	0.00033		88%	0.00035	1.00	0.00035
Sum:			**1.00**	**0.00033**				**1.00**	**0.00035**

Survival Change: 1.06

25-Year Survival For All Actions Completed within the next 10 Years

	Current					Potential			
AU	Hab (%)	SI	Weight	Totals		Hab (%)	SI	Weight	Totals
Secesh Basin	83%	0.00033	1.00	0.00033		92%	0.00037	1.00	0.00037
Sum:			**1.00**	**0.00033**				**1.00**	**0.00037**

Survival Change: 1.11

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ESU – Snake River Steelhead MPG - Salmon River Population - S.F. Salmon

Nez Perce Tribe DFRM Watershed Division

FCRPS BiOP Remand Potential Habitat Actions and Benefits

Col 4	Col 5	Col 6	Col 7	Col 8a	Col 8b	Col 9	Col 10A	Col 10B	Col 11B(1)	Col 11B(2)	PA % of Action						
Assessment Unit (AU)	AU Relative Size (AU % of pop. area)	Primary Limiting Factor(s) (PLF) by AU	Current % Function of each listed PLF in AU	PLF Weighted Effect on Survival	Current % Function of Average Habitat at AU	Actions	Resulting % Function of Limiting Factor		Resulting % Function of Habitat at AU scale		habitat function without past actions	Near-term (<= 10 years)	Long-term (> 10 years)	Resulting % Function of Limiting Factor		Resulting % Function of Habitat at AU scale	
							10 Years	25 Years	10 Years	25 Years				10 Years	25 Years	10 Years	25 Years
Hot Dry Canyon Tribs (from mouth of EFSF Salmon to mouth of SF Salmon)	8.1%	Sediment effects on rearing and spawning success - lack of intersticial space, reduced pool volume, reduced spawning success	76%	100%	76%	Road Decommissioning, Road Improvement, Culvert Removal / Replacement, Weed Control, silvacultural BMPs	84%	89%	84%	89%	76%	76%	76%	78%	80%	78%	80%
High Idaho Batholith Tribs (from the headwaters to the mouth of EFSF Salmon)	23.4%	Sediment effects on rearing and spawning success - lack of intersticial space, reduced pool volume, reduced spawning success	73%	80%	75%	Road Decommissioning, Soil Restoration, Culvert Removal / Replacement, Weed Control, Riparian restoration, Silvacultural BMPs, River access management	78%	83%	81%	85%	73%	73%	73%	76%	79%	79%	82%
		Migration Barriers	85%	20%		Assess stream crossings and anthropogenic migration barriers to determine actions necessary for salmonid passage. Provide for salmonid passage at identified passage barriers, Oxbow restoration	95%	95%			85%	85%	85%	92%	92%		
EFSF Salmon and tribs	29.9%	Sediment effects on rearing and spawning success - lack of intersticial space, reduced pool volume, reduced spawning success	62%	65%	66%	Road Decommissioning, Road Improvement, Culvert Removal / Replacement, Riparian Restoration, Mine rehabilitation	70%	75%	74%	77%	62%	64%	66%	65%	67%	69%	71%
		Migration Barriers	78%	20%		Assess stream crossings and anthropogenic migration barriers to determine actions necessary for salmonid passage. Provide for salmonid passage at identified passage barriers. The Stibnite-Glory Hole passage project is a priority.	86%	86%			78%	84%	84%	85%	85%		
		Heavy Metal Contamination	64%	15%		Mine oversight and management to protect and restore water quality and fish habitat. Riparian, floodplain, and wetland restoration.	74%	76%			64%	65%	66%	66%	67%		
Mainstem SF Salmon	38.6%	Sediment effects on rearing and spawning success - lack of intersticial space, reduced pool volume, reduced spawning success	66%	100%	66%	Road Decommissioning, Road Improvement, Culvert Removal / Replacement, Weed Control, silvacultural BMPs	78%	83%	78%	83%	66%	66%	66%	71%	74%	71%	74%

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Calculation of Steelhead Egg-Smolt Survival Change:

Assumes a maximum egg-smolt survival of 4% under "optimal" conditions.

Original NOAA Table (All Actions without any monetary constraints)

	Current				Potential			
AU	**Hab (%)**	**SI**	**Weight**	**Totals**	**Hab (%)**	**SI**	**Weight**	**Totals**
Hot Dry Canyon Tribs (from mouth of EFSF Salmon to	76	0.03040	0.08	0.00246	89	0.03560	0.08	0.00288
High Idaho Batholith Tribs	75	0.03000	0.23	0.00702	85	0.03400	0.23	0.00796
EFSF Salmon	66	0.02640	0.30	0.00789	77	0.03080	0.30	0.00921
Mainstem SF Salmon	66	0.02640	0.39	0.01019	83	0.03320	0.39	0.01282
Sum:			**1.00**	**0.02757**			**1.00**	**0.03286**

Survival Change:	**1.19**

Appendix C-8b South Fork Snake River Summary Table

INCLUDING BIOP PROJECTS, 07-09 AND 2010-2016

10-Year Survival For All Actions Completed within the next 10 Years

AU	Current				Potential			
	Hab (%)	SI	Weight	Totals	Hab (%)	SI	Weight	Totals
Hot Dry Canyon Tribs (from mouth of EFSF Salmon to mouth of SF Salmon)	76	0.03040	0.08	0.00246	78	0.03120	0.08	0.00253
High Idaho Batholith Tribs	75	0.03000	0.23	0.00702	79	0.03160	0.23	0.00739
EFSF Salmon	66	0.026	0.30	0.008	69	0.028	0.30	0.008
Mainstem SF Salmon	66	0.026	0.39	0.010	71	0.028	0.39	0.011
Sum:			**1.00**	**0.02757**			**1.00**	**0.02914**

Survival Change:	**1.06**

25-Year Survival For All Actions Completed within the next 10 Years

AU	Current				Potential			
	Hab (%)	SI	Weight	Totals	Hab (%)	SI	Weight	Totals
Hot Dry Canyon Tribs (from mouth of EFSF Salmon to mouth of SF Salmon)	76	0.03040	0.08	0.00246	80	0.03200	0.08	0.00259
High Idaho Batholith Tribs	75	0.03000	0.23	0.00702	82	0.03280	0.23	0.00768
EFSF Salmon	66	0.026	0.30	0.008	71	0.028	0.30	0.008
Mainstem SF Salmon	66	0.026	0.39	0.010	74	0.030	0.39	0.011
Sum:			**1.00**	**0.02757**			**1.00**	**0.03018**

Survival Change:	**1.09**

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ESU – Snake River Steelhead MPG - Salmon River Population

Nez Perce Tribe DFRM Watershed Division

FCRPS BiOP Remand Potential Habitat Actions and Benefits

Col 4	Col 5	Col 6	Col 7		Col 8b	Col 9	Col 10A	Col 10B	Col 11B(1)	Col 11B(2)	PA % of Action						
Assessment Unit (AU)	AU Relative Size (AU % of pop. area)	Primary Limiting Factor(s) (PLF) by AU	Current % Function of each listed PLF in AU	PLF Weighted Effect on Survival	Current % Function of Average Habitat at AU Scale	Actions	Resulting % Function of Limiting Factor		Resulting % Function of Habitat at AU scale		Completed (<=10 years)	Near-term (<= 10 years)	Long-term (> 10 years)	Resulting % Function of Limiting Factor		Resulting % Function of Habitat at AU scale	
							10 Years	25 Years	10 Years	25 Years				10 Years	25 Years	10 Years	25 Years
Entire Big Creek Watershed	100.0%	Chemical Pollution From Mining Activities	87%	30%	85%	Mine Rehabilitation and Riparian Restoration	89%	92%	91%	93%	87%	87%	87%	89%	91%	91%	93%
		Sediment effects on rearing and spawning success - lack of intersticial space, reduced pool volume, reduced spawning success	83%	40%		Road Decommissioning, Road Improvement, Culvert Removal / Replacement, Riparian Restoration near Mining Sites, Weed Management, Silvacultural BMPs	90%	94%			83%	83%	83%	90%	94%		
		Migration Barriers associated with roads and mining activities	86%	30%		Assess stream crossings and anthropogenic migration barriers to determine actions necessary for salmonid passage. Provide for salmonid passage at identified passage barriers (e.g., culvert replacement)	94%	94%			86%	86%	86%	93%	93%		

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Calculation of Steelhead Egg-Smolt Survival Change:

Assumes a maximum egg-smolt survival of 4% under "optimal" conditions.

Original NOAA Table (All actions without monetary constraints)

	Current				Potential			
AU	**Hab (%)**	**SI**	**Weight**	**Totals**	**Hab (%)**	**SI**	**Weight**	**Totals**
Big Creek Watershed	85%	0.00034	1.00	0.00034	93%	0.00037	1.00	0.00037
Sum:			**1.00**	**0.00034**			**1.00**	**0.00037**

Survival Change: 1.09

INCLUDING BIOP PROJECTS, 07-09 AND 2010-2016

10-Year Survival For All Actions Completed within the next 10 Years

	Current				Potential			
AU	**Hab (%)**	**SI**	**Weight**	**Totals**	**Hab (%)**	**SI**	**Weight**	**Totals**
Big Creek Watershed	85%	0.00034	1.00	0.00034	91%	0.00036	1.00	0.00036
Sum:			**1.00**	**0.00034**			**1.00**	**0.00036**

Survival Change: 1.07

25-Year Survival For All Actions Completed within the next 10 Years

	Current				Potential			
AU	**Hab (%)**	**SI**	**Weight**	**Totals**	**Hab (%)**	**SI**	**Weight**	**Totals**
Big Creek Watershed	85%	0.00034	1.00	0.00034	93%	0.00037	1.00	0.00037
Sum:			**1.00**	**0.00034**			**1.00**	**0.00037**

Survival Change:	**1.09**

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Population	Assessment Unit (AU)	AU Relative Size (AU % of pop. area)	Primary Limiting Factor(s) (PLF) by AU	Revisited Current % Function	Revisited Current % Function of Average Habitat at AU	Actions	Incremental Change in Habitat Function 2017-2007	Revisited Resulting % Function of Limiting Factor		Revisited Resulting % Function of Habitat at AU scale		07-09 Actions (<= 10 years)	07-09 Actions (> 10 years)	2007-2017 Habitat Actions		Incremental change in habitat function			Multipliers			Incremental Change in Habitat Function for 2010-2017 Actions at AU Scale		
								10 Years	25 Years	10 Years	25 Years			10 Years	25 Years	Scenario 1		Scenario 3	Scenario 1	Scenario 2	Scenario 3	Scenario 1	Scenario 2	Scenario 3
	Lower Wenatchee	0.022	High stream temperature	80	77	Increase Stream Flows to decrease temperature (See Flows)	1	81	81	79	81	80	80	78	78	0.4	0.25	0.6	0.4	0.5	0.6	0.9	0.8625	0.5375
			Low Stream flow	70		Improve general on farm Irrigation efficiency	2	72	72			70	70			0.8	0.2	0.2	0.05	0.1	0.05			
						Conversion of small pumps to wells																		
						Improve Irrigation delivery and use efficiency																		
			In-channel habitat quantity	60		Assess feasibility of reconnection side channels under Highway 2	5	65	70			62	64			2	2.5	0.75	0.25	0.15	0.1			
						Reconnect side channel																		
						Implement other CMZ Projects																		
						Evaluate Habitat lost and cost/benefits for Dams																		
						Riparian Plantings																		
			Barriers to passage or access	98		Passage Restoration	1	99	99			98	98			0.4	0.5	0.6	0.5	0.4	0.75			
	Mission	0.054	High stream temperature	55	44	See Riparian Action and Flows	5	60	60	53	54	55	55	46	46	2	1.25	3	0.4	0.5	0.6	3.6	2.5	3.26
			Low Stream flow	20		Increase Irrigation efficiency	20	40	40			20	20			8	2	2	0.05	0.1	0.05			
						water purchase, lease, transfers																		
						Identify and stop unpermitted irrigation withdrawal																		
			Riparian and floodplain function	55		See actions, location for habitat Quality conditions.	3	58	60			55	55.25			1.2	0.75	1.8	0.4	0.5	0.6			
						Riparian Restoration																		
			In-channel habitat quantity	20		Implement IRIS Program elements	2	22	26			20	20			0.8	1	0.5	0.25	0.15	0.1			
						Reconnect side channel																		
						Install pool forming in-channel structures																		
			Barriers to passage or access	70		Restore passage with Mission Creek prioritized	15	85	85			82	82			6	7.5	9	0.5	0.4	0.75			

Population	Assessment Unit (AU)	AU Relative Size (AU % of pop. area)	Primary Limiting Factor(s) (PLF) by AU	Revisited Current % Function	Revisited Current % Function of Average Habitat at AU	Actions	Incremental Change in Habitat Function 2017-2007	Revisited Resulting % Function of Limiting Factor		Revisited Resulting % Function of Habitat at AU scale		07-09 Actions (<= 10 years)	07-09 Actions (> 10 years)			Incremental change in habitat function			Multipliers			Incremental Change in Habitat Function for 2010-2017 Actions at AU Scale		
								10 Years	25 Years	10 Years	25 Years			10 Years	25 Years	Scenario 1		Scenario 3	Scenario 1	Scenario 2	Scenario 3	Scenario 1	Scenario 2	Scenario 3
Wenatchee River	Peshastin	0.104	High stream temperature	98	67		1	99	99	78	79	98	98	67	67	0.4	0.25	0.6	0.4	0.5	0.6	4.6	3.6875	2.525
			Low Stream flow	20		Irrigation Efficiency and passage	20	40	40			20	20			8	2	2	0.05	0.1	0.05			
			In-channel habitat quantity	55		Develop side-channel habitat (from CMZ).	20	75	78			57	57			8	10	4.5	0.25	0.15	0.1			
						Evaluate effects to riparian and stream channel structure																		
						Evaluate National Forests road effects to riparian and stream channel structure (USFS)																		
						Acquire easements and re-establish connection as opportunities arise below Ingalls Creek.																		
						Install Pool forming In-Channel Structures																		
						Conduct LIDAR																		
						Install stream structures to increase thalwag depth.																		
			Barriers to passage or access	93		Culvert Replacement	5	98	98			93	93			2	2.5	3	0.5	0.4	0.75			
	Chumstick	0.124	High stream temperature	80	66	Riparian Restoration - plantings	4	84	89	77	81	81	82	67	69	1.6	0.75	2.4	0.4	0.5	0.6	4.56	4.1	5.49
						Evaluate Biological Oxygen Demand affect on Dissolved Oxygen																		
						Remove metallic and other debris from stream channel.																		
			Low Stream flow	70		Evaluate and eliminate unpermitted water withdrawal and use	10	80	80			70	70			4	1	1	0.05	0.1	0.05			
						Conduct a surface/ground water interaction study																		
			Riparian and floodplain function	55		Reduce noxious weeds and restore native riparian vegetation	9	64	75			57	65			3.6	1.75	5.4	0.4	0.5	0.6			
						Livestock Control Fencing																		
						Noxious weed control																		
						Re-establish native vegetation																		
			In-channel habitat quantity	55		Reduce Road Densities	5	60	60			55	55			2	2.5	1.25	0.25	0.15	0.1			
						Reconnect side-channel																		
			Barriers to passage or access	70		Culvert Replacement	29	99	99			72	72			11.6	14.5	17.4	0.5	0.4	0.75			
						North Road																		

Population	Assessment Unit (AU)	AU Relative Size (AU % of pop. area)	Primary Limiting Factor(s) (PLF) by AU	Revisited Current % Function	Revisited Current % Function of Average Habitat at AU	Actions	Incremental Change in Habitat Function 2017-2007	Revisited Resulting % Function of Limiting Factor		Revisited Resulting % Function of Habitat at AU scale		07-09 Actions (<= 10 years)	07-09 Actions (> 10 years)			Incremental change in habitat function			Multipliers			Incremental Change in Habitat Function for 2010-2017 Actions at AU Scale		
								10 Years	25 Years	10 Years	25 Years			10 Years	25 Years	Scenario 1		Scenario 3	Scenario 1	Scenario 2	Scenario 3	Scenario 1	Scenario 2	Scenario 3
	Nason	0.119	High stream temperature	80	71		0	80	80	81	85	80	80	72	72	0	0	0	0.4	0.5	0.6	4.2	2.35	1.725
			In-channel habitat quantity	55		Conduct LIDAR	8	63	65			59	59			3.2	4	1	0.25	0.15	0.1			
						Acquire conservation easements																		
						Focus riparian plantings in floodplain areas, residential developments and side-channel developments																		
						Detailed lower river restoration evaluation and action plan in Nason																		
						Side/Off channel reconnections and restoration																		
						Move Highway 207 where adjacent to Nason Creek. (CMZ)																		
			Nutrients for food chain	55		Add nutrients using hatchery carcasses and/or carcass analogs	29	84	96			55	55			11.6	2.9	2.9	0	0.1	0.05			
			Barriers to passage or access	93		Restore Passage	5	98	98			93	93			2	2.5	3	0.5	0.4	0.75			
	Icicle	0.165	Low Stream flow	55	63	Work with irrigation districts to increase irrigation delivery and use efficiency	5	60	60	74	75	55	55	63	64	2	0.5	0.5	0.05	0.1	0.05	4.6	5.25	5.8375
						Improve intake, providing pump back (20 cfs) and improving the delivery pipe																		
			Riparian and floodplain function	70		Riparian Plantings	1	71	75			71	75			0.4	0.5	0.6	0.4	0.5	0.6			
						Acquire conservation easements or exercise other opportunities																		
						Conduct LIDAR																		
			In-channel habitat quantity	70		Reconnect side channel above LNFH	5	75	75			70	70			2	2.5	1.25	0.25	0.15	0.1			
			Barriers to passage or access	55		Restore Passage	35	90	90			55	55			14	17.5	21	0.5	0.4	0.75			
			Diversions			Screen Diversions																		
	Upper Wenatchee	0.104	In-channel habitat quantity	80	85	Riparian plantings for bank stabilization	3	83	88	91	93	80	80	89	89	1.2	1.5	0.75	0.25	0.15	0.1	2.2	2.75	2.775
						River Road Modification / Relocation																		
						Large wood structures																		
						Evaluate Habitat lost and cost/benefits for Dam																		
			Barriers to passage or access	90		Replace culverts	8	98	98			98	98			3.2	4	4.8	0.5	0.4	0.75			
			Habitat Diversity (Chiwaukum)			Riparian Restoration/Floodplain																		
						Floodplain Restoration																		
	Chiwawa	0.194	In-channel habitat quantity	93	93	Management of Recreation Areas (USFS)	1	94	95	96	97	93	93	94	94	0.4	0.5	0.25	0.25	0.15	0.1	1.06666667	1.25	1.48333333
						Acquire conservation easements and pursue other innovative measures																		
			Barriers to passage or access	93		Culvert replacement	6	99	99			95	95			2.4	3	3.6	0.5	0.4	0.75			
			Riparian/floodplain	93		Restoration (NF - Private)	1	94	96			93	93			0.4	0.25	0.6	0.4	0.5	0.6			
	Little Wenatchee	0.038	In-channel habitat quantity	97	97	Decommission roads, plant natives, restore mainstem and tributary connections	1	98	99	98	99	97	97	97	97	0.4	0.5	0.25	0.25	0.15	0.1	0.4	0.5	0.25
	White	0.074	In-channel habitat quantity	95	95	Acquire conservation acquisition / easements	1	96	98	96	98	95	95	95	95	0.4	0.5	0.25	0.25	0.15	0.1	0.4	0.5	0.25
						Focus riparian plantings in floodplain areas, residential developments and side-channel developments																		

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Wenatchee Steelhead Egg-Smolt Survival Change:

Assumed maximum egg-smolt survival under "optimal" conditions:

Base Info					Estimated 10-Year Juvenile Survivals						Estimated 25-Year Juvenile Survivals					
								BPA and Reclamation Actions only								
		Current			100 % Completed			Near-Term			Compelted + Near-Term			100% Completed		
AU	Weight	Hab (%)	Survival	Totals	Hab (%)	Survival	Totals	Hab (%)	Survival	Totals	Hab (%)	Survival	Totals	Hab (%)	Survival	Totals
1	0.022	77	0.031	0.001	79	0.032	0.001	78	0.031	0.001	78	0.031	0.001	81	0.032	0.001
2	0.054	44	0.018	0.001	53	0.021	0.001	46	0.018	0.001	46	0.019	0.001	54	0.022	0.001
3	0.104	67	0.027	0.003	78	0.031	0.003	67	0.027	0.003	67	0.027	0.003	79	0.032	0.003
4	0.124	66	0.026	0.003	77	0.031	0.004	67	0.027	0.003	69	0.028	0.003	81	0.032	0.004
5	0.119	71	0.028	0.003	81	0.033	0.004	72	0.029	0.003	72	0.029	0.003	85	0.034	0.004
6	0.165	63	0.025	0.004	74	0.030	0.005	63	0.025	0.004	64	0.026	0.004	75	0.030	0.005
7	0.104	85	0.034	0.004	91	0.036	0.004	89	0.036	0.004	89	0.036	0.004	93	0.037	0.004
8	0.194	93	0.037	0.007	96	0.038	0.007	94	0.037	0.007	94	0.037	0.007	97	0.039	0.008
9	0.038	97	0.039	0.001	98	0.039	0.001	97	0.039	0.001	97	0.039	0.001	99	0.040	0.002
10	0.074	95	0.038	0.003	96	0.038	0.003	95	0.038	0.003	95	0.038	0.003	98	0.039	0.003
Sum:	**1.00**			**0.030**			**0.033**			**0.031**			**0.031**			**0.034**
		Survival Change:		**1.00**	**Survival Change:**		**1.099**	**Survival Change:**		**1.013**	**Survival Change:**		**1.019**	**Survival Change:**		**1.123**

Wenatchee Steelhead Summary of Egg-Smolt Survival Change from Current Condition:

Estimated 10-Year Juvenile Survivals		Estimated 25-Year Juvenile Survivals	
	BPA and Reclamation Actions only		
100 % Completed	Near-Term	Compelted + Near-Term	100% Completed
10%	1%	2%	12%

	Weight	Scenario 1			Scenario 2			Scenario 3		
		Hab (%)	Survival	Totals	Hab (%)	Survival	Totals	Hab (%)	Survival	Totals
1	0.022	0.90	0.000	0.000	0.86	0.000	0.000	0.54	0.000	0.000
2	0.054	3.60	0.001	0.000	2.50	0.001	0.000	3.26	0.001	0.000
3	0.104	4.60	0.002	0.000	3.69	0.001	0.000	2.53	0.001	0.000
4	0.124	4.56	0.002	0.000	4.10	0.002	0.000	5.49	0.002	0.000
5	0.119	4.20	0.002	0.000	2.35	0.001	0.000	1.73	0.001	0.000
6	0.165	4.60	0.002	0.000	5.25	0.002	0.000	5.84	0.002	0.000
7	0.104	2.20	0.001	0.000	2.75	0.001	0.000	2.78	0.001	0.000
8	0.194	1.07	0.000	0.000	1.25	0.001	0.000	1.48	0.001	0.000
9	0.038	0.40	0.000	0.000	0.50	0.000	0.000	0.25	0.000	0.000
10	0.074	0.40	0.000	0.000	0.50	0.000	0.000	0.25	0.000	0.000
Sum:	**1.00**			**0.001**			**0.001**			**0.001**
		Survival Change from 2007-2017 Actions		**3.9%**			**3.6%**			**3.8%**

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Population	Assessment Unit (AU)	AU Relative Size (AU % of pop. area)	Primary Limiting Factor(s) (PLF) by AU	Revisited Current % Function	Revisited Current % Function of Average Habitat at AU	Actions	Incremental Change in Habitat Function 2017-2007	Revisited Resulting % Function of Limiting Factor		Revisited Resulting % Function of Habitat at AU scale		07-09 Actions (<= 10 years)	07-09 Actions (> 10 years)			Estimated Incremental Change in Habitat Function for 2007-2017 Actions			Multiplier			Incremental Change in Habitat Function for 2007-2017 Actions at AU Scale		
								10 Years	25 Years	10 Years	25 Years			10 Years	25 Years	Scenario 1	Scenario 2	Scenario 3	Scenario 1	Scenario 2	Scenario 3	Scenario 1	Scenario 2	Scenario 3
	Lower Methow	0.286	Low stream flow	93	89	Restore flows where feasible	0	93	93	89	89	93	93	89	89	0	0	0	0.1	0.05	0.2	0.25	0.23	0.30
						reestablish natural off channel storage capacity areas by reconnecting side channels, wetlands, beaver ponds.																		
						Restoration natural water storage areas																		
			Riparian and floodplain function	80		Revegetate riparian areas along unused agricultural areas	1	81	81			80	80			0.75	0.7	0.9	0.75	0.7	0.9			
						Soften rip rap																		
						Protect cottonwood forests, replant unused riparian agricultural areas where feasible.																		
			In-channel habitat quantity	93		Dike removal and side channel reconnection where appropriate	0	93	93			93	93			0	0	0	0.75	0.9	0.6			
						Protect relatively intact areas and restore existing areas																		
	Middle Methow	0.057	Low stream flow	75	61	Maintain natural water storage function	12	87	87	73	77	75	75	67	69	1.2	0.6	2.4	0.1	0.05	0.2	2.85	2.40	2.88
						Water Management Options including Irrigation efficiencies, Trust Water Rights Program, water lease banking																		
			Riparian and floodplain function	45		Protection Riparian and Floodplain	5	50	60			48	55			3.75	3.5	4.5	0.75	0.7	0.9			
						Revegetate riparian areas along unused agricultural areas																		
			In-channel habitat quantity	55		Assessment and implement as appropriate	3	58	64			58	61			2.25	2.7	1.8	0.75	0.9	0.6			
						Assess and inventory mill ponds (and others) relationship to mainstem (acclimation, off-channel habitat, etc)																		
						Dike removal (partial) and channel reconnections)																		
						BOR Reach Complex Side channel and main channel modification / re-connect, levy removal, and floodplain restoration																		
			Barriers to passage/access	70		Continued assess all species passage	28	98	98			85	85			4.2	2.8	2.8	0.15	0.1	0.1			
						Upgrade passage and screening at irrigation diversions																		

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								10 Years	25 Years	10 Years	25 Years			10 Years	25 Years	Scenario 1	Scenario 2	Scenario 3	Scenario 1	Scenario 2	Scenario 3	Scenario 1	Scenario 2	Scenario 3
	Upper Methow	0.049	In-channel habitat quantity	85	93	Bridge reconstruction	5	90	90	95	95	87	87	94	94	3.75	4.5	3	0.75	0.9	0.6	1.88	2.25	1.50
						Evaluate feasibility (coordinate with Conservancy - on-going channel studies) for dike removal / floodplain reconnection																		
						Habitat Protection																		
						Respect the River Program																		
						BOR Reach Complex, Primarily in-channel structures, floodplain restoration and protection,																		
						riparian, floodplain, side channel where appropriate																		
			Barriers to passage/access	100			0	100	100			100	100			0	0	0	0.15	0.1	0.1			
	Early Winters/ Lost River	0.021	Low stream flow	100	83	Water Quantity Restoration	0	100	100	91	95	100	100	84	84	0	0	0	0.1	0.05	0.2	5.75	6.57	5.10
						Encourage water use efficiency																		
						Move to ground water conversion (wells) (NRCS conversion)																		
			Riparian and floodplain function	75		Riparian / Floodplain Protection	5	80	93			75	75			3.75	3.5	4.5	0.75	0.7	0.9			
			In-channel habitat quantity	75		Implement Respect the River program	18	93	93			78	78			13.5	16.2	10.8	0.75	0.9	0.6			
						Encourage Channel Migration - Relocate road and campsite to allow river migration																		
						BOR Reach complex Primarily complexity and side channel development																		
						Establish flood channel - management plan																		
						Rebuild bridges to alleviate channel constriction																		
						Engineered Log Jams																		
	Black Canyon/ Squaw Creek	0.012	Low stream flow	50	78	Water Quantity Restoration	0	50	50	80	82	50	50	78	78	0	0	0	0.1	0.05	0.2	1.88	1.75	2.25
			Riparian and floodplain function	80		Wetlands at Black Canyon Snow Park Relocate snow park at RM 1.0	10	90	95			80	80			7.5	7	9	0.75	0.7	0.9			
						Riparian, Floodplain and Side Channel Restoration																		
			In-channel habitat quantity	90			0	90	90			90	90			0	0	0	0.75	0.9	0.6			
			Barriers to passage/access	91		USFS- Replace barrier culvert at RM 1.0. for steelhead	0	91	91			91	91			0	0	0	0.15	0.1	0.1			

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								10 Years	25 Years	10 Years	25 Years			10 Years	25 Years	Scenario 1	Scenario 2	Scenario 3	Scenario 1	Scenario 2	Scenario 3	Scenario 1	Scenario 2	Scenario 3
Methow River	Gold/Libby Creek	0.061	Low stream flow	80	66	Water Quantity Restoration	0	80	80	75	83	80	80	66	66	0	0	0	0.1	0.05	0.2	5.81	6.13	5.75
			Riparian and floodplain function	45		Riparian, Floodplain, Side Channel, Large Woody Debris and Instream Structure Restoration	15	60	75			45	45			11.25	10.5	13.5	0.75	0.7	0.9			
						USFS- Implement Respect the River Restore about 30 acres of riparian habitat																		
			In-channel habitat quantity	45		Road Management - Transportation planning in Gold and Libby: reconstruction, heavy maintenance, replace undersized culverts	15	60	75			45	45			11.25	13.5	9	0.75	0.9	0.6			
						Add log and rock complexes to channel at key locations to reactivate floodplain where appropriate																		
			Barriers to passage/access	95		Correct NF fish barriers	5	100	100			95	95			0.75	0.5	0.5	0.15	0.1	0.1			
						Restore upstream and downstream passage at irrigation dams on private land																		
	Beaver/ Bear Creek	0.1	High stream temperature	40	57		15	55	55	67	70	40	40	61	63	11.25	10.5	13.5	0.75	0.7	0.9	4.23	3.78	5.15
			Excess fine sediment	75		Transportation planning in Beaver creek watershed: reconstruction, heavy maintenance, replace undersized culverts in Lightning Cr.	5	80	85			75	75			0	0	0	0	0	0			
			Low stream flow	40		Water Quantity Restoration	15	55	55			50	50			1.5	0.75	3	0.1	0.05	0.2			
						Reestablish beaver populations and restore beaver habitats where feasible.																		
						Aquifer Recharge																		
						Water Conservation, restore natural water storage areas																		
						Livestock exclusion fence maintenance on NF																		
			Riparian and floodplain function	60		Riparian, Floodplain, Large Woody Debris and Instream Structures Restoration	15	75	85			70	80			11.25	10.5	13.5	0.75	0.7	0.9			
						Implement Respect the River: 20 acres on NF and 40 acres on WDFW																		
			In-channel habitat quantity	60		enforcement of NF firewood cutting regulations	0	60	60			60	60			0	0	0	0.75	0.9	0.6			
						Beaver reintroduction																		
			Barriers to passage/access	68		Passage Restoration	9	77	80			73	73			1.35	0.9	0.9	0.15	0.1	0.1			
						Improvement in flows and culvert replacement																		
						culvert replacement for fish passage on USFS																		

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								10 Years	25 Years	10 Years	25 Years			10 Years	25 Years	Scenario 1	Scenario 2	Scenario 3	Scenario 1	Scenario 2	Scenario 3	Scenario 1	Scenario 2	Scenario 3
	Lower Twisp	0.1	Low stream flow	20	46	improve irrigation efficiency and reduce withdrawals from mainstem Twisp R.	20	40	40	66	70	20	20	54	56	2	1	4	0.1	0.05	0.2	5.38	4.85	5.38
						Improve late summer base flow condition																		
						Reestablish beaver populations thus providing natural storage																		
			Riparian and floodplain function	55		Fence wetlands and riparian areas on USFS to allow recovery from livestock grazing and beaver recolonization. Protect steelhead and bull trout spawning areas.	9	64	75			60	62			6.75	6.3	8.1	0.75	0.7	0.9			
						BOR Reach Complex Side channel reconnection, LWD recruitment, levee removal, riparian restoration.																		
			In-channel habitat quantity	55		Dike and levee modification or removal. Remove or modify levees and dike were appropriate	9	64	70			60	65			6.75	8.1	5.4	0.75	0.9	0.6			
						Replace undersized culverts to restore alluvial fan function and delivery of LWD and gravel to Twisp River.																		
						Continue implementation of Respect the River program at dispersed and developed recreation sites																		
			Barriers to passage/access	55		Replace undersized culverts	40	95	95			75	75			6	4	4	0.15	0.1	0.1			
						Remove War Creek Weirs																		
						Upgrade passage and screening at irrigation diversions																		
	Upper Twisp	0.043	Riparian and floodplain function	80	89	Riparian, Floodplain and Side Channel Restoration	10	90	95	93	96	85	90	90	92	7.5	7	9	0.75	0.7	0.9	2.80	2.67	3.23
						Restore alluvial fan function - Relocate Twisp River trail to top end of fan, reduce road density on fan, remove abandoned Klinkert cabin, irrigation pipe and revegetate site; continue to implement Respect the River at large dispersed site.																		
						BOR Reach Complex - Modify levees, riparian restoration, LWD recruitment and side channel reconnection																		
			In-channel habitat quantity	93		Continue to implement Respect the River program	1	94	96			93	93			0.75	0.9	0.6	0.75	0.9	0.6			
			Barriers to passage/access	93			1	94	96			93	93			0.15	0.1	0.1	0.15	0.1	0.1			

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								10 Years	25 Years	10 Years	25 Years			10 Years	25 Years	Scenario 1	Scenario 2	Scenario 3	Scenario 1	Scenario 2	Scenario 3	Scenario 1	Scenario 2	Scenario 3
	Lower Chewuch	0.024	High stream temperature	80	67	See Riparian Habitat Actions	1	81	84	77	82	80	80	72	72	0.75	0.7	0.9	0.75	0.7	0.9	4.11	3.98	3.82
			Low stream flow	75		Water Quantity Restoration	0	75	75			75	75			0	0	0	0.1	0.05	0.2			
						Improve natural water storage by allowing beaver recolonization																		
						Road density/drainage network - water storage and timing of runoff																		
			Riparian and floodplain function	55		Continue Respect the River and expand to Eightmile	10	65	75			55	55			7.5	7	9	0.75	0.7	0.9			
						Livestock fencing (riparian protection) - fence riparian areas and wetlands; maintain existing fences																		
			In-channel habitat quantity	55		BOR Reach Complex - Primarily side channel and habitat complexity	10	65	75			65	65			7.5	9	6	0.75	0.9	0.6			
			Barriers to passage/access	68		Passage Restoration	32	100	100			85	85			4.8	3.2	3.2	0.15	0.1	0.1			
						Eightmile fish passage - Reconstruct road and channel for about 300'																		
	Upper Chewuch	0.212	Riparian and floodplain function	80	80	Riparian Restoration	1	81	89	83	90	80	80	80	80	0.75	0.7	0.9	0.75	0.7	0.9	2.25	2.60	1.95
						USFS Programmatic Riparian Management																		
			In-channel habitat quantity	80		Continue Respect the River	5	85	90			80	80			3.75	4.5	3	0.75	0.9	0.6			
						Beaver colonization - Programmatic																		
	Wolf/ Hancock Creek	0.023	Low stream flow	80	57	Well conversions	0	80	80	63	70	80	80	58	62	0	0	0	0.1	0.05	0.2	5.00	5.67	4.50
						Irrigation efficiency and water banking																		
			Riparian and floodplain function	50		Livestock management - Off-channel livestock water facility	5	55	65			50	50			3.75	3.5	4.5	0.75	0.7	0.9			
						Restoration 30%+ of lineal stream area																		
						Riparian re-plantings protection (1 stream mile - lower) conservations easement																		
			In-channel habitat quantity	40			15	55	65			45	55			11.25	13.5	9	0.75	0.9	0.6			
	Goat/Little Boulder Creek	0.012	Low stream flow	80	63		0	80	80	73	80	80	80	63	63	0	0	0	0.1	0.05	0.2	7.50	8.00	7.50
			Riparian and floodplain function	50			20	70	85			50	50			15	14	18	0.75	0.7	0.9			
			In-channel habitat quantity	50			20	70	85			50	50			15	18	12	0.75	0.9	0.6			
			Barriers to passage/access	70			0	70	70			70	70			0	0	0	0.15	0.1	0.1			

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Methow Steelhead Egg-Smolt Survival Change:

Assumed maximum egg-smolt survival under "optimal" conditions: **4%**

Base Info					Estimated 10-Year Juvenile Survivals						Estimated 25-Year Juvenile Survivals					
								BPA and Reclamation Actions only								
		Current			100 % Completed			Near-Term			Compelted + Near-Term			100% Completed		
AU	Weight	Hab (%)	Survival	Totals	Hab (%)	Survival	Totals	Hab (%)	Survival	Totals	Hab (%)	Survival	Totals	Hab (%)	Survival	Totals
1	0.286	89	0.035	0.010	89	0.036	0.010	89	0.035	0.010	89	0.035	0.010	89	0.036	0.010
2	0.057	61	0.025	0.001	73	0.029	0.002	67	0.027	0.002	69	0.028	0.002	77	0.031	0.002
3	0.049	93	0.037	0.002	95	0.038	0.002	94	0.037	0.002	94	0.037	0.002	95	0.038	0.002
4	0.021	83	0.033	0.001	91	0.036	0.001	84	0.034	0.001	84	0.034	0.001	95	0.038	0.001
5	0.012	78	0.031	0.000	80	0.032	0.000	78	0.031	0.000	78	0.031	0.000	82	0.033	0.000
6	0.061	66	0.027	0.002	75	0.030	0.002	66	0.027	0.002	66	0.027	0.002	83	0.033	0.002
7	0.1	57	0.023	0.002	67	0.027	0.003	61	0.025	0.002	63	0.025	0.003	70	0.028	0.003
8	0.1	46	0.019	0.002	66	0.026	0.003	54	0.022	0.002	56	0.022	0.002	70	0.028	0.003
9	0.043	89	0.035	0.002	93	0.037	0.002	90	0.036	0.002	92	0.037	0.002	96	0.038	0.002
10	0.024	67	0.027	0.001	77	0.031	0.001	72	0.029	0.001	72	0.029	0.001	82	0.033	0.001
11	0.212	80	0.032	0.007	83	0.033	0.007	80	0.032	0.007	80	0.032	0.007	90	0.036	0.008
12	0.023	57	0.023	0.001	63	0.025	0.001	58	0.023	0.001	62	0.025	0.001	70	0.028	0.001
13	0.012	63	0.025	0.000	73	0.029	0.000	63	0.025	0.000	63	0.025	0.000	80	0.032	0.000
Sum:	**1.00**			**0.030**			**0.032**			**0.031**			**0.031**			**0.034**
		Survival Change:		**1.00**	**Survival Change:**		**1.079**	**Survival Change:**		**1.024**	**Survival Change:**		**1.033**	**Survival Change:**		**1.124**

Methow Steelhead Summary of Egg-Smolt Survival Change from Current Condition:

Estimated 10-Year Juvenile Survivals		Estimated 25-Year Juvenile Survivals	
	BPA and Reclamation Actions only		
100 % Completed	Near-Term	Compelted + Near-Term	100% Completed
8%	2%	3%	12%

AU	Weight	Scenario 1			Scenario 2			Scenario 3		
		Hab (%)	Survival	Totals	Hab (%)	Survival	Totals	Hab (%)	Survival	Totals
1	0.286	0.25	0.000	0.000	0.23	0.000	0.000	0.30	0.000	0.000
2	0.057	2.85	0.001	0.000	2.40	0.001	0.000	2.88	0.001	0.000
3	0.049	1.88	0.001	0.000	2.25	0.001	0.000	1.50	0.001	0.000
4	0.021	5.75	0.002	0.000	6.57	0.003	0.000	5.10	0.002	0.000
5	0.012	1.88	0.001	0.000	1.75	0.001	0.000	2.25	0.001	0.000
6	0.061	5.81	0.002	0.000	6.13	0.002	0.000	5.75	0.002	0.000
7	0.1	4.23	0.002	0.000	3.78	0.002	0.000	5.15	0.002	0.000
8	0.1	5.38	0.002	0.000	4.85	0.002	0.000	5.38	0.002	0.000
9	0.043	2.80	0.001	0.000	2.67	0.001	0.000	3.23	0.001	0.000
10	0.024	4.11	0.002	0.000	3.98	0.002	0.000	3.82	0.002	0.000
11	0.212	2.25	0.001	0.000	2.60	0.001	0.000	1.95	0.001	0.000
12	0.023	5.00	0.002	0.000	5.67	0.002	0.000	4.50	0.002	0.000
13	0.012	7.50	0.003	0.000	8.00	0.003	0.000	7.50	0.003	0.000
Sum:	**1.00**			**0.001**			**0.001**			**0.001**
		Survival Change from 2007-2017 Actions		**3.5%**			**3.5%**			**3.5%**

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Population	Assessment Unit (AU)	AU Relative Size (AU % of pop. area)	Primary Limiting Factor(s) (PLF) by AU	Revisited Current % Function	Revisited Current % Function of Average Habitat at AU	Actions	Incremental Change in Habitat Function 2017-2007	Revisited Resulting % Function of Limiting Factor		Revisited Resulting % Function of Habitat at AU scale		07-09 Actions (<= 10 years)	07-09 Actions (> 10 years)	2007-2017 Habitat Actions		Incremental change in habitat function			Multipliers			Incremental Change in Habitat Function for 2007-2017 Actions at AU Scale		
								10 Years	25 Years	10 Years	25 Years			10 Years	25 Years	Scenario 1	Scenario 2	Scenario 3	Scenario 1	Scenario 2	Scenario 3	Scenario 1	Scenario 2	Scenario 3
Entiat River	Lower Entiat	0.4	Low Stream flow	80	28	Continue Knapp-Wham and Hanan Detwiler irrigation ditch consolidation effort	7	87	87	40	41	84	84	33	33	0.7	0.35	0	10	5	0	8.36	8.78	8.69
						Continue exploring extension of Entiat Irrigation District line upstream to serve PUD canal/system users																		
						Pursue other water conveyance efficiency and diversion improvements																		
						Improve on-farm irrigation application efficiency, scheduling, and general water conservation.																		
						Provide technical and cost-share assistance for water metering and reporting																		
						Continue conversion of surface water diversions to ground water/well withdrawals, when feasible																		
			Riparian condition	30		Implement riparian planting projects with willing landowners	5	35	40			33	36			3.75	2.5	1.25	75	50	25			
						Work with willing landowners to protect larger, undisturbed riparian areas by first pursuing conservation easement, lease, and options other than outright property acquisition																		
			Floodplain connectivity	20		Implement Ecosystem Diagnosis and Treatment (EDT) Alternative 5 related to side-channel options	1	21	21			20	20			0.25	0.5	0.25	25	50	25			
			Habitat diversity	15		Implement EDT Alternative 5, focusing on pool forming structures	26	41	41			23	23			22.1	23.4	24.7	85	90	95			
			Habitat quantity	15		Implement EDT Alternative 5, focusing on pool forming structures	26	41	41			23	23			22.1	23.4	24.7	85	90	95			
			Side-channel connectivity	10		Implement Ecosystem Diagnosis and Treatment (EDT) Alternative 5 related to side-channel options	5	15	15			12	12			1.25	2.5	1.25	25	50	25			
	Middle Entiat	0.4	Riparian condition	80	78	Implement riparian planting projects with willing landowners	5	85	90	83	86	85	90	83	86	3.75	2.5	1.25	75	50	25	2.87	2.43	2.00
						Work with willing landowners to protect larger, undisturbed riparian areas by first pursuing conservation easement, lease, and options other than outright property acquisition																		
			Habitat diversity	60		Fully implement Ecosystem Diagnosis and Treatment (EDT) Alternative 5 - LWD treatments	5	65	70			65	70			4.25	4.5	4.75	85	90	95			
			Stormy obstructions to passage	93		Repair 2 Stormy Creek culverts that present fish passage problems (open up 1-1.5 miles of habitat)	6	99	99			99	99			0.6	0.3	0	10	5	0			
			Water Quantity			Continue conversion of surface water diversions to ground water/well withdrawals, when feasible																		

Population	Assessment Unit (AU)	AU Relative Size (AU % of pop. area)	Primary Limiting Factor(s) (PLF) by AU	Revisited Current % Function	Revisited Current % Function of Average Habitat at AU	Actions	Incremental Change in Habitat Function 2017-2007	Revisited Resulting % Function of Limiting Factor		Revisited Resulting % Function of Habitat at AU scale		07-09 Actions (<= 10 years)	07-09 Actions (> 10 years)			Incremental change in habitat function			Multipliers			Incremental Change in Habitat Function for 2007-2017 Actions at AU Scale		
								10 Years	25 Years	10 Years	25 Years			10 Years	25 Years	Scenario 1	Scenario 2	Scenario 3	Scenario 1	Scenario 2	Scenario 3	Scenario 1	Scenario 2	Scenario 3
	Mad River	0.2	Habitat diversity	90	93	4 miles NF road decommissioning	7	97	99	98	99	90	90	93	93	5.95	6.3	6.65	85	90	95	2.05	2.25	4.43
						12 miles heavy maintenance reconstruction																		
						Estimate 40 miles decommission/heavy maintenance / reconstruction in Tillicum watershed																		
						Improve County road maintenance along lower Mad River road																		
						Install rock gravel catchers to promote gravel recruitment																		
			Habitat quantity	90		4 miles NF road decommissioning	7	97	99			90	90			0	0.35	6.65	0	5	95			
						12 miles heavy maintenance reconstruction																		
						Estimate 40 miles decommission/heavy maintenance / reconstruction in Tillicum watershed																		
						Improve County road maintenance along lower Mad River road																		
						Install rock gravel catchers to promote gravel recruitment																		
			Two obstructing pipes in Tillicum	98			2	100	100			98	98			0.2	0.1	0	10	5	0			

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Entiat Steelhead Egg-Smolt Survival Change:

Assumed maximum egg-smolt survival under "optimal" conditions: **4%**

Base Info					Estimated 10-Year Juvenile Survivals						Estimated 25-Year Juvenile Survivals					
								BPA and Reclamation Actions only								
		Current			100 % Completed			Near-Term			Compelted + Near-Term			100% Completed		
AU	Weight	Hab (%)	Survival	Totals	Hab (%)	Survival	Totals	Hab (%)	Survival	Totals	Hab (%)	Survival	Totals	Hab (%)	Survival	Totals
1	0.4	28	0.011	0.005	40	0.016	0.006	33	0.013	0.005	33	0.013	0.005	41	0.016	0.007
2	0.4	78	0.031	0.012	83	0.033	0.013	83	0.033	0.013	86	0.035	0.014	86	0.035	0.014
3	0.2	93	0.037	0.007	98	0.039	0.008	93	0.037	0.007	93	0.037	0.007	99	0.040	0.008
Sum:	**1.00**			**0.024**			**0.028**			**0.026**			**0.027**			**0.028**
		Survival Change:		**1.00**	**Survival Change:**		**1.129**	**Survival Change:**		**1.062**	**Survival Change:**		**1.088**	**Survival Change:**		**1.161**

Entiat Steelhead Summary of Egg-Smolt Survival Change from Current Condition:

Estimated 10-Year Juvenile Survivals		Estimated 25-Year Juvenile Survivals	
	BPA and Reclamation Actions only		
100 % Completed	Near-Term	Compelted + Near-Term	100% Completed
13%	6%	9%	16%

AU	Weight	Scenario 1			Scenario 2			Scenario 3		
		Hab (%)	Survival	Totals	Hab (%)	Survival	Totals	Hab (%)	Survival	Totals
1	0.4	8.36	0.003	0.001	8.78	0.004	0.001	8.69	0.003	0.001
2	0.4	2.87	0.001	0.000	2.43	0.001	0.000	2.00	0.001	0.000
3	0.2	2.05	0.001	0.000	2.25	0.001	0.000	4.43	0.002	0.000
Sum:	**1.00**			**0.002**			**0.002**			**0.002**
		Survival Change from 2007-2017 Actions		**7.6%**			**7.6%**			**8.0%**

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Okanogan Steelhead Habitat/Survival Changes

Assessment Unit (AU)	Primary Limiting Factor(s) (PLF) by AU	Habitat condition by limiting factor (%)						Habitat condition by Assessment Unit (%)					
		Current	07-09 Actions	10-17 (S1) Actions	10-17 (S2) Actions	10-17 (S3) Actions	Max	Current	07-09 Actions	10-17 (S1) Actions	10-17 (S2) Actions	10-17 (S3) Actions	Max
Lower Okanogan mSA	High stream temperature	65	65	65	65	65	70	76	76	76	76	76	81
	Riparian and floodplain function	80	80	80	80	80	85						
	In-channel habitat quality	70	70	70	70	70	70						
	Passage-thermal and screens	90	90	90	90	90	98						
Middle Okanogan MSA	High stream temperature	65	65	65	65	65	75	79	79	79	79	79	84
	Low stream flow	90	90	90	90	90	95						
	Riparian and floodplain function	80	80	80	80	80	85						
	In-channel habitat quantity	90	90	90	90	90	95						
	In-channel habitat quality	70	70	70	70	70	75						
	Passage-thermal and screens	80	81	81	81	81	81						
Upper Okanogan MSA	High stream temperature	65	65	65	65	65	67	77	77	77	77	77	81
	Low stream flow	95	95	95	95	95	96						
	Riparian and floodplain function	80	80	80	80	80	85						
	In-channel habitat quantity	70	70	70	70	70	80						
	In-channel habitat quality	70	70	70	70	70	75						
	Passage-thermal and screens	80	80	80	80	80	85						
Similkameen River MSA	High stream temperature	60	60	60	60	60	65	76	76	76	76	76	80
	Riparian and floodplain function	80	80	80	80	80	82						
	In-channel habitat quantity	90	90	90	90	90	95						
	In-channel habitat quality	75	75	75	75	75	76						
Omak Creek MSA	High stream temperature	75	79	79	79	79	80	77	78	80	80	79	81
	Low stream flow	90	90	90	90	90	92						
	Riparian and floodplain function	95	95	95	95	95	96						
	In-channel habitat quality	30	32	39	39	37	39						
	Passage-culverts	95	95	95	95	95	96						
Small Trib Creeks Combined mSA	High stream temperature	90	90	90	90	90	92	76	76	79	79	80	84
	Low stream flow	60	60	70	65	70	80						
	Riparian and floodplain function	90	90	91	91	94	94						
	In-channel habitat quantity	80	80	83	85	85	85						
	In-channel habitat quality	55	55	60	60	59	60						
	Passage-culverts	80	80	80	80	80	90						
Salmon Creek	Low stream flow	0	50	50	50	50	50	30	68	68	68	68	78
	Riparian and floodplain function	85	90	90	90	90	90						
	In-channel habitat quantity	0	75	75	75	75	75						
	In-channel habitat quality	65	66	66	66	66	75						
	Passage-flow barrier in lower reach	0	60	60	60	60	100						
Loup Loup Creek	Low stream flow	10	10	30	20	30	50	55	55	72	72	73	83
	Riparian and floodplain function	80	80	85	85	85	85						
	In-channel habitat quantity	80	80	85	90	90	90						
	In-channel habitat quality	85	85	85	90	85	90						
	Passage- flow barrier in lower reach	20	20	76	76	76	100						
			Survival Changes					1.12	1.14	1.14	1.14	1.21	

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Okanogan Steelhead Habitat Changes

Population	Assessment Unit (AU)	AU Relative Size (AU % of pop. area)	Primary Limiting Factor(s) (PLF) by AU	Current % Function of Limiting Factor	Current % Function of Average Habitat at AU	Actions Proposed in Draft Recovery Plan	Resulting % Function of Limiting Factor if All Action are Implemented		Resulting % Function of Habitat at AU Scale (for All Actions)		Resulting % Function of Limiting Factor (07-09 Actions)		Resulting % Function of Habitat at AU Scale		Potential increase available after 07-09 actions (by limiting factor)	Resulting % Function of Limiting Factor (10-17 Actions)			Resulting % Function of Habitat at AU Scale (10-17 Actions)		
							10 Years	25 Years	10 Years	25 Years	10 Years	25 Years	10 Years	25 Years		Scenario 1	Scenario 2	Scenario 3	Scenario 1	Scenario 2	Scenario 3
Okanogan River	Lower Okanogan mSA	0.156	High stream temperature	65	76	improve water temperature	70	75	81	85	65	65	76	76	5	65	65	65	76	76	76
						water conservation															
						water acquisition															
			Riparian and floodplain function	80		riparian restoration	85	90			80	80			5	80	80	80			
						land acquisition															
						conservation easement															
			In-channel habitat quality	70		improve water temperature	70	75			70	70			0	70	70	70			
			Passage-thermal and screens	90		improve water temperature	98	98			90	90			8	90	90	90			
						provide diversion/pump screens															
	Middle Okanogan MSA	0.26	High stream temperature	65	79	improve water temperature	75	75	84	86	65	65	79	79	10	65	65	65	79	79	79
						water acquisition/conservation															
			Low stream flow	90		water acquisition/conservation	95	95			90	90			5	90	90	90			
						improve water management															
			Riparian and floodplain function	80		riparian restoration	85	85			80	80			5	80	80	80			
						land acquisition															
						conservation easement															
			In-channel habitat quantity	90		reduce fine sediment	95	95			90	90			5	90	90	90			
			In-channel habitat quality	70		increase habitat quality	75	80			70	70			5	70	70	70			
			Passage-thermal and screens	80		provide screens on diversions or pumps	81	85			81	81			0	81	81	81			
						improve water management															
	Upper Okanogan MSA	0.071	High stream temperature	65	77	improve water management	67	70	81	82	65	65	77	77	2	65	65	65	77	77	77
						improve watershed hydrograph															
			Low stream flow	95		improve water management	96	96			95	95			1	95	95	95			
						improve watershed hydrograph															
			Riparian and floodplain function	80		riparian restoration	85	85			80	80			5	80	80	80			
						land acquisition															
						conservation easement															
			In-channel habitat quantity	70		improve water management	80	80			70	70			10	70	70	70			
						improve watershed hydrograph															
			In-channel habitat quality	70		floodplain enhancement	75	75			70	70			5	70	70	70			
						floodplain reconnection															
			Passage-thermal and screens	80		provide screens for pumps/diversions	85	85			80	80			5	80	80	80			
						improve water management															
	Similkameen River MSA	0.011	High stream temperature	60	76	improve water temperature	65	75	80	84	60	60	76	76	5	60	60	60	76	76	76
			Riparian and floodplain function	80		riparian restoration	82	84			80	80			2	80	80	80			
						conservation easement															
			In-channel habitat quantity	90		sediment control	95	95			90	90			5	90	90	90			
			In-channel habitat quality	75		floodplain enhancement	76	80			75	75			1	75	75	75			
						floodplain reconnection															
						improve habitat quality															
			Ecologic conditions -disease			reduce toxic materials															

Omak Creek MSA	0.202	High stream temperature	75	77	decrease water temperature	80	85	81	86	79	83	78	81	1	79	79	79	80	80	79
		Low stream flow	90		improve water management	92	92			90	90			2	90	90	90			
		Riparian and floodplain function	95		riparian rehabitlitation	96	96			95	95			1	95	95	95			
					land acquisition															
					conservation easement															
		In-channel habitat quantity			improve upland road management															
					sediment control															
		In-channel habitat quality	30		riparian rehabilitation	39	60			32	44			7	39	39	37			
					decrease water temperature															
					improve upland road management															
					sediment control															
		Passage-culverts	95		provide passage at barriers	96	96			95	95			1	95	95	95			
Small Trib Creeks Combined mSA	0.064	High stream temperature	90	76	water conservation	92	95	84	91	90	90	76	76	2	90	90	90	79	79	80
					water acquisition															
					riparian restoration															
		Low stream flow	60		water conservation	80	80			60	60			20	70	65	70			
					water acquisition															
		Riparian and floodplain function	90		floodplain enhancement	94	94			90	90			4	91	91	94			
					land acquisition															
					conservation easement															
					riparian restoration															
		In-channel habitat quantity	80		improve upland road management	85	85			80	80			5	83	85	85			
					sediment control															
		In-channel habitat quality	55		land acquisition	60	100			55	55			5	60	60	59			
					conservation easement															
					improve upland road management															
					sediment control															
					riparian restoration															
		Passage-culverts	80		provide passage at barriers	90	90			80	80			10	80	80	80			
Salmon Creek	0.204	High stream temperature		30	improve water temperature			78	86			68	73					68	68	68
		Low stream flow	0		water acquisition	50	75			50	75			0	50	50	50			
					improve water management/channel reconstruction															
					improve watershed hydrograph															
		Riparian and floodplain function	85		riparian restoration	90	95			90	91			0	90	90	90			
		In-channel habitat quantity	0			75	80			75	75			0	75	75	75			
		In-channel habitat quality	65		improve water temperature	75	80			66	66			9	66	66	66			
					riparian restoration															
		Passage-flow barrier in lower reach	0		improve water management/channel reconstruction	100	100			60	60			40	60	60	60			
Loup Loup Creek	0.032	High stream temperature		55	improve water temperature			83	95			55	55					72	72	73
		Low stream flow	10		improve water management	50	90			10	10			40	30	20	30			
					Protect existing flows															
					water conservation															
					improve water management															
					water acquisition															
		Riparian and floodplain function	80		water conservation	85	90			80	80			5	85	85	85			
					improve water management															
					water acquisition															
					improve habitat diversity															
					improve habitat quality															
		In-channel habitat quantity	80		improve habitat diversity	90	100			80	80			10	85	90	90			
					improve habitat quality															
		In-channel habitat quality	85		improve water management	90	95			85	85			5	85	90	85			
					Protect existing flows															
					water conservation															
					improve water management															
					improve habitat diversity															
					improve habitat quality															
		Passage- flow barrier in lower reach	20		provide passage at barriers	100	100			20	20			80	76	76	76			

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Okanogan Steelhead Egg-Smolt Survival Change:

Assumes a maximum egg-smolt survival of 4% under "optimal" conditions.

Changes By 2017																			
		Current			Maximum Potential			07-09 Improvements			10-17 Improvments (S1)			10-17 Improvments (S2)			10-17 Improvments (S3)		
AU	Weight	Hab (%)	Survival	Totals	Hab (%)	Survival	Totals	Hab (%)	Survival	Totals	Hab (%)	Survival	Totals	Hab (%)	Survival	Totals	Hab (%)	Survival	Totals
Lower Okanogan mSA	0.156	76	0.031	0.005	81	0.032	0.005	76	0.031	0.005	76	0.031	0.005	76	0.031	0.005	76	0.031	0.005
Middle Okanogan MSA	0.260	79	0.032	0.008	84	0.034	0.009	79	0.032	0.008	79	0.032	0.008	79	0.032	0.008	79	0.032	0.008
Upper Okanogan MSA	0.071	77	0.031	0.002	81	0.033	0.002	77	0.031	0.002	77	0.031	0.002	77	0.031	0.002	77	0.031	0.002
Similkameen River MSA	0.011	76	0.031	0.000	80	0.032	0.000	76	0.031	0.000	76	0.031	0.000	76	0.031	0.000	76	0.031	0.000
Omak Creek MSA	0.202	77	0.031	0.006	81	0.032	0.007	78	0.031	0.006	80	0.032	0.006	80	0.032	0.006	79	0.032	0.006
Small Trib Creeks Combined mSA	0.064	76	0.030	0.002	84	0.033	0.002	76	0.030	0.002	79	0.032	0.002	79	0.031	0.002	80	0.032	0.002
Salmon Creek	0.204	30	0.012	0.002	78	0.031	0.006	68	0.027	0.006	68	0.027	0.006	68	0.027	0.006	68	0.027	0.006
Loup Loup Creek	0.032	55	0.022	0.001	83	0.033	0.001	55	0.022	0.001	72	0.029	0.001	72	0.029	0.001	73	0.029	0.001
Sum:	**1**			**0.027**			**0.033**			**0.030**			**0.030**			**0.030**			**0.030**
					Survival Change:		**1.21**	**Survival Change:**		**1.12**	**Survival Change:**		**1.14**	**Survival Change:**		**1.14**	**Survival Change:**		**1.14**

Changes After 2017																			
		Current			Maximum Potential			07-09 Improvements			10-17 Improvments (S1)			10-17 Improvments (S2)			10-17 Improvments (S3)		
AU	Weight	Hab (%)	Survival	Totals	Hab (%)	Survival	Totals	Hab (%)	Survival	Totals	Hab (%)	Survival	Totals	Hab (%)	Survival	Totals	Hab (%)	Survival	Totals
Lower Okanogan mSA	0.156	76	0.031	0.005	85	0.034	0.005	76	0.031	0.005		0.000	0.000		0.000	0.000		0.000	0.000
Middle Okanogan MSA	0.260	79	0.032	0.008	86	0.034	0.009	79	0.032	0.008		0.000	0.000		0.000	0.000		0.000	0.000
Upper Okanogan MSA	0.071	77	0.031	0.002	82	0.033	0.002	77	0.031	0.002		0.000	0.000		0.000	0.000		0.000	0.000
Similkameen River MSA	0.011	76	0.031	0.000	84	0.033	0.000	76	0.031	0.000		0.000	0.000		0.000	0.000		0.000	0.000
Omak Creek MSA	0.202	77	0.031	0.006	86	0.034	0.007	81	0.033	0.007		0.000	0.000		0.000	0.000		0.000	0.000
Small Trib Creeks Combined mSA	0.064	76	0.030	0.002	91	0.036	0.002	76	0.030	0.002		0.000	0.000		0.000	0.000		0.000	0.000
Salmon Creek	0.204	30	0.012	0.002	86	0.034	0.007	73	0.029	0.006		0.000	0.000		0.000	0.000		0.000	0.000
Loup Loup Creek	0.032	55	0.022	0.001	95	0.038	0.001	55	0.022	0.001		0.000	0.000		0.000	0.000		0.000	0.000
Sum:	**1**			**0.027**			**0.034**			**0.031**			**0.000**			**0.000**			**0.000**
					Survival Change:		**1.28**	**Survival Change:**		**1.15**	**Survival Change:**		**0.00**	**Survival Change:**		**0.00**	**Survival Change:**		**0.00**

This is not a final federal agency product. Rather, it is a pre-decisional document prepared by the Action Agencies that reflects present understandings of currently available information and analyses, and of the progression of discussions with the sovereigns in the collaborative process. Revisions and refinements are to be expected based on further discussions with the sovereigns over new and modified proposed federal actions upon which the action agencies will ultimately consult. Finally, the information in this product does not constitute an analysis of whether the identified measures would or would not jeopardize the continued existence of a listed species or result in the destruction or adverse modification of designated critical habitat. Furthermore, this document does not in any way interpret or apply the regulatory definitions of the statutory phrases "jeopardize the continued existence of" and "destruction or adverse modification."

Tributary Habitat Benefits

Estimating Population Survival Associated with

Completed and Planned Tributary Habitat Actions

May 21, 2007

Executive Summary

This paper describes the specific approach used and results for estimating tributary habitat survival improvement benefits for each ESU/DPS. These tributary action benefits fall into two time periods:

1) **2000 – 2006**: survival estimates for completed actions adjusted for accrued future benefits through 2017
2) **2007 – 2017**: survival estimates attributable to the specific tributary habitat proposed actions for 2007-2009 (an expanded level of effort compared to 2000-2006) plus additional 2007-2017 actions described in the Tributary Habitat Proposed Action.

Summary of Methodology

The Action Agencies estimated survival benefits attributable to tributary habitat actions that are implemented in partnership with States, Tribes, and others with funding and/or technical assistance from the Action Agencies. These actions were described in the draft Tributary Habitat Proposed Action. Survival improvement estimates were made for actions completed from 2000-2006 and planned for 2007-2009. Survival improvement estimates from 2007-2009 were extrapolated to estimate survival improvement for 2010-2017 tributary habitat actions. Survival improvement estimates described in this report correspond with values for the base-to-current (2000-2006) and the current- to- prospective periods represented in the biological analysis.

To compile these estimates, the Action Agencies used information and methods produced in conjunction with the tributary Remand Collaboration Habitat Workgroup process. The Remand Collaboration Habitat Workgroup was charged by the Policy Work Group to evaluate the method used in Appendix E of the 2004 FCRPS Biological Opinion and decided to update the method used in Appendix E of the 2004 FCRPS Biological Opinion. The Action Agencies applied two main approaches to use data and information from the Remand Collaboration Habitat Workgroup to produce survival estimates for salmon and steelhead populations. Further detail on the procedures and components utilized are available in the attachment to this paper.

In the first approach, called the Hydrid Method, Remand Collaboration Habitat Workgroup products were supplemented with information obtained in meetings with local biologists (Federal, State, and Tribal) and tributary habitat project sponsors. Local biologists have the most knowledge about local watershed processes, habitat conditions, and fish populations in their respective areas. For a number of populations, local biologists helped define:

(1) reference habitat functions:

(a) current, existing habitat function and

(b) habitat functions associated with implementing all planned tributary habitat actions by 2017;

(2) habitat functions associated with tributary habitat actions implemented in partnership with States, Tribes, and others with funding and/or technical assistance from the Action Agencies.

Habitat functions were expressed with numerical values. The Action Agencies used this information and calculated survival estimates from them using the method developed in conjunction with the Remand Collaboration Habitat Workgroup.

In the second approach, referred to as the Appendix E method, the Action Agencies used base information from Appendix E, the tables of limiting factor information provided to the Remand Collaboration Habitat Workgroup, and best professional judgment to estimate survival estimates for another set of salmon and steelhead populations. The second approach is likely to be conservative (low) in estimating habitat benefits compared to the first method.

Both of these approaches are based on the linkages between improvements to limiting factors,

improvements to habitat quality and survival improvements. The logic path that demonstrates this determination of biological effectiveness is shown below:

$$$ → **Specific Projects** → **Address Limiting Factors at Programmatic Scale** → **Improvement in Habitat Function:** → **ΔS** Change in Survival

This methodology utilizes the best available information regarding key limiting factors, habitat improvement potential, habitat action effectiveness, and the expert views of local biologists.

The particular component of this method used by the Actions Agencies to quantify habitat changes and to calculate survival estimates was not formally endorsed by the Remand Collaboration Habitat Workgroup. Some critics did not endorse a numerical approach to expressing habitat functionality and potential improvements. However, through the course of the collaboration, no other option was identified that could produce survival estimates utilizing the best available scientific information.

Summary of Results

The following tables display estimated survival improvement percentages by population for each ESU. The percentages indicate the incremental survival improvement estimated to accrue by 2017 for actions implemented for each time period shown. These time periods correspond to the base-to current (2000-2006) and current- to- prospective (2007-2017) periods represented in the biological analysis. The actions identified represent an increase in Action Agency tributary habitat effort compared to efforts for the 2000 and 2004 FCRPS BiOps. Shaded populations were estimated using the Hybrid method; unshaded populations were estimated using the Appendix E method.

Upper Columbia Spring Chinook

Estimated Survival Improvement Percentages for Action Agencies Proposed Actions

ESA-listed ESU	MPG	Population	Estimated Percentage Survival Improvement		
			By 2017 for Actions Completed from 2000-2006 (Base-to-current)	By 2017 for Actions Completed from 2007-2017 (Prospective)	After 2017 for Actions Completed from 2007-2017 (within 25 years)
Upper Columbia Spring Chinook	Upper Columbia - Below Chief Joseph	Entiat River	2	22	2
		Methow River	2	6	1
		Wenatchee River	2	3	

Upper Columbia Steelhead

Estimated Survival Improvement Percentages for Action Agencies Proposed Actions

ESA-listed ESU	MPG	Population	Estimated Percentage Survival Improvement		
			By 2017 for Actions Completed from 2000-2006 (Base-to-current)	By 2017 for Actions Completed from 2007-2017 (Prospective)	After 2017 for Actions Completed from 2007-2017 (within 25 years)
Upper Columbia Steelhead	Upper Columbia River - Below Chief Joseph	Entiat River	2	8	3
		Methow River	2	4	1
		Okanogan River	6	14	3
		Wenatchee River	2	4	1

Shaded populations were estimated using the Hybrid method; unshaded populations were estimated using the Appendix E method.

Mid Columbia Steelhead

Estimated Survival Improvement Percentages for Action Agencies Proposed Actions

ESA-listed ESU	MPG	Population	Estimated Percentage Survival Improvement		
			By 2017 for Actions Completed from 2000-2006 (Base-to-current)	By 2017 for Actions Completed from 2007-2017 (Prospective)	After 2017 for Actions Completed from 2007-2017 (within 25 years)
Middle Columbia Steelhead	Cascades Eastern Slope Tributaries	Deschutes River - eastside	**1**	**3**	
		Deschutes River - westside	**0.2**	**1**	
		Fifteenmile Creek (winter run)	**0.1**	**<1**	
		Klickitat River	**4**	**12**	
		Rock Creek			
	John Day River	John Day River lower mainstem tributaries	**0.2**	**1**	
		John Day River upper mainstem	**0.2**	**1**	
		Middle Fork John Day River	**0.2**	**1**	
		North Fork John Day River	**0.3**	**1**	
		South Fork	**0.7**	**2**	

		John Day River			
	Umatilla and Walla Walla River	Touchet River	**4**	**12**	
		Umatilla River	**4**	**12**	
		Walla Walla River	**4**	**12**	
	Yakima River Group	Naches River	**4**	**12**	
		Satus Creek	**4**	**12**	
		Toppenish	**4**	**12**	
		Yakima River upper mainstem	**4**	**12**	

Snake River Spring/Summer Chinook

Action Agencies Proposed Actions

ESA-listed ESU	MPG	Population	Estimated Percentage Survival Improvement		
			By 2017 for Actions Completed from 2000-2006 (Base-to-current)	By 2017 for Actions Completed from 2007-2017 (Prospective)	After 2017 for Actions Completed from 2007-2017 (within 25 years)
Snake River Spring/Summer Chinook	Grande Ronde / Imnaha	**Catherine Creek**	**4**	**14**	**24**
		Lostine/Wallowa River	**1**	**18**	**9**
		Minam River			
		Grande Ronde River upper mainstem	**4**	**7**	**26**
		Wenaha River			

		Big Sheep Creek			
		Imnaha River mainstem	**1**	**<1**	
	Middle Fork Salmon River	Bear Valley Creek			
		Big Creek		**7**	**2**
		Camas Creek			
		Loon Creek			
		Marsh Creek			
		Sulphur Creek			
		Middle Fork Salmon River above Indian Creek			
		Chamberlain Creek			
		Middle Fork Salmon River below Indian Creek			
	South Fork Salmon River	East Fork South Fork Salmon River			
		Little Salmon River	**0.5**	**12**	**3**
		Secesh River		**6**	**5**
		South Fork Salmon River mainstem		**6**	**3**
	Lower Snake	Asotin Creek	**11.5**	**14**	**10**
		Tucannon River	**3.5**	**17**	**13**
	Upper Salmon River	East Fork Salmon River	**0.5**	**3**	
		Lemhi River	**0.5**	**21**	

		North Fork Salmon River			
		Pahsimeroi River	**0.5**	**43**	
		Salmon River lower mainstem below Redfish Lake	**0.5**	**3**	
		Salmon River upper mainstem above Redfish Lake	**0.5**	**42**	
		Valley Creek	**0.5**	**3**	
		Yankee Fork	**0**	**30**	**32**

Shaded populations were estimated using the Hybrid method; unshaded populations were estimated using the Appendix E method.

Snake River Steelhead

Estimated Survival Improvement Percentages for Action Agencies Proposed Actions

			Estimated Percentage Survival Improvement		
ESA-listed ESU	**MPG**	**Population**	**By 2017 for Actions Completed from 2000-2006 (Base-to-current)**	**By 2017 for Actions Completed from 2007-2017 (Prospective)**	**After 2017 for Actions Completed from 2007-2017 (within 25 years)**

Snake River Steelhead	Clearwater River	Clearwater River lower mainstem	**2.5**	**4**	**1**
		Lochsa River	**0.5**	**18**	**7**
		Lolo Creek	**0.5**	**12**	**6**
		Selway River	**0.7**	**2**	**2**
		South Fork Clearwater River	**1.5**	**14**	**12**
	Grande Ronde River	Grande Ronde River lower mainstem tributaries	**0.1**	**<1**	
		Grande Ronde River upper mainstem	**2**	**9**	**25**
		Joseph Creek (OR)	**0.1**	**<1**	
		Joseph Creek (WA)	**4**	**12**	
		Wallowa River	**2**	**27**	**16**
	Hells Canyon	Hells Canyon	**0**		
	Imnaha River	Imnaha River	**0.1**	**<1**	
	Lower Snake	Asotin Creek	**8.5**	**12**	**8**
		Tucannon River	**6.5**	**11**	**8**
	Salmon River	**Lower Middle Fork mainstem and tribs (Big**, Camas, and Loon **Creek**s)		**7**	**2**
		Chamberlain Creek			
		East Fork	**0.5**	**6**	**1**

		Salmon River			
		Lemhi River	**0.5**	**9**	
		Little Salmon and Rapid River	**0.5**	**10**	**3**
		Upper Middle Fork mainstem and tribs			
		North Fork Salmon River			
		Pahsimeroi River	**6.5**	**27**	
		Panther Creek			
		Salmon River upper mainstem	**0.5**	**18**	**15**
		Secesh River		**6**	**5**
		South Fork Salmon River		**6**	**3**

Shaded populations were estimated using the Hybrid method; unshaded populations were estimated using the Appendix E method.

Future refinements

If the suites of "all H" actions proposed by the Action Agencies and others in aggregate do not substantially fill the various survival gaps for a particular population, and where there is more potential from habitat actions, the Action Agencies are currently examining additional habitat actions and benefits.

Appendix: Tributary Habitat Benefits Supporting Information

Introduction

NOAA described a method (2004 FCRPS BiOp, Appendix E) to identify the status and potential to improve survival and recovery of listed salmon and steelhead through improvement of tributary habitat conditions. This method identified qualitative very high (VH), high (H), medium (M), low (L), and very low (VL) estimates for status and potential for improvement. This method is hereafter referred to as the "Appendix E method". The Action Agencies utilized the Appendix E framework to implement their tributary habitat proposed action in 2004 (UPA, 2004) and continue to rely heavily on the biological rationale articulated in Appendix E.

The Appendix E method employed by NOAA in 2004 used the best available information at the time to estimate effects of the tributary habitat proposed action for the 2004 FCRPS BiOp. However, additional information has become available from recovery planning and other efforts that have occurred since the 2004 FCRPS BiOp was issued.

The Remand Collaboration Habitat Workgroup (CHW) convened at the request of the Policy Work Group (PWG). The PWG tasked the CHW to review the Appendix E method and (1) decide whether the method needed to be updated, and (2) if that were the case, describe an approach to update Appendix E. The CHW met regularly during the spring and summer of 2006. CHW members included representatives from the sovereign States and Tribes and Federal Agencies involved in the Collaboration process. Meeting schedules, agendas, notes, and products are available at the "step 5 habitat" webpage on the secure Collaboration website maintained by BPA. The CHW determined that Appendix E needed to be updated. Furthermore, the group developed a process and provided information that could be used to update the Appendix E method.

The CHW explored possible approaches to update the qualitative estimates in Appendix E such as using the best available data since 2004 to update Appendix E, conduct EDT or other modeling, or seek more recent estimates from field biologists. The CHW determined that the

Appendix E method could be updated by taking a series of steps: 1) identify the primary factors limiting the recovery of salmon and steelhead populations, 2) identify the tributary habitat actions that could be implemented to address those limiting factors, 3) estimate the current habitat function, 4) estimate the habitat function that could be obtained by 2017 by implementing all tributary habitat restoration actions that were identified as planned by 2017, 5) estimate the habitat function that could be obtained after 2031 by implementing all tributary habitat restoration actions that were identified as planned by 2017, and 6) convert estimated habitat functions to survival estimates. CHW sought assistance from local biologists on steps 1-5, and reviewed methods, which the Action Agencies used to complete step 6.

The CHW determined it would be beneficial to create a logical path to obtain estimates of the habitat condition and survival improvement potential from habitat actions. After several meetings and revisions, the CHW settled on developing tables that included columns to consider the population, assessment unit, limiting factors, potential actions that could be implemented to address primary limiting factors, and the current and potential future habitat function.

The CHW developed a template and instructions to obtain the data and information that was provided by each State from field biologists. This table template provided the basis for estimating changes in habitat function for salmon and steelhead populations, which Remand Collaboration Habitat Workgroup members solicited from local field biologists and recovery planners.

Although data and information obtained by CHW participants varied by location, they represented the following general conditions. Local biologists[2] and recovery planning processes were enlisted by CHW members to identify primary limiting factors, tributary habitat actions needed to address those limiting factors, and to estimate habitat functions. Local biologists

[2] Local biologists enlisted in these efforts were employed by sovereign tribes and State and Federal agencies and were intimately familiar with the biological and physical status and needs of anadromous fish as well as the salient details entailed in subbasin and recovery planning and project funding processes for the salmon and steelhead populations they addressed. In Washington, these specialists were sponsored by experts and persons responsible for developing regional recovery plans

identified limiting factors and actions needed to reach recovery.

Information used to determine habitat functions varied by location. Local biologists determined habitat function utilizing their professional judgment and any other data and information at their disposal, including EDT (Ecosystem Diagnosis and Treatment) or any other data- analysis tools. Most CHW participants recognized that empirical data and information provides the best insight for determining habitat function. However, most CHW participants acknowledged that the extent of readily- available empirical data and information was not adequate at the time to make a precise determination of habitat function uniformly throughout the Columbia River Basin. Most CHW participants acknowledged that regardless of the amount of empirical data and information available, professional judgment by expert scientists provided a large part of the determination of habitat function in all locations simply because of the limited extent of readily-available empirical data and information.

The States of Washington, Idaho, and Oregon each provided tables of information in slightly different formats from the original template. Tables received from Washington were reformatted by the Action Agencies to conform to the original template.

The Action Agencies used base information from Appendix E, limiting factors, actions, and habitat functions provided by the CHW in the tables described above, and professional judgment to develop survival estimates attributable to tributary habitat actions to be implemented in partnership with States, Tribes, and others with funding and/or technical assistance from the Action Agencies. Specific tributary habitat actions are described in the Tributary Habitat Proposed Action. The following sections describe the methods the Action Agencies used to convert this information to survival improvement estimates.

Methods

Two methods were used to estimate survival improvements-- the Appendix E method and the Hybrid method. These methods were used to estimate survival improvements for actions completed from 2000-2006, and actions to be implemented from 2007-2017. The following

sections describe these methods, in general.

Appendix E Method

To estimate survival estimates based on Appendix E, the following steps were involved:

1a) Assembling lists of completed projects with habitat work element actions for the 2006-2006 timeframe for the respective ESU populations.

1b) Assembling lists of proposed projects that will be funded for 2007-2009 with habitat work element actions for the respective ESU populations.

2) Linking the projects to the populations to the extent enabled by database information.

3) Considering the project work elements linkage to beneficial on-the-ground habitat work to address important limiting factors for a population.

4) If habitat work element actions that help address limiting factors to benefit the population occur in the population area, then Appendix E estimate is possible. If no habitat work element actions that benefit the population occur in the population area, then no estimate of benefit is made.

5) Appendix E used a qualitative system of benefits associated with a quantitative range to estimate "adjusted improvement potential based on practical constraints" (VL: 0 ; L: > 0 > 2; M: 2-24; H: 25 < 100 ; VH: 100). This estimate that considers practical constraints is a conservative Appendix E estimate (Very low: 0 Low: 1 Medium: 4 High: 25 Very High: 100).

Using Low-end Appendix E Ranges in each timeframe, and develop rationale for supporting higher estimates for populations with gaps: This approach uses the low end of Appendix E ranges as the total survival estimate possible from implementing tributary habitat actions in each of the three timeframes (2000-2006; 2007-2009; 2010-2017), with the total capped by the maximum potential from recovery actions calculated by states for the remand workgroup process.

6) In using Appendix E for estimating population survival, a low end (conservative estimate) was initially used as follows: Very low: 0 Low: 1 Medium: 4 High: 25 Very High: 100. Thus, if a population area had beneficial habitat work elements from projects in 2000-2006 or 2007-2009 and the Appendix E improvement potential was Medium, then a survival estimate of 4% is used

in the tables. This survival estimate is expressed as a 1.04 survival multiplier in each of the first two timeframes of 2000-2006 and 2007-2009 if there are beneficial work element habitat actions for the respective time period. A survival multiplier of 1.08 is used for the 2010-2017 timeframe since twice as much time is involved than habitat efforts in 2007-2009. The total from multiplying the values from each of the timeframes should not exceed the "survival improvement (juvenile) potential from current condition (recovery plan actions estimated by remand habitat workgroup (25 yrs)" (see numbers in Draft NOAA staff product: Possible recovery scenarios based on ICTRT criteria).

7) Use only if maximum potential is exceeded: If the appendix E estimate results from combining the low end estimates in each timeframe results in a value that exceeds the "survival improvement (juvenile) potential from current condition (recovery plan actions estimated by remand habitat workgroup (25 yrs)" (see numbers in Draft NOAA staff product: Possible recovery scenarios based on ICTRT criteria), then the Appendix E estimate is adjusted downward to not exceed the maximum survival improvement potential from the remand habitat workgroup process. For example, the upper mainstem Grande Ronde population of Snake River Steelhead has a Medium improvement potential based on practical constraints from Appendix E and has actions that address important limiting factors for the population. The Medium potential from appendix E would yield a 1.04 survival multiplier estimate in 2000-2006 and 2007-2009 and a 1.08 survival multiplier in 2010-2017, but the remand potential was calculated at 1.05 (5%). In this instance, the 2010-2017 survival estimate would be adjusted by reducing the total survival benefit to be no greater than the maximum potential survival multiplier. In this example, the survival estimate was adjusted downward from a total 1.16 survival multiplier (16% survival benefit) to a 1.05 survival multiplier (or 5% survival benefit), the maximum survival improvement potential. For many populations, the potential estimate from the remand workgroup is higher than the Appendix E estimate and no adjustment to the maximum potential is necessary.

8) Only consider if a gap exists after All-H analysis: If using the low end estimates does not fill the gap for the population and there is more potential from habitat actions based on the "survival improvement (juvenile) potential from current condition," then the Action Agencies

will estimate survival improvements within the maximum potential by considering the actions that have and will be implemented, the key limiting factors that will be addressed, and the extent to which those actions address the limiting factors. The overall estimate of survival improvement will be based largely on the proportional amount of the key limiting factors that would be addressed by the actions. For instance, for the Upper Grande Ronde population of Snake River Spring/Summer Chinook, there is a gap identified after initial benefits when all the Hs are considered. Thus, the Action Agencies will consider the action linkage to limiting factors to make an estimate based on the proportional amount of the potential limiting factors that would be implemented. For example, if the actions implemented would be 25% effective at addressing five key limiting factors in one timeframe, the survival improvement potential for the population is 1.306 based on 25% of the Oregon estimated potential for the population.

9) Validate estimates to the extent possible with local biologists, project sponsors and/or recovery planners: After the estimates are complete, the Action Agencies may seek to validate the estimates for populations where gaps have been identified. The Action Agencies may coordinate with local biologists and recovery planners to help validate the estimates. In addition, the Action Agencies may seek to validate that the conservative low-end estimates for other populations if necessary to confirm the estimates are well within the potential for survival improvement from the actions to be implemented.

10) Potential to increase estimates may exist based on any additional actions and input from local biologists, project sponsors, and recovery planers.

The estimates using the Appendix E based approach could potentially be increased after additional input from local biologists and project sponsors. If more information about the limiting factors and the actions to be implemented for specific populations is added and the Habitat Workgroup estimate is used with a potential to recalculate the maximum potential for a population, many estimates would be expected to increase.

<u>Hybrid Method</u>

A number of methods to convert habitat function to survival estimates were discussed by the

CHW. These methods included habitat models and a simplified general approach. The habitat models included EDT (ISAB, 2001), Shiraz (Scheuerell and others, 2006), McHugh (McHugh and others, 2004), and an approach presented by one of the members of the HWC. Although each of these models have strong and weak points, most, but not all, HWC participants concluded that each model required a significant amount of empirical data and information that was not consistently and readily available for all salmon and steelhead populations throughout the Columbia River Basin.

A simplified general approach (Remand Collaboration Habitat Workgroup 2006) was developed by the HWC (Attachment 1).[3] This method uses the habitat functions provided in the CHW tables and averages available, generalized, empirically-derived egg-smolt survival relations to produce linear relations between habitat function and egg-smolt survival for salmon and steelhead. This method is certainly not precise; however, it provides a method that 1) uses habitat function information provided in the CHW tables, 2) is derived from the egg-smolt survival literature and 3) can be applied for all salmon and steelhead populations in the Columbia River Basin. This method is referred to as the Hybrid Method in the remainder of this report.

Survival estimates by 2017 and 25 years after 2017 calculated using the Hybrid Method for all planned tributary habitat restoration actions that could be implemented by 2017 were provided to the HWC for salmon and steelhead populations in Washington**.** Survival estimates 25 years after 2017 calculated using this approach for all planned tributary habitat restoration actions that could be implemented by 2017 were provided to the HWC for salmon and steelhead populations in Idaho.

The Action Agencies used the Hybrid Method to calculate survival estimates by 2017 and 25 years after 2017 for tributary habitat actions implemented in partnership with States, Tribes, and others with funding and/or technical assistance from the Action Agencies from 2000-2006 and tributary habitat actions expected to be implemented in partnership with States, Tribes, and others with funding and/or technical assistance from the Action Agencies from 2007-2009 with

[3] Note that not all participants in the CHW fully agreed to the methods develop by the Workgroup.

information provided by local biologists and project sponsors described below.

Action Agency representatives met with local biologists, project sponsors, and other CHW members in October and November, 2006, and in May, 2007, to obtain input about the effects on habitat function by 2017 and continuing effects after 2017 resulting from tributary habitat actions implemented in partnership with States, Tribes, and others with funding and/or technical assistance from the Action Agencies from 2000-2006 and habitat actions expected to be implemented in partnership with States, Tribes, and others with funding and/or technical assistance from the Action Agencies from 2007-2009.

In some cases the effects of tributary habitat actions completed from 2000-2006 were already included in the estimate of current habitat function. However, in some cases (most notably riparian protection and enhancement actions) habitat function could continue to improve for decades as a consequence of actions already completed. The objective of identifying habitat function associated with actions completed from 2000-2006 was to capture the continuing effects associated with those completed actions that continue to improve habitat function after completion. For example, riparian planting actions that occurred in 2002 may have small survival improvement benefits the first few years after planting, but shading, cooling, and habitat benefits accrue as the vegetation grows and matures in later years, sometimes continuing to accumulate additional survival improvement benefits for several decades.

Actions expected to be implemented from 2007-2009 are those that 1) have been identified for funding by BPA based on biological priorities and recommendations from the Northwest Power and Conservation Council. 2) are already “in the pipeline” for implementation in partnership with States, Tribes, and others with funding and/or technical assistance from the Action Agencies by the Action Agencies. Specific actions are described in the Tributary Habitat Proposed Action.

Identifying effects by 2017 of both actions completed from 2000-2006 and actions expected to be implemented in partnership with States, Tribes, and others with funding and/or technical

assistance from the Action Agencies from 2007-2009 quantifies those effects within the 10 year time frame of a Biological Opinion. Identifying effects after 2017 of both actions completed from 2000-2006 and expected to be implemented from 2007-2009 quantifies the continuing effects that some actions (most notably riparian protection and enhancement actions) could continue to provide after the initial 10 year time frame.

Tributary habitat actions for Tucannon and Asotin spring Chinook and steelhead were discussed at a meeting held in Walla Walla, Washington on October 18, 2006. Actions for Methow, Wenatchee, and Entiat spring Chinook and steelhead and Okanogan steelhead were discussed at an initial meeting in Wenatchee, Washington on October 19, 2006. Follow-up meetings for Upper Columbia populations of spring Chinook and steelhead populations were held in Wenatchee for Entiat populations on November 7, 2006, Methow populations on November 13, 2006, and Wenatchee populations on November 14, 2006. Actions for Snake River steelhead in the Clearwater and Little Salmon subbasins were discussed at a meeting held in Boise, Idaho on November 16, 2006. Actions for Snake River spring Chinook and steelhead in the Salmon River basin were discussed at a meeting held in Boise, Idaho on November 17, 2006. Actions for Upper Grande Ronde and Catherine Creek Chinook and Upper Grande Ronde steelhead were discussed at a meeting in La Grande, Oregon, on May 2 and 3, 2007. Additional actions for Okanogan steelhead were discussed at a meeting in Spokane, Washington, on May 4, 2007.

Walla Walla meeting

Meeting participants provided habitat function estimates and comments associated with tributary habitat actions implemented in partnership with States, Tribes, and others with funding and/or technical assistance from the Action Agencies. Estimates were reviewed and updated by biologists at the Lower Snake River Salmon Recovery Technical Team meeting on October 24.

Wenatchee meetings

Participants at the initial October 19 meeting had questions about derivation of the original current and resulting 10 and 25 year habitat functions. Working tables produced at this meeting

included comments and indicated relative changes in habitat function that fell between the original references of current and resulting 10 and 25 year habitat functions. Some of the original reference current and resulting 10 and 25 year habitat functions were revised and absolute habitat functions were provided at follow-up meetings.

Boise meetings

Meeting participants provided habitat function estimates and comments associated with tributary habitat actions implemented in partnership with States, Tribes, and others with funding and/or technical assistance from the Action Agencies in the Clearwater subbasin and the Salmon basin.

La Grande meeting

Meeting participants provided habitat function estimates for 2007-2009 tributary habitat actions funded through the NPCC 2007-2009 solicitation which are implemented in partnership with States, Tribes, and others with funding and/or technical assistance from the Action Agencies in the Grande Ronde subbasin.

Spokane meeting

Participants identified additional 2007-2017 actions and associated changes in habitat funuction for Okanogan steelhead for Action Agency consideration.

Survival improvement estimates for actions completed from 2000-2006 and actions to be implemented from 2007-2009

Survival improvement estimates were calculated with the Hybrid Method in a series of steps by applying information obtained from the original habitat tables and from information obtained at field verification meetings held with local biologists and project sponsors in October and November, 2006, and May, 2007. Information used from the original habitat tables included population name, assessment unit weight, assessment unit area, limiting factor, and reference habitat functions (current habitat function and the resulting habitat functions that could be

obtained by 2017 and after 2031 by implementing all planned actions identified to address limiting factors by 2017). Information used from the field verification meetings included any revised reference habitat functions and estimated habitat function by 2017 and after 2017 associated with tributary habitat actions implemented in partnership with States, Tribes, and others with funding and/or technical assistance from the Action Agencies from 2000-2006 and actions expected to be implemented from 2007-2009.

Numerical survival estimates were calculated using the method described by the Remand Collaboration Habitat Workgroup (2006) as follows:

1) For each assessment unit in a population:

a) The average habitat function was calculated as the sum of the habitat functions for each limiting factor in the assessment unit and dividing by the number of limiting factors

b) Assessment survival was calculated by multiplying the average habitat function determined in step 1a) by the assessment unit weight and by the average egg-smolt survival value (0.0018 for Chinook salmon; 0.0004 for steelhead, Remand Collaboration Habitat Workgroup (2006)).

2) For each population:

The resulting assessment unit survival estimates calculated in step 1b were summed to obtain the population survival estimate.

The calculation of habitat function described in step 1a is the same approach used by state and tribal participants in the CHW who provided the original tables that included limiting factors, actions to address those limiting factors, and calculation of current and resulting habitat functions from implementing all planned actions by 2017.

Numerical survival estimates were calculated in this fashion for six different representations of habitat function:

1) current habitat function,
2) habitat function by 2017 resulting from implementing all tributary habitat

restoration actions that were identified as planned by 2017,

3) resulting habitat function by 2017 associated with tributary habitat actions implemented in partnership with States, Tribes, and others with funding and/or technical assistance from the Action Agencies from 2000-2006,
4) resulting habitat function by 2017 associated with tributary habitat actions expected to be implemented in partnership with States, Tribes, and others with funding and/or technical assistance from the Action Agencies from 2007-2009,
5) resulting habitat function after 2017 associated with tributary habitat actions implemented in partnership with States, Tribes, and others with funding and/or technical assistance from the Action Agencies from 2000-2006 and actions expected to be implemented in partnership with States, Tribes, and others with funding and/or technical assistance from the Action Agencies from 2007-2009, and
6) habitat function after 2031 resulting from implementing all tributary habitat restoration actions that were identified as planned by 2017.

Numerical changes in estimated survival were calculated for each of the six different representations of habitat function described in the preceding paragraph by dividing the resulting population survival estimate by the numerical survival estimate for current habitat function.

<u>Extrapolation of survival improvement estimates for actions to be implemented from 2010-2017</u>

The survival improvement estimates calculated in the preceding section represent effects from implementing tributary habitat actions by the Action Agencies from 2007-2009. Survival improvement estimates for actions to be implemented from 2010-2017 were extrapolated to represent effects from implementing tributary habitat actions from 2010-2017. The extrapolation was based on these considerations:

- This approach represents a continuation of the level of effort documented in detail for 2007-2009.
- More detailed projects selection for 2010-2017 will be developed based on biological priorities forthcoming at 3 year intervals.
- The majority of Action Agency tributary habitat actions are implemented in partnership

with States, Tribes, and others with funding and/or technical assistance from BPA and Reclamation

- BPA funds a large part of the Action Agency tributary habitat actions through the NPCC proposal recommendation process and is providing future funding commitments for 2010-2017.
- There will be 2 more full NPCC proposal recommendation cycles between 2010 and 2017

The Action Agencies will implement tributary habitat actions from 2010-2017 at a rate similar to 2007-2009. Consequently, survival estimates associated with actions implemented after 2010 are expected to be related linearly to survival estimates associated with actions expected to be implemented from 2007-2009. Incremental survival improvement estimates for actions expected to be implemented for each salmon and steelhead population for the seven year period from 2010-2017 were estimated to be double the incremental survival improvement estimates for actions expected to be implemented for each respective salmon and steelhead population for the three-year period from 2007-2009. This survival improvement estimate was reduced to the potential survival if the estimate exceeded the potential.

Application of Methods and Results

The methods described above were applied to obtain survival improvement estimates for three sets of actions completed or to be implemented from: 2000-2006, 2007-2009, and 2010-2017. Furthermore, survival improvement estimates were obtained for these three sets of actions by 2017 (the term of the Biop) and after 2017 (to account for survival improvement benefits that accrue in the long term, such as riparian actions). During development of these documents the Action Agencies decided to report 2007-2017 tributary habitat results simply as the combination of the 2007-2009 and 2010-2017 results to be consistent with reporting for the other components described in the Proposed Action and biological analysis. In some cases a combination of both methods was used to estimate survival improvements as described below. Survival improvement estimates described in this appendix are presented in Table 1 and were used in the biological analysis described in separate reports.

Survival Improvement Estimates Through 2017 for Actions Completed from 2000-2006

The Appendix E method described in an earlier section of this report was used to estimate survival improvement associated with actions completed from 2000-2006 for the unshaded salmon and steelhead populations in Table 1 and for upper Grande Ronde and Catherine Creek Chinook and upper Grande Ronde steelhead populations.

The following method was used to estimate survival improvement associated with actions completed from 2000-2006 for salmon and steelhead populations which are shaded in Table 1 except for upper Grande Ronde and Catherine Creek Chinook and upper Grande Ronde steelhead populations for which the Appendix E method was used. A combination of the Appendix E and Hybrid method was used to calculate these estimates as follows.

1) Referred to qualitative biological benefits identified in the 2004 UPA for "Tributary Habitat Actions Implemented under the 2000 RPA". This indicated the survival improvement benefits expected by the AAs for 2000-2003 actions.

2) Referred to qualitative biological benefits identified in the 2004 UPA for "Tributary Habitat Actions" associated with the UPA. This indicated the survival improvement benefits expected by the AAs for actions after 2004

3) Referred to the qualitative determination of benefits associated with tributary habitat actions for each ESU contained in the "Conclusion" section of the 2004 FCRPS BiOp. This indicated the survival improvement benefits NOAA associated with tributary habitat actions to be implemented after 2004

4) Referred to tables of metrics for 2000-2006 completed actions associated with the 2000 and 2004 BiOps compiled by BPA and Reclamation

5) Referred to the Appendix E qualitative potential values (VL-to-VH) and associated numerical ranges

Converted the qualitative Appendix E values to the following numeric values

Appendix E Qualitative value	Appendix E Numeric Range	Representative numeric value (RNV)
Very Low	0	0
Low	0-2	1

Low end of Medium	N/A	4
Medium	2-24	N/A
High	25-100	N/A
Very High	100	N/A

Representative numeric values were assigned to associate a single numerical value with the numeric ranges cited in Appendix E. A midpoint value of 1 was assigned for the representative numeric value for Low. There was no numeric value identified in Appendix E for the qualitative value, “Low end of Medium”. A value of 4 was assigned for the representative numeric value for the “Low end of Medium” qualitative value.

Information from step 4 was reviewed to validate metrics associated with completed 2000-2006 actions for respective ESUs. The survival estimate for 2000-2006 completed actions was calculated by averaging the representative numeric values associated with step 1 and for step 5 for each ESU. This approach incorporates available information about expected biological benefits before 2004 (step 1) and after 2003 (step 5). The resulting value represented survival improvement associated with the 2000-2006 time period and was added to the survival improvement value obtained from the Hybrid Method for 2000-2006 completed actions which represented survival improvement benefits accrued from 2007-2017.

Survival Improvement Estimates Through 2017 for Actions to be Implemented from 2007-2009

The Appendix E method described in an earlier section of this report was used to estimate survival improvement associated with actions to be implemented from 2007-2009 for the unshaded salmon and steelhead populations in Table 1.

The Hybrid method described in an earlier section of this report was used to estimate survival improvement associated with actions completed from 2007-2009 for the shaded salmon and steelhead populations in Table 1.

Survival Improvement Estimates Through 2017 for Actions to be Implemented from 2010-

2017

The Appendix E method described in an earlier section of this report was used to estimate survival improvement associated with actions to be implemented from 2010-2017 for the unshaded salmon and steelhead populations in Table 1.

The Hybrid method described in an earlier section of this report was used to estimate survival improvement associated with actions to be completed from 2010-2017 for the shaded salmon and steelhead populations in Table 1.

Survival Improvement Estimates After 2017 for Actions Completed from 2000-2006 or to be Implemented from 2010-2017

The Hybrid method described in an earlier section of this report was used to estimate survival improvement after 2017 associated with actions completed from 2000-2006 and actions to be completed from 2007-2009 for the shaded salmon and steelhead populations in Table 1. These values do not include any estimated survival improvement benefits for effects of actions to be completed from 2010-2017.

Survival Improvement Estimates for Other Actions Reasonably Certain to Occur

[PLACEHOLDER]

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This is not a final federal agency product. Rather, it is a pre-decisional document prepared by the Action Agencies that reflects present understandings of currently available information and analyses, and of the progression of discussions with the sovereigns in the collaborative process. Revisions and refinements are to be expected based on further discussions with the sovereigns over new and modified proposed federal actions upon which the action agencies will ultimately consult. Finally, the information in this product does not constitute an analysis of whether the identified measures would or would not jeopardize the continued existence of a listed species or result in the destruction or adverse modification of designated critical habitat. Furthermore, this document does not in any way interpret or apply the regulatory definitions of the statutory phrases "jeopardize the continued existence of" and "destruction or adverse modification."

Approach to Estimating Survival Benefits of Habitat Actions

March 27, 2007

Over the decade many books on salmon conservation have emerged (e.g., NRC 1996; Stouder et al. 1997; Lichatowich 1999; Knudsen et al. 2000; Lynch et al. 2002; Montgomery et al. 2003; Wissmar and Bisson 2003), and all agree that habitat restoration should be a cornerstone of any recovery program. As such, it is important to identify locations where current habitat conditions would benefit from protection or restoration. In addition, it is also important to assess the potential benefits of habitat actions to target fish populations and ESUs.

Estimating potential biological benefits (e.g., increased survival or productivity) is a difficult task because most habitat actions do not affect biological parameters directly. The usual approach is to manipulate the environment (add wood, rock, vegetation, nutrients, passage, etc.) in the hope that the change in the environment will result in a desired change in the population (biological parameters). For example, one may add woody debris to a stream to increase the abundance and survival (productivity) of juvenile Chinook in a stream reach. In the chain-of-causation, the "cause" is the addition of wood (treatment), which directly "affects" the stream environment (presence of woody debris is the first link in the chain). The presence of woody debris should then "affect" the abundance and survival of juvenile Chinook (biological response is the second link). Note that abundance and survival of Chinook (biological response) is more than one link from the treatment (Figure 1).

Chain of Causation

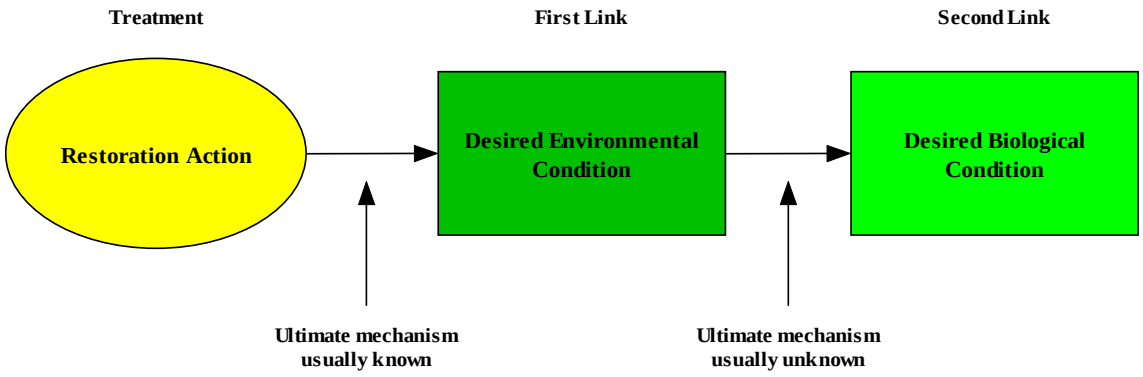

Figure 1. Conceptual model showing the chain-of-causation from the restoration action (treatment) to the environmental and biological responses. The mechanism(s) resulting in a biological change is less well understood as more links are added to the chain.

As a general rule, the more links there are between the treatment and desired effect, the more difficult it will be to detect or predict a treatment effect. Stated another way, the more links between the treatment and the desired effect, the less confidence one has that the treatment will actually result in a desired effect. This is because several other factors (extraneous or nuisance factors) may have a greater effect on the desired outcome than the treatment. For example, it is unlikely that one can predict with any confidence what affect rock weirs will have on the abundance and productivity of adult Chinook within a stream. Not only is adult abundance several links removed from the treatment, Chinook, like other anadromous species, use multiple ecosystems (tributary, mainstem, estuary, ocean systems) that are each replete with extraneous factors acting upon the survival of the fish (Figure 2). As the number of links between the action and the desired response increase, the number of extraneous factors increases making predictions about biological responses uncertain.

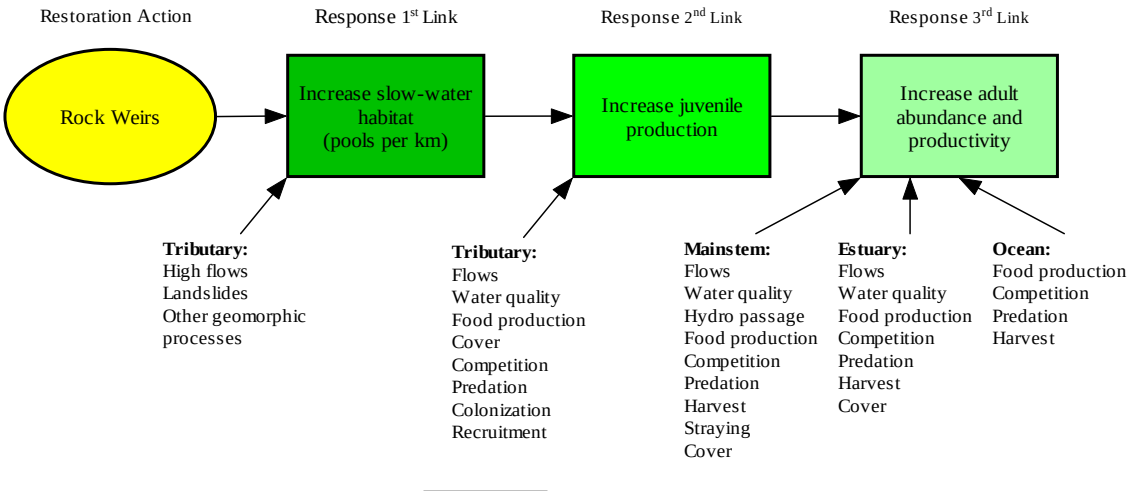

Figure 2. Relationship between a restoration action (rock weirs) and physical and biological responses. As the number of links increase, the number of extraneous factors (those listed below the causal chain) increase, making it more difficult to identify a treatment effect. The ability to predict desired outcomes decreases as more links are added to the chain (reflected in the decreasing shades of green).

For these reasons, it is very difficult to estimate with any certainty the potential benefits of habitat actions on adult abundance or productivity. Therefore, the Habitat Workgroup estimated survival benefits for only two life-stages, juvenile and pre-spawning adult.

There were two general approaches that the Habitat Workgroup explored: (1) life-cycle models and (2) professional judgment (similar to the Appendix E approach used in the 2004 BiOp). The workgroup considered models such as EDT, HQI, HEP, PHABSIM, Shiraz, and a simple model developed by CRITFC. One model, EDT, has been used by some recovery planning groups to estimate survival benefits associated with recovery actions. Although the model was used to generate hypotheses in draft recovery plans, it is very complex, relies on many assumptions, and requires considerable input based on empirical data, derived data, and/or professional judgment. In addition, outputs lack confidence limits and therefore sensitivity analysis is needed to estimate certainty. Populating and running the model is time-consuming. Other models (e.g., HQI, HEP, PHABSIM, and Shiraz) can be used to generate hypotheses about potential benefits, but, like EDT, these tools require significant input and time to run. Given the lack of time and information or data, such analytical tools or models were not an option in the Remand Process. The workgroup did use results from models used in other forums (e.g., recovery plans and subbasin plans).

The second approach relied on professional judgment. This method was deemed the most reasonable approach given the lack of time and information available. This approach relied heavily upon the expertise of local biologists. Local biologists with the most knowledge about local watershed processes, habitat conditions, and fish populations in their respective areas provided the workgroup with estimates of current habitat conditions, primary limiting factors, restoration actions needed to fix limiting factors, and potential habitat conditions that would result if the primary limiting factors were addressed.

In an attempt to standardize the habitat assessment process, the Habitat Workgroup provided local biologists with a guidance document and standardized matrices to aid in estimating current conditions, limiting factors, restoration actions, and potential habitat conditions. Local biologists, with guidance from the Habitat Workgroup, populated the habitat matrices. Data within these matrices were used by the Habitat Workgroup to estimate overall habitat quality and potential survival benefits associated with implementing proposed tributary habitat actions.

Estimating Habitat Quality

Habitat quality is dependent on more than one habitat variable (e.g., stream flows, temperature, water quality, fine sediments, pools, woody debris, off-channel habitat, etc.). Local biologists provided the Habitat Workgroup with estimates of current and potential conditions[1] for each habitat variable that was currently limiting fish productivity. The workgroup then combined the condition scores for each individual variable into a composite habitat quality score. The workgroup evaluated several different methods for combining conditions of individual habitat variables to obtain a composite score.

(1) The first method was multiplication (i.e., multiply the individual habitat scores to obtain a composite score). This method assumes that fish select each particular habitat variable independently of other variables (assumes no interaction or compensation). One problem with this method is that the product equation yields zero habitat quality for any given habitat variable of unsuitable condition. For example, a stream reach with no woody debris (0% function) would result in a composite habitat quality score of 0%.

(2) The second approach used the lowest condition habitat variable as the composite habitat quality score. This assumes that the most limiting factor (habitat variable with the lowest condition score) determines the upper limit of habitat quality and the fact that variables with high condition cannot compensate for low condition variables.

(3) The third approach was the geometric mean of individual habitat scores. This method provides some compensation, but like the product equation, it yields zero habitat quality for any zero-valued habitat variable.

(4) The final approach was the arithmetic mean of individual habitat scores. This approach assumes that good habitat conditions on one variable can compensate for poor conditions on other variables.

After evaluating these methods, the Habitat Workgroup concluded that a combination of the second and fourth approaches was reasonable. The second method was used when a limiting habitat variable was considered a lethal factor. Lethal factors included variables that at certain concentrations or levels kill fish (e.g., temperature and other water quality

[1] Current and potential conditions were given as percentages of optimal conditions. NOAA Fisheries definition of properly functioning condition (PFC) was used to help local biologist understand what was meant by optimal condition (see NMFS 1996).

parameters, fine sediment, flows, etc.).[2] Thus, overall habitat quality was based only on the condition of the lethal factor if its concentration was at a level that would kill fish. The arithmetic mean (fourth approach) was used if no lethal factors were identified by the local biologists.

Following this exercise, the Habitat Workgroup then identified "functional relationships" that would aid in estimating potential survival benefits corresponding to projected changes in habitat quality. The intent was to find a simple function or functions that would allow the workgroup to estimate how much juvenile or pre-spawning adult survival would increase if habitat quality improved from, say, 35% to 45% of optimal condition. The functional relationships were only used to guide professional judgment in estimating potential survival increases. They were not developed to estimate "absolute" survival rates.

Identification of Functional Relationships

Not knowing if the "shape" of the relationship between habitat quality (as a percent of optimal condition) and survival was linear or non-linear, the Habitat Workgroup began by exploring existing life-cycle models in search of common relationships that could be used to guide professional judgment. Examination of relationships in EDT was difficult, because of the complexities of the model. The workgroup found no simple functions in EDT that could be used to guide professional judgment. On the other hand, the Shiraz model (Scheuerell et al. 2006) and work by McHugh et al. (2004) were more transparent and provided analytical relationships between habitat attributes and survival. These models included relationships for temperature, fine sediment (embeddedness), flows, and cover (cobbles and wood) for different juvenile life stages and for pre-spawning adults. Listed below are relationships between survival and habitat attributes for different life stages.

[2] In contrast, controlling factors include variables that do not directly kill fish but can affect their abundance and distribution (e.g., number of pools, off-channel habitat, woody debris, etc.). These variables were averaged to estimate overall habitat quality.

Incubation

Scheuerell et al. (2006) described the following hockey-stick relationship between temperature and egg-fry survival based on data in Tappel and Bjornn (1983):

$$p_{1,2} = \begin{cases} 0.95 & \text{if } f < 0.268 \\ -3.32f + 1.81 & \text{if } 0.268 \le f < 0.544 \\ 0.06 & \text{if } f \ge 0.544 \end{cases}$$

This function relates survival ($p_{1,2}$) to the percentage of fine sediment (f < 6.35 mm) within spawning and incubation habitat. If fines less than 1.7 mm are used, the following relationship applies:

$$p_{1,2} = \begin{cases} 0.93 & \text{if } f < 0.116 \\ -5.21f + 1.54 & \text{if } 0.116 \le f < 0.283 \\ 0.06 & \text{if } f \ge 0.283 \end{cases}$$

McHugh et al. (2006) provided an alternative survival function based on data in Stowell et al. (1983) and Tappel and Bjornn (1983).

$$p_{1,2} = [92.95 / (1 + e^{-3.994+0.1067*\text{fines}})]/100$$

This relationship is based on fine sediments in spawning gravels less than 6.35 mm in diameter.

Scheuerell et al. (2006) described the following relationship between water temperature (T_{inc}) and egg-fry survival ($p_{1,2}$):

$$p_{2,1} = \begin{cases} 0.273T_{inc} - 0.342 & \text{if } 1.3 \le T_{inc} < 4.7 \\ 0.94 & \text{if } 4.7 \le T_{inc} < 14.3 \\ -0.245T_{inc} + 4.44 & \text{if } 14.3 \le T_{inc} < 18.1 \\ 0.01 & \text{if } T_{inc} \ge 18.1 \end{cases}$$

McHugh et al. (2004) described an alternative survival rate function for egg-fry survival.

$$p_{1,2} = -0.26 + 0.27(T_{inc}) - 0.02(T_{inc})^2$$

Scheuerell et al. (2006) described the following relationship between normalized flow (Q*) and egg-fry survival ($p_{1,2}$):

$$p_{2,2} = \begin{cases} 0.58 - 0.844Q^* & \text{if } Q^* < 0.675 \\ 0.01 & \text{if } Q^* \ge 0.675 \end{cases}$$

Summer Rearing

McHugh et al. (2006) provided the following functional relationship using a polynomial function reported in Stowell et al. (1983) based on the work of Bjornn et al. (1977).

$$S = [100 - 1.79(\text{Emb}) + 0.0081(\text{Emb})^2]/100$$

The function relates percentage summer stream capacity to the degree (%) that cobbles are embedded in riffle/run habitat.

McHugh et al. (2004) described the following relationship between water temperature and survival of Chinook parr during summer rearing:

$$S = \exp\left\{-\left[\left(\frac{sumT}{27.0271}\right)^{10.74}\right]\right\}$$

This function was computed using a Weibull function that related daily survival (*S*) to mean daily stream temperature (*sumT*) for any given day of the summer rearing period. Using this function, the daily survival rate decreases whenever the average daily temperature exceeds an upper temperature threshold of 17.8 °C.

Winter Rearing

McHugh et al. (2006) provided the following relationship using a function reported in Stowell et al. (1983) based on the work of Bjornn et al. (1977).

$$S = 1.001e^{-0.013(\text{Emb})}$$

This exponential function relates overwinter capacity for Chinook parr to percent pool embeddedness (Emb).

Cramer (2001) described the following relationship between percentage of cobbles and wood in pools (<15%) and overwinter survival of Chinook parr:

$$S = 20 + [80(\text{Cob})/15]/100$$

Pre-Spawning Adult

Cramer (2001) provided the following relationship for pre-spawner adult Chinook salmon:

$$p_1 = \begin{cases} 1 & \text{if } T_{pre} < 16 \\ 1 - 0.15(T_{pre} - 16) & \text{if } 16 \le T_{pre} < 22.6 \\ 0.01 & \text{if } T_{pre} \ge 22.6 \end{cases}$$

This function relates adult survival (p_1) to mean maximum temperatures (T_{pre}) during migration and pre-spawning.

These functions describe relationships between specific habitat attributes (e.g., temperature, fine sediment, etc.) and survival. However, local biologists provided habitat quality data scaled from 0% to 100% of optimal condition. Therefore, it was necessary to transform the habitat attributes into a common habitat quality index that ranged from 0-100%; where 0% habitat quality represented the worst habitat condition (lethal sediment levels and temperatures) and 100% habitat quality represented the best habitat condition (optimal temperature and sediment levels). These habitat quality ratings of 0-100% equated to survival indices that ranged from 0.0 to 1.0, respectively. In this case the survival index has no connection with "absolute" survival rate. That is, one cannot determine the absolute egg-smolt survival rate from these relationships. In contrast, the functions can be used to estimate possible survival increases associated with habitat actions if the ratio of the survival index under improved habitat conditions (potential survival index; S_{rp}) to the survival index under current conditions (S_{rc}) equals the ratio of potential absolute survival (S_{ap}) to current absolute survival (S_{ac}).

$$S_{rp} / S_{rc} \approx S_{ap} / S_{ac}$$

Thus, an estimated survival index ratio of 1.2, calculated as the ratio of the potential survival index of 0.30 to the current survival index of 0.25, implies that the absolute survival rate would increase approximately 20% if habitat restoration actions were implemented. If the current absolute survival rate is 0.08[3], the expected potential survival rate would increase about 20% to 0.10. In this exercise the workgroup is more concerned with the ratio than with the absolute survival values.

The workgroup plotted the relationships in an effort to find a common "shape" among the functions (Figure 3). It was clear that no "common" functional relationship existed within or among life stages. Therefore, the workgroup tried to combine relationships in an attempt to find a shape of central tendency.[4] The workgroup explored several different approaches: (1) average across all survival functions, (2) average survival functions within a life stage and multiply the mean functions across life stages, (3) multiply across all survival functions, and (4) use a simple linear function. These relationships are shown in Figure 4.

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[3] For many populations, absolute survival rates for juvenile Chinook are unknown. Calculating ratios of survival indices appears to be a useful alternative in the absence of absolute survival rates. This is based on the assumption that ratios of survival indices represent ratios of absolute survival rates.

[4] It is important to note that there are several problems with generating functions of central tendency. For example, absolute survival rates cannot be estimated, information is lost by converting habitat attributes into habitat quality ratings, and combining functions provides false precision and accuracy. However, the intent was simply to identify a functional shape that would guide professional judgment. The function was not developed to estimate absolute survival rates.

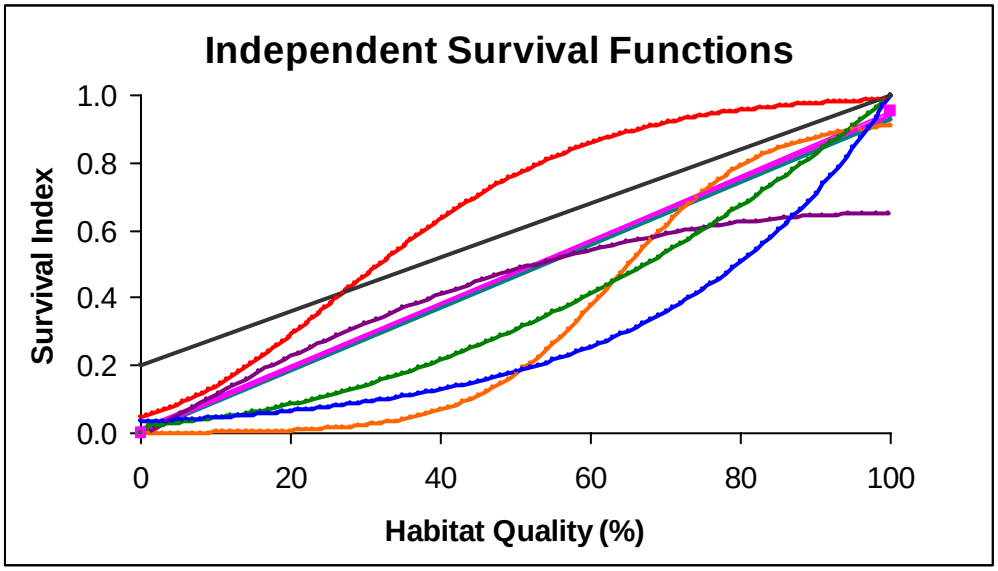

Figure 3. Various shapes of functional relationships between habitat quality and survival index.

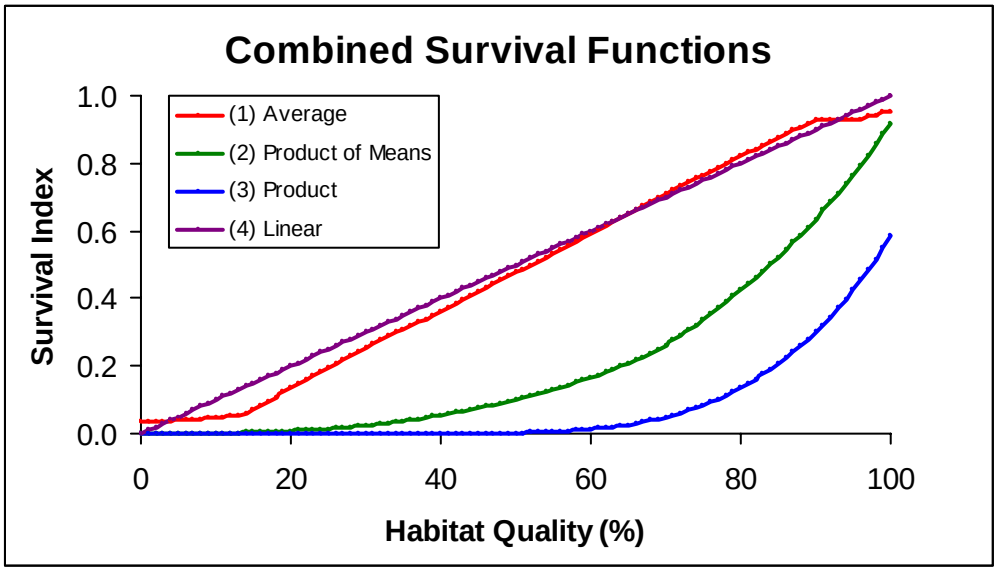

Figure 4. Comparison of shapes of functions generated by seeking relationships of central tendency.

Each of the "combined" functions was then evaluated by calculating potential survival gains associated with habitat quality data provided by local biologists. Where possible, estimated survival increases were compared with EDT results, historic redd counts, and/or survival benefits identified in the Human Impacts Report (from the Framework Workgroup). Both the linear function and the average function (based on median scores) provided estimates closest to EDT results and estimates contained in the Human Impacts Report. The exponential functions grossly overestimated survival benefits (in some cases they estimated well over 10,000 fold increases in juvenile survival). The workgroup

found no biological reason why the average function was the most appropriate relationship. There is no justification why there would be little survival increase associated with habitat quality increases from 0-10% and 90-100%. The workgroup collectively agreed, given the current data, that the linear function was the most realistic and should be used to guide professional judgment. This relationship also fits well with published literature that indicates that more intensive and extensive restoration actions result in greater survival benefits (e.g., see Paulsen and Fisher 2001).

To avoid the misconception that juvenile survival could be near 100% (survival index of 1.0) at high habitat quality, the Habitat Workgroup converted the survival indices into survival rates that represented actual juvenile and adult survivals measured in natural environments. The workgroup then developed different linear functions for Chinook salmon, steelhead, and chum salmon based on these actual survival rates. The goal was to identify what egg-smolt survivals for naturally produced Chinook salmon and steelhead and egg-fry survivals of chum salmon corresponded to optimal habitat conditions (100% habitat quality under natural conditions). The following is a brief summary of egg-smolt and egg-fry survival estimates that were readily available.

Chinook Salmon

Some of the highest Chinook survival rates were reported by Bugert and Seidel (1988) in the Tucannon River. Using a migrant trap on the lower Tucannon River, Bugert and Seidel (1988) estimated an egg-smolt survival that ranged from 13-22% between 1985 and 1987. In the Yakima River, Major and Mighell (1969) estimated that 5.4-16.4% of the potential spring Chinook egg deposition survived to migrate as yearling smolts. Later work by Fast et al. (1989) indicated that, on average, 4.94% (range, 4.2-6.5%) of the eggs survived to migrate as smolts in the Yakima River. In the John Day River, egg-smolt survivals of spring Chinook were estimated as 3.6-8.6% (Knox et al. 1984), while Lindsay et al. (1989) reported spring Chinook survivals of 2.1-8.7% in the Deschutes River.

In the Methow, Wenatchee, and Entiat systems, Mullan et al. (1992) estimated egg-smolt survivals of 1.35-2.15%, 1.55-2.35%, and 2.90-6.65%, respectively, for spring Chinook. Mullan et al. (1992) calculated these survivals by extrapolating rearing densities for the total basin rearing areas by habitat quality index ranking with an assumed 40% overwinter survival. In the Chiwawa Basin, WDFW (unpublished data) has estimated egg-smolt survivals for spring Chinook brood years 1991-2003. They estimated an average egg-smolt survival of 8.6% (range, 3.7-16.9%). Quinn (2005) recently reviewed published and unpublished estimates for wild or naturally produced Chinook populations and reported a mean egg-smolt survival of 10.4%.

Steelhead

Ward and Slaney (1993) conducted a thorough study of steelhead egg-smolt survival for seven years in the Keogh River, B.C. and estimated a mean survival of 0.51% (range, 0.28-1.30%). Bley and Moring (1988) described a study that was conducted by the WDW Snow Creek Research Station in Washington. Using winter steelhead, WDW estimated an egg-smolt survival of 1.6%. Bjornn (1978) reported that survival of steelhead from egg-smolt in the Lemhi River ranged from 0.16-3.61%. WDF et al. (1990) estimated an egg-smolt survival of 1.7% for steelhead in the Wenatchee River. In contrast, Peven

(1992) repored a survival of 0.4%. Peven's estimate included the entire mid-Columbia basin.

Thurow (1987) reviewed egg-smolt survival rates for wild steelhead. He found that rates ranged from 0.5-2.5%. Most of the work reported for seven river systems indicated survivals from 1-2% (Bjornn 1978; Phillips et al. 1981; WDG 1983). Thurow (1987) assumed survival of 1% under poor spawning conditions (e.g., poor quality spawning habitat, abnormal flows, abnormal temperature regimes, and redd superimposition), 1.5% under average conditions, and 2% under optimal conditions in the South Fork Salmon River. Quinn's (2005) review of published and unpublished estimates for wild or naturally produced steelhead populations indicated a mean egg-smolt survival of 1.4%.

Chum Salmon

Salo (1991) summarized egg-fry survival rates of chum salmon in his Tables 10 and 11. His summary indicates that egg-fry survivals of naturally produced chum salmon in natural environments can range from 0.1 to 85.9%. The latter is an estimate of survival of chum in the Iski River (tributary to the Amur River in Russia). This estimate appears to be an outlier when compared to estimates from other systems. Most survival estimates were less than 35%. Quinn's (2005) review indicated a mean egg-fry survival of 12.9% for chum salmon.

Based on this review of readily available literature, the following egg-smolt and egg-fry survival estimates appear reasonable if one assumes optimal (100% habitat quality) spawning and rearing conditions:

Chinook Salmon:	18% egg-smolt survival
Steelhead:	4% egg-smolt survival
Chum Salmon:	35% egg-fry survival

These estimates represent the highest survivals that could be achieved under optimal habitat conditions. The workgroup also assumed that the maximum pre-spawning adult survival would be 100% at optimal conditions. It is important to note that some systems may never achieve these life-stage survivals, because the systems are naturally unable to establish conditions that would be "optimal," even if all anthropogenic effects could be removed.

Applying these maximum survival rates to optimal habitat conditions resulted in linear functions with different slopes (rates of change) for each species and life stage (Figure 5). The Habitat Workgroup used the following linear functions to guide professional judgment in estimating survival improvements associated with habitat quality improvements:

Chinook salmon egg-smolt survival = 0.0018*(Habitat Quality)

Steelhead egg-smolt survival = 0.0004*(Habitat Quality)

Chum salmon egg-fry survival = 0.0035*(Habitat Quality)

Adult pre-spawning survival = 1.0*(Habitat Quality)

These functions provided a conservative approach to estimating survival gains and resulted in estimates that were generally less than those calculated with EDT.

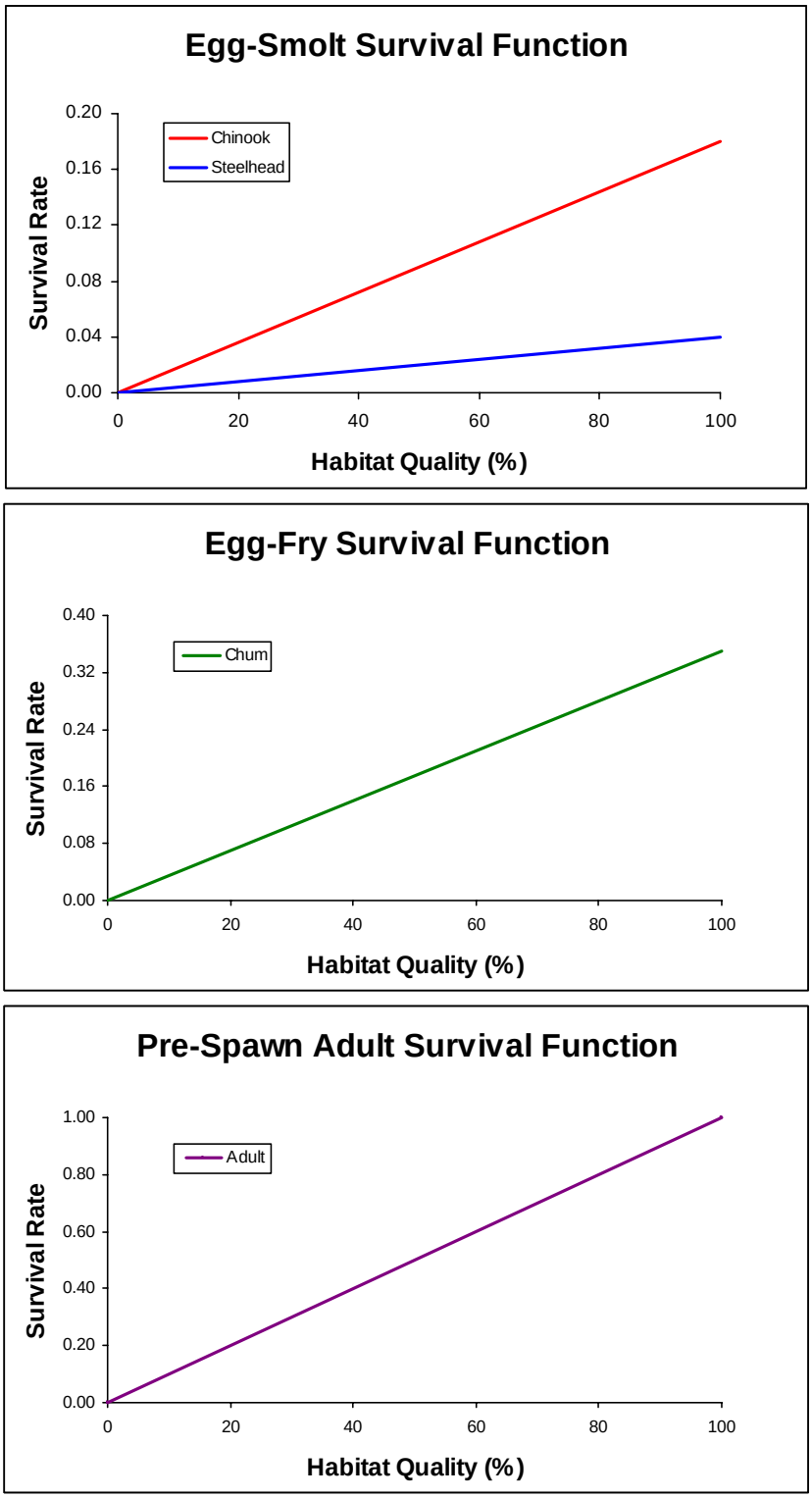

Figure 5. Linear functions for egg-smolt, egg-fry, and pre-spawning adult survival of Chinook salmon, chum salmon, and steelhead.

Estimating Survival Changes within Assessment Units

Local biologists have subdivided the geographic areas of some populations into smaller assessment units (AUs) or watersheds. Within these smaller units, they described current habitat conditions (as a percent of optimal conditions), identified primary limiting factors, proposed restoration actions that would address limiting factors, and estimated the potential habitat condition (as a percent of optimal condition) that would result if restoration actions were implemented. These habitat conditions within AUs were translated into relative survival estimates using the linear relationships described above. Current and potential survival rates were estimated based on current and potential habitat conditions. Potential survival rates were based on habitat conditions that could be achieved if actions were implemented within each AU.

Because different AUs within a population have different capacities and/or production potentials, survival estimates for those AUs were weighted according to their capacities or production potentials. Weightings were based on the fraction of the population that spawns within each AU or on the fraction of the total geographic area of the population that was contained in each AU. For example, if a given population had three AUs and one unit supported 65% of the spawners, another supported 10%, and the last supported 25% of the spawners, then AU1 was given a weight of 0.65, AU2 a weight of 0.10, and AU3 a weight of 0.25. Survival estimates for each AU were then multiplied by their respective weights to estimate a weighted survival rate. These weighted rates were added together to estimate the overall survival rate for the juvenile (tributary) life-stage of the population.

Overall current and potential survival estimates for the population were calculated separately. That is, current and potential survival estimates for each AU were multiplied by there respective weights and summed independently of each other. Once the workgroup had calculated the current and potential survival estimates for the population, the survival increase associated with habitat restoration actions was calculated simply as the ratio of the potential survival estimate for the population (S_p) to the current survival estimate for the population (S_c). That is,

$$S = S_p/S_c$$

The Habitat Workgroup reported these ratios as the survival improvements associated with habitat restoration actions.

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This is not a final federal agency product. Rather, it is a pre-decisional document prepared by the Action Agencies that reflects present understandings of currently available information and analyses, and of the progression of discussions with the sovereigns in the collaborative process. Revisions and refinements are to be expected based on further discussions with the sovereigns over new and modified proposed federal actions upon which the action agencies will ultimately consult. Finally, the information in this product does not constitute an analysis of whether the identified measures would or would not jeopardize the continued existence of a listed species or result in the destruction or adverse modification of designated critical habitat. Furthermore, this document does not in any way interpret or apply the regulatory definitions of the statutory phrases "jeopardize the continued existence of" and "destruction or adverse modification."

Table 1. Estimated survival improvement percentages for actions completed from 2000-2006 and actions to be funded from 2007-2017. Improvements are shown for time periods through 2017 and after 2017. Base-to-current and Prospective values were used in the biological analysis. Shaded populations were estimated using the Hybrid method. Unshaded populations were estimated using the Appendix E method with exceptions to both methods indicated by footnotes. Although improvements are to be expected, no improvement estimates were made after 2017 (within 25 years) for populations where the Appendix E method was used. Blank cells indicate that estimates are not available. Percent change in habitat quality and percent change in survival are equivalent here (i.e., changes in juvenile survival are directly proportional to changes in habitat condition). The information we actually received from the collaborators was related to habitat condition, and the actions we are undertaking will improve habitat condition. The Habitat Benefits report describes derivation of juvenile survival from changes in habitat quality, and juvenile survival is reported in this table.

			Estimated Percentage Survival Improvement		
ESA-listed ESU	**MPG**	**Population**	**By 2017 for Actions Completed from 2000-2006 (Base-to-current)**	**By 2017 for Actions Completed from 2007-2017 (Prospective)**	**After 2017 for Actions Completed from 2007-2017 (within 25 years)**
Snake River Spring/Summer Chinook	Grande	**Catherine**	**4**	**14**[1]	**24**

[1] Estimates derived from additional actions identified through collaboration with parties in the Grande Ronde subbasin

	Ronde / Imnaha	**Creek**			
		Lostine/Wallowa River	**1**	**18[2,3]**	**9**
		Minam River			
		Grande Ronde River upper mainstem	**4**	**7[1]**	**26**
		Wenaha River			
		Big Sheep Creek			
		Imnaha River mainstem	**1**	**<1[4]**	
	Middle Fork Salmon River	Bear Valley Creek			
		Big Creek		**7[2]**	**2**
		Camas Creek			
		Loon Creek			
		Marsh Creek			
		Sulphur Creek			
		Middle Fork Salmon River above Indian Creek			
		Chamberlain Creek			
		Middle Fork Salmon River below Indian Creek			
	South				
		East Fork South			

[2] Estimates derived from additional actions identified through collaboration with the Nez Perce Tribe. Estimates provided by Nez Perce Tribe
[3] Represents estimated percentage survival improvements associated with approximately 54% of actions identified by the Nez Perce Tribe
[4] Low estimates are constrained by low habitat potential values which were initially provided by Oregon to the Remand Collaboration Habitat Workgroup but are now being reviewed with the collaboration parties

	Fork Salmon River	Fork Salmon River			
		Little Salmon River	**0.5**	**12**[2]	**3**
		Secesh River		**6**[2]	**5**
		South Fork Salmon River mainstem		**6**[2]	**3**
	Lower Snake	Asotin Creek	**11.5**	**14**	**10**
		Tucannon River	**3.5**	**17**	**13**
	Upper Salmon River	East Fork Salmon River	**0.5**	**3**	[5]
		Lemhi River	**0.5**	**21**	[5]
		North Fork Salmon River			
		Pahsimeroi River	**0.5**	**43**[6]	[5]
		Salmon River lower mainstem below Redfish Lake	**0.5**	**3**	[5]
		Salmon River upper mainstem above Redfish Lake	**0.5**	**42**	[5]
		Valley Creek	**0.5**	**3**	[5]
		Yankee Fork	**0**	**30**	**32**
Upper Columbia Spring Chinook	Upper Columbia - Below Chief Joseph	Entiat River	**2**	**22**	**2**
		Methow River	**2**	**6**	**1**
		Wenatchee River	**2**	**3**	[5]

[5] Estimates are not currently available, but will be developed when 2010-2017 actions are refined
[6] Represents estimate targeted by the action agencies

Middle Columbia Steelhead	Cascades Eastern Slope Tributaries	Deschutes River - eastside	**1**	**3**[4]	
		Deschutes River - westside	**0.2**	**1**[4]	
		Fifteenmile Creek (winter run)	**0.1**	**<1**[4]	
		Klickitat River	**4**	**12**	
		Rock Creek			
	John Day River	John Day River lower mainstem tributaries	**0.2**	**1**[4]	
		John Day River upper mainstem	**0.2**	**1**[4]	
		Middle Fork John Day River	**0.2**	**1**[4]	
		North Fork John Day River	**0.3**	**1**[4]	
		South Fork John Day River	**0.7**	**2**[4]	
	Umatilla and Walla Walla River	Touchet River	**4**	**12**	
		Umatilla River	**4**	**12**	
		Walla Walla River	**4**	**12**	
	Yakima River Group	Naches River	**4**	**12**	
		Satus Creek	**4**	**12**	
		Toppenish	**4**	**12**	
		Yakima River upper mainstem	**4**	**12**	
Snake River Steelhead	Clearwater River	Clearwater River lower mainstem	**2.5**	**4**	**1**
		Lochsa River	**0.5**	**18**[2]	**7**
		Lolo Creek	**0.5**	**12**[2]	**6**
		Selway River	**0.7**	**2**[2]	**2**

		South Fork Clearwater River	**1.5**	**14[2]**	**12**
	Grande Ronde River	Grande Ronde River lower mainstem tributaries	**0.1**	**<1[4]**	
		Grande Ronde River upper mainstem	**2**	**9[1]**	**25**
		Joseph Creek (OR)	**0.1**	**<1[4]**	
		Joseph Creek (WA)	**4**	**12**	
		Wallowa River	**2**	**27[2]**	**16**
	Hells Canyon	Hells Canyon	**0**		
	Imnaha River	Imnaha River	**0.1**	**<1[4]**	
	Lower Snake	Asotin Creek	**8.5**	**12**	**8**
		Tucannon River	**6.5**	**11**	**8**
	Salmon River	**Lower Middle Fork mainstem and tribs (Big,** Camas, and Loon **Creek**s)		**7[2]**	**2**
		Chamberlain Creek			
		East Fork Salmon River	**0.5**	**6**	**1**
		Lemhi River	**0.5**	**9**	**[5]**
		Little Salmon and Rapid River	**0.5**	**10[2]**	**3**
		Upper Middle Fork mainstem and tribs			

		North Fork Salmon River			
		Pahsimeroi River	**6.5**	**27**	[5]
		Panther Creek			
		Salmon River upper mainstem	**0.5**	**18**	**15**
		Secesh River		**6**[2]	**5**
		South Fork Salmon River		**6**[2]	**3**
Upper Columbia Steelhead	Upper Columbia River - Below Chief Joseph	**Entiat River**	**2**	**8**	**3**
		Methow River	**2**	**4**	**1**
		Okanogan River	**6**	**14**[7]	**3**
		Wenatchee River	**2**	**4**	**1**

[7] Estimates derived from additional actions identified through collaboration with the Colville Tribes. Estimates do not reflect any limiting factor constraints for Loup Loup Creek assessment unit

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Estuary Habitat Proposed Action

Global Strategies that Affect All ESUs

Objective: Protect and Increase the Distribution of High Quality Habitat for all ESUs

Strategy: Estuary Habitat Protection and Improvement

Action: Protect and restore habitat in the estuary based on biological effectiveness.

Implementation:

- 2007-2009: Fund expanded implementation of specific estuary habitat projects.
- 2010-2017: Continue to implement (approximately $5.5 million per year with Corps funding subject to Congressional appropriations) estuary habitat projects identified based on biological effectiveness criteria consistent with the Willamette/Lower River Recovery Plan (Recovery Plan). Implementation will be funded at the expanded '07-'09 level. The Recovery Plan and Lower Columbia River Estuary Partnership and other local resources will be used to help identify projects.

1. Introduction:

A key step in conserving and rebuilding Endangered Species Act (ESA)-listed salmon and steelhead is determining the potential benefits that could accrue from actions implemented to conserve and improve estuary habitats and their effects on the status of salmon and steelhead Evolutionarily Significant Units (ESU). The Federal Columbia River Power System (FCRPS) Hydropower biological opinion remand collaboration Estuary Subgroup of the Habitat Collaboration Workgroup developed approaches to determine the potential to improve and protect ESA-listed salmon and steelhead viability through estuary habitat actions.

The Estuary Subgroup has produced several products that have been used in developing and assessing the following estuary habitat actions. These products include several Estuary Habitat Tables that list limiting factors affecting anadromous fish survival, actions and locations that address those limiting factors (Appendix A), estimated implementation benefits and estimated percent of survival improvement targets (*Estimated Benefits of Federal Agency Habitat Projects in the Lower Columbia River and Estuary*, Trask, 2007). The subgroup relied heavily on the September 27, 2006, draft *Columbia River Estuary Recovery Plan Module* (Estuary Module) and worked closely with local experts to develop and populate the tables and estimate benefits attributable to potential projects. The estuary tables provide information about the implementation of actions on a geographic basis addressing ESUs by life history type (stream-type or ocean-type). At this time, information does not allow for finer distinctions down to the ESU or population level for salmonid use in the estuary.

For purposes of this action, the estuary is defined as the area from the mouth of the Columbia River upstream to the limit of tidal influence at Bonneville Dam. This is consistent with the 2004 UPA, the limits for the National estuary program and Fresh et al., 2005 and the NOAA Recovery Plan Estuary Module.

The NOAA and the Action Agencies organized estuary habitat actions using specific reaches or segments. The Estuary Tables use eight reaches (A thru H) to differentiate the lower Columbia River and estuary. The estuary reaches were developed for the Lower Columbia River Estuary Partnership (LCREP), in conjunction with the University of Washington and the U.S. Geological Survey as part of the development of ecosystem classification for the lower Columbia River and estuary and were used in the estuary module.

BPA funding commitments were increased from approximately $600,000 per year (average between 2000 and 2006) to approximately $2 million per year for habitat actions to benefit listed ESUs during 2007-2009, more than doubling efforts over the 2000 and 2004 BiOp programs in the recently issued BPA decision on ’07 –’09 Fish and Wildlife Program funding.

In addition, in response to draft biological analyses prepared by the Action Agencies subsequent to BPA’s ’07 – ’09 funding decision and input from the PWG, additional actions have been added for ’08 and ’09 to address listed ESUs. An additional $1.5 million each year for ’08 and ’09 to expand acquisition and restoration efforts and to fund BPA’s new Pile Dike Removal Program (see Appendix B for discussion of new projects). Project prioritization and selection will be done in coordination with LCREP’s Science Workgroup other local resources and will be consistent with Recovery Plans. Projects will proceed to implementation following issuance of FCRPS BiOp and in coordination with the BPA/Northwest Power Planning and Conservation Council (Council) process. The Corps funding commitments are approximately $2 million per year and are subject to annual Congressional appropriations.

Benefits are estimated for specific projects identified. If these projects are not implemented for some reason, such as local sponsorship or real estate issues, the Action Agencies will work to identify alternative projects to provide the same or greater benefits. Projects will be selected using the process identified below for future project implementation.

Background

The 2000 FCRPS BiOp included RPA actions calling for habitat work and RM&E efforts in the estuary to help offset impacts of the FCRPS. The Action Agencies and others in the region developed a comprehensive estuary restoration program to inventory, protect and restore key habitats. The program includes a major monitoring, analysis and research program to better understand habitat use and needs in the estuary (to focus actions) and to evaluate progress toward rebuilding the productivity of the system over the long term. This program is outlined in more detail in the Action Agencies' restoration plan, entitled *An Ecosystem-Based Approach to Habitat Restoration Projects with Emphasis on Salmonids in the Columbia River Estuary* (Estuary Habitat Plan)(Johnson et al., 2003). This restoration plan identifies five elements for the implementation of scientifically sound habitat projects to address the potential limiting factors identified for the estuary. – protection, conservation, enhancement, restoration and creation. The Action Agencies also prepared an estuary action plan (*Action Plan to Implement the Federal Columbia River Power System Biological Opinion in the Columbia River Estuary, September 2003*) (Estuary Action Plan). The Action Agencies will continue to implement actions based on these plans directed at providing biological benefit to ESA-listed fish.

From 2000 to 2006 the Action Agencies have implemented multiple actions in the estuary (for a complete list of 2000 to 2006 implemented projects see: *Estimated Benefits of Federal Agency Habitat Projects in the Lower Columbia River and Estuary*, Trask, 2007).

Method

The estuary habitat table draws most of its information from the Estuary Module. The Estuary Module identifies and evaluates management actions that, if implemented, would likely reduce threats to salmon and steelhead in the Columbia River estuary and plume. This was accomplished in the Estuary Module by reviewing and synthesizing current literature such as the *Mainstem Lower Columbia River and Columbia River Estuary Subbasin Plan and Supplement* and two NOAA Northwest Fisheries Science Center technical memoranda for the estuary: *Salmon at River's End* (Bottom et al. 2005) and *Role of the Estuary in the Recovery of Columbia River Basin Salmon and Steelhead* (Fresh et al. 2005). Technical input was also garnered from area experts, including staff at NOAA's Northwest Fisheries Science Center, the LCREP, and the Lower Columbia Fish Recovery Board (LCFRB). The estuary habitat table (Appendix A) also builds upon Appendix E of the 2004 FCRPS Hydropower biological opinion, especially as it related to limiting factors.

Relation to Recovery Plans and LCREP

Recovery Plans: The AA's will continue to work with NOAA, the states, and other local groups such as the LCREP and the LCFRB utilizing the Recovery Plans to help identify future projects.

LCREP: The AA's are working closely with the LCREP in their acquisition and restoration efforts in the Columbia River Estuary. The LCREP, one of 28 programs in the National Estuary Program, is a two-state, public-private initiative. Using a watershed approach, the Estuary Partnership integrates 28 cities, 9 counties, and the states of Oregon and Washington over an

area that stretches 146 miles from Bonneville Dam to the Pacific Ocean. The Estuary Partnership provides a regional framework to support and enhance local efforts. That support includes providing funds to local entities. Many public and private partners help the LCREP accomplish its work. Funding from the states of Oregon and Washington and Congress – through the National Estuary Program – supports base operations and help secure matching public and private dollars. According to LCREP every dollar invested by the Action Agencies in the Estuary Partnership currently leverages sixteen additional dollars.

2. Description of Estuary Habitat Action

The Action Agencies are committing to implement "on-the-ground" actions to address biological priorities and key limiting factors identified for estuary habitat for Columbia and Snake River ESUs. These actions are designed to improve function of the limiting factors. This habitat program will be implemented in 3 year increments. For the 2007-2009 timeframe, specific locations and actions are identified or are undergoing scoping. These actions represent a substantial expansion and a commitment from the Action Agencies for increased funding from the 2000-2006 implementation of the 2000 and 2004 BiOps. For the 2010-2017 period, the Action Agencies have committed to continue the same level of increased funding from the previous timeframe of 2007-2009. Specific BPA projects will be selected on a 3 year basis based on biological priorities, analysis of limiting factors, and improvements in habitat quality. Projects funded to implement this action will be consistent with Recovery Plans.

Initial Actions

The first phase of implementation of these commitments is 2007-2009. The Action Agencies will complete the habitat actions initiated under the 2000 and 2004 BiOps and will substantially expand the level of implementation with particular focus on projects with greatest biological value.

Rationale

Habitat actions for the estuary are being accomplished by the Corps and BPA. Corps projects will be funded under Section 536 of WRDA 2000 or other authorities, as appropriate. Estuary habitat projects are also covered in the programmatic Lower Columbia River/Estuary Project (2003-011-00) sponsored through the LCREP and other proposals under review through the Fish and Wildlife program. Although habitat related research, monitoring, and evaluation (RME) will not provide direct survival benefits, the Action Agencies will be monitoring action effectiveness for certain habitat projects and will be supporting RME work to improve our understanding of habitat needs and benefits in the estuary. This improved understanding will help shape future project development and success.

For years 2007-2009, we have identified specific projects the Action Agencies will implement based on collaborative efforts with LCREP, the Northwest Power and Conservation Council, and local partners. After that time, additional projects will be identified based on research and

regional coordination and developed following the Action Agencies Restoration Plan criteria, providing greater benefits in the future. For these future estuary habitat projects, the Action Agencies will provide funding of approximately an average of $5 million each year for FY07-09. For future estuary habitat projects BPA will provide funding of approximately $2.0 million for FY07 and 3.5 million per year for FY08 and FY09., an increase of approximately $2.4million annually above 2000-2006 average. The COE expects to continue funding estuary habitat projects at a similar level to current levels (approximately $2 million per year) subject to Congressional appropriations. The COE is seeking funding for a general investigation (GI) study to identify further ecosystem opportunities in the lower Columbia River (estuary). If funded this study could lead to additional authorities and funding for habitat work in the estuary.

In the Columbia River estuary, both ocean- (smaller subyearling fish) and stream-type (somewhat larger yearling fish) salmonids experience significant mortality. However, because the two types typically spend different amounts of time in the estuary and plume environments, they are subject to somewhat different combinations of threats and opportunities. For ocean-type juveniles (Columbia River chum, Snake River Fall Chinook, Upper Willamette Chinook, Lower Columbia fall Chinook), mortality in the estuary is believed to be related most closely to lack of habitat, changes in food availability, and the presence of contaminants. Stream types (Snake River sockeye salmon, Lower Columbia River coho salmon, Upper Columbia River steelhead, Snake River steelhead, Lower Columbia River steelhead, Middle Columbia River steelhead, Upper Willamette River steelhead, Upper Columbia River spring Chinook salmon and Snake River spring/summer Chinook salmon) are affected by these same factors, although presumably to a lesser degree because of their shorter residency times in the estuary. However, stream-type salmonids are thought to use the low-salinity gradients of the plume to achieve growth and gradually acclimate to saltwater. Stream-type fish, especially steelhead, are also impacted to a greater extent by avian predation in the estuary.

The estuary habitat restoration projects proposed by the Action Agencies will provide estuary habitat improvements expected to in turn improve juvenile and adult fish survival. These projects will provide an increase in juvenile salmonid shallow water habitat that would benefit all listed ESUs, with the greatest habitat benefit to those ESUs expressing ocean type life histories that use the estuarine environment for longer periods of time. Finally, as the habitat restoration projects listed are intended to expand and improve juvenile salmonid off-channel habitat and wetlands habitat, this increase and improvement in rearing habitat is believed to provide refuge for many of the ESUs, thereby increasing survival and decreasing predation. More specific estimated benefits are described in the Survival Benefits section below. Some of the projects will especially benefit lower Columbia River ESUs such as Columbia River chum, Lower Columbia fall Chinook, Lower Columbia River coho salmon, and lower Columbia River steelhead by restoring access to or improving habitat in lower Columbia River tributaries.

Future Implementation

For each subsequent phase of implementation of the estuary habitat PA, the Action Agencies will work with LCREP and others to identify projects based on research and regional coordination, providing greater benefits in the future. The Action Agencies will use the Recovery Planning products to adjust the direction and location for implementing future estuary habitat projects.

As the estuary studies continue to improve our understanding, the Action Agencies will be better able to target the amount and types of habitat that would help increase survival and better quantify the biological benefits of these actions. Ultimately, our goal is to implement actions that provide the greatest and most efficient biological benefit to listed ESUs.

In addition to undertaking actions to protect and restore habitats in the estuary, the Action Agencies can have a role in affecting actions of others in the estuary. The Action Agencies do not directly regulate land use or development, such as large industrial projects, agriculture, or residential development. Through the Corps' Regulatory Program authorities (Section 404 of the Clean Water Act, Section 10 of the Rivers and Harbors Act), development proposals that affect waters of the United States and navigable waters sponsored by individuals, organizations, or other Federal agencies are evaluated to determine the potential impacts of the activity on relevant public interest factors. These factors include general environmental concerns, fish and wildlife values, water quality, energy needs, safety, and navigation. Proposals for development are also evaluated under the Endangered Species Act (ESA), National Historic Properties Act, and other appropriate laws and regulations to ensure consistency (compliance). Those projects that could affect listed species or their critical habitat undergo Section 7 consultation under the ESA. This public review process will ensure that impacts to listed salmon and steelhead, and their critical habitat, are minimized.

Description of Estuary Habitat Elements

Protection: This includes estuary projects that would secure a property interest through land acquisition, lease, or easement. Metrics tracked for these types of projects include: 1). the *number and location of acres protected*; 2). *the term of protection* and; 3). the *riparian miles protected.*

The Action Agencies are attempting to acquire ownership or development (protection) rights to intact patches of habitat or critical areas in need of further restoration treatments.

Conservation: Habitat conservation is geared toward the goal of increasing the potential for natural processes to work for the benefit of multiple species and can be a critical component of a larger restoration plan, limiting harmful impacts of conventional management practices and complementing other measures to help boost the site's potential for self maintenance. Examples of habitat conservation incentives include financial support for the implementation of riparian setbacks, the addition of riparian buffer strips, integrated pest management, and off-stream livestock watering techniques. The Action Agencies' restoration plan includes additional discussion of protection and conservation strategies and applications.

Enhancement: Habitat enhancement entails the improvement of a targeted ecological attribute and/or process. Several groups are implementing enhancement projects to improve different elements of the ecosystem including: riparian plantings and fencing; tide gate or culvert replacement; invasive species removal; and stream bank stabilization.

Restoration: Like habitat enhancement projects, restoration projects can take place in a variety of ways. According to the working definition, restoration means the return to a previously

existing ecological condition. This can involve more intense modification and manipulation of site conditions than enhancement. As a result, restoration projects typically require more careful planning, design, and maintenance than enhancement projects. For example, we can gain miles of habitat by reconnecting tidal channels that have been cut off by tide gates, dike construction, and placement of fill material for land-use activities. Reconnecting these areas through the removal of tide gate structures, dike breaching, and or culvert installation into a roadbed, however, can increase the risk of flooding landowners that were previously protected by these structures. Therefore, reconnecting tidal channels may require a combination of strategies, such as acquisition and enhancement. At sites where dike breaching or tide gate removal is not possible, self-regulating tide gates that allow fish passage will be considered.

Creation: Habitat creation involves constructing or placing habitat features that did not exist previously, but which attempt to mimic conditions of an intact, functioning ecosystem. Tidal channel excavation is an example of a habitat creation strategy intended to replicate the natural structure and function of an intact channel in close proximity to the project site. Another is the placement of dredged material intended to create marsh, shallow water, or other habitat. Because of the uncertainty about the potential ecological gain from a habitat creation strategy, it needs to be accompanied by a stronger effectiveness-monitoring component.

The Estuary Habitat Actions 2007-2009

For 2007-2009, BPA will implement specific projects funded through our Fish and Wildlife Program to provide survival benefits to listed ESUs. Much of this funding will be channeled through LCREP, and BPA will work closely with the LCREP and others in further project selection, identification and prioritization. LCREP's Strategic Habitat Restoration Prioritization Framework identifies the most ecologically beneficial locations for restoration and describes the most appropriate types of restoration strategies for those locations. Projects are prioritized based on which provide the greatest benefit to the lower Columbia River Estuary and its resources. Placing potential projects through a scientifically rigorous framework allows decisions to be made on what projects to implement within the context of opportunity and help prioritize use of available funds. Taken together, projects selected through this framework provide greater ecological benefit compared to projects implemented in a simple ad hoc manner.

The Corps will also implement habitat restoration or enhancement projects in the estuary under available authorizes including Section 536 of the Water Resources Development Act of 2000 and the Corps continuing authorities programs for ecosystem restoration.

For the near-term, the Action Agencies plan to implement approximately 35 key habitat restoration projects listed below. Additional projects will be identified based on research and regional coordination and developed following the AA's Restoration Plan and Estuary Habitat and Action Plans over the near-term.

Further Action Expansion in Response to Biological Analysis and PWG Input: Based on biological needs identified in the recent lifecycle biological analyses and input from the remand collaboration process, a suite of further actions beyond those funded in BPA's '07 – '09 Fish and

Wildlife Program decision have been selected or are undergoing preliminary scoping for implementation during 2008-2009. The estimated annual average budget for these additional actions is $1.5 million each year (total of $3million for '08 and '09) beyond the '07-'09 Fish and Wildlife Program decision. Actions will benefit all listed ESUs in the estuary.

LCREP's Habitat Project: BPA's LCREP project is funded in FY07 for $1.5 million; FY08 for $3 million and FY09 for $3 million. The following projects, or projects similar in nature, will be implemented in FY07-09. Specific project details are currently confidential in light of ongoing negotiations.

- Acquisition in Reach D . This acquisition will provide permanent conservation protection, and allow for restoration work to commence. Conservation ownership provides an opportunity to rehabilitate approximately 380 acres of off-channel rearing habitat for a variety of salmonid populations, and manage the riparian habitat to enhance its value for salmon as well as watershed function.

- Project #1(Reach A). This is a 45 acre floodplain reconnection project (tide gate removal).

- (Project #2 (Reach A). This is a 45 acre acquisition of floodplain intended for future restoration activities (dike breach).

- Project #3 (Reach A). This is a 50 acre floodplain reconnection project (dike breach).

- Project #4 (Reach A). This project is the acquisition of 320 acres of tidelands and 119 acres of riparian/upland forest.

- Project #5 (Reach F). Restoration of 30 acres of riparian area, including 2 linear miles of fencing.

- Approximately 15 to 20 Bonneville unscoped FY2007-09 projects. These are FY 2007-09 projects that are undergoing preliminary scoping and sponsor development.

- Pile Dike Removal. Preliminary scoping ongoing. Implementation in FY08 and FY09. The AAs are currently working with the LCREP in developing a strategy for assessing pile dikes and identifying structures that may be candidates for removal.

Additional near-term projects will be identified through LCREP's Strategic Habitat Restoration Prioritization Framework and the Recovery Plan. LCREP's Framework identifies the most ecologically beneficial locations for restoration and describes the most appropriate types of restoration strategies for those locations. All projects implemented through the LCREP will be ranked within a competitive review process by their Science Workgroup utilizing the Estuary Partnership's "Criteria for Identifying and Prioritizing Habitat Protection and Restoration Projects on the Lower Columbia River and Estuary" include ecosystem, implementation and monitoring criteria (Appendix C)[1]. These criteria can be located on LCREP's website. The

Action Agencies participate in LCREP's Science Workgroup. For additional information see BPA project 2003-011-00.

Grays River Restoration Project: The project proposal species for this project is Lower Columbia River chum. The Grays River is located between river mile 19 and 23 along the Columbia River in Wahkiakum County, Washington. This project will aid in restoring habitat-forming processes to enhance salmon and steelhead populations in the Grays River. This project will be the first step in restoring channel structure and function that will increase instream habitat diversity, channel stability, and riparian integrity in the critical response reach upstream and adjacent to critical salmon spawning areas of the Grays River. The major component of this strategy is the planning, design, installation, and monitoring of engineered logjams (ELJ) that will rejuvenate historic channel and floodplain processes. Additional restoration measures include reforesting the riparian corridor to enhance future large woody debris recruitment and investigation of conservation activities within ecologically critical areas. These activities include land acquisition and levee removal to protect critical areas and reconnect floodplain areas. This project will be implemented from 2007-2009. For additional information see BPA project 2003-013-00.

Chinook River: The proposed project is located near Chinook, Washington. The intent of the project is to restore partial tidal influence and access to several acres of the Chinook River Estuary. To accomplish this goal, a tide gate will be retrofitted. At this time, the number of acres (or lineal miles of channel access) influenced by the project are unknown. This project is likely to benefit chum salmon.

Julia Butler Hanson: The proposed project is located on the Julia Butler Hanson National Wildlife Refuge near Cathlamet Washington. The intent of the project is to install fish friendly tide gates to increase tidal flushing and fisheries access to approximately 110 acres. Riparian plantings of up to 210 acres will likely be included as well.

Vancouver Lake: This project is a tide gate retrofit project located in Reach F (in the City of Vancouver area). The number of acres affected by this project is currently uncertain.

Ramsey Lake: This project, located at River Mile 2 on Columbia Slough, will re-establish hydrologic connectivity to the Lower Columbia Slough to reclaim and improve floodplain wetland functions (forested wetland and soft bottom, mud backwater sloughs) and to increase the amount and quality of off-channel rearing and refuge habitat for juvenile salmonids. This project will return approximately 5.0 acres of isolated habitat. Native vegetation will be planted along shorelines and within the wetland restoration site. Reconstructed slough channels will provide approximately 2.5 acres of annually inundated off-channel habitat.

Dairy Creek: This project is intended to improve hydrologic flushing and salmonid access to Sturgeon Lake on Sauvie Island, Oregon. Sturgeon Lake is approximately 3,200 acres in size.

Sandy River: This project is located at the confluence of the Sandy and Columbia rivers just north of I-84, and east of the Troutdale airport. This project is part of a long-term effort to restore 1,500 acres of the Sandy River delta. Near-term future restoration includes breaching

the dike and re-establishing flow to a portion of the original Sandy River channel, planting vegetation on 50 acres, removing invasive weeds on 180 acres, planting wetland scrub shrub on 45 acres, and controlling and removing invasive wetland plants on 45 acres.

Vancouver Water Resources: This proposed project is intended to protect and restore approximately five to ten acres of emergent wetland and riparian forest habitat.

The Corps expects to complete additional projects that will provide similar benefits that will be identified during the FY2007-09 period. These are FY 2007-09 projects that are undergoing preliminary scoping and sponsor development.

The Estuary Habitat Action 2010-2017

Additional projects for longer term implementation will be identified based on research and regional coordination, providing greater benefits in the future. The Action Agencies will use the Estuary Plan and draw on priorities identified through LCREP's Science Work Group utilizing their "Criteria for Identifying and Prioritizing Habitat Protection and Restoration Projects on the Lower Columbia River and Estuary", the collaboration process and Recovery Plan products to adjust the direction and location for implementing future estuary habitat projects.

From 2010-2017, BPA will commit approximately $3.5 million every year for these priority habitat projects, working through the LCREP program. The Corps expects to continue to fund estuary habitat projects at a similar level to current funding (approximately $2 Million per year), but actual funding will be dependant on Congressional appropriations.

Survival Benefits Associated With the AA's Actions

To estimate project benefits, each federal project was linked to a recommended recovery action in NOAA Fisheries' draft *Columbia River Estuary Recovery Plan Module* (NOAA Fisheries 2006) and then evaluated in terms of the project's certainty of success, potential benefits, and contribution to implementation of the recovery action. A more thorough report detailing this evaluation process is: *Estimated Benefits of Federal Agency Habitat Projects in the Lower Columbia River Estuary* (Trask, 2007).

The evaluation of federal projects was accomplished in two distinct steps. The first involved scoring projects using the Lower Columbia River Estuary Partnership's *Criteria for Identifying and Prioritizing Habitat Protection and Restoration Projects on the Lower Columbia River and Estuary*. The second step involved linking federal projects to recovery actions identified in the *Estuary Recovery Plan Module* and estimating the relative contribution of each project to the implementation of the action. The survival benefits associated with the AA's actions are qualitative in nature.

The table below summarizes these results in terms of survival benefits for completed (or in-progress) and proposed projects.

Conversion of Results for Columbia River Basin-Wide Integration			
Federal Projects	**Salmonid Type**	**Project Contribution Totals***	**Estuary Survival Benefit (x .2)**
Baseline Projects	Ocean	3.72	0.7 %
	Stream	1.48	0.3 %
2007-09 Projects	Ocean	9.40	2.3%
	Stream	4.27	1.4%
2010-17 Projects	Ocean	25.07	6.7%
	Stream	11.39	4/3%
* Units are a percent of the 20 percent survival improvement target in the *Estuary Recovery Plan Module*.			

Ocean-type: total survival benefit for 2000-2017 9.7%
Stream-type: total survival benefit for 2000-2017 is 6.0%

4. Action Criteria Linked to ESA Limiting Factors

The Action Agencies' estuary program is designed to address ESA limiting factors in the estuary for all listed fish affected by the FCRPS. The Action Agencies' adopted the limiting factors in the Estuary Module. The Estuary Module identified and prioritized limited factors based on a thorough review and synthesis of pertinent literature, supplemented by input from area experts that included staff from NOAA's Northwest Fisheries Science Center and Portland office, the LCREP, and the LCFRB. Several key documents provided consistent guidance. They included the following:

- *Salmon at River's End: The Role of the Estuary in the Decline and Recovery of Columbia River* (Bottom et al. 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* (Fresh et al. 2005)—NOAA technical memorandum
- *Mainstem Lower Columbia River and Columbia River Estuary Subbasin Plan* and its supplement—Lower Columbia River Estuary Partnership (2004a)

Following are key limiting factors identified for the estuary and the criteria from the Recovery Module for actions that the AA's will be implementing to address these limiting factors. The Action Agencies are not able to address all of the limiting factors and criteria under their authorities. For example, the Action Agencies have no regulatory authority over toxics or exotic invertebrates and have limited ability to address this factor under existing authorities and programs.

OCEAN TYPE HABITAT RELATED LIMITING FACTORS: habitat, flow, toxics, temperature, sediment, predation, exotic invertebrates, and stranding. Ocean type life histories include Columbia River chum, Snake River Fall Chinook, Upper Willamette Chinook, Lower Columbia fall Chinook.

Related Habitat Action Criteria:

- Protect remaining high-quality off-channel habitat
- Reduce noxious weeds

- Breach or lower dikes or levees
- Adjust the timing, magnitude, and frequency of flows within the estuary
- Restore contaminated sites
- Protect and restore riparian areas
- Remove pile dikes
- Use dredge materials beneficially
- Reduce over-water structures

STREAM TYPE HABITAT RELATED LIMITING FACTORS: habitat, flow, toxics, temperature, sediment, predation, and exotic invertebrates. Stream type life histories include Snake River sockeye salmon, Lower Columbia River coho salmon, Upper Columbia River steelhead, Snake River steelhead, Lower Columbia River steelhead, Middle Columbia River steelhead, Upper Willamette River steelhead, Upper Columbia River spring Chinook salmon and Snake River spring/summer Chinook salmon.

Related Habitat Action Criteria

- Protect remaining high-quality off-channel habitat
- Reduce noxious weeds
- Breach or lower dikes or levees
- Adjust the timing, magnitude, and frequency of flows within the estuary
- Restore contaminated sites
- Protect and restore riparian areas
- Remove pile dikes
- Use dredge materials beneficially
- Reduce entrainment from dredging
- Reduce over-water structures

In addition to these limiting factors and criteria, we will also be using more detailed criteria for project selection based on the Estuary Plan, Recovery Plans, coordination with LCREP and the region., to identify future projects

[1] These are LCREP's criteria and not AA criteria (though they are used by LCREP in selecting projects under the AA's PA).

FCRPS Habitat Workgroup Table - Estuary

REACH Assessment Unit (AU)	River Mile	Ocean or Stream TYPE	Primary Limiting Factors (PLF)	Action	Spatial Structure	Life History Diversity	Estimated Implementation Benefits (scale 1-5)	Estimated Percent of Ocean Type Survival Improvement Target (juveniles only)	Estimated Percent of Stream Type Survival Improvement Target (juveniles only)
Select one from table	User defined, one per AU	One or both TYPES per AU	One or Multiple choices per TYPE	One or Multiple Actions per PLF			User defined, one per Action	20 % target defined by action, not reach (see Appendix A)	20 % target defined by action, not reach (see Appendix A)
A - Estuary entrance	RM 0-15	STREAM TYPE (Snake River sockeye salmon, Lower Columbia River coho salmon, Upper Columbia River steelhead, Snake River steelhead, Lower Columbia River steelhead, Middle Columbia River steelhead, Upper Willamette River steelhead, Upper Columbia River spring chinook salmon and Snake River spring/summer chinook salmon)	Predation	Redistribute Caspian terns		X	5 - very high		~27% of target
			Predation	Redistribute cormorants		X	5 - very high		~21% of target
			Predation	Reduce predation by pinnipeds		X	4 - high		n/a (adults only)
			Flow	Adjust the timing, magnitude, and frequency of flows	X	X	4 - high		~14% of target
			Temperature (Macrodetrital)	Protect/restore riparian areas	X	X	4 - high		~6% of target
			Habitat	Breach or lower dikes and levees	X	X	4 - high		~6% of target
			Toxics	Monitor and/or restore contaminated sites	X	X	3 - medium		~5% of target
			Habitat	Protect remaining high-quality off-channel habitat	X	X	3 - medium		~5% of target
			Sediment, predation	Remove pile dikes	X	X	3 - medium		~2% of target
			Toxic	Implement pesticide/fertilizer BMPs	X	X	3 - medium		<1% of target
			Flow, sediment	Use dredge materials beneficially	X	X	2 - low		<1% of target
			Habitat	Reduce noxious weeds	X	X	2 - low		<1% of target
			Exotic invertebrates	Prevent invertebrate introductions	X	X	1 - very low		<1% of target
A - Estuary entrance	RM 0-15	OCEAN TYPE (Columbia River chum salmon, Snake River Fall chinook, Upper Willamette River chinook salmon, and Lower Columbia River fall chinook salmon)	Habitat	Breach or lower dikes and levees	X	X	5 - very high	~15% of target	
			Flow	Adjust the timing, magnitude, and frequency of flows	X	X	5 - very high	~14% of target	
			Habitat	Protect remaining high-quality off-channel habitat	X	X	5 - very high	~13% of target	
			Toxics	Monitor and/or restore contaminated sites	X	X	5 - very high	~13% of target	
			Temperature (Macrodetrital)	Protect/restore riparian areas	X	X	4 - high	~6% of target	
			Sediment, predation	Remove pile dikes	X	X	4 - high	~4% of target	
			Toxic	Implement pesticide/fertilizer BMPs	X	X	3 - medium	~2% of target	
			Habitat	Reduce noxious weeds	X	X	3 - medium	~2% of target	
			Predation	Redistribute Caspian terns		X	3 - medium	<1% of target	
			Predation	Redistribute cormorants		X	3 - medium	<1% of target	
			Flow, sediment	Use dredge materials beneficially	X	X	3 - medium	<1% of target	
			Exotic invertebrates	Prevent invertebrate introductions	X	X	2 - low	<1% of target	
B - Mixing Zone	RM 15-38	STREAM TYPE (Snake River sockeye salmon, Lower Columbia River coho salmon, Upper Columbia River steelhead, Snake River steelhead, Lower Columbia River steelhead, Middle Columbia River steelhead, Upper Willamette River steelhead, Upper Columbia River spring chinook salmon and Snake River spring/summer chinook salmon)	Predation	Redistribute Caspian terns		X	5 - very high		~27% of target
			Predation	Redistribute cormorants		X	5 - very high		~21% of target
			Predation	Reduce predation by pinnipeds		X	4 - high		n/a (adults only)
			Flow	Adjust the timing, magnitude, and frequency of flows	X	X	4 - high		~14% of target
			Temperature (Macrodetrital)	Protect/restore riparian areas	X	X	4 - high		~6% of target
			Habitat	Breach or lower dikes and levees	X	X	4 - high		~6% of target
			Toxics	Monitor and/or restore contaminated sites	X	X	3 - medium		~5% of target
			Habitat	Protect remaining high-quality off-channel habitat	X	X	3 - medium		~5% of target
			Sediment, predation	Remove pile dikes		X	3 - medium		~2% of target
			Toxic	Implement pesticide/fertilizer BMPs	X	X	3 - medium		<1% of target
			Flow, sediment	Use dredge materials beneficially	X	X	2 - low		<1% of target
			Habitat	Reduce noxious weeds	X	X	2 - low		<1% of target
			Exotic invertebrates	Prevent invertebrate introductions	X	X	1 - very low		<1% of target

FCRPS Habitat Workgroup Table - Estuary

REACH Assessment Unit (AU)	River Mile	Ocean or Stream TYPE	Primary Limiting Factors (PLF)	Action	Spatial Structure	Life History Diversity	Estimated Implementation Benefits (scale 1-5)	Estimated Percent of Ocean Type Survival Improvement Target (juveniles only)	Estimated Percent of Stream Type Survival Improvement Target (juveniles only)
Select one from table	User defined, one per AU	One or both TYPES per AU	One or Multiple choices per TYPE	One or Multiple Actions per PLF			User defined, one per Action	20 % target defined by action, not reach (see Appendix A)	20 % target defined by action, not reach (see Appendix A)
B - Mixing Zone	RM 15-38	OCEAN TYPE (Columbia River chum salmon, Snake River Fall chinook, Upper Willamette River chinook salmon, and Lower Columbia River fall chinook salmon)	Habitat	Breach or lower dikes and levees	X	X	5 - very high	~15% of target	
			Flow	Adjust the timing, magnitude, and frequency of flows	X	X	5 - very high	~14% of target	
			Habitat	Protect remaining high-quality off-channel habitat	X	X	5 - very high	~13% of target	
			Toxics	Monitor and/or restore contaminated sites	X	X	5 - very high	~13% of target	
			Temperature (Macrodetrital)	Protect/restore riparian areas	X	X	4 - high	~6% of target	
			Sediment, predation	Remove pile dikes		X	4 - high	~4% of target	
			Stranding	Reduce vessel wake stranding	X	X	3 - medium	~3% of target	
			Toxic	Implement pesticide/fertilizer BMPs	X	X	3 - medium	~2% of target	
			Habitat	Reduce noxious weeds	X	X	3 - medium	~2% of target	
			Predation	Redistribute Caspian terns		X	3 - medium	<1% of target	
			Predation	Redistribute cormorants		X	3 - medium	<1% of target	
			Flow, sediment	Use dredge materials beneficially	X	X	3 - medium	<1% of target	
			Sediment, predation	Reduce entrainment from dredging	X	X	2 - low	<1% of target	
			Exotic invertebrates	Prevent invertebrate introductions	X	X	2 - low	<1% of target	
C - Ends downstream of Longview	RM 38-63	STREAM TYPE (Snake River sockeye salmon, Lower Columbia River coho salmon, Upper Columbia River steelhead, Snake River steelhead, Lower Columbia River steelhead, Middle Columbia River steelhead, Upper Willamette River steelhead, Upper Columbia River spring chinook salmon and Snake River spring/summer chinook salmon)	Flow	Adjust the timing, magnitude, and frequency of flows	X	X	4 - high		~14% of target
			Habitat	Breach or lower dikes and levees	X	X	4 - high		~6% of target
			Temperature (Macrodetrital)	Protect/restore riparian areas	X	X	4 - high		~6% of target
			Predation	Reduce predation by pinnipeds		X	4 - high		n/a (adults only)
			Habitat	Protect remaining high-quality off-channel habitat	X	X	3 - medium		~5% of target
			Toxics	Monitor and/or restore contaminated sites	X	X	3 - medium		~5% of target
			Sediment, predation	Remove pile dikes		X	3 - medium		~2% of target
			Toxic	Implement pesticide/fertilizer BMPs	X	X	3 - medium		<1% of target
			Flow, sediment	Use dredge materials beneficially	X	X	2 - low		<1% of target
			Habitat	Reduce noxious weeds	X	X	2 - low		<1% of target
			Exotic invertebrates	Prevent invertebrate introductions	X	X	1 - very low		<1% of target
C - Ends downstream of Longview	RM 38-63	OCEAN TYPE (Columbia River chum salmon, Snake River Fall chinook, Upper Willamette River chinook salmon, and Lower Columbia River fall chinook salmon)	Habitat	Breach or lower dikes and levees	X	X	5 - very high	~15% of target	
			Flow	Adjust the timing, magnitude, and frequency of flows	X	X	5 - very high	~14% of target	
			Habitat	Protect remaining high-quality off-channel habitat	X	X	5 - very high	~13% of target	
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			Temperature (Macrodetrital)	Protect/restore riparian areas	X	X	4 - high	~6% of target	
			Sediment, predation	Remove pile dikes		X	4 - high	~4% of target	
			Stranding	Reduce vessel wake stranding	X	X	3 - medium	~3% of target	
			Toxic	Implement pesticide/fertilizer BMPs	X	X	3 - medium	~2% of target	
			Habitat	Reduce noxious weeds	X	X	3 - medium	~2% of target	
			Flow, sediment	Use dredge materials beneficially	X	X	3 - medium	<1% of target	
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FCRPS Habitat Workgroup Table - Estuary

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			Predation	Reduce predation by pinnipeds		X	4 - high		n/a (adults only)
			Toxics	Monitor and/or restore contaminated sites	X	X	3 - medium		~5% of target
			Toxic	Implement pesticide/fertilizer BMPs	X	X	3 - medium		<1% of target
			Sediment, predation	Remove pile dikes		X	3 - medium		~2% of target
			Toxic	Implement stormwater BMPs	X	X	2 - low		<1% of target
			Habitat	Reduce noxious weeds	X	X	2 - low		<1% of target
			Predation	Manage exotic fish		X	1 - very low		<1% of target
			Exotic invertebrates	Prevent invertebrate introductions	X	X	1 - very low		<1% of target
D - Longview to Kalama	RM 63-74	OCEAN TYPE (Columbia River chum salmon, Snake River Fall chinook, Upper Willamette River chinook salmon, and Lower Columbia River fall chinook salmon)	Habitat	Breach or lower dikes and levees	X	X	5 - very high	~15% of target	
			Flow	Adjust the timing, magnitude, and frequency of flows	X	X	5 - very high	~14% of target	
			Toxics	Monitor and/or restore contaminated sites	X	X	5 - very high	~13% of target	
			Toxics	Identify and reduce sources of pollutants	X	X	5 - very high	~11% of target	
			Sediment, predation	Remove pile dikes		X	4 - high	~4% of target	
			Stranding	Reduce vessel wake stranding	X	X	3 - medium	~3% of target	
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			Toxic	Implement stormwater BMPs	X	X	3 - medium	~2% of target	
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			Habitat	Reduce noxious weeds	X	X	3 - medium	~2% of target	
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			Exotic invertebrates	Prevent invertebrate introductions	X	X	2 - low	<1% of target	
			Predation	Manage exotic fish		X	2 - low	<1% of target	
			Flow	Adjust the timing, magnitude, and frequency of flows	X	X	4 - high		~14% of target
E - Kalama to Woodland	RM 74-86	STREAM TYPE (Snake River sockeye salmon, Lower Columbia River coho salmon, Upper Columbia River steelhead, Snake River steelhead, Lower Columbia River steelhead, Middle Columbia River steelhead, Upper Willamette River steelhead, Upper Columbia River spring chinook salmon and Snake River spring/summer chinook salmon)	Temperature (Macrodetrital)	Protect/restore riparian areas	X	X	4 - high		~6% of target
			Habitat	Breach or lower dikes and levees	X	X	4 - high		~6% of target
			Habitat	Protect remaining high-quality off-channel habitat	X	X	4 - high		~5% of target
			Toxics	Monitor and/or restore contaminated sites	X	X	3 - medium		~5% of target
			Predation	Reduce predation by pinnipeds		X	4 - high		n/a (adults only)
			Sediment, predation	Remove pile dikes		X	3 - medium		~2% of target
			Toxic	Implement pesticide/fertilizer BMPs	X	X	3 - medium		<1% of target
			Habitat	Reduce noxious weeds	X	X	2 - low		<1% of target
			Predation	Manage exotic fish		X	1 - very low		<1% of target
			Exotic invertebrates	Prevent invertebrate introductions	X	X	1 - very low		<1% of target

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E - Kalama to Woodland	RM 74-86	OCEAN TYPE (Columbia River chum salmon, Snake River Fall chinook, Upper Willamette River chinook salmon, and Lower Columbia River fall chinook salmon)	Habitat	Breach or lower dikes and levees	X	X	5 - very high	~15% of target	
			Flow	Adjust the timing, magnitude, and frequency of flows	X	X	5 - very high	~14% of target	
			Habitat	Protect remaining high-quality off-channel habitat	X	X	5 - very high	~13% of target	
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			Habitat	Reduce noxious weeds	X	X	3 - medium	~2% of target	
			Sediment, predation	Reduce entrainment from dredging	X	X	2 - low	<1% of target	
			Predation	Manage exotic fish		X	2 - low	<1% of target	
			Exotic invertebrates	Prevent invertebrate introductions	X	X	2 - low	<1% of target	
F - Lewis River to Salmon Creek	RM 86-103	STREAM TYPE (Snake River sockeye salmon, Lower Columbia River coho salmon, Upper Columbia River steelhead, Snake River steelhead, Lower Columbia River steelhead, Middle Columbia River steelhead, Upper Willamette River steelhead, Upper Columbia River spring chinook salmon and Snake River spring/summer chinook salmon)	Flow	Adjust the timing, magnitude, and frequency of flows	X	X	4 - high		~14% of target
			Predation	Reduce predation by pinnipeds		X	4 - high		n/a (adults only)
			Habitat	Breach or lower dikes and levees	X	X	4 - high		~6% of target
			Toxics	Monitor and/or restore contaminated sites	X	X	3 - medium		~5% of target
			Sediment, predation	Remove pile dikes		X	3 - medium		~2% of target
			Toxic	Implement pesticide/fertilizer BMPs	X	X	3 - medium		<1% of target
			Habitat	Reduce noxious weeds	X	X	2 - low		<1% of target
			Predation	Manage exotic fish		X	1 - very low		<1% of target
			Exotic invertebrates	Prevent invertebrate introductions	X	X	1 - very low		<1% of target
F - Lewis River to Salmon Creek	RM 86-103	OCEAN TYPE (Columbia River chum salmon, Snake River Fall chinook, Upper Willamette River chinook salmon, and Lower Columbia River fall chinook salmon)	Habitat	Breach or lower dikes and levees	X	X	5 - very high	~15% of target	
			Flow	Adjust the timing, magnitude, and frequency of flows	X	X	5 - very high	~14% of target	
			Habitat	Protect remaining high-quality off-channel habitat	X	X	5 - very high	~13% of target	
			Toxics	Monitor and/or restore contaminated sites	X	X	5 - very high	~13% of target	
			Temperature (Macrodetrital)	Protect/restore riparian areas	X	X	4 - high	~6% of target	
			Sediment, predation	Remove pile dikes		X	4 - high	~4% of target	
			Stranding	Reduce vessel wake stranding	X	X	3 - medium	~3% of target	
			Toxic	Implement pesticide/fertilizer BMPs	X	X	3 - medium	~2% of target	
			Habitat	Reduce noxious weeds	X	X	3 - medium	~2% of target	
			Sediment, predation	Reduce entrainment from dredging	X	X	2 - low	<1% of target	
			Predation	Manage exotic fish		X	2 - low	<1% of target	
			Exotic invertebrates	Prevent invertebrate introductions	X	X	2 - low	<1% of target	

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			Flow	Adjust the timing, magnitude, and frequency of flows	X	X	4 - high		~14% of target
			Predation	Reduce predation by pinnipeds		X	4 - high		n/a (adults only)
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			Habitat	Reduce noxious weeds	X	X	2 - low		<1% of target
			Predation	Manage exotic fish		X	1 - very low		<1% of target
			Predation	Reduce over-water structures		X	1 - very low		<1% of target
			Exotic invertebrates	Prevent invertebrate introductions	X	X	1 - very low		<1% of target
			Habitat	Breach or lower dikes and levees	X	X	5 - very high	~15% of target	
			Flow	Adjust the timing, magnitude, and frequency of flows	X	X	5 - very high	~14% of target	
			Habitat	Protect remaining high-quality off-channel habitat	X	X	5 - very high	~13% of target	
			Toxics	Monitor and/or restore contaminated sites	X	X	5 - very high	~13% of target	
			Toxics	Identify and reduce sources of pollutants	X	X	5 - very high	~11% of target	
			Sediment, predation	Remove pile dikes		X	4 - high	~4% of target	
			Predation	Reduce over-water structures		X	3 - medium	~2% of target	
G - Salmon Creek to Reed Island	RM 103-128	OCEAN TYPE (Columbia River chum salmon, Snake River Fall chinook, Upper Willamette River chinook salmon, and Lower Columbia River fall chinook salmon)	Habitat	Reduce noxious weeds	X	X	3 - medium	~2% of target	
			Toxic	Implement stormwater BMPs	X	X	3 - medium	~2% of target	
			Toxic	Implement pesticide/fertilizer BMPs	X	X	3 - medium	~2% of target	
			Predation	Reduce over-water structures		X	3 - medium	~2% of target	
				Manage exotic fish		X	2 - low	<1% of target	
			Predation	Prevent invertebrate introductions	X	X	2 - low	<1% of target	
			Flow	Adjust the timing, magnitude, and frequency of flows	X	X	4 - high		~14% of target
			Temperature (Macrodetrital)	Protect/restore riparian areas	X	X	4 - high		~6% of target
			Habitat	Protect remaining high-quality off-channel habitat	X	X	3 - medium		~5% of target
			Toxics	Monitor and restore contaminated sites	X	X	3 - medium		~5% of target
			Predation	Reduce predation by pinnipeds		X	4 - high		n/a (adults only)
H - Reed Island to Bonneville Dam	RM 128-147	STREAM TYPE (Snake River sockeye salmon, Lower Columbia River coho salmon, Upper Columbia River steelhead, Snake River steelhead, Lower Columbia River steelhead, Middle Columbia River steelhead, Upper Willamette River steelhead, Upper Columbia River spring chinook salmon and Snake River spring/summer chinook salmon)	Sediment, predation	Remove pile dikes		X	3 - medium		~2% of target
			Toxic	Implement pesticide/fertilizer BMPs	X	X	3 - medium		<1% of target
			Habitat	Reduce noxious weeds	X	X	2 - low		<1% of target
			Predation	Manage exotic fish		X	1 - very low		<1% of target
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This is not a final federal agency product. Rather, it is a pre-decisional document prepared by the Action Agencies that reflects present understandings of currently available information and analyses, and of the progression of discussions with the sovereigns in the collaborative process. Revisions and refinements are to be expected based on further discussions with the sovereigns over new and modified proposed federal actions upon which the action agencies will ultimately consult. Finally, the information in this product does not constitute an analysis of whether the identified measures would or would not jeopardize the continued existence of a listed species or result in the destruction or adverse modification of designated critical habitat. Furthermore, this document does not in any way interpret or apply the regulatory definitions of the statutory phrases "jeopardize the continued existence of" and "destruction or adverse modification."

Expanded Efforts/New Actions Beginning in 2008

In response to draft biological analyses prepared by the Action Agencies subsequent to BPA's '07 – '09 funding decision and input from the PWG, additional actions have been added for '08 and '09 to address listed ESUs. BPA has committed to provide an additional $1.5 million each year for '08 and '09 to expand acquisition and restoration efforts and to fund BPA's new Pile Dike Removal Program.

Expand Habitat Acquisition, Restoration, and/or Enhancement

BPA will fund additional habitat projects such as acquisition, restoration, and/or enhancement at $500,000 per year beginning in 2008. The new funding is in addition to approximately $4 million ($2 million BPA & $2 million Corps) per year of habitat improvement funds committed by the AAs in the estuary. The AAs will work in coordination with the Lower Columbia River Estuary Partnership (LCREP) and others in project prioritization and selection consistent with the Willamette/Lower River Recovery Plan (Recovery Plan). These additional habitat projects are in the preliminary stage of scoping and sponsor development.

As with other BPA habitat projects the suite of additional projects implemented through the LCREP will be ranked within a competitive review process by their Science Workgroup utilizing the Estuary Partnership's "Criteria for Identifying and Prioritizing Habitat Protection and Restoration Projects on the Lower Columbia River and Estuary" include ecosystem, implementation and monitoring criteria (see Appendix C). The AAs are active members in LCREP's Science Workgroup. For additional information on survival benefits associated with these additional projects see *Estimated Benefits of Federal Agency Habitat Projects in the Lower Columbia River and Estuary*, Trask, 2007).

Pile Dike Removal Program

This is a new program with implementation beginning in FY 08. The program consists of a study to evaluate pilings and pile dikes that can be removed without negative effects on the navigation channel operations or private property, several demonstration projects to test methodologies, and limited monitoring to learn which techniques are best suited for future funding years.

Program Overview: The AAs have committed to fund a new Pile Dike Removal Program (PDR Program) in the lower Columbia River and Estuary for improved ecosystem health. The AAs PDR Program is being developed in cooperation with the Lower Columbia River Estuary Partnership (LCREP). PDR Program on-the-ground implementation will begin in 2008 and will be funded at the $1 million level per year .

The AAs are currently working with the LCREP in developing a strategy for assessing pile dikes and identifying structures that may eventually be candidates for removal. The strategy is expected to help guide the strategic removal of structures that have low value for navigation channel maintenance, present low-risk to adjacent land use, support increased ecosystem function, and are cost effective.

Draft criteria have been developed by LCREP to help identify potential projects beginning in 2008. The draft criteria include project support, ecosystem function, long-term management, and cost effectiveness categories.

The emerging strategy is intended to identify a suite of pile dike (or pile structure) projects that meets the checklist criteria, are geographically related to reduce mobilization/demobilization costs, and follow a critical pathway toward reducing the number of derelict pile dikes in the lower river and estuary.

Criteria for Identifying and Prioritizing Habitat Protection and Restoration Projects on the Lower Columbia River and Estuary*

Ecosystem Criteria

1) Habitat Connectivity
This criterion recognizes that habitat connectivity is a landscape level concept. It emphasizes linkages between habitat areas that provide a variety of functions for species at various stages of their life cycle and that gradual alteration of landscapes through natural succession and retrogression allow species that require a variety of habitat components to disperse and survive. In the Lower Columbia, historic changes have limited or cut off species' access to resources needed for their development. Specific emphasis on species with narrow ecological requirements should be considered. Upland habitat areas adjacent to drainage ways, existing protected/restored sites, and areas offering diverse habitat types, function, and successional stages should also be considered.

2) Areas of Historic Habitat Type Loss
Land use activities such as diking, filling, and shoreline hardening have removed many of the shallow, peripheral wetlands along the Lower Columbia, isolating the river from its floodplain. This criterion recognizes that historic wetland types such as emergent and forested wetlands that are particularly important for salmonids and a variety of bird species, have been greatly diminished. These habitats promote networks of physical complexity such as shallow, dendritic channels and backwater sloughs.

3) Improvement in Ecosystem Function
This criterion acknowledges that some restoration actions can result in greater enhancement of ecosystem functions than others. This criterion emphasizes that location of a project may in some cases be more important than size of the project.

4) Adequate Size and Shape
Size refers to reach length and the size of the potential habitat within a reach. In general, larger size enhances habitat stability, increases the number of species that can potentially use the site, makes it easier to find by migratory species, and increases within-habitat complexity.

5) Level of Complexity
This criterion refers to the number and interspersion of different types of habitats within a given restoration reach or area. As the number of habitats increase, so do the number of species that can occupy an area, and the number of functions supported by an area. Higher complexity potentially results in higher biodiversity. It is recognized that some restoration efforts, such as a chum channel, may not strive for habitat complexity.

6) Accessibility For Target Species
Accessibility refers to unencumbered access by Columbia River estuary habitat-dependent aquatic and terrestrial species. Projects that allow or enhance access of these species to important habitats would potentially enhance the feeding, rearing, and refuge functions of the site are preferred. This criterion acknowledges the need to restore habitat for those threatened and endangered species, both aquatic and terrestrial, whose populations are at precariously low numbers and who might benefit from improved near-shore habitat conditions.

Implementation Criteria

1) Use Natural Processes to Restore and Maintain Structure over Habitat Creation
This criterion recognizes that restoration measures should attempt to re-establish the dynamics of estuarine hydrology, sedimentology, geomorphology and other habitat-forming processes that naturally create and maintain habitat, rather than implanting habitat structures at inappropriate or unsustainable locations. Restoration tasks should initiate or accelerate natural processes. Nearly all manifestations of restoration are accomplished by these processes and not by the direct artifice of the restoration. Complex engineering manipulations to create new habitats or to enhance existing habitats can introduce levels of uncertainty about the ecological impacts of such actions and/or the application of the results to other locations.

Restoration methods such as dike, levee, and tide gate removal should receive first priority for restoration since historic habitat features of the surrounding area may still be intact. Areas that require minor alterations and maximize ecosystem function and processes offer a higher certainty of outcomes and may be more cost-effective and self-sustaining. Weight should be given to tidegate improvements with access to quality stream channels where dike breaching is not an option. For purposes of setting natural processes rapidly in motion some artificial manipulation is required, the best ecological engineering practices should be applied in implementing restoration projects, using all available ecological knowledge and maximizing the use of natural processes to achieve goals.

2) Community Support and Participation
Developing partnerships among communities, organizations, individuals and agencies is a critical element to long term estuary restoration success. The following are considerations regarding this criterion:

A. Choose projects with local support that are popular and visible, and have political and environmental education components.
B. Visible, local partners (i.e., those that are technically capable/and can facilitate discussions between local project sponsors and Federal/State agency representatives) are needed to build community support for habitat restoration and protection projects
C. Select habitat restoration and protection projects that are linked to community/watershed councils' goals and objectives
D. Look for synergy with existing projects, spatially and biologically, and those with community support and ecological output. That involvement requires creativity and flexibility on the part of all involved to look for ecological, social, and economics incentives when identifying potential projects
E. Depending on the stakeholder and/or landowner, social and economic considerations may be as important as environmental considerations when choosing potential habitat restoration and protection projects

3) Potential for Self Maintenance and Certainty of Success
Self-maintenance addresses the ability of a site to persist and evolve toward a natural (historical) habitat condition without significant on-going human intervention. Conditions for controlling factors in the reach and in the management unit must be appropriately developed and maintained. Self-maintenance means that the habitat can persist and develop under natural climatic variation, and that the system has a natural degree of resilience to natural perturbations. This criterion relies on needing to know the historical conditions and factors attributed to the current conditions.

4) Potential for Improvement in Ecosystem Function While Avoiding Impacts to Healthy and Functioning Ecosystems
This criterion observes that at times there are competing restoration goals, and while attempting to improve some ecosystem functions, others may be impaired or lost. This criteria stresses that restoration actions should achieve proposed benefits while avoiding the long term or permanent degradation of other ecological functions of natural habitats or broader ecosystems. Restoration actions should avoid replacing one naturally functioning habitat with another, even if the replacement is perceived to benefit salmon. In particular, activities that further reduce the estuarine tidal prism or impair other large-scale estuarine processes (e.g., circulation, salinity intrusion) or attributes should be avoided.

5) Avoid Sites Where Irreversible Change Has Occurred
Many aquatic ecosystems within the Estuary have been so heavily modified that the fundamental processes responsible for historic conditions have been significantly altered, in some cases irrevocably. In the Lower Columbia River, freshwater volume has been reduced or the natural flow cycle altered, inputs of sediments and detritus have changed, and tidal flow has been compromised. In some cases, restoration of historic conditions in their original location or state is simply no longer attainable without restoration of historic processes.

Reconstructing the historical river, tidal floodplain and estuarine structure does not necessarily guarantee restoration success; it only decreases uncertainty. Historic templates often provide the framework for restoration goals, as well as a perspective on how ecosystems have been incrementally degraded. At the minimum, the modified capacities of natural processes to support restoring habitats under present conditions must be well understood to develop realistic restoration goals. In some instances, ecological engineering may be necessary to compensate for diminished processes, but such approaches should be used to initiate self-sustaining restoration rather than as an artificial “fix” requiring long-term maintenance.

6) Capacity of Sponsor/Partnership
Restoration projects are often complex and costly. To effectively implement and monitor a restoration project over the long term it is necessary that the sponsor and project partners have the capacity to successfully manage the project and achieve success. This criterion will consider an organization’s record of project management, its technical expertise, and financial stability.

7) Project Context Within Broader Management and Planning Objectives
This criterion recognizes that within the Lower Columbia system there are a number of management plans and objectives that articulate specific restoration and conservation recommendations. Some of these include; Northwest Power and Conservation Council’s Subbasin Plans, Lower Columbia Fish Recovery Board priorities, Oregon’s Coastal and Estuarine Land Conservation Plan, North American Waterfowl Management Plan, and the Columbia Land Trust’s Land Conservation Priorities. In evaluating proposed restoration projects, considerations should be made to coordinate with these initiatives to minimize duplication of services or contradictory endeavors.

Monitoring Criteria

1) Monitoring and Evaluation with Relationship to Stated Goals and Objectives
Monitoring and adaptive management are essential components of restoration and habitat management. Restoration activities should be placed in the context of an experimental design strategy. Metrics should be developed that enhance an understanding of the connection between habitat variables and species' needs. Restoration designs should be monitored and, based on the concept of adaptive management, altered if necessary to achieve desired endpoints and to insure that local projects are self-sustaining. Information already available on limiting factors and properly functioning conditions should be included in the site selection and project design. The monitoring information must span both water quality and physical habitat parameters. Determining an appropriate scale is a critical component of developing a monitoring and effectiveness criteria.

Goals and biological objectives for restoration should be clearly stated, site specific, measurable and long-term, in many cases greater than 20 years. Performance criteria should derive directly from these goals, and should include both functional and structural elements and be linked to suitable, local reference ("target") habitats. Scientific monitoring based on the established performance criteria is essential to improve restoration techniques and to achieve estuarine restoration goals. Performance criteria should indicate whether restoration is progressing as intended and how the project may be altered or redesigned to better achieve project goals.

2) Linkages to Reference Site(s)
Determining the effectiveness of restoration activities requires comparison to relatively unaltered reference habitats in close proximity to serve as a "control" for evaluating habitat change. This allows for monitoring the growth, species composition, successional stage and time period of the restoration site in comparison to the reference site and assist in developing performance standards and benchmarks for restoration activities in the estuary. Choosing sites that include an experimental restoration design tied to effectiveness monitoring helps promote a better understanding of the relationship between habitat restoration activities and species response and performance resulting from the restoration activity.

3) Transferability of Results
Projects should be designed as explicit tests of restoration actions that will be evaluated, and, if effective, can be scaled up and applied systematically across the landscape. Restoration results should be evaluated uniformly at individual sites and comprehensively at landscape and ecosystem scales to assess whether the cumulative results of local restoration actions achieve overall recovery goals. The results of monitoring can provide the foundation for more effective restoration methods in future projects.

* These criteria are derived in part from:

- **Guiding Ecological Principles For Restoration of Salmon Habitat in the Columbia River Estuary**, Charles ("Si") Simenstad, Dan Bottom
- **An Ecosystem-based Approach to Habitat Restoration Projects with Emphasis on Salmonids in the Columbia River Estuary** - Johnson, G.E., R.M. Thom, A.H. Whiting, G.B. Sutherland, N. Ricci, J.A. Southard, B.D. Ebberts, and J.D. Wilcox. September 30, 2003.
- **Proceedings of the Lower Columbia River and Estuary Habitat Conservation and Restoration Workshop**, Astoria, Oregon - 2001

This is not a final federal agency product. Rather, it is a pre-decisional document prepared by the Action Agencies that reflects present understandings of currently available information and analyses, and of the progression of discussions with the sovereigns in the collaborative process. Revisions and refinements are to be expected based on further discussions with the sovereigns over new and modified proposed federal actions upon which the action agencies will ultimately consult. Finally, the information in this product does not constitute an analysis of whether the identified measures would or would not jeopardize the continued existence of a listed species or result in the destruction or adverse modification of designated critical habitat. Furthermore, this document does not in any way interpret or apply the regulatory definitions of the statutory phrases "jeopardize the continued existence of" and "destruction or adverse modification."

Estimated Benefits of Federal Agency Habitat Projects in the Lower Columbia River and Estuary

Prepared for

Policy Work Group of the
FCRPS Hydropower BiOp Remand

Prepared by
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Estimated Benefits of Federal Habitat Projects in the Columbia River Estuary

Introduction

This document explains the process used to evaluate federally funded habitat projects in the Columbia River estuary for their potential to improve the survival of salmon and steelhead in the estuary, which extends from Bonneville Dam at River Mile 146 to the mouth of the Columbia and includes the river's plume. The evaluation includes 21 baseline projects (those completed between 2000 and 2006), current projects in various stages of development (2007 through 2009), and future anticipated projects not yet identified (years 2010 through 1017).

The document builds on information in the *Guidance from the Habitat Technical Subgroup of the FCRPS Hydropower BiOp Remand Collaboration for Providing Columbia River Basin Estuary Habitat Action Information*, provided to the Policy Work Group on August 18, 2006 (Habitat Technical Subgroup 2006). To estimate survival benefits, each federal project was linked to a recommended recovery action in NOAA Fisheries' draft *Columbia River Estuary Recovery Plan Module* (NOAA Fisheries 2006) and then evaluated in terms of the project's certainty of success, potential benefits, and contribution to implementation of the recovery action. The projects in question are summarized beginning on page 5 of this document[1].

Approach

The evaluation of federal projects was accomplished in two distinct steps. The first involved scoring projects using the Lower Columbia River Estuary Partnership's *Criteria for Identifying and Prioritizing Habitat Protection and Restoration Projects on the Lower Columbia River and Estuary*. The second step involved linking federal projects to recovery actions identified in the *Estuary Recovery Plan Module* and estimating the relative contribution of each project to the implementation of the action.

Step 1: Project Scoring

Each federal project was examined in terms of two types of criteria from the Lower Columbia River Estuary Partnership: certainty of success and potential benefits.

- Certainty of success. These criteria help measure how likely a project is to accomplish the intended objectives. Examples of criteria include the use of natural processes to restore and maintain structure (rather than habitat creation), self maintenance, and the selection of sites that have not been irreversibly changed. In this evaluation, urban projects often scored lower than similar rural projects because of complicating issues that occur more commonly in cities, such as high water temperature or the presence of contaminants resulting from urban stressors.

[1] Includes descriptions for those projects with sufficient detail. Some 2007-09 projects were abstractly characterized because of the sensitivity of on-going negotiations with property owners or project sponsors. The 2010-17 project descriptions are placeholders because projects have not yet been identified.

- **Potential benefits**. These criteria help measure how much a project improves salmonid survival or ecosystem health. Examples of specific criteria include habitat connectivity, habitat complexity, and improvement in ecosystem function.

Each project was given a numeric score for certainty of success and potential benefits, with zero being a low score and five being a high score. The two scores were multiplied to yield a total project score of up to 25 points. Table 1 summarizes the results of Step 1 for the 35 federal projects[2], both those that have been completed or are in progress and those that are pending.

Step 2: Linking Projects to Recovery Actions and Estimating Benefits

Each federal project was linked to a related recovery action in the *Estuary Recovery Plan Module* (NOAA Fisheries 2006) and evaluated for its contribution to implementation of that action. Contribution to implementation was evaluated using survival improvement targets[3] from the *Estuary Recovery Plan Module* to determine the level of benefit that could be gained from different actions.

Survival Improvement Targets: Determining Potential Benefits of Recovery Actions

As a planning exercise, the *Estuary Recovery Plan Module* assigns a survival improvement target to each of its 22 recovery actions, in an effort to characterize the types of actions—and level of implementation effort—that would be needed to achieve a given amount of increase in the number of juveniles exiting the estuary and plume environments. In the module, this given amount of increase in survival is a 20 percent, a hypothetical but plausible level of improvement assuming that all 22 recovery actions are implemented to a significant extent. A 20 percent survival improvement in the estuary equals 4.18 million additional juveniles—2.5 million ocean type and 1.68 million stream type. (Survival improvement targets are not scientifically defensible, but they are based on best available science. Appendix B of the *Estuary Recovery Plan Module* spells out how individual survival targets were developed.) The module then allocates the 2.5 million ocean type and 1.68 million stream type juveniles across the 22 recovery actions. The result is two numerical survival improvement targets for each action—one for ocean-type juveniles and one for stream types. These targets express the proportion of improvement in salmonid survival that a given recovery action might accomplish, assuming that all of the 22 recovery actions are implemented, each to a significant degree.

Table 5-5 in Appendix A shows the allocation of survival improvement targets by action for both ocean- and stream-type juveniles. (Appendix A is taken directly from the *Columbia River Estuary Recovery Plan Module* [NOAA Fisheries 2006]). Targets are presented both numerically and as a percentage of the total survival improvement that is presumed to result if all actions are implemented. For example, Action CRE-9, "Protect remaining high-quality off-channel habitat," is assigned a survival improvement target of 350,000 for ocean-type juveniles and 80,000 for stream-type juveniles; these figures represent 13 percent of the total survival improvement target for ocean types and 5 percent of the total target for stream types. Together, implementation of all 22 projects adds up to 100 percent of the total survival improvement of 2.5

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[2] Fifteen 2007-09 projects were not evaluated for certain of success and potential benefits because specific details are pending.

[3] See Appendix A for an explanation of survival improvement targets taken from the *Columbia River Estuary Recovery Plan Module* (NOAA Fisheries 2006).

million ocean types and 1.68 million stream types—a 20 percent increase in the number of juveniles exiting the estuary and plume environments.[4]

Table 2 lists the five *Estuary Recovery Plan Module* recovery actions that the federal projects in question contribute to. The table also breaks those actions down into a set of sub-actions (taken from Table 5-6 of the module; see Appendix A) and shows the survival benefit that could be expected from implementation of each action and sub-action. The total survival benefit for each of the six actions equates to its relative contribution to 100 percent of the survival target (20 percent survival improvement of juveniles exiting the estuary and plume). For example, in the module, protecting high-quality off-channel habitat (Action CRE-9) contributes 13 percent of the total benefits to ocean types that could be expected from implementing all of the recovery actions, and it contributes 5 percent of the total benefits to stream types. For the analysis in this evaluation of federal projects, CRE-9 is assigned 13 possible survival benefit units (13 percent) for ocean-type juveniles and 5 survival benefit units (5 percent) for stream types. These units represent the presumed benefit that could be gained from that recovery action, if it were fully implemented as envisioned in the module.

In Table 2 the 13 survival benefit units for ocean types are then broken down by sub-action, with 1 unit assigned to educating landowners about the value of intact habitat, 4 units assigned to providing incentives for regulatory agencies, and 8 units assigned to actual purchase of off-channel habitat. The same is done for stream-type juveniles. In this way, the potential benefits of each sub-action can be compared, with the benefits relating back to analysis in the *Estuary Recovery Plan Module*.

Linking Federal Projects to Recovery Actions

Once the pertinent *Estuary Recovery Plan Module* recovery actions were broken down to a finer scale, into sub-actions (see Table 2), the federal projects that contribute to implementation of the sub-actions could be associated with them. Projects and the recovery sub-actions they contribute to are listed in Tables 3 (baseline projects), 4 (2007-09 projects) and 5 (2010-17 projects). Several projects are linked to more than one sub-action.

Estimating the Benefits of Federal Projects

Tables 3, 4, and 5 shows the results of the evaluation of federal projects, broken down by the recovery sub-action or sub-actions it contributes to. For each project, the tables list the associated recovery sub-action(s); that sub-action's total possible survival benefit units for ocean- and stream-type juveniles, assuming that the sub-action is fully implemented as envisioned in the *Estuary Recovery Plan Module*[5]; and the number of survival benefit units assigned to the sub-action for implementation of the federal project. Survival benefit units were assigned based on the results of Step 1 (the project's certainty of success and expected benefit) and the general scale of the project compared to the unit goals in the *Estuary Recovery Plan Module* (see Table 5-6 in Appendix A). Although the assignment of scores was not quantitative, an attempt was made to ensure consistency across the projects.

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[4] This can also be expressed as reducing the mortality of juvenile salmonids during their residency in the estuary and plume by 20 percent.

[5] The *Columbia River Estuary Recovery Plan Module* identifies a number of assumptions about achieving the 20 percent survival target—including the suggestion that all actions, to some degree, may need to be implemented to achieve the target. This evaluation of federal project survival benefits does not account for all module assumptions.

The assigned survival benefit units reflect how much a federal project is likely to contribute to implementation of a recovery sub-action, and how much of a survival benefit that contribution represents. For example, the Lewis and Clark River project is a full dike breach, which contributes to Sub-Action 10.1, "Breach or lower the elevation of dikes, and levees." For this sub-action there are a total of 10 possible survival benefit units for ocean-type juveniles and 4 possible units for stream types, assuming that the sub-action is implemented as widely as possible in the estuary, over a period of years. The Lewis and Clark River project has a relatively high likelihood of success and potential benefit (a score of 16 out 25 from Table 1), but its acreage is relatively small compared to the module's goal of 3,000 acres. For these reasons, the project is assigned .24 survival benefit units for ocean-type juveniles and .08 units for stream-type juveniles (who are less likely than ocean types to benefit from the off-channel habitat the project would create). Project survival benefits are likely to accrue over a 20+ year time horizon.

Table 6 summarizes the project contribution totals for baseline projects, 2007-09 projects, and 2010-17 projects. The total estimated contribution of all projects toward the 20 percent survival target in the *Estuary Recovery Plan Module* is approximately 49 percent for ocean type and 30 percent for stream type. The far-right hand column of the table is the estimated estuary survival benefit for ocean type and stream type juvenile salmonids. This number is intended to show the total percent increase in ocean type and stream type juvenile salmonids exiting the estuary and plume as a result of implementing the projects.

Proposed and Completed Federal Projects

Completed Projects (baseline)

These are projects that have been constructed or for which an Endangered Species Act (ESA) consultation has been completed (Environmental Baseline projects)

Alder Creek Culvert Replacement. This project is located on Alder Creek, a tributary of North Scappoose Creek in the Scappoose Bay Watershed. The project provides unrestricted fish passage for salmonids by replacing three culverts with full-spanning bridges; this provides approximately 3 miles of access to quality habitat.

Brownsmead. This tide gate retrofit project provides approximately 10 miles of improved tidal channel connectivity. The project does not provide for full inundation to the floodplain due to flooding concerns of landowners.

Burris Creek. This project is a tide gate retrofit project located in Reach E (area between Kalama and Woodland). The Burris Creek tide gate retrofit and fish slide project will be developed in conjunction with the Woodland Bottoms wildlife mitigation project. This project is scheduled to be completed in FY 09.

Crims Island Acquisition. This project is an acquisition of a lower Columbia River island located downstream of Longview, Washington, in Reach C. The acquisition included approximately 473 acres of off-channel and riparian habitats.

Crims Island Restoration. This project restores and/or creates approximately 90 acres of marsh and tidal sloughs and approximately 100 acres of riparian forest.

Crooked River. This project protects 55 acres of high-quality riparian and floodplain habitat on Crooked Creek, a tributary to the Grays River.

Deep River. This project is one phase of a multi-phased project intended to restore and preserve approximately 154 acres of off-channel habitat in the Deep River floodplain.

Devils Elbow. This project protects 80 acres of high-value off-channel forested wetland habitat near the mouth of the Grays River.

Fort Columbia. This project restores 96 acres of tidal wetland habitat in the Chinook River Watershed by replacing an undersized culvert that limits fish access to this area. Fort Columbia State Park is located at River Mile 10 of the Columbia River near Chinook, Washington.

Germany Creek. This project conserved 155 acres of forested riparian and upland habitat along Germany Creek; additionally, it provides the foundation for the enhancement of 2.5 miles of stream habitat for chum salmon. Germany Creek is a tributary of the Columbia River at River Mile 56 in Reach C.

Grizzly Slough. This project is a tide gate retrofit project that provides partial tidal channel reconnection. The linear miles of channel reconnected have not been identified.

Hall Creek. This project is a tide gate retrofit project that provides partial tidal channel reconnection. The linear miles of channel reconnected have not been identified.

Hump-Fisher Islands. This project is a channel modification designed to improve embayment circulation for an unknown number of acres of marsh/swamp and shallow-water and flats habitat. This project is scheduled to be completed in FY 07.

Integrated Pest Management (for purple loosestrife). This ongoing project documents the presence, abundance, and distribution of purple loosestrife in the Columbia River estuary. In addition, bio-control agents are being employed to help slow existing stands and results are being monitored. Purple loosestrife is an introduced exotic plant that is spreading throughout emergent tidal marshes in the Columbia River estuary. This project is a 5-

year effort that began in FY 05, has been conducted in FY 06 and will continue for three additional years. Native vegetation such as Lyngby's sedge, tufted hair grass, and softstem bulrush are being displaced by this invasive species. Currently more than 10,000 acres of estuarine tidal marsh are infested, although the degree of infestation varies widely among locations.

Kandoll Farm. This project protects 183 rural acres of habitat. The restoration action included a full breach of 183 acres of tidally reconnected floodplain.

Lewis and Clark River. This project restored 25 acres of historical floodplain by breaching a dike onto adjacent properties. The project site is on the Lewis and Clark River, a tributary of Youngs Bay that meets the Columbia River at River Mile 12 in Reach A.

Malarkey Fish Passage. This project involved the removal of two culvert barriers to fish passage, and their replacement with bridges that provide fish passage access to 6 miles of stream habitat. Malarkey Ranch is near the confluence of the Multnomah Channel and the Columbia River at River Mile 85 in Reach E.

Sandy River Delta I. The project is located at the confluence of the Sandy and Columbia rivers just north of I-84 and east of the Troutdale airport. This project is part of a long-term effort to restore 1,500 acres of the Sandy River delta. The Action Agencies restored 310 acres of native hardwood riparian forest and 200 acres of a seasonally wet slough; they also protected and restored approximately 155 acres of degraded riparian habitats in the Sandy River Delta.

Tenasillahe Island Water Circulation. This project is a tide gate retrofit project at the Julia Butler Hansen National Wildlife Refuge that is intended to increase circulation in approximately 92 acres of backwater and side-channel habitat.

Walker-Lord Island. This project is a channel modification designed to improve embayment circulation for about 335 acres of marsh/swamp and shallow-water and flats habitat.

Walluski River. This project conserves a critical property within the Youngs Bay and Walluski River watersheds, and preserves the historical wetland habitat community. The project involves acquisition and restoration of two properties, totaling 35 acres and more than ½ mile of the river. The property is located on the Walluski River, which is a tributary of Youngs Bay that meets the Columbia River at River Mile 12 in Reach A.

Proposed New Federal Projects (2007-09)

Chinook River. The proposed project is located near Chinook, Washington. The intent of the project is to restore partial tidal influence and access to several acres of the Chinook River estuary. To accomplish this goal, a tide gate will be retrofitted. At this time, the number of acres (or lineal miles of channel access) influenced by the project are unknown.

Dairy Creek. This project is intended to improve hydrologic flushing and salmonid access to Sturgeon Lake on Sauvie Island, Oregon. Sturgeon Lake is approximately 3,200 acres in size.

Grays River Restoration. This combination acquisition and protection project includes the purchase of 40 acres of critical floodplain property and 40 acres of riparian forest restoration. It also includes the installation of six to eight engineered log jams in the Grays River that are intended to help slow flood flows, reduce erosion, contribute to sediment storage in the project area, enhance fish habitat, and contribute wood into the project area. The structures also will divert partial flows into alternate channels within the Grays River floodplain, thus increasing total aquatic habitat area and restoring spawning habitat.

Habitat Acquisition, Reach D. This project targets approximately 380 acres of off-channel rearing habitat for juvenile salmonids in key areas beginning just downstream of Longview and as far upstream as Kalama. Extensive diking and filling around Longview and the mouth of the Kalama River have significantly reduced access to the floodplain, and islands created through the disposal of dredged materials are prevalent.

Julia Butler Hansen. The proposed project is located on the Julia Butler Hansen National Wildlife Refuge near Cathlamet, Washington. The intent of the project is to install fish-friendly tide gates to increase tidal flushing and fisheries access to approximately 110 acres. Riparian plantings of up to 210 acres will likely be included as well.

Ramsey Lake. This project, located at River Mile 2 on Columbia Slough, will re-establish hydrologic connectivity to the Lower Columbia Slough to reclaim and improve floodplain wetland functions (forested wetland and soft bottom, mud backwater sloughs) and increase the amount and quality of off-channel rearing and refuge habitat for juvenile salmonids. This project will return approximately 5.0 acres of isolated habitat. Native vegetation will be planted along shorelines and within the wetland restoration site. Reconstructed slough channels will provide approximately 2.5 acres of annually inundated off-channel habitat.

Sandy River Delta II. This project is located at the confluence of the Sandy and Columbia rivers just north of I-84 and east of the Troutdale airport. This project is part of a long-term effort to restore 1,500 acres of the Sandy River delta. Near-term future restoration includes breaching the dike and re-establishing flow to a portion of the original Sandy River channel, planting vegetation on 50 acres, removing invasive weeds on 180 acres, planting wetland scrub shrub on 45 acres, and controlling and removing invasive wetland plants on 45 acres.

Vancouver Lake. This project is a tide gate retrofit project located in Reach F (in the City of Vancouver area). The number of acres affected by this project is currently uncertain.

Vancouver Water Resources. This proposed project is intended to protect and restore approximately 5 to 10 acres of emergent wetland and riparian forest habitats.

Project #1 (Reach A). This is a 45 acre floodplain reconnection project (tide gate removal).

Project #2 (Reach A). This is a 45 acre acquisition of floodplain intended for future restoration activities (dike breach).

Project #3 (Reach A). This is a 50 acre floodplain reconnection project (dike breach).

Project #4 (Reach A). This project is the acquisition of 320 acres of tidelands and 119 acres of riparian/upland forest.

Project #5 (Reach F). This project includes the restoration of 30 acres of riparian lands, including 2 linear miles of fencing.

Un-scoped Bonneville Projects (15 – 20). These projects are FY 2007-09 projects that are undergoing preliminary scoping and sponsor development.

Bonneville Piling and Pile Dike Removal Projects. This is a new program intended to begin in FY 08. The program consists of a study to evaluate pilings and pile dikes that can be removed without negative effects on the navigation channel operations or private property, several demonstration projects to test methodologies, and limited monitoring to learn which techniques are best suited for future funding years.

Un-scoped USACE Projects. These are FY 2007-09 projects that are undergoing preliminary scoping and sponsor development. The projects were assumed equal to three years of funding with survival benefits equaling Projects 1 – 5 above.

Proposed New Federal Projects (2010 - 12)

2010-12 Bonneville Projects (15 – 20). This suite of projects has not been identified at this time; however the survival units are based upon FY 2007-09. This includes restoration and protection projects as well as a piling and pile dike removal program.

2010- 14 USACE Projects. This suite of projects has not been identified at this time; however the survival units are based upon FY 2007-09 and assumes a consistent level of funding.

Proposed New Federal Projects (2013 - 15)

2013-15 Bonneville Projects (15 – 20). This suite of projects has not been identified at this time; however the survival units are based upon FY 2007-09. This includes restoration and protection projects as well as a piling and pile dike removal program.

2013- 15 USACE Projects. This suite of projects has not been identified at this time; however the survival units are based upon FY 2007-09 and assumes a consistent level of funding.

Proposed New Federal Projects (2016 - 17)

2016-17 Bonneville Projects (15 – 20). This suite of projects has not been identified at this time; however the survival units are based upon FY 2007-09. This includes restoration and protection projects as well as a piling and pile dike removal program.

2016- 17 USACE Projects. This suite of projects has not been identified at this time; however the survival units are based upon FY 2007-09 and assumes a consistent level of funding.

References

Federal Columbia River Power System Hydropower Biological Opinion Remand Collaboration Habitat Technical Subgroup. 2006. *Guidance from the Habitat Technical Subgroup of the FCRPS Hydropower BiOp Remand Collaboration for Providing Columbia River Basin Estuary Habitat Action Information.* Prepared by PC Trask & Associates under contract to NOAA Fisheries. August 18, 2006.

Lower Columbia River Estuary Partnership. *Criteria for Identifying and Prioritizing Habitat Protection and Restoration Projects on the Lower Columbia River and Estuary.* www.lcrep.org/habitat_strategy.htm. Accessed January 5, 2007.

NOAA Fisheries. 2006. *Draft Columbia River Estuary Recovery Plan Module*. Prepared by the Lower Columbia River Estuary Partnership under contract to NOAA Fisheries. September 27, 2006.

TABLE 1

Summary of Scoring (by Certainty and Benefit) of Federal Projects

Project	Status		Certainty	Benefit	Total
	2000-06*	2007-09**			
Alder Creek Culvert Replacement	X		5	5	25
Brownsmead	X		3	2	6
Burris Creek	X		3	2	6
Crims Island Acquisition	X		5	5	25
Crims Island Restoration	X		5	5	25
Crooked River	X		4	4	16
Deep River	X		5	5	25
Devil's Elbow	X		4	4	16
Fort Columbia	X		4	4	16
Germany Creek	X		4	4	16
Grizzly Slough	X		3	2	6
Hall Creek	X		3	2	6
Hump-Fisher Islands	X		4	3	12
Integrated Pest Management	X		(not scored)	(not scored)	(not scored)
Kandoll Farm	X		5	5	25
Lewis and Clark	X		4	4	16
Malarkey Fish Passage	X		5	5	25
Sandy River Delta, Phase I	X		4	3	12
Tenasillahe Island Water Circ.	X		3	2	6
Walker-Lord Islands	X		4	3	12
Walluski River	X		4	4	16
Chinook River		X	3	2	6
Dairy Creek		X	3	3	9
Grays River Restoration		X	4	4	16
Habitat Acquisition (Reach D)		X	5	4	20
Julia Butler Hansen		X	4	3	12
Ramsey Lake		X	4	3	12
Sandy River Delta, Phase II		X	3	5	15
Vancouver Lake		X	3	2	6
Vancouver Water Resources		X	4	3	12
Project #1		X	4	4	16
Project #2		X	5	5	25
Project #3		X	4	4	16
Project #4		X	5	5	25
Project #5		X	4	3	12

0 = low, 5 = high.

*Projects that have been constructed or for which an Endangered Species Act (ESA) consultation has been completed (baseline projects)

**In-progress 2007-09 projects (not a complete list of all 2007-09 projects).

TABLE 2

Benefits of Estuary Module Actions and Sub-Actions Addressed by Federal Projects

Estuary Module Actions	Total Possible Survival Benefit Units* (by Action)		Estuary Module Sub-Actions	Total Possible Survival Benefits Units* (by Sub-Action)	
	Ocean	Stream		Ocean	Stream
CRE-1: Protect/restore riparian areas	6	6	**CRE-1.1:** Educate landowners about the ecosystem benefits of intact riparian areas and the costs of degraded riparian areas.	.5	.5
			CRE-1.2: Encourage and provide incentives for local, state, and federal regulatory entities to maintain, improve (where needed), and enforce consistent riparian area protections throughout the lower Columbia region.	1.5	1.5
			CRE-1.3: Actively purchase riparian areas in urban and rural settings that (1) cannot be effectively protected through regulation, (2) are intact, or (3) are degraded but have good restoration potential.	2.0	2.0
			CRE-1.4: Restore and maintain ecological benefits in riparian areas; this includes managing vegetation on dikes and levees to enhance ecological function.	2.0	2.0
CRE-8: Remove pilings and pile dikes	7	7	**CRE-8.1:** Inventory, assess, and evaluate pilings and in-channel pile dikes for their economic value and their impact on the estuary ecosystem; develop criteria for establishing project priorities; implement demonstration projects to test approach.	.8	.8
			CRE-8.2: Remove priority pilings and pile dikes.	6.0	6.0
			CRE-8.3: Monitor the physical and biological effects of pile dike removal.	.2	.2
CRE-9: Protect remaining high-quality off-channel habitat	13	5	**CRE-9.1:** Educate landowners about the ecosystem benefits of protecting and stewarding intact off-channel areas and the costs of restoring degraded areas.	1.0	.5
			CRE-9.2: Encourage and provide incentives for local, state, and federal regulatory entities to maintain, improve (where needed), and enforce consistent riparian area protections throughout the lower Columbia region.	4.0	1.5
			CRE-9.3: Actively purchase off-channel habitats in urban and rural settings that (1) cannot be effectively protected through regulation, (2) are degraded but have good restoration potential, or (3) are highly degraded but could benefit from long-term restoration solutions.	8.0	3.0

CRE-10. Breach or lower dikes and levees	15	6	**CRE-10.1:** Breach or lower the elevation of dikes and levees; create and/or restore tidal marshes, shallow-water habitats, and tide channels.	10.0	4.0
			CRE-10.2: Remove tide gates to improve the hydrology between wetlands and the channel and to provide juveniles with physical access to off-channel habitat; use a habitat connectivity index to prioritize projects.	3.0	1.2
			CRE-10.3: Upgrade tide gates where (1) no other options exist, (2) upgraded structures can provide appropriate access for juveniles, and (3) ecosystem function would be improved over current conditions.	2.0	.8
CRE-15: Reduce noxious weeds	2	<1	**CRE-15.1:** Increase public awareness of exotic plant species and proper stewardship techniques.	.2	.1
			CRE-15.2: Inventory exotic plant species infestations and develop a GIS layer with detailed metadata files.	.1	.1
			CRE-15.3: Implement projects to address infestations on public and private lands.	1.5	.7
			CRE-15.4: Monitor infestation sites.	.2	.1

* Units are a percent of the 20 percent survival improvement target in the *Estuary Recovery Plan Module*.

TABLE 3

Estimated Benefits of Baseline Projects (2000 – 2006)

Federal Project	Estuary Module Sub-Action	Total Possible Survival Units by Sub-Action*		Assigned Survival Units By Project*		Notes
		Ocean	Stream	Ocean	Stream	
Alder Creek Culvert Replacement	CRE-1.4	2	2	.06	.06	The estuary module sets restoration of riparian areas at 20 miles. This project restores approximately 3 miles of linear habitat. Project was scored very high (5) for certainty of success and very high (5) for potential benefit.
Brownsmead	CRE-10.3	2	.8	.03	.01	The estuary module sets an acreage target of 500. Certainty of success was scored medium (3) and potential benefit was scored low (2). Tide gate retrofit projects rank relatively low because of uncertainties related to this unproven technique. Also, there are limited spatio-temporal habitat opportunity and connectivity benefits because only tidal channels and not their associated floodplains are typically connected. This project provides approximately 10 miles of improved tidal channel connectivity.
Burris Creek	CRE-10.3	2	.8	.03	.01	The estuary module sets an acreage target of 500. Certainty of success was scored medium (3) and potential benefit was scored low (2). Tide gate retrofit projects rank relatively low because of uncertainties related to this unproven technique. Also, there are limited spatio-temporal habitat opportunity and connectivity benefits because only tidal channels and not their associated floodplains are typically connected.
Crims Island Acquisition	CRE-9.3	8	3	.3	.1	The estuary module sets an acreage protection target of 3,000 acres of rural and 150 acres of urban off-channel habitat. This project anticipates approximately 473 rural acres of protection. Project scored very high (5) in certainty of success and very high (5) in potential benefit.
Crims Island	CRE-10.1	10	4	.36	.13	The estuary module sets an acreage target of 3,000; this project is a full breach of 90 acres. Certainty of success was scored very high (5) and potential benefit was scored very high (5).
Crooked River	CRE-9.3	8	3	.18	.05	The estuary module sets acreage protection target at 3,000 acres of rural and 55 acres of urban off-channel habitat. This project anticipates approximately 200 rural acres of protection. Project scored high (4) in certainty of success and high (4) in potential benefit.

Deep River	CRE-9.3	8	3	.25	.08	The estuary module sets acreage and protection target of 3,000 acres of rural and 150 acres of urban off-channel habitat. This project anticipates approximately 200 rural acres of protection. Project scored very high (5) in certainty of success and very high (5) in potential benefit.
	CRE-10.1	10	4	.36	.13	The estuary module sets an acreage target of 3,000 rural acres. This project is a full breach of 200 acres. The project scored very high for certainty of success (5) and very high for potential benefit (5).
Devils Elbow	CRE-9.3	8	3	.18	.05	The estuary module sets an acreage protection target of 3,000 acres of rural and 80 acres of urban off-channel habitat. This project anticipates approximately 200 rural acres of protection. Project scored high (4) in certainty of success and high (4) in potential benefit.
Fort Columbia	CRE-10.1	10	4	.09	.03	The estuary module sets an acreage target of 1,500 acres. Certainty of success was scored high (4) and potential benefit was scored high (4). This is a culvert replacement project and a modification of a tide gate. This project scored high relative to other tide gate retrofit projects because of full tidal reconnection to the floodplain.
Germany Creek	CRE-1.3	2	2	.06	.06	The estuary module sets acquisition of riparian protection at 1,500 rural acres and 75 urban acres. This project acquires 40 rural acres of critical floodplain habitat. Project was scored high (4) for certainty of success and high (4) for potential benefit.
	CRE-1.4	2	2	.09	.09	The estuary module sets restoration of riparian areas at 20 miles. This project restores riparian habitat on 80 rural acres. Project was scored high (4) for certainty of success and high (4) for potential benefit.
Grizzly Slough	CRE-10.3	2	.8	.03	.01	The estuary module sets an acreage target of 500. Certainty of success was scored medium (3) and potential benefit was scored low (2). tide gate retrofit projects rank relatively low because of uncertainties related to this unproven technique, and the limited spatio-temporal habitat opportunity and connectivity benefits since only tidal channels and not there associated floodplains are typically connected.
Hall Creek	CRE-10.3	2	.8	.03	.01	The estuary module sets an acreage target of 500. Certainty of success was scored medium (3) and potential benefit was scored low (2). Tide gate retrofit projects rank relatively low because of uncertainties related to this unproven technique. Also, there are limited spatio-temporal habitat opportunity and connectivity benefits because only tidal channels and not their associated floodplains are typically connected.

Hump-Fisher Islands	CRE-10.1	10	4	.06	.03	The estuary module sets an acreage target of 3,000. However, this project does not provide new access; rather, it provides secondary access to existing habitat opportunity. Project was scored high (4) for certainty of success and medium (3) for potential benefit.
Integrated Pest Management	CRE-15.3	1.5	.7	.06	.03	Metrics for this type of project are difficult to establish. The evaluation assumes a significant level of effort, but the score reflects the magnitude of the problem. The estuary module assigned low survival units because of the uncertainty of ecological-type projects.
	CRE-15.4	.2	.1	.02	.01	Monitoring of infestation sites is a large-scale project. The evaluation assumes limited monitoring relative to the overall problem. The estuary module assigned low survival units because of the uncertainty of ecological-type projects.
Kandoll Farm	CRE-9.3	8	3	.24	.08	The estuary module sets an acreage protection target of 3,000 acres of rural and 80 acres of urban off-channel habitat. This project anticipates approximately 183 rural acres of protection. Project scored very high (5) in certainty of success and very high (5) in potential benefit.
	CRE-10.1	10	4	.48	.15	The estuary module sets an acreage target of 3,000; this project is a full breach of 183 acres. Certainty of success was scored very high (5) and potential benefit was scored very high (5).
Lewis and Clark River	CRE-10.1	10	4	.24	.08	The estuary module sets an acreage target of 3,000; this project is a full breach of 35 acres. Certainty of success was scored high (4) and potential benefit was scored high (4).
Malarkey Fish Passage	CRE-1.4	2	2	.06	.05	The estuary module sets restoration of riparian areas at 20 miles. This project restores approximately 6 miles of linear habitat. Project was scored very high (5) for certainty of success and very high (5) for potential benefit.
	CRE-10.1	10	4	.12	.05	The estuary module sets an acreage target of 3,000. This project restores approximately 6 miles of linear habitat. Project was scored very high (5) for certainty of success and very high (5) for potential benefit.
Sandy River Delta I	CRE-1.4	2	2	.06	.06	The estuary module sets restoration of riparian areas at 20 miles. Project was scored high (4) for certainty of success and medium (3) for potential benefit.

Tenasillahe Island[6]	CRE-10.3	2	.8	.03	.01	The estuary module sets an acreage target of 500. Certainty of success was scored medium (3) and potential benefit was scored low (2). Tide gate retrofit projects rank relatively low because of uncertainties related to this unproven technique. Also, there are limited spatio-temporal habitat opportunity and connectivity benefits because only tidal channels and not their associated floodplains are typically connected. Little is known about this project.
Walker-Lord Islands	CRE-10.1	10	4	.06	.03	The estuary module sets an acreage target of 3,000. However, this project does not provide new access; rather, it provides secondary access to existing habitat opportunity. Project was scored high (4) for certainty of success and medium (3) for potential benefit.
Walluski River	CRE-9.3	8	3	.12	.05	The estuary module sets an acreage protection target of 3,000 acres of rural and 150 acres of urban off-channel habitat. This project anticipates approximately 35 rural acres of protection. The project scored high (4) in certainty of success and high (4) in potential benefit.
	CRE-10.1	10	4	.12	.03	The estuary module sets an acreage target of 3,000; this project is a full breach of 35 acres. Certainty of success was scored high (4) and potential benefit was scored high (4).
			Total	**3.72**	**1.48**	

* Units are a percent of the 20 percent survival improvement target in the *Estuary Recovery Plan Module*.

[6] This project is part of a larger, long-term project that will likely include other project types, including the potential for a full-breach that will allow significant hydrology and juvenile salmonid access to off-channel habitats.

TABLE 4

Estimated Benefits of 2007 – 09 Federal Projects

Federal Project	Estuary Module Sub-Action	Total Possible Survival Benefit Units by Sub-Action*		Assigned Survival Benefit Units By Project*		Notes
		Ocean	Stream	Ocean	Stream	
Chinook River	CRE-9.3	8	3	.12	.03	The Columbia River Estuary Recovery Plan Module (NOAA Fisheries 2006) sets acreage protection target at 3,000 acres of rural and 150 acres of urban off-channel habitat. Project scored low (2) in certainty of success and medium (3) in potential benefit.
	CRE-10.3	2	.8	.03	.01	The estuary module sets an acreage target of 500. Certainty of success was scored medium (3), and potential benefit was scored low (2). Tide gate retrofit projects rank relatively low because of uncertainties related to this unproven technique. Also, there are limited spatio-temporal habitat opportunity and connectivity benefits because only tidal channels and not their associated floodplains are typically connected.
Dairy Creek	CRE-10.1	10	4	.09	.03	The estuary module sets an acreage target of 3,000 rural acres. Project was scored medium (3) for certainty of success and medium (3) for potential benefit.
Grays River Restoration	CRE-1.3	2	2	.06	.05	The estuary module sets acquisition of riparian protection at 1,500 rural acres and 75 urban acres. This project acquires 40 rural acres of critical floodplain habitat. Project was scored high (4) for certainty of success and high (4) for potential benefit.
	CRE-1.4	2	2	.18	.18	The estuary module sets an acreage target of 3,000 rural acres. Project was scored high (4) for certainty of success and high (4) for potential benefit.
Habitat Acquisition "Reach D"	CRE-9.3	8	3	.3	.08	The estuary module sets an acreage protection target of 3,000 acres of rural and 150 acres of urban off-channel habitat. This project anticipates approximately 380 acres of protection. Project scored very high (5) in certainty of success and high (4) in potential benefit.
Julia Butler Hansen	CRE-10.3	2	.8	.06	.02	The estuary module sets an acreage target of 500. Certainty of success was scored high (4) and potential benefit was scored medium (3). This project rated higher than other tide gate retrofit projects because includes up to 8 new tide gates, several include new access for juveniles, and the project is using advanced technologies.

Ramsey Lake	CRE-10.1	10	4	.12	.05	The estuary module sets an acreage target of 3,000 rural acres. Project was scored high (4) for certainty of success and medium (3) for potential benefit.
Sandy River Delta II	CRE-10.1	10	4	.15	.05	The estuary module sets an acreage target of 3,000 rural acres. Project was scored medium (3) for certainty of success and very high (5) for potential benefit.
Vancouver Lake	CRE-10.3	2	.8	.03	.01	The estuary module sets an acreage target of 500. Certainty of success was scored medium (3) and potential benefit was scored low (2). Tide gate retrofit projects rank relatively low because of uncertainties related to this unproven technique. Also, there are limited spatio-temporal habitat opportunity and connectivity benefits because only tidal channels and not their associated floodplains are typically connected.
Vancouver Water Resources	CRE-1.4	2	2	.06	.06	The estuary module sets a linear mile target of 20 miles. Project scored high (4) for certainty of success and medium (3) for potential benefit. Restoration in the urban environment increases the uncertainty as it relates to stressors, such as water temperatures, contaminants, and invasive species.
Project #1 (reach A)	CRE-10.2	3	1.2	.25	.1	This is a 45 acre floodplain reconnection project (tide gate removal).
Project #2 (reach A)	CRE-9.3	8	3	.3	.1	This is a 45 acre acquisition of floodplain intended for future restoration activities (dike breach).
Project #3 (reach A)	CRE-10.1	15	6	.25	.1	This is a 50 acre floodplain reconnection project (dike breach).
Project #4 (reach A)	CRE-1.3	2	2	.3	.3	This project is the acquisition of 320 acres of tidelands and 119 acres of riparian/upland forest.
Project #5 (reach F)	CRE-1.4	2	2	.1	.1	Restoration of 30 acres of riparian area, including 2 linear miles of fencing.

Bonneville Piling & Pile Dike Removal Program	CRE-8.1	.8	.8	.8	.8	This project completes CRE-8.1 as envisioned in the Estuary Recovery Plan Module. The survival units are based upon full implementation of CRE-8.1 and $2 million expended in FY 2008 and 2009.
	CRE-8.3	.2	.2	.02	.02	Piling and pile dike removal is a new program in the lower river and estuary. Monitoring will be required to adaptively learn which techniques will be effective under various conditions.
Additional Bonneville Restoration & Protection Projects**	TBD	-	-	4.8	2.8	These are FY 2007-09 projects that are undergoing preliminary scoping and sponsor development.
Additional USACE Restoration & Protection Projects***	TBD	-	-	3.6	2.1	These are FY 2007-09 projects that are undergoing preliminary scoping and sponsor development.
			Total	**11.62**	**6.99**	

* Units are a percent of the 20 percent survival improvement target in the *Estuary Recovery Plan Module*.

** Assumes 5 additional projects per year (for 3 years) with survival benefits equal to projects 1 – 5 and a 33 percent increase in level-of-effort for the 3 year period (compared to projects 1 – 5).

*** Assumes additional unidentified projects with survival benefits equal to projects 1 – 5 (based upon current funding levels for 3 years.

TABLE 5

Estimated Benefits of 2010 – 17 Federal Projects

Federal Project	Estuary Module Sub-Action	Total Possible Survival Units by Sub-Action*		Assigned Survival Units By Project*		Notes
		Ocean	Stream	Ocean	Stream	
Bonneville & USACE Projects FY 2010-12**	TBD	-	-	12.62	7.99	This suite of projects has not been identified at this time; however the survival units are based upon FY 2007-09. This includes restoration and protection projects as well as a new piling and pile dike removal program. An additional 1 survival unit for ocean and stream type was added to this total to reflect 3 years of program implementation compared to 2 years in FY 2007-09 and the implementation of CRE-8.2 rather than CRE-8.1.
Bonneville & USACE Projects FY 2013-15**	TBD	-	-	12.62	7.99	This suite of projects has not been identified at this time; however the survival units are based upon FY 2007-09. This includes restoration and protection projects as well as a new piling and pile dike removal program. An additional 1 survival unit for ocean and stream type was added to this total to reflect 3 years of program implementation compared to 2 years in FY 2007-09 and the implementation of CRE-8.2 rather than CRE-8.1.
Bonneville & USACE Projects FY 2016-17***	TBD	-	-	8.33	5.27	This suite of projects has not been identified at this time; however the survival units are based upon FY 2007-09. This includes restoration and protection projects as well as a new piling and pile dike removal program. An additional 1 survival unit for ocean and stream type was added to this total to reflect 3 years of program implementation compared to 2 years in FY 2007-09 and the implementation of CRE-8.2 rather than CRE-8.1.
			Total	**33.57**	**21.25**	

* Units are a percent of the 20 percent survival improvement target in the *Estuary Recovery Plan Module*.

** Assumes same funding and survival benefits as FY 2007-09 (3 years).

*** Assumes same funding and survival benefits as FY 2007-09 except period is only 2 years (multiply by .6666).

TABLE 6

Conversion of Results for Columbia River Basin-Wide Integration

Federal Projects	Salmonid Type	Project Contribution Totals*	Estuary Survival Benefit (x .2)
Baseline Projects	Ocean	3.72	0.744 %
	Stream	1.48	0.296 %
2007-09 Projects	Ocean	11.62	2.324 %
	Stream	6.99	1.398 %
2010-17 Projects	Ocean	33.57	6.714 %
	Stream	21.25	4.250 %

* Units are a percent of the 20 percent survival improvement target in the *Estuary Recovery Plan Module*.

Total Ocean-type Estuary Survival Benefit:..... 9.782 %
Total Stream-type Estuary Survival Benefit..... 5.944 %

This is not a final federal agency product. Rather, it is a pre-decisional document prepared by the Action Agencies that reflects present understandings of currently available information and analyses, and of the progression of discussions with the sovereigns in the collaborative process. Revisions and refinements are to be expected based on further discussions with the sovereigns over new and modified proposed federal actions upon which the action agencies will ultimately consult. Finally, the information in this product does not constitute an analysis of whether the identified measures would or would not jeopardize the continued existence of a listed species or result in the destruction or adverse modification of designated critical habitat. Furthermore, this document does not in any way interpret or apply the regulatory definitions of the statutory phrases "jeopardize the continued existence of" and "destruction or adverse modification."

APPENDIX A

CHAPTER 5

Management Actions

Chapters 3 and 4 of this recovery plan module identify factors that currently limit salmonids' biological performance in the estuary and the threats that contribute to those limiting factors. Chapter 5 presents 23 management actions that, together, address the range of threats salmonids in the estuary face, from altered habitat-forming processes to structures in the estuary, changes in the food web, and poor water quality. If implemented, the actions presented in this chapter would reduce the impacts of threats to salmonids during their migration and residency in the estuary and plume.

In addition to identifying the management actions, Chapter 5 evaluates them in terms of constraints to implementation, potential improvement in salmonid survival, and cost. More specifically, the chapter discusses each management action's potential benefits and implementation constraints, hypothesizes how benefits could translate into increased survival of salmonids, breaks each action into component projects, and estimates the cost of each project, and thus of each action. Also included is a list of actions that would address threats to salmonids in the estuary but that would need to be implemented outside the estuary, in either estuary tributaries or upstream areas of the Columbia River basin.

As in other chapters of this recovery plan module, the analysis in Chapter 5 does not fully capture the subtleties of the ecological interactions that influence salmonid survival. Despite continuing research, many aspects of the salmonid life cycle are poorly understood, in part because of the sheer complexity of the ecosystems that salmonids transition into and out of during their lives. The actual relationships among threats and management actions are far more intricate than what is described here. Additionally, given the limits in scientific understanding, there is a degree of uncertainty at each step of the analysis in this chapter. Yet the categories, ratings, and associations presented here are useful tools for discussing complex ecological relationships and comparing possible outcomes of different management actions.

Identification of Management Actions

For the purposes of this recovery plan module, a management action is any action that has the potential to reduce the impact of human-caused or naturally occurring threats to salmonids while they migrate or rear in the estuary, plume, and nearshore. Management actions were identified using available literature and input from area experts. Key documents used to identify management actions are the "Mainstem Lower Columbia River and Columbia River

Estuary Subbasin Plan" (Northwest Power and Conservation Council 2004) and its supplement, *Role of the Estuary in the Recovery of Columbia River Salmon and Steelhead (*Fresh et al. 2005), *Salmon at River's End*, (Bottom et al. 2005) and the *FCRPS Biological Opinion Remand* (Bonneville Power Administration, U.S. Bureau of Reclamation, and U.S. Army Corps of Engineers 2004). Table 5-1 lists threats to salmonids in the estuary and plume and management actions that would address those threats.

Several of the management actions in Table 5-1 are associated with more than one threat (italics indicate an action's second occurrence in the table). This illustrates the complex interplay of ecological processes in the estuary, particularly those related to flow, sediment, the food web, and water quality, all of which influence salmon survival. Again, given the complexity of the riverine, estuarine, and marine ecosystems that salmon use during their lives, the actual relationships among threats and management actions are more complicated than Table 5-1 suggests.

TABLE 5-1
Management Actions to Address Threats

	Threat	Management Action
Flow-related threats	Climate cycles and global warming[2]	**CRE[1]-1:** Protect intact riparian areas in the estuary and its tributaries and restore riparian areas that are degraded.[2]
		CRE-2: Modify hydrosystem operations to reduce the effects of reservoir surface heating, or conduct mitigation measures. [2]
		CRE-3: Establish legal instream flows for the estuary that would help prevent further degradation of the ecosystem. [2]
	Water withdrawal	***CRE-3:*** *Establish legal instream flows for the estuary that would help prevent further degradation of the ecosystem.*
	Flow regulation	**CRE-4**: Adjust the timing, magnitude and frequency of flows (especially spring freshets) entering the estuary and plume to provide better transport of sediments and access to habitats in the estuary, plume, and littoral cell.
Sediment-related threats	Entrapment of sediment in reservoirs	**CRE-5:** Study and mitigate the effects of entrapment of sediment in reservoirs, to improve nourishment of the littoral cell.
	Impaired sediment transport	**CRE-6:** Reduce the export of sand and gravels via dredge operations by using dredged materials beneficially.
		CRE-4: *Adjust the timing, magnitude and frequency of flows (especially spring freshets) entering the estuary and plume to provide better transport of sediments and access to habitats in the estuary, plume, and littoral cell.*
	Dredging	**CRE-7:** Reduce entrainment and habitat effects resulting from main- and side-channel dredge activities in the estuary.
Structural threats	Pile dikes and navigational structures	**CRE-8:** Remove pile dikes that have low navigational value but high impact on estuary circulation and/or juvenile predation effects.
	Dikes and filling	**CRE-9:** Protect remaining high-quality off-channel habitat from degradation through education, regulation, and fee simple and less-than-fee acquisition.

		CRE-10: Breach or lower dikes and levees to improve access to off-channel habitats.
	Reservoir heating	***CRE-2:*** *Modify hydrosystem operations to reduce the effects of reservoir surface heating, or conduct mitigation measures.*
	Over-water structures	**CRE-11:** Reduce the square footage of over-water structures in the estuary.
Food web-related threats	Reservoir phytoplankton production	***CRE-10:*** *Breach or lower dikes and levees to improve access to off-channel habitats.*
	Altered predator/prey relationships	**CRE-13:** Manage pikeminnow, smallmouth bass, walleye, and channel catfish to prevent increases in abundance.
		CRE-14: Identify and implement actions to reduce salmonid predation by pinnipeds.
		CRE-15: Implement education and monitoring projects and enforce existing laws to reduce the introduction and spread of noxious weeds.
		CRE-16: Implement projects to redistribute part of the Caspian tern colony currently nesting on East Sand Island.
		CRE-17: Implement projects to reduce double-crested cormorant habitats and encourage dispersal to other locations.
		CRE-18: Reduce the abundance of shad entering the estuary.
	Ship ballast practices	**CRE-19:** Prevent new invertebrate introductions and reduce the effects of existing infestations.
Water quality-related threats	Agricultural practices	**CRE-20:** Implement pesticide and fertilizer best management practices to reduce estuary and upstream sources of toxic contaminants entering the estuary.
	Urban and industrial practices	**CRE-21:** Identify and reduce industrial, commercial, and public sources of pollutants.
		CRE-22: Monitor the estuary for contaminants and/or restore contaminated sites.
		CRE-23: Implement stormwater best management practices in cities and towns.
		CRE-1: *Protect intact riparian areas in the estuary and its tributaries and restore riparian areas that are degraded.*
Other threats	Riparian practices	***CRE-1:*** *Protect intact riparian areas in the estuary and its tributaries and restore riparian areas that are degraded.*
	Ship wakes	**CRE-12:** Reduce the effects of vessel wake stranding in the estuary.

[1] CRE = Columbia River estuary.

[2] It is unclear what the regional effects of climate cycles and global warming will be during the coming decades. In the absence of unambiguous data on the future effects of climate cycles and global warming in the Pacific Northwest, this recovery plan module takes a conservative approach of assuming reduced snowpacks, groundwater recharge, and stream flows, with associated rises in stream temperature and demand for water supplies. The climate-related management actions in Table 5-1 reflect this assumption. Although the management actions clearly would not change the threat itself, they have the potential to lessen its impact on salmonids in the estuary. Even if climate cycles and global warming have effects different from those assumed in this document, the management actions that Table 5-1 associates with climate would provide benefits to salmonids by addressing other threats, such as water withdrawal, urban and industrial practices, and reservoir heating. All three of the management actions associated with climate in Table 5-1 are associated with other threats listed in Table 5-1.

Other Recommended Management Actions

In many ways, conditions in the estuary are the sum of conditions throughout the Columbia River basin. Although some threats to salmonids in the estuary originate exclusively in the estuary itself (Caspian tern predation is one example), others are the result of activities in estuary tributaries or in upstream areas; examples of such threats are timber riparian practices and upstream water withdrawals that reduce stream flow in the estuary. Still other threats, such as urban and industrial practices that contribute contaminants to the river, originate in all three areas—estuary, estuary tributaries, and upstream. Because of the geographic scope of these threats, fully addressing them will require effort not just in the estuary but throughout the basin.

When it comes to management actions, though, the geographic scope of this estuary recovery plan module is limited. For the most part the module focuses on management actions that can be implemented within the estuary itself and that will address threats that either originate exclusively within the estuary itself or have a significant in-estuary component. The assumption is that threats originating from outside the estuary are affecting local conditions in tributary and upstream areas and that actions to address these threats will be included in recovery plans being developed for upstream salmonid populations.

Even so, the analysis in Chapters 3 and 4 of this recovery plan module and a review of contemporary literature yielded four management actions that would directly affect threats to salmonids in the estuary yet would need to be implemented almost exclusively outside of the estuary:

- Upgrade up-river irrigation structures using water conservation best management practices (BMPs) to reduce evaporation and conveyance losses and improve estuary instream flows.
- Implement water conservation best management practices for public and private water purveyors.
- Incorporate water availability analysis in land use planning activities to ensure efficient use of water.
- Protect and restore timberland riparian areas for shade and future wood sources.

Because these four actions are outside the geographic scope of the estuary recovery plan module, they are not analyzed in this chapter. Nevertheless, implementation of these four out-of-estuary actions is important to improving the survival of salmonids in the estuary, so it is recommended that the actions be included in recovery plans being developed for upstream areas of the Columbia River basin.

The recommendation of out-of-estuary actions to improve survival in the estuary is another reflection of the interconnectedness of the various ecosystems salmonids use during their life cycles, the power of the river as a connector, and how the effects of problematic upstream activities are manifested—and sometimes magnified—in the estuary.

Evaluation of Management Actions: Constraints to Implementation

Constraints to implementation is a key factor in evaluating management actions and their likely impacts on salmonids. No management action can benefit salmonids if it cannot be implemented, and in many cases the degree of benefit corresponds to the degree of implementation. For this reason, the 23 management actions identified above are evaluated in terms of the constraints to their implementation, which yields information about the actions' likely outcomes and starts to provide a basis for comparing the probable effectiveness of different actions.

For each management action, Table 5-2 summarizes the primary threat and limiting factors that the action addresses and expresses the significance of those threats and limiting factors in terms of a threat index. (The threat index indicates whether the threat is a major contributor to a significant limiting factor or a minor contributor to a minor limiting factor. The index is useful in distinguishing those actions that, even if they were successful, would affect a relatively small number of fish from those actions that, even if they were only partially implemented or partially successful, would have more profound benefits because they would affect a larger number of fish.) Table 5-2 also provides a score for the potential benefit to salmonids in the estuary if the action were fully implemented and a brief rationale for the score.

Assigning a score for potential benefit with full implementation is just the first step in evaluating management actions. In fact, decisions about management actions will be made within a complex social and political context that includes a wide variety of interests, and it is likely that many of the actions will not be able to be implemented fully because of various technical, financial, political, or social obstacles. To address this issue Table 5-2 assigns an implementation constraints score to each management action and briefly explains how various factors could keep the action from being implemented fully.

The table concludes with a score for potential benefit of each action assuming that implementation of the action is constrained. This score is an attempt to identify more realistically what the results of an action would be given the social, political, and financial climate in which management actions will be decided on. Also, the difference in Table 5-2 between potential benefit with full implementation of an action and potential benefit with constrained implementation is helpful in identifying where it might be worthwhile to expend effort to reduce constraints because the benefits under full implementation would be great. This topic is discussed more fully in Chapter 7.

Some measure of caution should be exercised when viewing the results of this evaluation. In particular, scientific literature generally falls short of prescribing discrete actions to address threats, and the literature is even less robust when it comes to evaluating constraints to the implementation of actions.

TABLE 5-2
Constraints to Implementation of Management Actions

Management Action CRE-1: Protect intact riparian areas in the estuary and its tributaries and restore riparian areas that are degraded.	
Primary threat this action would address	**Riparian Practices.** Riparian areas provide key ecological functions that affect water temperature, the availability of insects, and macrodetrital inputs to the ecosystem. Riparian areas in the

		lower Columbia River have been degraded by a number of factors, including shoreline modifications, diking and dike maintenance practices, and activities related to the disposal of dredged material.
Associated limiting factors		Water temperature, reduced macrodetrital inputs, and exotic plants.
Threat index[1]	15	This threat is a primary contributor to two top-priority limiting factors (water temperature and reduced macrodetrital inputs) and a tertiary contributor to one additional limiting factor.
Potential benefits with full implementation of action [2]	4	Protecting intact riparian areas and restoring degraded riparian areas in priority reaches would provide significant benefits to salmonids by reducing water temperatures and increasing macrodetrital inputs to the system.
Affected salmonids		Ocean-type salmonids; stream-type salmonids displaying less dominant life history strategies (e.g., early and late fingerlings and subyearlings).
Implementation constraints[3]	2	Levels of protection vary across the lower Columbia region. In some cases, cities and counties are protected through regulatory mechanisms such as growth management or shoreline rules. Regulatory tools such as buffer zones along streams can be effective but require broad public support over time. Restoration projects are expensive and can take decades to provide their full benefit to tributaries directly entering the estuary.
Potential benefits with constrained implementation of action	3	

[1] *From Table 4-1. Indicates the significance of the associated limiting factor and the threat's contribution to that limiting factor. High numbers indicate threats that have a major contribution to high-priority limiting factors; lower numbers indicate threats that have a minor contribution to low-priority limiting factors. Numbers indicate the highest score per threat category and do not account for multiple limiting factor contributions.*

[2] *Estimate of the expected benefits to salmonids (ocean- and stream-types combined) if the action were fully implemented.*
1 = very low benefits.
5 = very high benefits.

[3] *Indicates the feasibility of implementing the action.*
1 = significant potential for implementation.
5 = significant constraints to implementation.

Management Action CRE-2: Modify hydrosystem operations to reduce the effects of reservoir surface heating, or conduct mitigation measures.		
Primary threat this action would address		**Reservoir heating.** Low-velocity flows and broad surface area exposure in reservoirs increase the temperature of flows in the estuary. Salmonids are cool-water fish that need stream temperatures of 20º C or lower for normal metabolism, growth, disease resistance, and timing of important life functions such as smoltification and adult migration. Salmonids in the estuary are experiencing water temperatures at the upper limit of their tolerance for longer periods and more frequently than they did historically.
Associated limiting factors		Water temperature.
Threat index[1]	15	This threat is a primary contributor to a top-priority limiting factor.
Potential benefits with full implementation of action [2]	4	Given that at many times during the year water temperatures in the estuary are at or above the upper limits of salmonids' thermal tolerance, any lowering of water temperature could provide significant survival benefits. Water temperatures of below 20º C throughout the year would aid salmonids in carrying out essential physiological processes and life functions.
Affected salmonids		Ocean-type salmonids; stream-type salmonids displaying less dominant life history strategies (e.g., early and late fingerlings and subyearlings).
Implementation constraints[3]	5	Elevated temperatures that result from reservoir heating are difficult to reduce. Temperatures may be influenced by the volume and speed of flows through the hydrosystem and the source of those flows (some impoundments have cooler water than others do). International treaties, conflicting fish management objectives systemwide, the need for flood control, power management, and other factors constrain management of the hydrosystem to allow cooler flows to enter the estuary.
Potential benefits with constrained implementation of action	2	

[1] From Table 4-1. Indicates the significance of the associated limiting factor and the threat's contribution to that limiting factor. High numbers indicate threats that have a major contribution to high-priority limiting factors; lower numbers indicate threats that have a minor contribution to low-priority limiting factors. Numbers indicate the highest score per threat category and do not account for multiple limiting factor contributions.

[2] Estimate of the expected benefits to salmonids (ocean- and stream-types combined) if the action were fully implemented.
1 = very low benefits.
5 = very high benefits.

[3] Indicates the feasibility of implementing the action.
1 = significant potential for implementation.
5 = significant constraints to implementation.

Management Action CRE-3: Establish legal instream flows for the estuary that would help prevent further degradation of the ecosystem.		
Primary threat this action would address		**Water withdrawal.** Instream flows in the estuary are important for salmonids because they maintain habitat-forming processes and conditions in the estuary and plume. Although some instream flows have been established in the Columbia River basin tributaries, others are needed, especially with the growing human population in the basin.
Associated limiting factors		Flow-related estuary habitat changes, flow-related changes in access to off-channel habitat, flow-related plume changes, and reduced macrodetrital inputs.
Threat index[1]	10	This threat is a secondary contributor to four top-priority limiting factors.
Potential benefits with full implementation of action [2]	2	Instream flow laws legally protect tributary and mainstem flows. These water rights have legal standing and are senior to predecessor water rights. Establishing legal instream flows for the estuary would protect minimum flow levels in the estuary and plume and support associated habitat-forming processes.
Affected salmonids		Ocean-type salmonids; stream-type salmonids displaying less dominant life history strategies (e.g., early and late fingerlings and subyearlings); stream-type salmonids in the plume.
Implementation constraints[3]	3	The process of setting instream flows is challenging, often takes years, and is not always successful. Implementation of this action would require the involvement of multiple stakeholders, including irrigation, hydrosystem operation, commercial, industrial, tribal, federal, state, and local interests, plus a significant amount of public involvement.
Potential benefits with constrained implementation of action	1	

[1] From Table 4-1. Indicates the significance of the associated limiting factor and the threat's contribution to that limiting factor. High numbers indicate threats that have a major contribution to high-priority limiting factors; lower numbers indicate threats that have a minor contribution to low-priority limiting factors. Numbers indicate the highest score per threat category and do not account for multiple limiting factor contributions.

[2] Estimate of the expected benefits to salmonids (ocean- and stream-types combined) if the action were fully implemented.
1 = very low benefits.
5 = very high benefits.

[3] Indicates the feasibility of implementing the action.
1 = significant potential for implementation.
5 = significant constraints to implementation.

Management Action CRE-4: Adjust the timing, magnitude and frequency of flows (especially spring freshets) entering the estuary and plume to improve access to habitats and provide better transport of sediments in the estuary, plume, and littoral cell.		
Primary threats this action would address		**Flow regulation and impaired sediment transport.** The magnitude, frequency, and timing of flows are an important determinant of habitat opportunity for salmonids in the estuary. Salmonids have adapted to historical flows and depend on them to complete their life cycles. The transport of sand and gravel from upstream and estuary sources helps maintain salmonid habitats, contributes to turbidity that shelters salmonids from predation, and influences food sources in the plume. Spring freshets are important habitat-shaping events for the estuary, plume, and littoral cell.
Associated limiting factors		Flow-related estuary habitat changes, flow-related changes in access to off-channel habitat, flow-related plume changes, reduced macrodetrital inputs in the estuary, and sediment/nutrient-related estuary habitat changes.
Threat index[1]	15	This threat is a primary contributor to several top-priority limiting factors.
Potential benefits with full implementation of action [2]	5	Return to a more natural hydrograph would have significant ecosystem benefits and would affect all facets of salmonid life histories expressed in the estuary and plume. Adjustments to the timing, magnitude, and frequency of flows entering the estuary would be likely to have synergistic effects that would increase the benefit of many of the other actions.
Affected salmonids		Ocean-type salmonids; stream-type salmonids displaying less dominant life history strategies; stream-type juveniles rearing in the plume.
Implementation constraints[3]	5	Constraints on hydrosystem operations prevent the return to a natural hydrograph in the estuary. Implementation of this action would be limited by international treaties, the need for flood control, fish management objectives systemwide, and power management.
Potential benefits with constrained implementation of action	3	

[1] From Table 4-1. Indicates the significance of the associated limiting factor and the threat's contribution to that limiting factor. High numbers indicate threats that have a major contribution to high-priority limiting factors; lower numbers indicate threats that have a minor contribution to low-priority limiting factors. Numbers indicate the highest score per threat category and do not account for multiple limiting factor contributions.

[2] Estimate of the expected benefits to salmonids (ocean- and stream-types combined) if the action were fully implemented.
1 = very low benefits.
5 = very high benefits.

[3] Indicates the feasibility of implementing the action.
1 = significant potential for implementation.
5 = significant constraints to implementation.

Management Action CRE-5: Study and mitigate the effects of entrapment of sediment in reservoirs, to improve nourishment of the littoral cell.		
Primary threat this action would address		**Entrapment of sediment in reservoirs.** Fine sediment, sand, and gravel are deposited behind slow-velocity impoundments in the Columbia River, and their transport into the estuary, plume, and littoral cell has been reduced. This alters habitat-forming processes and reduces turbidity that otherwise would shelter salmonids from predation.
Associated limiting factors		Flow-related plume changes and sediment/nutrient-related estuary habitat changes.
Threat index[1]	12	This threat is a contributor to both top-priority and high-priority limiting factors.
Potential benefits with full implementation of action [2]	3	Sediment transport processes are important determinants of estuary, plume, and littoral habitats. Effective mitigation of this threat would provide shallow-water habitats, reduce predation of salmonids in the main channel and plume, and strengthen habitat-forming processes.
Affected salmonids		Ocean- and stream-type salmonids.
Implementation constraints[3]	5	There are no apparent technical solutions to this threat. Mitigation is recommended, but research is needed to identify the magnitude of the threat and potential solutions or mitigation measures.
Potential benefits with constrained implementation of action	2	

[1] From Table 4-1. Indicates the significance of the associated limiting factor and the threat's contribution to that limiting factor. High numbers indicate threats that have a major contribution to high-priority limiting factors; lower numbers indicate threats that have a minor contribution to low-priority limiting factors. Numbers indicate the highest score per threat category and do not account for multiple limiting factor contributions.

[2] Estimate of the expected benefits to salmonids (ocean- and stream-types combined) if the action were fully implemented.
1 = very low benefits.
5 = very high benefits.

[3] Indicates the feasibility of implementing the action.
1 = significant potential for implementation.
5 = significant constraints to implementation.

Management Action CRE-6: Reduce the export of sand and gravels via dredge operations by using dredged materials beneficially.		
Primary threat this action would address		**Impaired sediment transport.** The transport of sand and gravel from upstream and estuary sources helps maintain salmonid habitats, contributes to turbidity that shelters salmonids from predation, and influences food sources in the plume. While there are many potential beneficial uses of dredged materials—including enhanced nourishment of the littoral cell, land creation, property stabilization, and out-of-stream uses—there is also potential for using sand for habitat creation within the estuary.
Associated limiting factors		Sediment/nutrient-related estuary habitat changes and flow-related plume changes.
Threat index[1]	12	Although impaired sediment transport is a primary contributor to a top-priority limiting factor (flow-related plume changes), this management action is likely to have its greatest effect in addressing sediment/nutrient-related estuary habitat changes, a high-priority limiting factor; thus it has a threat index of 12.
Potential benefits with full implementation of action [2]	4	The beneficial use of sand resulting from dredge activities could play an important role in restoring habitat capacity and habitat opportunity in the estuary, plume, and littoral cell. The beneficial use of dredged materials to provide sand nourishment could reduce the effects of ship wake stranding, improve habitat for *Corphium* (a food source for salmonids), and be beneficial in the development of emergent marshes and other salmonid habitat features. Sand entering the plume could also have important ecological benefits.
Affected salmonids		Ocean-type salmonids; stream-type salmonids displaying less dominant life history strategies (e.g., early and late fingerlings and subyearlings). This particularly applies to ocean-type juveniles because of their significant use of the nearshore environment.
Implementation constraints[3]	2	Beneficial uses of dredged materials, such as through littoral cell sand nourishment and direct beach nourishment, are currently receiving significant attention, The most obvious constraint to implementation is identifying funding sources to pay for activities beyond the minimum required by law.
Potential benefits with constrained implementation of action	3	

[1] From Table 4-1. Indicates the significance of the associated limiting factor and the threat's contribution to that limiting factor. High numbers indicate threats that have a major contribution to high-priority limiting factors; lower numbers indicate threats that have a minor contribution to low-priority limiting factors. Numbers indicate the highest score per threat category and do not account for multiple limiting factor contributions.

[2] Estimate of the expected benefits to salmonids (ocean- and stream-types combined) if the action were fully implemented.
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5 = very high benefits.

[3] Indicates the feasibility of implementing the action.
1 = significant potential for implementation.
5 = significant constraints to implementation.

Management Action CRE-7:		
Reduce entrainment and habitat effects resulting from main- and side-channel dredge activities in the estuary.		
Primary threat this action would address		**Dredging**. Annual dredge operations maintain a navigational channel that concentrates flows, alters tidal influences, reduces circulation patterns around the estuary, and releases toxic contaminants from substrates. Dredging activities can result in deposited contaminants being disturbed and redistributed throughout the estuary and littoral cell.
Associated limiting factors		Sediment/nutrient-related estuary habitat changes, native birds, and sediment/nutrient-related plume changes.
Threat index[1]	4	As it relates to this action, dredging is a tertiary contributor to a high-priority limiting factor (sediment/nutrient-related estuary habitat changes) and thus has a threat index of 4.
Potential benefits with full implementation of action [2]	2	Continued dredge operations represent a physical change to the Columbia River estuary. However, reducing or mitigating the effects of dredging would improve habitat-forming processes that would benefit salmonids.
Affected salmonids		Ocean-type salmonids; stream-type salmonids displaying less dominant life history strategies (e.g., early and late fingerlings and subyearlings).
Implementation constraints[3]	2	Dredging activities have been occurring since the 1870s to provide sufficient draft for ships entering the Columbia River and will continue into the foreseeable future. Ongoing maintenance is needed to keep the channel to specifications for ships, and additional dredging will be conducted in the estuary as part of the channel deepening process. Maintaining the navigation channel requires dredging and disposal of large volumes of material (4 to 5 million cubic yards) each year. Changing dredging equipment and practices to reduce entrainment and habitat effects would be expensive.
Potential benefits with constrained implementation of action	1	

[1] From Table 4-1. Indicates the significance of the associated limiting factor and the threat's contribution to that limiting factor. High numbers indicate threats that have a major contribution to high-priority limiting factors; lower numbers indicate threats that have a minor contribution to low-priority limiting factors. Numbers indicate the highest score per threat category and do not account for multiple limiting factor contributions.

[2] Estimate of the expected benefits to salmonids (ocean- and stream-types combined) if the action were fully implemented.
1 = very low benefits.
5 = very high benefits.

[3] Indicates the feasibility of implementing the action.
1 = significant potential for implementation.
5 = significant constraints to implementation.

Management Action CRE-8: Remove pile dikes that have low navigational value but high impact on estuary circulation or juvenile predation effects.		
Primary threat this action would address		**Pile dikes and navigational structures**. Extensive use of pile dikes and navigational structures has altered sediment accretion and erosion processes and reduced flow circulation through shallow-water habitats in the estuary. Pile dikes and other structures also have created favorable conditions for predators of salmonids.
Associated limiting factors		Sediment/nutrient-related estuary habitat changes, sediment/nutrient-related plume changes, and exotic fish.
Threat index[1]	8	This threat is a secondary contributor to a high-priority limiting factor (sediment/nutrient-related estuary habitat changes) and two low-priority limiting factors.
Potential benefits with full implementation of action [2]	3	Removing many instream structures would improve circulation in shallow-water habitats and eliminate some salmonid predator habitats.
Affected salmonids		Ocean-type salmonid; stream-type salmonids displaying less dominant life history strategies (e.g., early and late fingerlings and subyearlings).
Implementation constraints[3]	2	Only some of the thousands of pile dikes and navigational structures in the Columbia River estuary are necessary to maintain the shipping channel or protect property. Removal of superfluous structures generally is restricted only by cost and would be unlikely to affect property rights or the shipping industry. In cases where pile dikes that do aide in navigation are removed, constraints to implementation would include the cost for additional dredging to maintain the channel.
Potential benefits with constrained implementation of action	2	

[1] From Table 4-1. Indicates the significance of the associated limiting factor and the threat's contribution to that limiting factor. High numbers indicate threats that have a major contribution to high-priority limiting factors; lower numbers indicate threats that have a minor contribution to low-priority limiting factors. Numbers indicate the highest score per threat category and do not account for multiple limiting factor contributions.

[2] Estimate of the expected benefits to salmonids (ocean- and stream-types combined) if the action were fully implemented.
1 = very low benefits.
5 = very high benefits.

[3] Indicates the feasibility of implementing the action.
1 = significant potential for implementation.
5 = significant constraints to implementation.

***Management Action CRE-9*:** Protect remaining high-quality off-channel habitat from degradation through education, regulation, and fee simple and less-than-fee acquisition.		
Primary threat this action would address		**Dikes and filling.** High-quality off-channel habitat provides crucial feeding, rearing, and refuge opportunities for juvenile salmonids and supplies macrodetrital inputs to the estuarine food web. Reduced floodplain inundation has limited juvenile salmonids' access to historical wetland and swamp habitat, much of which has been converted to other land uses. Protecting remaining intact and accessible off-channel habitats is critical to maintaining key habitats and food sources for juvenile salmonids.
Associated limiting factors		Reduced macrodetrital inputs, sediment/nutrient-related estuary habitat changes, bankfull elevation changes, sediment/nutrient-related plume changes, and exotic plants.
***Threat index*[1]**	15	This threat is a primary contributor to both top-priority and high-priority limiting factors.
***Potential benefits with full implementation of action* [2]**	5	Protection of high-quality off-channel areas would help maintain important wetland habitats and supply macrodetrital inputs to the food web and insect food sources for juvenile salmonids—a main component of their diet.
Affected salmonids		Ocean-type salmonids; stream-type salmonids displaying less dominant life history strategies (e.g., early and late fingerlings and subyearlings).
***Implementation constraints*[3]**	2	Regulatory programs often do not effectively protect floodplains from conversion to other uses. The acquisition of land for habitat protection remains controversial in the estuary. Rural 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. The fact that many habitats already have been converted to other land uses limits opportunities to protect high-quality off-channel habitat.
Potential benefits with constrained implementation of action	3	

[1] *From Table 4-1. Indicates the significance of the associated limiting factor and the threat's contribution to that limiting factor. High numbers indicate threats that have a major contribution to high-priority limiting factors; lower numbers indicate threats that have a minor contribution to low-priority limiting factors. Numbers indicate the highest score per threat category and do not account for multiple limiting factor contributions.*

[2] *Estimate of the expected benefits to salmonids (ocean- and stream-types combined) if the action were fully implemented.*
1 = very low benefits.
5 = very high benefits.

[3] *Indicates the feasibility of implementing the action.*
1 = significant potential for implementation.
5 = significant constraints to implementation.

Management Action CRE-10: Breach or lower dikes and levees to improve access to off-channel habitats.		
Primary threat this action would address		**Dikes and filling.** Many juvenile salmonids rely on off-channel habitats for feeding and refuge opportunities. Historically, insects and macrodetritus from these habitats were important inputs to the estuarine food web. Dikes, levees, tide gates, and filling have limited the amount and accessibility of key off-channel habitats by reducing floodplain inundation and allowing conversion of land to agricultural, residential, and industrial uses.
Associated limiting factors		Reduced macrodetrital inputs, sediment/nutrient-related estuary habitat changes, bankfull elevation changes, sediment/nutrient-related plume changes, and exotic plants.
Threat index[1]	15	This threat is a primary contributor to both top-priority and high-priority limiting factors.
Potential benefits with full implementation of action [2]	5	Restoring off-channel areas would reclaim habitat that is important to salmonids. In most cases, project benefits would accrue over relatively long periods of time.
Affected salmonids		Ocean-type salmonids; stream-type salmonids displaying less dominant life history strategies (e.g., early and late fingerlings and subyearlings).
Implementation constraints[3]	4	Opportunities to restore off-channel habitats are limited because many such habitats already have been filled with dredge materials. Breaching or lowering dikes and levees or removing tide gates often requires the cooperation of multiple landowners and may fundamentally alter land uses. The associated habitat restoration is expensive.
Potential benefits with constrained implementation of action	2	

[1] From Table 4-1. Indicates the significance of the associated limiting factor and the threat's contribution to that limiting factor. High numbers indicate threats that have a major contribution to high-priority limiting factors; lower numbers indicate threats that have a minor contribution to low-priority limiting factors. Numbers indicate the highest score per threat category and do not account for multiple limiting factor contributions.

[2] Estimate of the expected benefits to salmonids (ocean- and stream-types combined) if the action were fully implemented.
1 = very low benefits.
5 = very high benefits.

[3] Indicates the feasibility of implementing the action.
1 = significant potential for implementation.
5 = significant constraints to implementation.

Management Action CRE-11: Reduce the square footage of over-water structures in the estuary.		
Primary threat this action would address		**Over-water structures.** Over-water structures may provide habitats for predators and affect instream and shoreline plant communities. However, the total surface area of over-water structures in the estuary has not been quantified and the structures' case-by-case functions have not been analyzed.
Associated limiting factors		Sediment/nutrient-related estuary habitat changes and exotic fish.
Threat index[1]	4	This threat is a tertiary contributor to a high-priority limiting factor (habitat changes) and a secondary contributor to one of the lowest priority limiting factors (exotic fish).
Potential benefits with full implementation of action [2]	3	Given the uncertainty about how much of a threat over-water structures actually pose to salmonids, the potential improvement in survival must be considered low pending additional research and analysis.
Affected salmonids		Ocean-type salmonids (because of their preference for the shallow-water habitats where most structures are located); stream-type salmonids displaying less dominant life history strategies (e.g., early and late fingerlings and subyearlings).
Implementation constraints[3]	3	It is assumed that some over-water structures are more important than others and that removing superfluous or less useful structures would not have deleterious effects on adjacent land uses. Removal of over-water structures that are in currently use would likely require compensation. In some cases, structures such as log rafts could be relocated.
Potential benefits with constrained implementation of action	1	

[1] *From Table 4-1. Indicates the significance of the associated limiting factor and the threat's contribution to that limiting factor. High numbers indicate threats that have a major contribution to high-priority limiting factors; lower numbers indicate threats that have a minor contribution to low-priority limiting factors. Numbers indicate the highest score per threat category and do not account for multiple limiting factor contributions.*

[2] *Estimate of the expected benefits to salmonids (ocean- and stream-types combined) if the action were fully implemented.*
1 = very low benefits.
5 = very high benefits.

[3] *Indicates the feasibility of implementing the action.*
1 = significant potential for implementation.
5 = significant constraints to implementation.

Management Action CRE-12: Reduce the effects of vessel wake stranding in the estuary.		
Primary threat this action would address		**Ship wakes.** Wakes from deep-draft vessels traveling through the estuary wash subyearling salmonids onto shore, leaving them stranded. Factors that affect stranding include beach slope and time of day as well as vessel draft, speed, and hull design.
Associated limiting factors		Stranding.
Threat index[1]	6	This threat is a primary contributor to a low-priority limiting factor.
Potential benefits with full implementation of action [2]	3	The extent of mortality caused by ship wake stranding is unknown. Studies in 1977 and 1994 (Bauersfeld 1977, Hinton and Emmett 1994) reached different conclusions, using different approaches. A soon-to-be-released study by the University of Washington and U.S. Army Corps of Engineers may provide further clarification of the issue.
Affected salmonids		Ocean-type salmonids (because of their longer estuarine residency times, their relatively small size, and the habitats they prefer); stream-type salmonids displaying less dominant life history strategies (e.g., early and late fingerlings and subyearlings).
Implementation constraints[3]	4	Options for reducing the effects of vessel wake stranding are limited. Ship traffic through the estuary will continue, ship hull design is unlikely to change, and the speed of ships traveling the estuary may be difficult to alter. Modification of some habitats may be necessary to reduce this threat and would likely be expensive.
Potential benefits with constrained implementation of action	1	

[1] From Table 4-1. Indicates the significance of the associated limiting factor and the threat's contribution to that limiting factor. High numbers indicate threats that have a major contribution to high-priority limiting factors; lower numbers indicate threats that have a minor contribution to low-priority limiting factors. Numbers indicate the highest score per threat category and do not account for multiple limiting factor contributions.

[2] Estimate of the expected benefits to salmonids (ocean- and stream-types combined) if the action were fully implemented.
1 = very low benefits.
5 = very high benefits.

[3] Indicates the feasibility of implementing the action.
1 = significant potential for implementation.
5 = significant constraints to implementation.

Management Action CRE-13: Manage pikeminnow, smallmouth bass, walleye, and channel catfish to prevent increases in abundance.		
Primary threat this action would address		**Altered predator/prey relationships.** Introductions of smallmouth bass, walleye, and channel catfish in the freshwater reaches of the estuary have increased predation on juvenile salmonids, as have in-water structures that offer predation opportunities for pikeminnow.
Associated limiting factors		Native fish and exotic fish..
Threat index[1]	6	This threat contributes to many limiting factors, although the management action addresses only the native and exotic fish limiting factors, which have a threat index of 6 and 2, respectively.
Potential benefits with full implementation of action [2]	2	Ecosystem alterations in the estuary as a result of pikeminnow, smallmouth bass, walleye, and channel catfish are uncertain. Scientists speculate that pikeminnow may be preying on both ocean- and stream-type juveniles. Maintaining warm-water species at or below current levels would have minor benefits to salmonids by reducing predation and competition.
Affected salmonids		Ocean-type salmonids; stream-type salmonids displaying less dominant life history strategies (e.g., early and late fingerlings and subyearlings).
Implementation constraints[3]	2	Although the introduction of exotic fish to the estuary may be irreversible, there are viable tools for managing pikeminnow, smallmouth bass, walleye, and channel catfish; these include habitat management and less restricted harvest management. It is likely that warm-water fishers would actively support maintaining the abundance of these species at current—rather than reduced—levels.
Potential benefits with constrained implementation of action	2	

[1] From Table 4-1. Indicates the significance of the associated limiting factor and the threat's contribution to that limiting factor. High numbers indicate threats that have a major contribution to high-priority limiting factors; lower numbers indicate threats that have a minor contribution to low-priority limiting factors. Numbers indicate the highest score per threat category and do not account for multiple limiting factor contributions.

[2] Estimate of the expected benefits to salmonids (ocean- and stream-types combined) if the action were fully implemented.
1 = very low benefits.
5 = very high benefits.

[3] Indicates the feasibility of implementing the action.
1 = significant potential for implementation.
5 = significant constraints to implementation.

Management Action CRE-14: Identify and implement actions to reduce salmonid predation by pinnipeds.		
Primary threat this action would address		**Altered predator/prey relationships.** Pinniped predation on salmonids at Bonneville Dam has been estimated at from 0.5 percent to 3.4 percent of the spring chinook and winter steelhead runs. Estuarywide estimates are unsubstantiated, but it is likely that losses exceed 10 percent of the runs each spring. The extent of predation needs further study and documentation.
Associated limiting factors		Native pinnipeds.
Threat index[1]	12	This threat contributes to many limiting factors, although the management action relates only to native pinnipeds.
Potential benefits with full implementation of action [2]	3	Actions to reduce predation by pinnipeds would be likely to have only minor impacts on salmonid survival, depending on how many adults are actually being eaten by pinnipeds—a question that remains controversial.
Affected salmonids		Ocean- and stream-type salmonids.
Implementation constraints[3]	4	Methods for reducing salmonid predation by pinnipeds are limited because pinnipeds are protected under the Marine Mammal Protection Act. It could take years to amend the act to allow additional pinniped management tools. Non-lethal methods have been only minimally successful, although it is possible that additional testing would identify effective non-lethal methods.
Potential benefits with constrained implementation of action	2	

[1] From Table 4-1. Indicates the significance of the associated limiting factor and the threat's contribution to that limiting factor. High numbers indicate threats that have a major contribution to high-priority limiting factors; lower numbers indicate threats that have a minor contribution to low-priority limiting factors. Numbers indicate the highest score per threat category and do not account for multiple limiting factor contributions.

[2] Estimate of the expected benefits to salmonids (ocean- and stream-types combined) if the action were fully implemented.
1 = very low benefits.
5 = very high benefits.

[3] Indicates the feasibility of implementing the action.
1 = significant potential for implementation.
5 = significant constraints to implementation.

Management Action CRE-15:		
Implement education and monitoring projects and enforce existing laws to reduce the introduction and spread of noxious weeds.		
Primary threat this action would address		**Altered predator/prey relationships.** Exotic plants in the estuary often out-compete native plants and change the structure of plant communities. The resulting habitat frequently does not provide the same food or shelter that other species, including salmonids, have adapted to over time.
Associated limiting factors		Exotic plants.
Threat index[1]	3	This threat contributes to many limiting factors, although the management action relates only to exotic plants, one of the lowest priority limiting factors.
Potential benefits with full implementation of action [2]	2	Preventing and controlling noxious weeds would help maintain the estuarine food web and habitats that juvenile salmonids rely on.
Affected salmonids		Ocean-type salmonids; stream-type salmonids displaying less dominant life history strategies (e.g., early and late fingerlings and subyearlings).
Implementation constraints[3]	3	Controlling existing infestations of certain species is functionally impossible once the species are established. Although landowners are the most important agents in preventing and controlling exotic plant infestations, landowner education is a significant task that requires a large effort.
Potential benefits with constrained implementation of action	1	

[1] From Table 4-1. Indicates the significance of the associated limiting factor and the threat's contribution to that limiting factor. High numbers indicate threats that have a major contribution to high-priority limiting factors; lower numbers indicate threats that have a minor contribution to low-priority limiting factors. Numbers indicate the highest score per threat category and do not account for multiple limiting factor contributions.

[2] Estimate of the expected benefits to salmonids (ocean- and stream-types combined) if the action were fully implemented.
1 = very low benefits.
5 = very high benefits.

[3] Indicates the feasibility of implementing the action.
1 = significant potential for implementation.
5 = significant constraints to implementation.

Management Action CRE-16: Implement projects to redistribute part of the Caspian tern colony currently nesting on East Sand Island.		
Primary threat this action would address		**Altered predator/prey relationships.** Caspian tern predation represents a significant source of mortality for stream-type juveniles migrating to saltwater. Stream-type salmonids are particularly vulnerable because of the timing of their out-migration (during tern nesting season) and their preference for deep-channel habitats near tern nesting sites.
Associated limiting factors		Native birds.
Threat index[1]	12	This threat contributes to many limiting factors, although the management action relates only to Caspian terns.
Potential benefits with full implementation of action [2]	4	Reducing tern predation could have significant effects on the survival of stream-type salmonids, as terns have been documented to consume as much as 3 percent of stream-type juveniles migrating through the estuary.
Affected salmonids		Stream-type salmonids; ocean-type salmonids displaying less dominant life history strategies (e.g., early and late fingerlings and subyearlings).
Implementation constraints[3]	3	Recent management efforts have helped reduce mortality by relocating terns to nearby habitats. Long-term solutions will require habitat improvements elsewhere for Caspian terns.
Potential benefits with constrained implementation of action	3	

[1] From Table 4-1. Indicates the significance of the associated limiting factor and the threat's contribution to that limiting factor. High numbers indicate threats that have a major contribution to high-priority limiting factors; lower numbers indicate threats that have a minor contribution to low-priority limiting factors. Numbers indicate the highest score per threat category and do not account for multiple limiting factor contributions.

[2] Estimate of the expected benefits to salmonids (ocean- and stream-types combined) if the action were fully implemented.
1 = very low benefits.
5 = very high benefits.

[3] Indicates the feasibility of implementing the action.
1 = significant potential for implementation.
5 = significant constraints to implementation.

Management Action CRE-17: Implement projects to reduce double-crested cormorant habitats and encourage dispersal to other locations.		
Primary threat this action would address		**Altered predator/prey relationships.** Predation by double-crested cormorants represents a significant source of mortality for stream-type juveniles migrating to saltwater.
Associated limiting factors		Native birds.
Threat index[1]	12	This threat contributes to many limiting factors, although the management action relates only to double-crested cormorants.
Potential benefits with full implementation of action [2]	4	Recent studies indicate that double-crested cormorants prey on salmonid juveniles in the estuary at a rate equal to or greater than the rate by Caspian terns. In some years cormorants may consume as many as 6 million juveniles.
Affected salmonids		Ocean- and stream-type juvenile salmonids are preyed upon by double-crested cormorants with some fluctuation from year to year. In 2004 double-crested cormorants consumed approximately 4 million subyearling chinook.
Implementation constraints[3]	4	Double-crested cormorants are more difficult to relocate than Caspian terns. Techniques such as the use of decoys and audio playback have not been as effective compared to terns. Perch habitats are plentiful enough in the estuary that removal of pile dikes and other structures may not be an effective tool.
Potential benefits with constrained implementation of action	2	

[1] *From Table 4-1. Indicates the significance of the associated limiting factor and the threat's contribution to that limiting factor. High numbers indicate threats that have a major contribution to high-priority limiting factors; lower numbers indicate threats that have a minor contribution to low-priority limiting factors. Numbers indicate the highest score per threat category and do not account for multiple limiting factor contributions.*

[2] *Estimate of the expected benefits to salmonids (ocean- and stream-types combined) if the action were fully implemented.*
1 = very low benefits.
5 = very high benefits.

[3] *Indicates the feasibility of implementing the action.*
1 = significant potential for implementation.
5 = significant constraints to implementation.

Management Action CRE-18: Reduce the abundance of shad entering the estuary.		
Primary threat this action would address		**Altered predator/prey relationships.** Shad returns to the Columbia River number approximately 4 million annually. Shad's effects on the estuary ecosystem and salmonids are poorly understood. However, shad are an introduced species and their biomass alone represents a threat to trophic relationships in the Columbia River.
Associated limiting factors		Exotic fish.
Threat index[1]	3	This threat contributes to many limiting factors, although the management action relates only to shad.
Potential benefits with full implementation of action [2]	2	The impacts of shad in the estuary are unclear. However, it is likely that reducing shad numbers would have some benefits for salmonids.
Affected salmonids		Ocean-type salmonids; stream-type salmonids displaying less dominant life history strategies (e.g., early and late fingerlings and subyearlings).
Implementation constraints[3]	5	Shad are thought to have permanently altered the estuary ecosystem, and their complete removal from the estuary is neither practical nor feasible. Effective management tools to limit shad productivity in the Columbia River basin currently are not available. Research is needed in the near term to determine the significance of this threat and identify potential management actions to manage the abundance of shad.
Potential benefits with constrained implementation of action	1	

[1] From Table 4-1. Indicates the significance of the associated limiting factor and the threat's contribution to that limiting factor. High numbers indicate threats that have a major contribution to high-priority limiting factors; lower numbers indicate threats that have a minor contribution to low-priority limiting factors. Numbers indicate the highest score per threat category and do not account for multiple limiting factor contributions.

[2] Estimate of the expected benefits to salmonids (ocean- and stream-types combined) if the action were fully implemented.
1 = very low benefits.
5 = very high benefits.

[3] Indicates the feasibility of implementing the action.
1 = significant potential for implementation.
5 = significant constraints to implementation.

Management Action CRE-19: Prevent new introductions of invertebrates and reduce the effects of existing infestations.		
Primary threat this action would address		**Ship ballast practices.** Ship ballast water is responsible for the introduction of exotic invertebrates in the estuary. The effects of these introductions are poorly understood, but it is likely that exotic invertebrates disrupt food webs and out-compete juvenile salmonids' native food sources.
Associated limiting factors		Introduced invertebrates.
Threat index[1]	3	This threat is a primary contributor to one of the lowest priority limiting factors.
Potential benefits with full implementation of action [2]	2	Reducing the impacts of exotic invertebrates would help maintain traditional salmonid food sources and the trophic relationships that salmon have adapted to.
Affected salmonids		Ocean-type salmonids; stream-type salmonids displaying less dominant life history strategies (e.g., early and late fingerlings and subyearlings).
Implementation constraints[3]	5	Improvements in ship ballast practices have already been implemented by the industry as a result of new regulations, and stricter regulations are currently being debated at the federal level. However, there are inherent challenges in managing ballast water that contains organisms from other ecosystems. Also, once exotic invertebrates have been introduced, they represent a permanent alteration of the ecosystem and opportunities to reduce their effects may be few. Current understanding of how the estuary ecosystem is affected by introductions of exotic invertebrates is very limited.
Potential benefits with constrained implementation of action	1	

[1] From Table 4-1. Indicates the significance of the associated limiting factor and the threat's contribution to that limiting factor. High numbers indicate threats that have a major contribution to high-priority limiting factors; lower numbers indicate threats that have a minor contribution to low-priority limiting factors. Numbers indicate the highest score per threat category and do not account for multiple limiting factor contributions.

[2] Estimate of the expected benefits to salmonids (ocean- and stream-types combined) if the action were fully implemented.
1 = very low benefits.
5 = very high benefits.

[3] Indicates the feasibility of implementing the action.
1 = significant potential for implementation.
5 = significant constraints to implementation.

Management Action CRE-20: Implement pesticide and fertilizer best management practices to reduce estuary and upstream sources of toxic contaminants entering the estuary.		
Primary threat this action would address		**Agricultural practices.** Water-soluble contaminants such as simazine, atrazine, chlorpyrifos, metolachlor, diazinon, and carbaryl enter the estuary as a result of tributary and upstream agricultural practices. DDT and PCBs have been detected at elevated levels in the estuary. These and other agricultural contaminants can cause salmonid mortality through bioaccumulation or short-term toxicity.
Associated limiting factors		Short-term and bioaccumulative toxicity.
Threat index[1]	12	This threat is a primary contributor to a high-priority limiting factor (short-term toxicity) and a medium-priority limiting factor.
Potential benefits with full implementation of action [2]	3	Reducing the level of pesticides and herbicides in the estuary would improve survival by reducing ocean-type salmonids' acute and chronic exposure to toxic contaminants and stream-type salmonids' acute exposure.
Affected salmonids		Ocean- and stream-type salmonids.
Implementation constraints[3]	2	Impacts from pesticides and fertilizers have lessened dramatically since the 1950s as a result of new application technologies, new products, and better understanding and regulation of these toxins. Best management practices offer additional ways to reduce the impacts of pesticides and fertilizers. The integration of new practices can be expensive and time-consuming and also can influence the economics of a particular crop.
Potential benefits with constrained implementation of action	2	

[1] *From Table 4-1. Indicates the significance of the associated limiting factor and the threat's contribution to that limiting factor. High numbers indicate threats that have a major contribution to high-priority limiting factors; lower numbers indicate threats that have a minor contribution to low-priority limiting factors. Numbers indicate the highest score per threat category and do not account for multiple limiting factor contributions.*

[2] *Estimate of the expected benefits to salmonids (ocean- and stream-types combined) if the action were fully implemented.*
1 = very low benefits.
5 = very high benefits.

[3] *Indicates the feasibility of implementing the action.*
1 = significant potential for implementation.
5 = significant constraints to implementation.

Management Action CRE-21: Identify and reduce industrial, commercial, and public sources of pollutants.		
Primary threat this action would address		**Urban and industrial practices.** The estuary has been affected by historical and current releases of toxic contaminants, including industrial and commercial pollutants such as PCBs and PAHs. These substances have been found near Portland, Vancouver, Longview, and Astoria. Recent studies have demonstrated significant juvenile mortality in the estuary as a result of toxic contaminants.
Associated limiting factors		Short-term toxicity and bioaccumulation toxicity.
Threat index[1]	12	This threat is a primary contributor to high- and medium-priority limiting factors.
Potential benefits with full implementation of action [2]	4	Reducing sources of pollutants would lower water temperature, nutrient loading, and the amount of toxic contaminants in the estuary. This would improve both habitat capacity in the estuary and the fitness level of salmonids.
Affected salmonids		Ocean- and stream-type salmonids (particularly ocean types because of their longer residency in the estuary).
Implementation constraints[3]	4	While some discharges of industrial and commercial pollutants are permitted, others are not. Efforts to reduce industrial and commercial pollutants are already under way, and there is potential to reduce point-source emissions. Efforts to reduce sources of pollutants are expensive and time-consuming and often have a negative economic effect on operations.
Potential benefits with constrained implementation of action	3	

[1] From Table 4-1. Indicates the significance of the associated limiting factor and the threat's contribution to that limiting factor. High numbers indicate threats that have a major contribution to high-priority limiting factors; lower numbers indicate threats that have a minor contribution to low-priority limiting factors. Numbers indicate the highest score per threat category and do not account for multiple limiting factor contributions.

[2] Estimate of the expected benefits to salmonids (ocean- and stream-types combined) if the action were fully implemented.
1 = very low benefits.
5 = very high benefits.

[3] Indicates the feasibility of implementing the action.
1 = significant potential for implementation.
5 = significant constraints to implementation.

Management Action CRE-22: Monitor the estuary for contaminants and/or restore contaminated sites.		
Primary threat this action would address		**Urban and industrial practices.** The estuary has been affected by historical and current releases of toxic contaminants, including industrial and commercial pollutants such as PCBs and PAHs. These substances have been found near Portland, Vancouver, Longview, and Astoria. Recent studies have demonstrated significant juvenile mortality in the estuary as a result of toxic contaminants. The action is intended to address the need to monitor the entire estuary for contaminants; however, actual restoration activities are feasible only in specific reaches.
Associated limiting factors		Short-term toxicity and bioaccumulation toxicity.
Threat index[1]	12	This threat is a primary contributor to high- and medium-priority limiting factors.
Potential benefits with full implementation of action [2]	4	Reducing toxic contaminants in the estuary would improve both habitat capacity and the fitness level of salmonids.
Affected salmonids		Ocean- and stream-type salmonids (particularly ocean types because of their longer residency in the estuary).
Implementation constraints[3]	4	Monitoring activities are already occurring; however, actual restoration of contaminated sites is expensive and technically challenging in many cases. In some cases, restoration may not be feasible or practical.
Potential benefits with constrained implementation of action	3	

[1] From Table 4-1. Indicates the significance of the associated limiting factor and the threat's contribution to that limiting factor. High numbers indicate threats that have a major contribution to high-priority limiting factors; lower numbers indicate threats that have a minor contribution to low-priority limiting factors. Numbers indicate the highest score per threat category and do not account for multiple limiting factor contributions.

[2] Estimate of the expected benefits to salmonids (ocean- and stream-types combined) if the action were fully implemented.
1 = very low benefits.
5 = very high benefits.

[3] Indicates the feasibility of implementing the action.
1 = significant potential for implementation.
5 = significant constraints to implementation.

Management Action CRE-23: Implement stormwater best management practices in cities and towns.		
Primary threat this action would address		**Urban and industrial practices.** Municipal stormwater runoff can convey toxic contaminants to the estuary, reduce groundwater recharge, and increase the "flashiness" of stream flows. Although cities and towns in the Columbia River basin generally have programs to reduce the impacts of stormwater runoff, stormwater best management practices have not been universally implemented throughout the basin.
Associated limiting factors		Short-term toxicity and bioaccumulation toxicity.
Threat index[1]	12	This threat is a primary contributor to high- and medium-priority limiting factors.
Potential benefits with full implementation of action [2]	2	Implementing stormwater best management practices would markedly improve conditions and provide a net benefit to salmonids in the estuary through a more normal hydrograph, reduced exposure to contaminants, and lower water temperatures.
Affected salmonids		Ocean- and stream-type salmonids (particularly ocean types because of their longer residency in the estuary).
Implementation constraints[3]	2	Some cities lack the resources or will to implement or enforce stormwater best management practices. The benefits of improved stormwater practices generally are associated only with new development and do not offset the full impact of the impervious surfaces in those developments, or the existing impervious surfaces in areas that have already been developed.
Potential benefits with constrained implementation of action	1	

[1] From Table 4-1. Indicates the significance of the associated limiting factor and the threat's contribution to that limiting factor. High numbers indicate threats that have a major contribution to high-priority limiting factors; lower numbers indicate threats that have a minor contribution to low-priority limiting factors. Numbers indicate the highest score per threat category and do not account for multiple limiting factor contributions.

[2] Estimate of the expected benefits to salmonids (ocean- and stream-types combined) if the action were fully implemented.
1 = very low benefits.
5 = very high benefits.

[3] Indicates the feasibility of implementing the action.
1 = significant potential for implementation.
5 = significant constraints to implementation.

Table 5-2 estimates the potential of each management action to benefit salmonids under two different implementation scenarios. Assuming that few of the actions will be able to be implemented fully, which management actions would be likely to result in the greatest survival improvements?

In partial answer to this question, Table 5-3 summarizes the potential benefits of each action under both full and constrained implementation scenarios. It is tempting to sort the actions in Table 5-3 by potential benefit with constrained implementation and view the sorted list as a prioritized list of management actions, with the actions at the top being those predicted to have the greatest benefits.

However, Table 5-3 is misleading as a tool for guiding recovery actions because the potential benefit scores it uses do not accurately account for the magnitude of impact of an action—in other words, the number of fish that could be affected by the action. For example, a given management action could be fully implemented yet result in the survival of only hundreds of additional juvenile salmonids because the threat and limiting factors that the action addresses are relatively minor. Implementation of another action could be constrained, but the action could result in many thousands of additional juveniles surviving because the threat and limiting factors the action addresses are so great.

This consideration of magnitude of impact is important and calls for development of a second analysis of potential benefits of management actions: survival improvement targets, which are presented in the next section of this document.

TABLE 5-3
Summary of Constraints to Implementation of Management Actions

Number	Action Description	Benefit with Full Implementation of Action[1]	Benefit with Constrained Implementation of Action[2]
CRE-01	Protect intact riparian areas in the estuary and its tributaries and restore riparian areas that are degraded.	4	3
CRE-02	Modify hydrosystem operations to reduce the effects of reservoir surface heating, or conduct mitigation measures.	4	2
CRE-03	Establish legal instream flows for the estuary that would help prevent further degradation of the ecosystem.	2	1
CRE-04	Adjust the timing, magnitude and frequency of flows (especially spring freshets) entering the estuary and plume to improve access to habitats and provide better transport of sediments in the estuary, plume, and littoral cell.	5	3
CRE-05	Study and mitigate the effects of entrapment of sediment in reservoirs, to improve nourishment of the littoral cell.	3	2
CRE-06	Reduce the export of sand and gravels via dredge operations by using dredged materials beneficially.	4	3
CRE-07	Reduce entrainment and habitat effects resulting from main- and side-channel dredge activities in the estuary.	2	1

CRE-08	Remove pile dikes that have low navigational value but high impact on estuary circulation or juvenile predation effects.	3	2
CRE-09	Protect remaining high-quality off-channel habitat from degradation through education, regulation, and fee simple and less-than-fee acquisition.	5	3
CRE-10	Breach or lower dikes and levees to improve access to off-channel habitats.	5	2
CRE-11	Reduce the square footage of over-water structures in the estuary.	3	1
CRE-12	Reduce the effects of vessel wake stranding in the estuary.	3	1
CRE-13	Manage pikeminnow, smallmouth bass, walleye, and channel catfish to prevent increases in abundance.	2	2
CRE-14	Identify and implement actions to reduce salmonid predation by pinnipeds.	3	2
CRE-15	Implement education and monitoring projects and enforce existing laws to reduce the introduction and spread of noxious weeds.	2	1
CRE-16	Implement projects to redistribute part of the Caspian tern colony currently nesting on East Sand Island.	4	3
CRE-17	Implement projects to reduce double-crested cormorant habitats and encourage dispersal to other locations.	4	2
CRE-18	Reduce the abundance of shad entering the estuary.	2	1
CRE-19	Prevent new introductions of invertebrates and reduce the effects of existing infestations.	2	1
CRE-20	Implement pesticide and fertilizer best management practices to reduce estuary and upstream sources of toxic contaminants entering the estuary.	3	2
CRE-21	Identify and reduce industrial, commercial, and public sources of pollutants.	4	3
CRE-22	Monitor the estuary for contaminants and/or restore contaminated sites.	4	3
CRE-23	Implement stormwater best management practices in cities and towns.	2	1

[1]Estimate of potential benefit if action is fully implemented.
1 = very low benefits.
5 = very high benefits.

[2]Estimate of potential benefit if implementation is constrained.
1 = very low benefits.
5 = very high benefits.

Evaluation of Management Actions: Survival Improvement Targets

The Columbia River estuary and plume are only two of many ecosystems that salmonids travel in their complex and lengthy journey from headwaters to ocean and back again. Mortality occurs at every stage of this journey. Each year, NOAA Fisheries scientists estimate the number of juvenile salmonids that enter the estuary from upstream of Bonneville Dam and from estuary tributaries. For 2006, NOAA Fisheries scientists estimate that about 168 million juvenile salmonids (both wild and hatchery) will enter the estuary (Ferguson 2006b). To put this number in context, it is estimated that each year approximately 200 million juveniles are planted or emerge from gravel in the tributaries. This means that upstream mortality is about 20 percent of all juvenile salmonids produced in the basin. Some years later, the surviving fish return to the estuary in varying numbers, with the average return in the last 10 years being approximately 1.7 million fish. In other words, less than 1 percent of the juveniles originating in the tributaries are returning as adults, including both hatchery and wild fish.

How much juvenile mortality is occurring in the estuary and plume? The answer to this question is fundamental to developing an understanding of the role the estuary will play in the recovery of salmonid populations basinwide. The answer also is critical in evaluating the benefits and costs of potential management actions because it helps establish the level of effort needed to offset threats to salmonids in the estuary. Unfortunately, determining how much juvenile mortality is occurring in the estuary and plume is challenging for scientists. Counting juveniles in the Columbia River estuary and plume is problematic because available tracking device technologies are limited, and it is difficult to monitor juveniles—which tend to move in and out of saltwater—in large, high-energy sites such as the mouth of the Columbia River.

However, some efforts have been made to separate mortality that occurs in the estuary and plume from mortality that occurs in the ocean. One such effort has been the underlying assumptions in the Ecosystem Diagnosis and Treatment (EDT) model, which is used extensively throughout the Columbia River basin. EDT assumes juvenile mortality rates in the estuary of between 18 and 58 percent, depending on the salmonid species and the amount of time juveniles spend in the estuary (Lower Columbia Fish Recovery Board 2004).

In addition, new research is currently under way by NOAA Fisheries, the U.S. Army Corps of Engineers, and Battelle Laboratories to estimate the survival rate of juvenile salmonids in the lower Columbia River. This research involves new technologies for miniaturizing acoustic tags to a size capable of tracking yearling and subyearling juveniles. Current technology developed for the project allows for the tracking of subyearlings of sizes down to approximately 90 mm. Results for the first year (2005) have not been formally released; however, preliminary data indicate an approximate range of survival of 65 to 75 percent for subyearlings and yearlings during their residency in the estuary (Ferguson 2006a). It is probable that actual survival rates are lower than these preliminary estimates suggest because the research did not address mortality among juveniles smaller than 90 mm or mortality occurring in the plume and nearshore.

Some specific estimates of salmonid mortality are known in the estuary; they include estimates for double-crested cormorants and Caspian terns. For other threats to salmonids, such as toxic contamination, ship wake stranding, and pinniped predation, information on mortality in the

estuary is incomplete or relatively new in the literature. Still other threats, especially threats related to the food web, are poorly understood and have no mortality estimates associated with them, although in some cases the change in conditions from the historical template to the present has been well documented.

An important goal of this estuary recovery plan module is to estimate the potential benefits—in terms of increased survival of salmonids in the estuary—that could result from the implementation of different management actions. To accomplish this goal, the estuary recovery plan module uses what is known about limiting factors, threats, and constraints to implementation of management actions to assign benefits that could possibly result from different actions.

If scientific understanding of the relationships between ecological conditions and biological responses in estuarine systems were robust, it would be attractive to assign specific mortality rates to each of the factors limiting salmonids' biological performance in the Columbia River estuary. Then one could follow a deterministic logic path that associates mortality rates with specific threats, relates the mortality rates to management actions, and ultimately arrives at an estimate of the survival improvement that would be likely to result from each action. This is not possible at this time, and it will likely not be possible until there have been significant advances in scientific understanding of the complex estuarine environment.

To compensate for the lack of comprehensive information on mortality in the estuary, this recovery plan module establishes targets for improved survival of wild salmonids rearing and migrating in the estuary and plume. These survival targets are intended to serve as a planning tool useful in characterizing the potential results of actions and describing the level of effort needed to recover salmonids.

The primary purpose of the survival improvement targets is to help compare the potential benefits of different management actions, particularly actions that partially address major limiting factors versus actions that fully address minor limiting factors. Assigning survival improvement targets to management actions is necessary because most other evaluation techniques (such as high, medium, and low type ratings) lack the specificity to indicate that, in some cases, even constrained implementation of an action that addresses a very important limiting factor could result in large survival improvements. However, it should be noted that the usefulness of assigning survival improvement targets is limited by the lack of conclusive field data on the various mortalities that salmonids experience while rearing in or traversing the habitats in the estuary and plume.

The survival improvement targets in this chapter were based on an estimate of the number of wild, ESA-listed ocean- and stream-type juvenile salmonids entering the estuary. The total number of wild, ESA-listed juvenile salmonids estimated to enter the estuary in 2006 is approximately 39 million (Ferguson 2006b).[1] Of these, approximately 25 million are ocean type and 14 million are stream type.

To establish survival improvement targets, some assumptions were made about the overall mortality to juvenile salmonids occurring during estuary and plume residency. Ocean-type juveniles were assumed to have an overall mortality rate of 50 percent during their estuary

[1] Approximately 98.9 million ESA-listed juveniles (wild and hatchery) are estimated to enter the estuary in 2006. This estuary recovery plan module uses only the wild fraction of these ESA-listed fish.

residency; this includes the 35 percent mortality suggested by the unpublished micro-acoustic tagging research (Ferguson 2006a), plus an additional 15 percent to account for juveniles too small to be tracked. Stream-type juveniles were assumed to have an overall mortality rate of 40 percent during estuary and plume residency. This rate was based on the 25 percent mortality found in the micro-acoustic tagging research (Ferguson 2006a), plus an additional 15 percent to account for mortality occurring in the plume, which was not part of study. These assumptions about estuary mortality are not scientifically justifiable; rather, they are estimates used for the purposes of the survival improvement target exercise only.

Table 5-4 shows the number of wild, ESA-listed ocean- and stream-type juveniles thought to be entering the lower Columbia estuary and plume, their estimated mortality and survival rates based on the assumptions above, and the number of juveniles estimated to survive their journey through the estuary and plume—again, based on the assumptions above.

TABLE 5-4
Estimated Mortality Rates, Survival Rates, and Survival Improvement Targets for Wild, ESA-Listed Juveniles

Type	Juveniles Entering Estuary*	Assumed Mortality Rate	Assumed Survival Rate	Estimated Number of Juveniles Exiting Estuary and Plume*	Survival Improvement Target (20 percent)**
Ocean Type	25 million	50%	50%	12.5 million	2.5 million
Stream Type	14 million	40%	60%	8.4 million	1.68 million

* = Wild, ESA-listed juveniles.

** = Twenty percent of the estimated number of juveniles exiting the estuary and plume.

Table 5-4 also presents the survival improvement targets for ocean- and stream-type salmonids in the estuary and plume. These are administrative targets equal to 20 percent of the number of wild, ESA-listed juveniles exiting the estuary and plume, with 20 percent representing a hypothetical level of improvement that might be realized through the implementation of the management actions, assuming that constraints to implementation can be overcome and that threats and limiting factors can effectively be reduced.

The usefulness of the 20 percent target lies not in the 20 percent number itself, but in the distribution of the targets (2.5 million ocean-type juveniles and 1.68 million stream-type juveniles) across the various management actions, as a way of characterizing where survival improvements would need to be realized given the various constraints to action implementation.[2] Table 5-5 shows this allocation of survival improvement targets to the 22 management actions, based on literature sources that identify limiting factors, threats, and management actions. (More information about how survival improvement targets were allocated to the different actions is presented in Appendix B.) The value of this exercise should be viewed within the limitations of the assumptions and estimates described in this section of the estuary recovery plan module.

[2] Although for the purposes of this analysis 20 percent is considered a hypothetical number, it is a plausible number. The 20 percent figure is based on overall estimates of juvenile mortality in the estuary, known mortality that can be attributed to specific threats, and professional judgment regarding the efficacy of the different management actions and the likelihood that constraints to their implementation can be overcome.

Although the accuracy of the numbers in Table 5-5 is uncertain, establishing survival improvement targets complements the analysis summarized in Table 5-3. In addition, the approach illustrates how a small increment of implementation of a far-reaching action could offer significantly more potential for recovery than full implementation of an action that is more limited in scope. Comparison of Tables 5-3 and 5-5 and the cost estimates that are developed in the next section form the basis for prioritization of actions in Chapter 7, "Perspectives on Implementation."

While the survival improvement targets in Table 5-5 only estimate the actual survival potential that might be realized by implementing management actions, the targets do provide a useful way of showing the potential magnitude of juvenile survival at the action scale relative to other actions. In cases where there is good scientific literature that supports survival estimates, as with terns and cormorants, that information has been used. In other cases, such as reservoir heating, an estimate was made by PC Trask & Associates based on literature discussion of related limiting factors and threats. These numbers should be viewed as a product of a planning exercise, not a representation of deterministically based estimates.

The purpose of the analysis reflected in Table 5-5 is to help characterize where survival improvements would need to be realized given the various constraints to action implementation. This is only one scenario; however, given the constraints on all the management actions, it would be difficult to meet the survival improvement targets without the improvements associated with those actions most likely to have significant benefits, such as adjusting flows, breaching or lowering dikes and levees, and, for stream types, reducing predation by cormorants and Caspian terns.

Evaluation of Management Actions: Costs and Schedule

Implementing recovery actions in the estuary will be expensive and require a long-term commitment by many entities. In Tables 5-2 and 5-5, two approaches were used to portray the potential survival improvements associated with implementing actions. In this section, each action is broken down into one or more projects that can be considered elements of that action. Each project has a corresponding unit and cost, and the project costs are summed to produce a total cost.

The costs identified in this section do not represent a detailed economic analysis; in fact, they are not economic costs and have not been discounted across time. Instead, the cost estimates are in constant dollars over a 25-year period. For many projects, the estimates are general because of the speculative nature of the level of effort that will be applied to implement them. Also, this cost estimate attempts to establish a reasonable cost for recovery—it is not a detailed "wish list" of projects that are waiting to be completed. This point is important in the estuary because many of the actions and their component projects do not lend themselves to the type of discrete restoration projects that might occur in a small tributary, like adding large woody debris. In the future, as restoration and protection actions in the estuary occur, this more detailed level of cost estimates may be possible.

TABLE 5-5
Survival Improvement Targets Allocated to Management Actions[1]

Number	Action Description	Survival Improvement Target[1] with Constrained Implementation (numbers of wild, ESA-listed fish)			
		Ocean Type[1]	% of Total Improvement Target	Stream Type[1]	% of Total Improvement Target
CRE-01	Protect intact riparian areas in the estuary and its tributaries and restore riparian areas that are degraded.	150,000	6%	100,000	6%
CRE-02	Modify hydrosystem operations to reduce the effects of reservoir surface heating, or conduct mitigation measures.	140,000	6%	50,000	3%
CRE-03	Establish legal instream flows for the estuary that would help prevent further degradation of the ecosystem.	50,000	2%	20,000	1%
CRE-04	Adjust the timing, magnitude and frequency of flows (especially spring freshets) entering the estuary and plume to improve access to habitats and provide better transport of sediments an the estuary, plume, and littoral cell.	350,000	14%	250,000	14%
CRE-05	Study and mitigate the effects of entrapment of sediment in reservoirs, to improve nourishment of the littoral cell.	6,000	<1%	5,000	<1%
CRE-06	Reduce the export of sand and gravels via dredge operations by using dredged materials beneficially.	20,000	<1%	12,000	<1%
CRE-07	Reduce entrainment and habitat effects resulting from main- and side-channel dredge activities in the estuary.	10,000	<1%	1,000	<1%
CRE-08	Remove pile dikes that have low navigational value but high impact on estuary circulation or juvenile predation effects.	100,000	4%	35,000	2%
CRE-09	Protect remaining high-quality off-channel habitat from degradation through education, regulation, and fee simple and less-than-fee acquisition.	350,000	13%	80,000	5%
CRE-10	Breach or lower dikes and levees to improve access to off-channel habitats.	400,000	15%	100,000	6%
CRE-11	Reduce the square footage of over-water structures in the estuary.	50,000	2%	4,000	<1%

CRE-12	Reduce the effects of vessel wake stranding in the estuary.	60,000	3%	1,000	<1%
CRE-13	Manage pikeminnow, smallmouth bass, walleye, and channel catfish to prevent increases in abundance.	4,000	<1%	3,000	<1%
CRE-14	Identify and implement actions to reduce salmonid predation by pinnipeds.	500[2]	N/A	4,500[2]	N/A
CRE-15	Implement education and monitoring projects and enforce existing laws to reduce the introduction and spread of noxious weeds.	50,000	2%	15,000	<1%
CRE-16	Implement projects to redistribute part of the Caspian tern colony currently nesting on East Sand Island.	2,000	<1%	450,000	27%
CRE-17	Implement projects to reduce double-crested cormorant habitats and encourage dispersal to other locations.	2,000	<1%	350,000	21%
CRE-18	Reduce the abundance of shad entering the estuary.	6,000	<1%	2,000	<1%
CRE-19	Prevent new introductions of invertebrates and reduce the effects of existing infestations.	10,000	<1%	2,000	<1%
CRE-20	Implement pesticide and fertilizer best management practices to reduce estuary and upstream sources of toxic contaminants entering the estuary.	40,000	2%	18,000	<1%
CRE-21	Identify and reduce industrial, commercial, and public sources of pollutants.	300,000	11%	80,000	5%
CRE-22	Monitor the estuary for contaminants and/or restore contaminated sites.	350,000	13%	90,000	5%
CRE-23	Implement stormwater best management practices in cities and towns.	50,000	2%	12,000	<1%
	Total	2.5 million		1.68 million	

[1] Appendix B presents more information on how survival improvement targets were developed.

[2] CRE-14 relates only to adult salmonids; the survival numbers in Table 5-5 for CRE-14 are not included in the 20 percent survival improvement targets for juvenile salmonids.

In most cases, project costs are direct costs, meaning out-of-pocket costs that a public or private interest would pay to initiate and complete the action. A few actions include indirect costs, meaning the costs associated with foregone economic opportunities or costs that ripple out to the local or regional economy. Finally, action implementation costs should be viewed from a level-of-effort perspective. In most cases, the degree to which actions can be implemented is

speculative. This is true for a variety of reasons, but economic, social, political, scientific, and public safety constraints often limit an action's potential for implementation.

Table 5-6 establishes costs for each of the 23 actions in the estuary recovery plan module. It may be determined that not all actions or their corresponding projects should be implemented. On the other hand, new actions or projects may emerge. Most importantly, the development of costs for this suite of actions and projects is an optimistic view of the potential to overcome constraints. This is partly because constraints often represent past societal choices that are virtually impossible to reverse. The costs identified in Table 5-6 were developed by PC Trask & Associates with input from jurisdictions and agencies. It is anticipated that these estimates will be refined as larger societal decisions are made.

Each action in Table 5-6 includes a proposed schedule for implementation. The schedule is designed to place projects in a logical order and spread costs over a long period of time when possible. Costs are identified over a 25-year span, with some projects being implemented once over a relatively short period and others continuing over the entire 25 years.

Other elements contained in Table 5-6 include the association of actions to specific geographical reaches, key assumptions about actions, and notes that help explain how costs were developed. The relationship of actions to the eight geographic reaches and the plume helps to define the breadth of the action and may also indicate which jurisdictions may implement actions in the future. Key assumptions relate primarily to implementation and provide insight into the level of effort reflected in the action costs. Notes are specific information that helps clarify a particular unit or cost.

TABLE 5-6
Estimated Cost and Schedule

Management Action CRE-1:

Protect intact riparian areas in the estuary and its tributaries and restore riparian areas that are degraded.

Project	Unit	Cost	Schedule
1. Educate landowners about the ecosystem benefits of intact riparian areas and the costs of degraded riparian areas.	25 years @ $250,000/year	$6.25 million	2008 - 2033
2. Encourage and provide incentives for local, state, and federal regulatory entities to maintain, improve (where needed), and enforce consistent riparian area protections throughout the lower Columbia region.	8 years @ $200,000/year	$1.6 million	2008 - 2016
3. Actively purchase riparian areas in urban and rural settings that (1) cannot be effectively protected through regulation, (2) are intact, or (3) are degraded but have good restoration potential.	Rural: 1,500 acres at $5,000/acre[1] Urban: 75 acres at $100,000/acre	$15 million	2007 - 2031
4. Restore and maintain ecological benefits in riparian areas; this includes managing vegetation on dikes and levees to enhance ecological function.	20 miles @ $500,000/mile	$ 10 million	2006 - 2031

Total costs: $32.85 million

Geographical extent: Reaches A, B, C and H.

Key assumptions: (1) New homes, businesses, and industry will increase with population growth in the basin. (2) Some intact riparian areas are not adequately protected. (3) Protecting intact riparian areas would be cheaper than restoring degraded areas. (4) Some degraded riparian areas could be restored and gain ecological function, with associated downstream benefits. (5) Comprehensive protection and restoration of riparian habitats would occur concurrently with population growth, which will continue at a high rate.

Notes:
[1] Acreage amounts are 25-year targets that depend on willing sellers and funding.

Management Action CRE-2:

Modify hydrosystem operations to reduce the effects of reservoir surface heating, or conduct mitigation measures.

Project	Unit	Cost	Schedule
1. Conduct a reservoir heating study to determine the extent of the issue and identify hydrosystem operational changes that would reduce effects and/or mitigate downstream temperature issues.	1 study	$2.5 million	2007 - 2013
2. Implement hydrosystem operational changes to reduce temperature effects; if no change is possible, mitigate effects through restoration of tributary riparian areas.	25 years @ $900,000/year[1]	$22.5 million	2010 - 2032

Total costs: $25 million

Geographical extent: All reaches (A-H), including the plume and nearshore.

Key assumption: (1) Either there is potential to alter management practices in the hydrosystem to reduce flow temperatures or a commensurate level of mitigation in tributaries would reduce temperatures in the estuary. (2) If temperatures continue to increase above 19° C, the estuary could become completely lethal for salmonids and other native species.

Notes:
[1] Assumes that some level of improvement is possible, but that the level of possible improvement is likely to be minor because of complexities of the hydrosystem; assumes that mitigation will be needed to offset temperature increases.

Management Action CRE-3:

Establish legal instream flows for the estuary that would help prevent further degradation of the ecosystem.

Project	Unit	Cost	Schedule
1. Establish a forum to explore options and develop policy recommendations on instream flows.	5 years @ $1 million/year[1]	$5 million	2007 - 2015
2. Implement instream flow regulations in accordance with the policy recommendations in Project No. 1.	5 years @ $1 million/year[2]	$5 million	2015 - 2023

Total costs: $10 million

Geographical extent: All reaches, including the plume and nearshore.

Key assumptions: (1) Demand for water for human use will grow as the human population in the basin increases. (2) Additional legal instream flows in the Columbia River mainstem and tributaries could be established through the efforts of affected parties basinwide. (3) Establishing a legal instream flow would protect flows entering the estuary in the future. (4) An instream flow law would help develop additional water conservation efforts and guide land use development in concert with water availability.

Notes:
[1]Costs are associated with developing the planning capacity (i.e., staff, office, technical support) to support the basinwide entity.
[2]Costs are associated with staffing the law-making activities needed to implement basinwide instream flow.

Management Action CRE-4:

Adjust the timing, magnitude and frequency of flows (especially spring freshets) entering the estuary and plume to improve access to habitats and provide better transport of sediments in the estuary, plume, and littoral cell.

Project	Unit	Cost	Schedule
1. Conduct a flood study to determine the risks and feasibility of returning the estuary hydrograph to more normative flows.	2 years @ $500,000/year	$1 million	2009 - 2010
2. Conduct a study to determine the habitat effects of increasing the magnitude and frequency of flows (i.e., how much access of river to off-channel habitats would increase).	3 years @ $500,000/year	$1.5 million	2009 - 2011
3. Conduct additional studies to determine the extent of other constraints, including international treaties, systemwide fish management objectives, and power management.	4 years @ $500,000/year	$2 million	2010 - 2014
4. Make policy recommendations to action agencies on flow, taking into consideration beneficial estuary flows, flood management, power generation, irrigation, water supply, fish management, and other interests.	25 years @ $100,000/year	$2.5 million	2010 - 2035
5. Implement modified estuary flow regime annually in concert with other interests, including hydroelectric, flood control, and water withdrawals.	25 years @ $2 million/year[1]	$50 million	2011 - 2036

Total costs: $57 million

Geographical extent: All reaches (A-H), the plume, and the Columbia River littoral cell.

Key assumptions: (1) Even incremental changes in the magnitude and frequency of flows would improve salmonid habitat opportunity and food inputs, which would have benefits throughout the ecosystem. (2) Studies of flood risk and the effect of flow changes on estuarine habitat would provide data useful in modifying hydrosystem operations to benefit salmonids. (3) Studies of constraints to implementation would identify some obstacles that could be overcome. (4) Small to moderate changes in the magnitude, frequency, and timing of flows would improve sediment transport-related habitat opportunity in the estuary. (5) Increased spring freshets would yield greater sediment transport-related benefits than would other flow modifications.

Notes:

[1] Assumes a $2 million per year cost of decreased hydrosystem generation revenues to compensate for hydrosystem impacts to fish and wildlife; also assumes that flood risk associated with beneficial estuary flows does not increase significantly.

Management Action CRE-5:

Study and mitigate the effects of entrapment of sediment in reservoirs, to improve nourishment of the littoral cell.

Project	Unit	Cost	Schedule
1. Identify the effects of reservoir sediment entrapment on economic and ecological processes; this includes effects on ship channels, turning basins, port access, jetty activities, littoral cell erosion and accretion, and habitat availability.	1 study	$2 million	2008 - 2011
2. Establish a forum to develop a regionwide sediment plan for the estuary and littoral cell.	10 years at $100,000/year	$1 million	2006 – 2031
3. Implement projects recommended in the plan to mitigate the effects of sediment entrapment.	5 projects @ $1 million/project	$5 million	2010 - 2020

Total costs: $7 million

Geographical extent: All reaches (A-H), including the plume and littoral cell.

Key assumptions: (1) Sediment entrapment in reservoirs will continue. (2) Sediment entrapment has negative effects, both ecologically and economically. (3) The extent of these effects warrants exploration and implementation of potential mitigation measures. (4) Studying potential mitigation measures would identify some actions that would be effective and could be implemented.

Management Action CRE-6:

Reduce the export of sand and gravels via dredge operations by using dredged materials beneficially.

Project	Unit	Cost	Schedule
1. Establish a forum to develop a regionwide sediment plan for the estuary and littoral cell.	See CRE-5.	See CRE-5.	See CRE-5.
2. Identify and implement demonstration projects designed to assess ecosystem beneficial uses of dredged materials.	10 projects @ $100,000/project	$1 million	2006 - 2012
3. Dispose of dredged materials using techniques identified through the demonstration projects and regionwide planning.	10 years @ $500,000/year[1]	$5 million	2008 - 2033

Total costs: $7 million

Geographical extent: Reaches A, B, C and the plume and nearshore.

Key assumptions: (1) Dredging activities will continue or increase over time. (2) Opportunities to beneficially use dredged materials for habitat can be identified. (3) Beneficial use of dredged material would have a positive effect on sediment transport and habitat-forming processes in the estuary, plume, and littoral cell.

Notes:
[1]Unit cost is funding to pay for activities beyond the minimum required by law, to achieve regional-scale ecosystem benefits.

Management Action CRE-7:

Reduce entrainment and habitat effects resulting from main- and side-channel dredge activities in the estuary.

Project	Unit	Cost	Schedule
1. Identify and evaluate dredge operation techniques designed to reduce entrainment and other habitat effects.	1 project	$500,000	2008 - 2010
2. Initiate demonstration projects designed to test and evaluate dredge operations.	5 projects @ $200,000/project	$1 million	2009 - 2012
3. Implement best management techniques.	10 years @ $250,000/year[1]	$2.5 million	2011 - 2036

Total costs: $4 million

Geographical extent: Reaches B, C, D, E and F.

Key assumptions: (1) Improved best management practices can be identified that would help reduce the impact of dredging. (2) Mitigation activities would help offset changes to the estuary caused by dredging.

Notes:
[1]This is an estimate of the incremental cost above permitted dredge activities. Cost may vary significantly depending on site-specific conditions.

Management Action CRE-8:

Remove pile dikes that have low navigational value but high impact on estuary circulation or juvenile predation effects.

Project	Unit	Cost	Schedule
1. Inventory, assess, and evaluate in-channel pile dikes for their economic value and their impact on the estuary ecosystem; develop criteria for establishing project priority.	1 plan	$200,000	2007 - 2009
2. Remove priority pile dikes.	10 sets[1] @ $250,000/set	$2.5 million	2008 - 2033
3. Monitor the physical and biological effects of pile dike removal.	10 years @ $100,000/year	$1 million	2010 - 2020

Total costs: $3.7 million

Geographical extent: Reaches A, B, C, D, E, F, G and H.

Key assumption: (1) Many pile dikes and navigational structures could be removed without compromising the shipping channel or protection of property. (2) Over time, the removal of superfluous pile dikes would improve conditions for salmonids and the ecosystem.

Notes:

[1]A set is a logical grouping of a large number of priority pile dikes targeted for removal.

Management Action CRE-9:

Protect remaining high-quality off-channel habitat from degradation through education, regulation, and fee simple and less-than-fee acquisition.

Project	Unit	Cost	Schedule
1. Educate landowners about the ecosystem benefits of protecting and stewarding intact off-channel areas and the costs of restoring degraded areas.	15 years @ $250,000/year	$3.75 million	2007 - 2032
2. Encourage and provide incentives for local, state, and federal regulatory entities to maintain, improve (where needed), and enforce consistent riparian area protections throughout the lower Columbia region.	10 years @ $1 million/year	$10 million	2007 - 2032
3. Actively purchase off-channel habitats in urban and rural settings that (1) cannot be effectively protected through regulation, (2) are degraded but have good restoration potential, or (3) are highly degraded but could benefit from long-term restoration solutions.[1]	Rural: 3,000 acres at $5,000/acre Urban: 150 acres at $100,000/acre	$30 million	2007 - 2031

Total costs: $43.75 million

Geographical extent: Reaches A, B, and C.

Key assumptions: (1) Protection opportunities can be increased over the next decade through public awareness, education, regulatory, and acquisition programs. (2) Protection of off-channel habitats is less expensive than restoration. (3) High-quality off-channel habitats offer benefits to salmonids that cannot be provided in other ways. (4) Protection will be needed to off-set increasing threats resulting from human population increases in the estuary and basin.

Notes: [1]

Assumes purchases are made over a 25-year period with willing sellers.

Management Action CRE-10:

Breach or lower dikes and levees to improve access to off-channel habitats.

Project	Unit	Cost	Schedule
1. Breach or lower the elevation of dikes and levees; create and/or restore tidal marshes, shallow-water habitats, and tide channels.	3,000 acres[1] @ $10,000/acre	$30 million	2006 - 2031
2. Remove tide gates to improve the hydrology between wetlands and the channel and to provide juveniles with physical access to off-channel habitat; use a habitat connectivity index to prioritize projects.	1,500 acres[1] @ $10,000/acre	$15 million	2006 - 2031
3. Upgrade tide gates where (1) no other options exist, (2) upgraded structures can provide appropriate access for juveniles, and (3) ecosystem function would be improved over current conditions.	500 acres[1] @ $10,000/acre	$5 million	2006 - 2031

Total costs: $50 million

Geographical extent: Reaches A, B, C, E, F, and G.

Key assumptions: (1) Additional opportunities to restore off-channel habitats can be developed through long-term outreach and improved landowner relationships. (2) Restoration of sites, including elevation restoration, would yield broad-scale ecosystem benefits over time. (3) A habitat connectivity index would help target efforts toward the projects that would provide the greatest benefits. (4) Restoration of highly degraded sites may be necessary to yield long-term benefits.

Notes:
[1]Acreage equals amount of affected area. Costs include those associated with protecting other land uses from renovated hydrology (i.e., moving dikes and levees).

Management Action CRE 11:

Reduce the square footage of over-water structures in the estuary.

Project	Unit	Cost	Schedule
1. Inventory over-water structures and develop a GIS layer with detailed metadata files.	2 projects @ $150,000/project	$300,000	2007 - 2009
2. Initiate a planning process to evaluate existing and new over-water structures for their economic, ecological, and recreational value.	2 phases[1] @ $100,000/phase	$200,000	2009 - 2013
3. Remove over-water structures that no longer serve a functional use and/or reduce the footprint of viable structures when appropriate.	10 projects @ $500,000/project[2]	$5 million	2012 - 2037
4. Establish criteria for new permit applications to consider the cumulative impacts of over-water structures.	1 project	$300,000	2008 - 2010

Total costs: $5.8 million

Geographical extent: Reaches D and G.

Key assumptions: (1) Over-water structures pose some threat to salmonids. (2) A fair number of over-water structures are no longer in use or have relatively minor value to owners. (3) An inventory of over-water structures would aid in assessing individual structures' economic, ecological, and recreational value.

Notes:
[1]The first phase is technical and the second phase is policy.
[2]A project is defined as a set of structures that have been identified for removal; cost is level of effort.

Management Action CRE-12:

Reduce the effects of vessel wake stranding in the estuary.

Project	Unit	Cost	Schedule
1. Use existing research results documenting stranding by ship wakes to estimate juvenile mortality throughout the estuary. Modeling could use newly emerging Light Detection and Ranging (LIDAR) satellite imagery to conduct analyses.	1 study	$500,000	2007
2. Analyze factors contributing to ship wake stranding to determine potential approaches to reducing mortality in locations where juveniles are most vulnerable. Design and implement demonstration projects and monitor their results.	1 three-phase study @ $500,000/phase	$1.5 million	2007 - 2010
3. Implement projects identified in Project No. 2 that are likely to result in the reduction of ship wake stranding events.	10 projects @ $1.5 million/project[1]	$15 million	2011 - 2026

Total costs: $17 million

Geographical extent: Reaches C, D, E and F.

Key assumptions: (1) Vessel wake stranding is a significant issue for ocean- and stream-type salmonids employing the fry life history strategy in the estuary.

Notes:

[1] This is a level-of-effort cost approach that will require information generated in Projects No. 1 and 2.

Management Action CRE-13:

Manage pikeminnow, smallmouth bass, walleye, and channel catfish to prevent increases in abundance.

Project	Unit	Cost	Schedule
1. Monitor the abundance levels of pikeminnow, smallmouth bass, walleye, and channel catfish.	5 monitoring events @ $10,000/event (every 5 years)	$50,000	2006 - 2031
2. Implement actions as necessary to prevent population growth (i.e., modify habitat); continue the northern pikeminnow bounty program.	5 projects @ $200,000/project[1]	$1 million	2006 - 2031

Total costs: $1.050 million

Geographical extent: Reaches D, E, F, G and H.

Key assumption: Management techniques would maintain populations at levels that would maintain or reduce predation impacts to salmonids.

Notes:
[1] It is unknown whether projects will be needed to manage warm-water fish. In some cases, there may be warm-water habits close to juvenile habitat, in which case site-specific action would be required.

Management Action CRE-14:

Identify and implement actions to reduce salmonid predation by pinnipeds.

Project	Unit	Cost	Schedule
1. Expand federal and state activities at Bonneville Dam to test non-lethal and potentially lethal methods of reducing pinniped populations throughout the estuary. This includes efforts to manage pinnipeds through the Marine Mammal Protection Act.	3 projects @ $500,000/project	$1.5 million	2007 - 2011
2. Implement actions likely to reduce pinniped predation on adult salmonids.	25 years @ $500,000/year[1]	$12.5 million	2007 - 2032

Total costs: $12.65 million

Geographical extent: All reaches (especially H).

Key assumptions: (1) Mortality from pinnipeds may be a larger source of salmonid mortality than previously understood. (2) Further study would clarify the impact of pinniped predation on salmonids. (3) Mortality from pinniped predation could be reduced through non-lethal and lethal methods. (4) The Marine Mammal Protection Act could be modified over time to allow more tools for managing pinnipeds in the estuary.

Notes:
[1] Units are years; given legal constraints, it is likely that ongoing efforts to prevent predation will continue over the next 25 years.

Management Action CRE-15:

Implement education and monitoring projects and enforce existing laws to reduce the introduction and spread of noxious weeds.

Project	Unit	Cost	Schedule
1. Increase public awareness of exotic plant species and proper stewardship techniques.[1]	15 years @ $300,000/year	$4.5 million	2008 - 2023
2. Inventory exotic plant species infestations and develop a GIS layer with detailed metadata files.	5 phases @ $250,000/phase	$1.25 million	2007 - 2012
3. Implement projects to address infestations on public and private lands.	15 years @ $1 million/year	$15 million	2008 - 2033
4. Monitor infestation sites.	20 years @ $25,000/year	$500,000	2010 - 2035

Total costs: $21.25 million

Geographical extent: All reaches (A-H).

Key assumptions: (1) Aquatic noxious weeds have a negative effect on the estuary ecosystem and affect juvenile salmonids by altering habitat and causing food webs to deteriorate. (2) Additional information is needed on the location, extent, and type of infestations and their effects on the estuary ecosystem. (3) Because introductions of noxious weeds can permanently alter the estuary ecosystem, prevention activities are crucial. (4) Education, outreach, and monitoring would help prevent further introductions of exotic plants.

Notes:
[1]This project is recommended for upstream mainstem and tributaries, but the costs presented here are for activities in the estuary only. Many exotic plants have established themselves upstream and represent a constant downstream threat to the estuary.

Management Action CRE-16:

Implement projects to redistribute part of the Caspian tern colony currently nesting on East Sand Island.

Project	Unit	Cost	Schedule
1. Enhance or create tern nesting habitat at alternative sites in Washington, Oregon, and California.	3 sites @ $1 million/site	$3 million	2008 - 2012
2. Reduce tern nesting habitat on East Sand Island to 1 to 1.5 acres.	1 project @ $2.5 million/project	$2.5 million	2007 - 2010
3. Monitor the regional tern population.	25 years @ $100,000/year	$2.5 million	2010 - 2035

Total costs: $8 million

Geographical extent: Reaches A and B.

Key assumption: Ongoing and new management actions directed to Caspian tern nesting habitat would continue to reduce salmonid mortality from tern predation.

Management Action CRE-17:

Implement projects to reduce double-crested cormorant habitats and encourage dispersal to other locations.

Project	Unit	Cost	Schedule
1. Identify, assess, and evaluate methods of reducing double-crested cormorant abundance numbers.	1 multiphase study	$2.5 million	2007 - 2011
2. Implement demonstration projects resulting from Project No. 1 (i.e., decoys and audio playback methods).	5 pilot projects @ $500,000/project	$2.5 million	2010 - 2015
3. Implement projects resulting in reduced predation by cormorants.[1]	10 years @ $500,000/year	$5 million	2013 - 2023

Total costs: $10 million

Geographical extent: Reaches A and B.

Notes:
[1]This is a level-of-effort cost estimate; efforts to manage cormorants in the estuary are significantly lagging Caspian tern management efforts.

Management Action CRE-18:

Reduce the abundance of shad entering the estuary.

Project	Unit	Cost	Schedule
1. Initiate a planning process to organize technical information about shad and identify potential control methods.	2 phases @ $250,000/phases	$500,000	2007 - 2011
2. Implement demonstration projects to evaluate effective management methods.	4 projects @ $500,000/project	$2 million	2008 - 2015
3. Implement shad population management techniques.[1]	10 years @ $25,000/year	$2.5 million	2010 - 2015
4. Monitor and evaluate management techniques.	10 years @ $50,000/year	$500,000	2011 - 2021

Total costs: $5.5 million

Geographical extent: All reaches (A-H).

Key assumptions: (1) Shad have negative affects on salmonids in the estuary. (2) Additional research would shed light on how shad affect salmonids and suggest new management techniques. (3) New management techniques would be unlikely to cause significant change.

Notes:
[1]This is a level-of-effort cost estimate; currently there are no plans to manage shad abundance levels in the Columbia River.

Management Action CRE-19:

Prevent new introductions of invertebrates and reduce the effects of existing infestations.

Project	Unit	Cost	Schedule
1. Establish a forum to (1) assemble existing technical information on introduced invertebrates in the estuary, and (2) develop a plan for managing existing infestations.	2 phases @ $250,000/phase	$500,000	2007 - 2010
2. Implement recommendations from the plan for managing existing infestations (Project No. 1, above).[1]	5 projects @ $500,000/project	$2.5 million	2008 - 2013

Total costs: $3 million

Geographical extent: All reaches (A-H).

Key assumptions: (1) Ship ballast practices could be improved to help prevent further degradation of the estuary ecosystem. (2) Additional research would help scientists understand the effects of exotic invertebrates on the ecosystem. (3) Because the effects of exotic invertebrates on the ecosystem usually cannot be reversed, it is important to prevent introductions when possible.

Notes:
[1]This is a level-of-effort cost estimate.

Management Action CRE-20:

Implement pesticide and fertilizer best management practices to reduce estuary and upstream sources of toxic contaminants entering the estuary.

Project	Unit	Cost	Schedule
1. Increase funding for education and outreach programs targeted to professional and leisure agricultural activities so as to promote reduced use of toxic materials.	10 years @ $700,000/year[1]	$7 million	2008 - 2018

Total costs: $7 million

Geographical extent: All reaches (A-H).

Key assumptions: (1) Some users of pesticides and fertilizers are not adequately informed about best management practices for these toxic contaminants. (2) Additional benefits to salmonids could be realized through continued efforts by farmers, chemical manufacturers, and regulatory programs to reduce impacts from fertilizers and pesticides. (3) Benefits to salmonids would increase over a relatively long period time as agricultural practices improve.

Notes:
[1]Unit cost includes estimates for the estuary and estuary tributaries only; the action recommends similar upstream activities.

Management Action CRE-21:

Identify and reduce industrial, commercial, and public sources of pollutants.

Project	Unit	Cost	Schedule
1. Identify non-permitted point-source pollutant discharge sites and take enforcement action where necessary.	8 years @ $150,000/year	$1.2 million	2007 - 2014
2. Provide cost-share incentives for National Pollution Discharge Elimination System (NPDES) permit holders to upgrade effluent above their permit requirements.	10 years @ $2 million/year	$20 million	2010 - 2020
3. Study and establish threshold treatment standards for pharmaceuticals and other unregulated substance discharges; update existing NPDES permits to reflect the new standards.	5 years @ $2 million/year	$10 million	2007 - 2012
4. Provide grants and low-cost loans to permit holders required to treat effluent to standards established in Project No. 3.	10 years @ $2 million/year	$20 million	2012 - 2017

Total costs: $51.2 million

Geographical extent: Reaches D and G.

Key assumptions: (1) Non-permitted discharges that currently are occurring would be identified and curtailed. (2) Financial incentives or support would motivate NPDES permit holders to raise their effluent treatment levels above permit requirements. (3) Releases of industrial and commercial pollutants into the estuary would be reduced over time.

Management Action CRE-22:

Monitor the estuary for contaminants and/or restore contaminated sites.

Project	Unit	Cost	Schedule
1. Implement contamination monitoring recommendations identified in the *Federal Columbia River Estuary Research, Monitoring, and Evaluation Program* (Pacific Northwest National Laboratory 2006).	TBD	TBD[1]	2006 - 2031
2. Develop criteria and a process for evaluating contaminated sites to establish their restoration potential.	1 phase @ $500,000/phase	$500,000	2007 - 2017
3. Develop an integrated multi-state funding strategy to address contamination cleanup in the estuary from non-identifiable upstream sources.	Out-of-Estuary[2]	n/a	2007 - 2012
4. Restore those contaminated sites that will yield the greatest ecological and economic benefits.	25 years @ $2.7 million/year	$67.5 million	2007 - 2032

Total costs: $68 million

Geographical extent: Reaches A, B, C, D, E, F, G, and H.

Key assumptions: (1) Monitoring will continue to provide vital data needed to understand the toxic contaminant problem and identify potential solutions. (2) Monitoring will identify hot spots of contamination. (3) Contamination sites will be identified for which responsible parties cannot be determined. (4) Additional analysis would identify contamination sites whose restoration would yield significant ecological and economic benefits. (5) Restoration of contaminated sites would benefit salmonids and the ecosystem over time.

Notes:
[1] Monitoring costs to be developed through the estuary/ocean subgroup established in response to the Federal Columbia River Power System (FCRPS) Biological Opinions.
[2] Cost is considered to be outside the purview of estuary-specific projects.

Management Action CRE-23:

Implement stormwater best management practices in cities and towns.

Project	Unit	Cost	Schedule
1. Monitor stormwater outputs to measure treatment compliance with existing local and state regulations throughout the basin.	10 years @ $200,000/year	$2 million	2007 - 2015
2. Establish a fund source for regulatory agencies to use when insufficient resources are available to (1) access best available science, (2) develop standards beyond requirements, or (3) adequately enforce regulations.	4 years @ $2 million/year	$8 million	2007 - 2015

Total costs: $10 million

Geographical extent: Reaches D and G.

Key assumptions: (1) Population growth in the Columbia River basin will continue to influence the hydrology and water quality in the estuary. (2) Stormwater practices could be improved by monitoring and enforcing compliance with existing regulations, making best scientific information available, and developing higher standards. (3) The resulting improvements in hydrology and contaminant exposure in the estuary would occur slowly over time. (4) This action is protective in nature; costs are not associated with retrofitting existing stormwater facilities.

Notes:
This project is recommended for upstream mainstem and tributaries, but the costs presented here are for activities in the estuary only.

Table 5-7 is a summary of costs for the 23 management actions. The total estimated budget for implementation of the actions at this level of effort approaches $500 million over 25 years. This number contrasts with the $1.1 billion estimated to help restore salmon in Puget Sound tributaries over a 10-year period. Other major ecosystem restoration efforts across the United States, including San Francisco Bay, Chesapeake Bay, the Everglades, and the Louisiana Coast, are estimated to cost several billion dollars apiece.

TABLE 5-7
Summary of Costs of Management Actions

Number	Action Description	Cost for Constrained Implementation	%*
CRE-01	Protect intact riparian areas in the estuary and its tributaries and restore riparian areas that are degraded.	$32.85 million	7%
CRE-02	Modify hydrosystem operations to reduce the effects of reservoir surface heating, or conduct mitigation measures.	$25 million	5%
CRE-03	Establish legal instream flows for the estuary that would help prevent further degradation of the ecosystem.	$10 million	2%
CRE-04	Adjust the timing, magnitude and frequency of flows (especially spring freshets) entering the estuary and plume to improve access to habitats and provide better transport of sediments in the estuary, plume, and littoral cell.	$57 million	11%
CRE-05	Study and mitigate the effects of entrapment of sediment in reservoirs, to improve nourishment of the littoral cell.	$7 million	1%
CRE-06	Reduce the export of sand and gravels via dredge operations by using dredged materials beneficially.	$7 million	1%
CRE-07	Reduce entrainment and habitat effects resulting from main- and side-channel dredge activities in the estuary.	$4 million	1%
CRE-08	Remove pile dikes that have low navigational value but high impact on estuary circulation or juvenile predation effects.	$3.7 million	1%
CRE-09	Protect remaining high-quality off-channel habitat from degradation through education, regulation, and fee simple and less-than-fee acquisition.	$43.75 million	9%
CRE-10	Breach or lower dikes and levees to improve access to off-channel habitats.	$50 million	10%
CRE-11	Reduce the square footage of over-water structures in the estuary.	$5.8 million	1%
CRE-12	Reduce the effects of vessel wake stranding in the estuary.	$17 million	3%
CRE-13	Manage pikeminnow, smallmouth bass, walleye, and channel catfish to prevent increases in abundance.	$1.05 million	0%
CRE-14	Identify and implement actions to reduce salmonid	$12.65 million	3%

	predation by pinnipeds.		
CRE-15	Implement education and monitoring projects and enforce existing laws to reduce the introduction and spread of noxious weeds.	$21.25 million	4%
CRE-16	Implement projects to redistribute part of the Caspian tern colony currently nesting on East Sand Island.	$8 million	2%
CRE-17	Implement projects to reduce double-breasted cormorant habitats and encourage dispersal to other locations.	$10 million	2%
CRE-18	Reduce the abundance of shad entering the estuary.	$5.5 million	1%
CRE-19	Prevent new introductions of invertebrates and reduce the effects of existing infestations.	$3 million	1%
CRE-20	Implement pesticide and fertilizer best management practices to reduce estuary and upstream sources of toxic contaminants entering the estuary.	$7 million	1%
CRE-21	Identify and reduce industrial, commercial, and public sources of pollutants.	$51.2 million	10%
CRE-22	Monitor the estuary for contaminants and/or restore contaminated sites.	$68 million	13%
CRE-23	Implement stormwater best management practices in cities and towns.	$10 million	2%
	Total	$460.75 million	

*Column shows the relative percentage of each action to the total cost.

Summary

The estuary and plume ecosystems are especially vulnerable to threats because these ecosystems are affected by factors across a wide geographic range—from upstream to the estuary itself, and even well out in the Pacific Ocean. A set of actions has been identified to help address threats to salmonids in the estuary, plume, and nearshore. Other recovery venues must also address upstream threats to effectively improve degraded habitats in the estuary. It is difficult to characterize these estuary actions in terms of their effectiveness because overall salmonid mortality in the estuary and specific mortality rates related to certain threats are only beginning to be understood. This estuary recovery plan module uses survival improvement targets to help characterize the level of effort required and the costs of that effort.

FCRPS Habitat Workgroup Table - Estuary

REACH Assessment Unit (AU)	River Mile	Ocean or Stream TYPE	Primary Limiting Factors (PLF)	Action	Spatial Structure	Life History Diversity	Estimated Implementation Benefits (scale 1-5)	Estimated Percent of Ocean Type Survival Improvement Target (juveniles only)	Estimated Percent of Stream Type Survival Improvement Target (juveniles only)
Select one from table	User defined, one per AU	One or both TYPES per AU	One or Multiple choices per TYPE	One or Multiple Actions per PLF			User defined, one per Action	20 % target defined by action, not reach (see Appendix A)	20 % target defined by action, not reach (see Appendix A)
A - Estuary entrance	RM 0-15	STREAM TYPE (Snake River sockeye salmon, Lower Columbia River coho salmon, Upper Columbia River steelhead, Snake River steelhead, Lower Columbia River steelhead, Middle Columbia River steelhead, Upper Willamette River steelhead, Upper Columbia River spring chinook salmon and Snake River spring/summer chinook salmon)	Predation	Redistribute Caspian terns		X	5 - very high		~27% of target
			Predation	Redistribute cormorants		X	5 - very high		~21% of target
			Predation	Reduce predation by pinnipeds		X	4 - high		n/a (adults only)
			Flow	Adjust the timing, magnitude, and frequency of flows	X	X	4 - high		~14% of target
			Temperature (Macrodetrital)	Protect/restore riparian areas	X	X	4 - high		~6% of target
			Habitat	Breach or lower dikes and levees	X	X	4 - high		~6% of target
			Toxics	Monitor and/or restore contaminated sites	X	X	3 - medium		~5% of target
			Habitat	Protect remaining high-quality off-channel habitat	X	X	3 - medium		~5% of target
			Sediment, predation	Remove pile dikes	X	X	3 - medium		~2% of target
			Toxic	Implement pesticide/fertilizer BMPs	X	X	3 - medium		<1% of target
			Flow, sediment	Use dredge materials beneficially	X	X	2 - low		<1% of target
			Habitat	Reduce noxious weeds	X	X	2 - low		<1% of target
			Exotic invertebrates	Prevent invertebrate introductions	X	X	1 - very low		<1% of target
A - Estuary entrance	RM 0-15	OCEAN TYPE (Columbia River chum salmon, Snake River Fall chinook, Upper Willamette River chinook salmon, and Lower Columbia River fall chinook salmon)	Habitat	Breach or lower dikes and levees	X	X	5 - very high	~15% of target	
			Flow	Adjust the timing, magnitude, and frequency of flows	X	X	5 - very high	~14% of target	
			Habitat	Protect remaining high-quality off-channel habitat	X	X	5 - very high	~13% of target	
			Toxics	Monitor and/or restore contaminated sites	X	X	5 - very high	~13% of target	
			Temperature (Macrodetrital)	Protect/restore riparian areas	X	X	4 - high	~6% of target	
			Sediment, predation	Remove pile dikes	X	X	4 - high	~4% of target	
			Toxic	Implement pesticide/fertilizer BMPs	X	X	3 - medium	~2% of target	
			Habitat	Reduce noxious weeds	X	X	3 - medium	~2% of target	
			Predation	Redistribute Caspian terns		X	3 - medium	<1% of target	
			Predation	Redistribute cormorants		X	3 - medium	<1% of target	
			Flow, sediment	Use dredge materials beneficially	X	X	3 - medium	<1% of target	
			Exotic invertebrates	Prevent invertebrate introductions	X	X	2 - low	<1% of target	
B - Mixing Zone	RM 15-38	STREAM TYPE (Snake River sockeye salmon, Lower Columbia River coho salmon, Upper Columbia River steelhead, Snake River steelhead, Lower Columbia River steelhead, Middle Columbia River steelhead, Upper Willamette River steelhead, Upper Columbia River spring chinook salmon and Snake River spring/summer chinook salmon)	Predation	Redistribute Caspian terns		X	5 - very high		~27% of target
			Predation	Redistribute cormorants		X	5 - very high		~21% of target
			Predation	Reduce predation by pinnipeds		X	4 - high		n/a (adults only)
			Flow	Adjust the timing, magnitude, and frequency of flows	X	X	4 - high		~14% of target
			Temperature (Macrodetrital)	Protect/restore riparian areas	X	X	4 - high		~6% of target
			Habitat	Breach or lower dikes and levees	X	X	4 - high		~6% of target
			Toxics	Monitor and/or restore contaminated sites	X	X	3 - medium		~5% of target
			Habitat	Protect remaining high-quality off-channel habitat	X	X	3 - medium		~5% of target
			Sediment, predation	Remove pile dikes		X	3 - medium		~2% of target
			Toxic	Implement pesticide/fertilizer BMPs	X	X	3 - medium		<1% of target
			Flow, sediment	Use dredge materials beneficially	X	X	2 - low		<1% of target
			Habitat	Reduce noxious weeds	X	X	2 - low		<1% of target
			Exotic invertebrates	Prevent invertebrate introductions	X	X	1 - very low		<1% of target

FCRPS Habitat Workgroup Table - Estuary

REACH Assessment Unit (AU)	River Mile	Ocean or Stream TYPE	Primary Limiting Factors (PLF)	Action	Spatial Structure	Life History Diversity	Estimated Implementation Benefits (scale 1-5)	Estimated Percent of Ocean Type Survival Improvement Target (juveniles only)	Estimated Percent of Stream Type Survival Improvement Target (juveniles only)
Select one from table	User defined, one per AU	One or both TYPES per AU	One or Multiple choices per TYPE	One or Multiple Actions per PLF			User defined, one per Action	20 % target defined by action, not reach (see Appendix A)	20 % target defined by action, not reach (see Appendix A)
B - Mixing Zone	RM 15-38	OCEAN TYPE (Columbia River chum salmon, Snake River Fall chinook, Upper Willamette River chinook salmon, and Lower Columbia River fall chinook salmon)	Habitat	Breach or lower dikes and levees	X	X	5 - very high	~15% of target	
			Flow	Adjust the timing, magnitude, and frequency of flows	X	X	5 - very high	~14% of target	
			Habitat	Protect remaining high-quality off-channel habitat	X	X	5 - very high	~13% of target	
			Toxics	Monitor and/or restore contaminated sites	X	X	5 - very high	~13% of target	
			Temperature (Macrodetrital)	Protect/restore riparian areas	X	X	4 - high	~6% of target	
			Sediment, predation	Remove pile dikes		X	4 - high	~4% of target	
			Stranding	Reduce vessel wake stranding	X	X	3 - medium	~3% of target	
			Toxic	Implement pesticide/fertilizer BMPs	X	X	3 - medium	~2% of target	
			Habitat	Reduce noxious weeds	X	X	3 - medium	~2% of target	
			Predation	Redistribute Caspian terns		X	3 - medium	<1% of target	
			Predation	Redistribute cormorants		X	3 - medium	<1% of target	
			Flow, sediment	Use dredge materials beneficially	X	X	3 - medium	<1% of target	
			Sediment, predation	Reduce entrainment from dredging	X	X	2 - low	<1% of target	
			Exotic invertebrates	Prevent invertebrate introductions	X	X	2 - low	<1% of target	
C - Ends downstream of Longview	RM 38-63	STREAM TYPE (Snake River sockeye salmon, Lower Columbia River coho salmon, Upper Columbia River steelhead, Snake River steelhead, Lower Columbia River steelhead, Middle Columbia River steelhead, Upper Willamette River steelhead, Upper Columbia River spring chinook salmon and Snake River spring/summer chinook salmon)	Flow	Adjust the timing, magnitude, and frequency of flows	X	X	4 - high		~14% of target
			Habitat	Breach or lower dikes and levees	X	X	4 - high		~6% of target
			Temperature (Macrodetrital)	Protect/restore riparian areas	X	X	4 - high		~6% of target
			Predation	Reduce predation by pinnipeds		X	4 - high		n/a (adults only)
			Habitat	Protect remaining high-quality off-channel habitat	X	X	3 - medium		~5% of target
			Toxics	Monitor and/or restore contaminated sites	X	X	3 - medium		~5% of target
			Sediment, predation	Remove pile dikes		X	3 - medium		~2% of target
			Toxic	Implement pesticide/fertilizer BMPs	X	X	3 - medium		<1% of target
			Flow, sediment	Use dredge materials beneficially	X	X	2 - low		<1% of target
			Habitat	Reduce noxious weeds	X	X	2 - low		<1% of target
			Exotic invertebrates	Prevent invertebrate introductions	X	X	1 - very low		<1% of target
C - Ends downstream of Longview	RM 38-63	OCEAN TYPE (Columbia River chum salmon, Snake River Fall chinook, Upper Willamette River chinook salmon, and Lower Columbia River fall chinook salmon)	Habitat	Breach or lower dikes and levees	X	X	5 - very high	~15% of target	
			Flow	Adjust the timing, magnitude, and frequency of flows	X	X	5 - very high	~14% of target	
			Habitat	Protect remaining high-quality off-channel habitat	X	X	5 - very high	~13% of target	
			Toxics	Monitor and/or restore contaminated sites	X	X	5 - very high	~13% of target	
			Temperature (Macrodetrital)	Protect/restore riparian areas	X	X	4 - high	~6% of target	
			Sediment, predation	Remove pile dikes		X	4 - high	~4% of target	
			Stranding	Reduce vessel wake stranding	X	X	3 - medium	~3% of target	
			Toxic	Implement pesticide/fertilizer BMPs	X	X	3 - medium	~2% of target	
			Habitat	Reduce noxious weeds	X	X	3 - medium	~2% of target	
			Flow, sediment	Use dredge materials beneficially	X	X	3 - medium	<1% of target	
			Sediment, predation	Reduce entrainment from dredging	X	X	2 - low	<1% of target	
			Exotic invertebrates	Prevent invertebrate introductions	X	X	2 - low	<1% of target	

FCRPS Habitat Workgroup Table - Estuary

REACH Assessment Unit (AU)	River Mile	Ocean or Stream TYPE	Primary Limiting Factors (PLF)	Action	Spatial Structure	Life History Diversity	Estimated Implementation Benefits (scale 1-5)	Estimated Percent of Ocean Type Survival Improvement Target (juveniles only)	Estimated Percent of Stream Type Survival Improvement Target (juveniles only)
Select one from table	User defined, one per AU	One or both TYPES per AU	One or Multiple choices per TYPE	One or Multiple Actions per PLF			User defined, one per Action	20 % target defined by action, not reach (see Appendix A)	20 % target defined by action, not reach (see Appendix A)
			Flow	Adjust the timing, magnitude, and frequency of flows	X	X	4 - high		~14% of target
			Habitat	Breach or lower dikes and levees	X	X	4 - high		~6% of target
			Predation	Reduce predation by pinnipeds		X	4 - high		n/a (adults only)
			Toxics	Monitor and/or restore contaminated sites	X	X	3 - medium		~5% of target
			Toxic	Implement pesticide/fertilizer BMPs	X	X	3 - medium		<1% of target
			Sediment, predation	Remove pile dikes		X	3 - medium		~2% of target
			Toxic	Implement stormwater BMPs	X	X	2 - low		<1% of target
			Habitat	Reduce noxious weeds	X	X	2 - low		<1% of target
			Predation	Manage exotic fish		X	1 - very low		<1% of target
			Exotic invertebrates	Prevent invertebrate introductions	X	X	1 - very low		<1% of target
D - Longview to Kalama	RM 63-74	OCEAN TYPE (Columbia River chum salmon, Snake River Fall chinook, Upper Willamette River chinook salmon, and Lower Columbia River fall chinook salmon)	Habitat	Breach or lower dikes and levees	X	X	5 - very high	~15% of target	
			Flow	Adjust the timing, magnitude, and frequency of flows	X	X	5 - very high	~14% of target	
			Toxics	Monitor and/or restore contaminated sites	X	X	5 - very high	~13% of target	
			Toxics	Identify and reduce sources of pollutants	X	X	5 - very high	~11% of target	
			Sediment, predation	Remove pile dikes		X	4 - high	~4% of target	
			Stranding	Reduce vessel wake stranding	X	X	3 - medium	~3% of target	
			Predation	Reduce over-water structures		X	3 - medium	~2% of target	
			Toxic	Implement stormwater BMPs	X	X	3 - medium	~2% of target	
			Toxic	Implement pesticide/fertilizer BMPs	X	X	3 - medium	~2% of target	
			Habitat	Reduce noxious weeds	X	X	3 - medium	~2% of target	
			Sediment, predation	Reduce entrainment from dredging	X	X	2 - low	<1% of target	
			Exotic invertebrates	Prevent invertebrate introductions	X	X	2 - low	<1% of target	
			Predation	Manage exotic fish		X	2 - low	<1% of target	
			Flow	Adjust the timing, magnitude, and frequency of flows	X	X	4 - high		~14% of target
E - Kalama to Woodland	RM 74-86	STREAM TYPE (Snake River sockeye salmon, Lower Columbia River coho salmon, Upper Columbia River steelhead, Snake River steelhead, Lower Columbia River steelhead, Middle Columbia River steelhead, Upper Willamette River steelhead, Upper Columbia River spring chinook salmon and Snake River spring/summer chinook salmon)	Temperature (Macrodetrital)	Protect/restore riparian areas	X	X	4 - high		~6% of target
			Habitat	Breach or lower dikes and levees	X	X	4 - high		~6% of target
			Habitat	Protect remaining high-quality off-channel habitat	X	X	4 - high		~5% of target
			Toxics	Monitor and/or restore contaminated sites	X	X	3 - medium		~5% of target
			Predation	Reduce predation by pinnipeds		X	4 - high		n/a (adults only)
			Sediment, predation	Remove pile dikes		X	3 - medium		~2% of target
			Toxic	Implement pesticide/fertilizer BMPs	X	X	3 - medium		<1% of target
			Habitat	Reduce noxious weeds	X	X	2 - low		<1% of target
			Predation	Manage exotic fish		X	1 - very low		<1% of target
			Exotic invertebrates	Prevent invertebrate introductions	X	X	1 - very low		<1% of target

FCRPS Habitat Workgroup Table - Estuary

REACH Assessment Unit (AU)	River Mile	Ocean or Stream TYPE	Primary Limiting Factors (PLF)	Action	Spatial Structure	Life History Diversity	Estimated Implementation Benefits (scale 1-5)	Estimated Percent of Ocean Type Survival Improvement Target (juveniles only)	Estimated Percent of Stream Type Survival Improvement Target (juveniles only)
Select one from table	User defined, one per AU	One or both TYPES per AU	One or Multiple choices per TYPE	One or Multiple Actions per PLF			User defined, one per Action	20 % target defined by action, not reach (see Appendix A)	20 % target defined by action, not reach (see Appendix A)
E - Kalama to Woodland	RM 74-86	OCEAN TYPE (Columbia River chum salmon, Snake River Fall chinook, Upper Willamette River chinook salmon, and Lower Columbia River fall chinook salmon)	Habitat	Breach or lower dikes and levees	X	X	5 - very high	~15% of target	
			Flow	Adjust the timing, magnitude, and frequency of flows	X	X	5 - very high	~14% of target	
			Habitat	Protect remaining high-quality off-channel habitat	X	X	5 - very high	~13% of target	
			Toxics	Monitor and/or restore contaminated sites	X	X	5 - very high	~13% of target	
			Temperature (Macrodetrital)	Protect/restore riparian areas	X	X	4 - high	~6% of target	
			Sediment, predation	Remove pile dikes		X	4 - high	~4% of target	
			Stranding	Reduce vessel wake stranding	X	X	3 - medium	~3% of target	
			Toxic	Implement pesticide/fertilizer BMPs	X	X	3 - medium	~2% of target	
			Habitat	Reduce noxious weeds	X	X	3 - medium	~2% of target	
			Sediment, predation	Reduce entrainment from dredging	X	X	2 - low	<1% of target	
			Predation	Manage exotic fish		X	2 - low	<1% of target	
			Exotic invertebrates	Prevent invertebrate introductions	X	X	2 - low	<1% of target	
F - Lewis River to Salmon Creek	RM 86-103	STREAM TYPE (Snake River sockeye salmon, Lower Columbia River coho salmon, Upper Columbia River steelhead, Snake River steelhead, Lower Columbia River steelhead, Middle Columbia River steelhead, Upper Willamette River steelhead, Upper Columbia River spring chinook salmon and Snake River spring/summer chinook salmon)	Flow	Adjust the timing, magnitude, and frequency of flows	X	X	4 - high		~14% of target
			Predation	Reduce predation by pinnipeds		X	4 - high		n/a (adults only)
			Habitat	Breach or lower dikes and levees	X	X	4 - high		~6% of target
			Toxics	Monitor and/or restore contaminated sites	X	X	3 - medium		~5% of target
			Sediment, predation	Remove pile dikes		X	3 - medium		~2% of target
			Toxic	Implement pesticide/fertilizer BMPs	X	X	3 - medium		<1% of target
			Habitat	Reduce noxious weeds	X	X	2 - low		<1% of target
			Predation	Manage exotic fish		X	1 - very low		<1% of target
			Exotic invertebrates	Prevent invertebrate introductions	X	X	1 - very low		<1% of target
F - Lewis River to Salmon Creek	RM 86-103	OCEAN TYPE (Columbia River chum salmon, Snake River Fall chinook, Upper Willamette River chinook salmon, and Lower Columbia River fall chinook salmon)	Habitat	Breach or lower dikes and levees	X	X	5 - very high	~15% of target	
			Flow	Adjust the timing, magnitude, and frequency of flows	X	X	5 - very high	~14% of target	
			Habitat	Protect remaining high-quality off-channel habitat	X	X	5 - very high	~13% of target	
			Toxics	Monitor and/or restore contaminated sites	X	X	5 - very high	~13% of target	
			Temperature (Macrodetrital)	Protect/restore riparian areas	X	X	4 - high	~6% of target	
			Sediment, predation	Remove pile dikes		X	4 - high	~4% of target	
			Stranding	Reduce vessel wake stranding	X	X	3 - medium	~3% of target	
			Toxic	Implement pesticide/fertilizer BMPs	X	X	3 - medium	~2% of target	
			Habitat	Reduce noxious weeds	X	X	3 - medium	~2% of target	
			Sediment, predation	Reduce entrainment from dredging	X	X	2 - low	<1% of target	
			Predation	Manage exotic fish		X	2 - low	<1% of target	
			Exotic invertebrates	Prevent invertebrate introductions	X	X	2 - low	<1% of target	

FCRPS Habitat Workgroup Table - Estuary

REACH Assessment Unit (AU)	River Mile	Ocean or Stream TYPE	Primary Limiting Factors (PLF)	Action	Spatial Structure	Life History Diversity	Estimated Implementation Benefits (scale 1-5)	Estimated Percent of Ocean Type Survival Improvement Target (juveniles only)	Estimated Percent of Stream Type Survival Improvement Target (juveniles only)
Select one from table	User defined, one per AU	One or both TYPES per AU	One or Multiple choices per TYPE	One or Multiple Actions per PLF			User defined, one per Action	20 % target defined by action, not reach (see Appendix A)	20 % target defined by action, not reach (see Appendix A)
			Flow	Adjust the timing, magnitude, and frequency of flows	X	X	4 - high		~14% of target
			Predation	Reduce predation by pinnipeds		X	4 - high		n/a (adults only)
			Habitat	Breach or lower dikes and levees	X	X	4 - high		~6% of target
			Temperature (Macrodetrital)	Protect/restore riparian areas	X	X	4 - high		~6% of target
			Toxics	Monitor and/or restore contaminated sites	X	X	3 - medium		~5% of target
			Habitat	Protect remaining high-quality off-channel habitat	X	X	3 - medium		~5% of target
			Sediment, predation	Remove pile dikes		X	3 - medium		~2% of target
			Toxic	Implement pesticide/fertilizer BMPs	X	X	3 - medium		<1% of target
			Toxic	Implement stormwater BMPs	X	X	2 - low		<1% of target
			Habitat	Reduce noxious weeds	X	X	2 - low		<1% of target
			Predation	Manage exotic fish		X	1 - very low		<1% of target
			Predation	Reduce over-water structures		X	1 - very low		<1% of target
			Exotic invertebrates	Prevent invertebrate introductions	X	X	1 - very low		<1% of target
			Habitat	Breach or lower dikes and levees	X	X	5 - very high	~15% of target	
			Flow	Adjust the timing, magnitude, and frequency of flows	X	X	5 - very high	~14% of target	
			Habitat	Protect remaining high-quality off-channel habitat	X	X	5 - very high	~13% of target	
			Toxics	Monitor and/or restore contaminated sites	X	X	5 - very high	~13% of target	
			Toxics	Identify and reduce sources of pollutants	X	X	5 - very high	~11% of target	
			Sediment, predation	Remove pile dikes		X	4 - high	~4% of target	
			Predation	Reduce over-water structures		X	3 - medium	~2% of target	
G - Salmon Creek to Reed Island	RM 103-128	OCEAN TYPE (Columbia River chum salmon, Snake River Fall chinook, Upper Willamette River chinook salmon, and Lower Columbia River fall chinook salmon)	Habitat	Reduce noxious weeds	X	X	3 - medium	~2% of target	
			Toxic	Implement stormwater BMPs	X	X	3 - medium	~2% of target	
			Toxic	Implement pesticide/fertilizer BMPs	X	X	3 - medium	~2% of target	
			Predation	Reduce over-water structures		X	3 - medium	~2% of target	
				Manage exotic fish		X	2 - low	<1% of target	
			Predation	Prevent invertebrate introductions	X	X	2 - low	<1% of target	
			Flow	Adjust the timing, magnitude, and frequency of flows	X	X	4 - high		~14% of target
			Temperature (Macrodetrital)	Protect/restore riparian areas	X	X	4 - high		~6% of target
			Habitat	Protect remaining high-quality off-channel habitat	X	X	3 - medium		~5% of target
			Toxics	Monitor and restore contaminated sites	X	X	3 - medium		~5% of target
			Predation	Reduce predation by pinnipeds		X	4 - high		n/a (adults only)
H - Reed Island to Bonneville Dam	RM 128-147	STREAM TYPE (Snake River sockeye salmon, Lower Columbia River coho salmon, Upper Columbia River steelhead, Snake River steelhead, Lower Columbia River steelhead, Middle Columbia River steelhead, Upper Willamette River steelhead, Upper Columbia River spring chinook salmon and Snake River spring/summer chinook salmon)	Sediment, predation	Remove pile dikes		X	3 - medium		~2% of target
			Toxic	Implement pesticide/fertilizer BMPs	X	X	3 - medium		<1% of target
			Habitat	Reduce noxious weeds	X	X	2 - low		<1% of target
			Predation	Manage exotic fish		X	1 - very low		<1% of target
			Exotic invertebrates	Prevent invertebrate introductions	X	X	1 - very low		<1% of target
			Flow	Adjust the timing, magnitude, and frequency of flows	X	X	5 - very high	~14% of target	

FCRPS Habitat Workgroup Table - Estuary

REACH Assessment Unit (AU)	River Mile	Ocean or Stream TYPE	Primary Limiting Factors (PLF)	Action	Spatial Structure	Life History Diversity	Estimated Implementation Benefits (scale 1-5)	Estimated Percent of Ocean Type Survival Improvement Target (juveniles only)	Estimated Percent of Stream Type Survival Improvement Target (juveniles only)
Select one from table	User defined, one per AU	One or both TYPES per AU	One or Multiple choices per TYPE	One or Multiple Actions per PLF			User defined, one per Action	20 % target defined by action, not reach (see Appendix A)	20 % target defined by action, not reach (see Appendix A)
H - Reed Island to Bonneville Dam	RM 128-147	OCEAN TYPE (Columbia River chum salmon, Snake River Fall chinook, Upper Willamette River chinook salmon, and Lower Columbia River fall chinook salmon)	Habitat	Protect remaining high-quality off-channel habitat	X	X	5 - very high	~13% of target	
			Toxics	Monitor and/or restore contaminated sites	X	X	5 - very high	~13% of target	
			Temperature (Macrodetrital)	Protect/restore riparian areas	X	X	4 - high	~6% of target	
			Sediment, predation	Remove pile dikes		X	4 - high	~4% of target	
			Toxic	Implement pesticide/fertilizer BMPs	X	X	3 - medium	~2% of target	
			Habitat	Reduce noxious weeds	X	X	3 - medium	~2% of target	
			Predation	Manage exotic fish		X	2 - low	<1% of target	
			Exotic invertebrates	Prevent invertebrate introductions	X	X	2 - low	<1% of target	