# Supplemental Biological Assessment
## of the Effects of the Willamette River Basin Flood Control Project on Species Listed Under the Endangered Species Act

*Submitted by:*

**U.S. Army Corps of Engineers, Portland District**
**Bonneville Power Administration**
**Bureau of Reclamation**

*Submitted to:*

**National Marine Fisheries Service**
**U.S. Fish and Wildlife Service**

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# ACRONYMS AND ABBREVIATIONS

| | |
|---|---|
| AAR | After Action Review |
| BA | Biological Assessment |
| BiOp | Biological Opinion |
| BKD | bacterial kidney disease |
| BLM | Bureau of Land Management |
| BMP | best management practice |
| BPA | Bonneville Power Administration |
| CAP | Continuing Authorities Program |
| CE/ICA | cost effectiveness/incremental cost analysis |
| cfs | cubic feet per second |
| CG | Construction General |
| CPEC | Construction Projects Environmental Coordinating Committee |
| CRHRP | Columbia River Hatchery Reform Project |
| CWA | Clean Water Act |
| CWT | coded wire tag(s) |
| DDR | Detailed Design Report |
| DO | dissolved oxygen |
| DPS | Distinct Population Segment |
| ECC | (Cougar) Environmental Coordination Committee |
| EFH | Essential Fish Habitat |
| EIS | Environmental Impact Statement |
| ER | Engineer Regulation |
| ERGO | Environmental Review Guide for Operations |
| ESA | Endangered Species Act |
| ESU | Evolutionarily Significant Unit |
| EWEB | Eugene Water & Electric Board |
| FCA | Flood Control Act |
| FCRPS | Federal Columbia River Power System |
| FERC | Federal Energy Regulatory Commission |
| FM | Flow Management Committee |
| FPHM | Fish Passage and Hatchery Management Committee |
| FPMP | Fish Passage and Management Plan |
| FPOM | Columbia Basin Fish Passage Operations and Maintenance Committee |
| FR | Federal Register |
| FY | fiscal year |
| GI | General Investigations (Program) |
| gpm | gallon(s) per minute |
| HD | House Document |
| HGMP | Hatchery and Genetic Management Plan |
| HSRG | Hatchery Scientific Review Group |
| IHOT | Integrated Hatchery Operations Team |
| ITS | Incidental Take Statement |
| LCREP | Lower Columbia River Estuary Partnership |
| LWD | large woody debris |

## Acronyms and Abbreviations (continued)

| | |
|---|---|
| MAF | million acre-feet |
| mg/L | milligram(s) per liter |
| MSA | Magnuson-Stevens Fishery Conservation and Management Act |
| NEPA | National Environmental Policy Act |
| NMFS | National Marine Fisheries Service |
| NPCC | Northwest Power and Conservation Council |
| NPDES | National Pollutant Discharge Elimination System |
| NTP | natural thermal potential |
| NTU | nephelometric turbidity unit(s) |
| O&M | operations and maintenance |
| ODEQ | Oregon Department of Environmental Quality |
| ODFW | Oregon Department of Fish and Wildlife |
| OPRD | Oregon Parks and Recreation Department |
| OWEB | Oregon Watershed Enhancement Board |
| OWRD | Oregon Water Resources Department |
| PAC | post-authorization change |
| PCE | primary constituent element(s) |
| PED | preconstruction engineering and design |
| PFC | proper functioning condition |
| Reclamation | Bureau of Reclamation |
| RM | river mile (s) |
| RM&E | research, monitoring and evaluation |
| ROD | Record of Decision |
| RPA | reasonable and prudent alternative |
| SCAB | Steelhead and Chinook above Barriers (Committee) |
| SRP | Sustainable Rivers Project |
| STEP | Salmon and Trout Enhancement Program |
| TDG | total dissolved gas |
| TMDL | total maximum daily load |
| TNC | The Nature Conservancy |
| TU | temperature unit(s) |
| UPA | Updated Proposed Action |
| USACE | U.S. Army Corps of Engineers |
| USEPA | U.S. Environmental Protection Agency |
| USFS | U.S. Forest Service |
| USGS | U.S. Geological Survey |
| USFWS | U.S. Fish and Wildlife Service |
| UWR | Upper Willamette River |
| VSP | viable salmonid population |
| WATER | Willamette Action Team for Ecosystem Restoration |
| WCP | Willamette Conservation Plan |
| W/LC TRT | Willamette/Lower Columbia Technical Recovery Team |
| WQMP | Water Quality Management Plan |
| WQTC | Water Quality and Temperature Control Committee |
| WTC | water temperature control |

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## APPENDICES

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Appendix B – Willamette Mainstem Flow Operations Strategy
Appendix C – Willamette Mainstem and Tributary Flow Summary
Appendix D – Water Marketing Program

# 1. PURPOSE AND SCOPE OF THE SUPPLEMENTAL BIOLOGICAL ASSESSMENT

This document supplements the April 2000 *Biological Assessment of the Effects of the Willamette River Basin Flood Control Project on Species Listed under the Endangered Species Act* (USACE 2000). The 2000 Biological Assessment (BA) was prepared to meet the requirements of the U.S. Army Corps of Engineers (USACE) under Section 7 of the Endangered Species Act (ESA) with regard to continued operation and maintenance of the Willamette River Basin Project, Oregon, a system of 13 dams and reservoirs (11 are multiple purpose storage reservoirs and 2 are re-regulating reservoirs), an authorized navigation channel, and bank protection works (collectively called the Willamette Project; Figure 1-1).

In the 2000 BA (USACE 2000), the proposed action described the operation and maintenance of the Willamette Project prior to listing of the Upper Willamette River (UWR) spring Chinook salmon (*Oncorhynchus tshawytscha*) and winter steelhead (*Oncorhynchus mykiss*) Evolutionarily Significant Units (ESUs) as threatened in 1999 [64 *Federal Register* (FR) 14308, March 24, 1999]. The 2000 BA concluded that continued operation of the Willamette Project was "likely to adversely affect" a number of species listed as threatened or endangered by the National Marine Fisheries Service (NMFS) and U.S. Fish and Wildlife Service (USFWS; collectively called the "Services" in this BA). The 2000 BA was submitted to the Services with a request for simultaneous consultation. The Bonneville Power Administration (BPA) and Bureau of Reclamation (Reclamation) joined the USACE as "Action Agencies" in the consultation.

In January 2006, the USACE notified the Services of the Action Agencies' decision to prepare a supplement to the 2000 BA and revising the proposed action. The Supplemental BA provides an update on the biological information for listed species, the environmental baseline condition, and analysis of the effects of the revised proposed action. The intent of the Supplemental BA is not to replace the 2000 BA, but to provide information on the changes influencing the consultation since the 2000 BA was completed; hence, it is not intended to be a stand alone document. Unless otherwise stated herein, the elements of the revised proposed action supplement the proposed action described in the 2000 BA; the base operation for the Willamette Project to meet authorized purposes remains in place. Likewise, the analysis of effects of the revised proposed action described in the Supplemental BA focuses on changes from the analysis of effects described in the 2000 BA.

**Figure 1-1. Willamette Project**

# 2. BACKGROUND

This section provides information on the changes influencing the Willamette Project consultation since the 2000 BA (USACE 2000) was completed.

## 2.1. History of the Willamette Project Consultation

Formal ESA Section 7 consultation on continued operation and maintenance of the Willamette Project was initiated in April 2000 with completion of the BA (USACE 2000). The proposed action contained in the 2000 BA was based on operation of the Willamette Project prior to the ESA-listing of spring Chinook salmon and winter steelhead in 1999. The 2000 BA concluded that the proposed action was "likely to adversely affect" several fish species and one plant species. On the basis of this finding, the USACE requested formal consultation with the Services. The BPA and Reclamation joined the USACE as Action Agencies for the Section 7 consultation.

The initial formal consultation meeting was held on August 1, 2000. In September 2000, the Services provided a preliminary joint federal review draft Biological Opinion (BiOp). The Action Agencies provided a consolidated written response to the federal review draft BiOp in January 2001.

On March 3, 2001 the Services transmitted a revised draft Reasonable and Prudent Alternative (RPA) and Incidental Take Statement (ITS) provided to the Action Agencies. The draft RPA/ITS was based on the federal review draft BiOp. On April 25 2001, the Action Agencies provided consolidated comments back to the Services on the draft RPA/ITS. The Action Agencies expressed concerns about the approach taken by the Services to define the baseline conditions and the effects of the proposed action, as well as a number of other considerations. The Action Agencies also expressed concern that they did not have the authority to implement many of the actions specified in the draft RPA/ITS.

From March 2001 through February 2002, the Action Agencies and the Services worked collaboratively to refine the draft RPA/ITS. A key element of this process was development of mainstem and tributary flow management protocols developed specifically to address flow management operations in extremely dry years, such as those experienced in 2001 in the Willamette Basin. The flow management protocols were implemented beginning in water year 2002 and have been used to guide flow management in the Willamette Basin since that time.

On November 13, 2001 the Action Agencies and the Services met jointly with representatives of the Grand Ronde, Siletz, and Warm Springs tribes for informal coordination regarding the scope and content of the Willamette Project ESA consultation.

In May 2002, the Action Agencies submitted an amendment to the 2000 BA (USACE 2000) raising a potential release of 95,000 acre-feet of water contracted through Reclamation for irrigation. Also, in September 2002, the Action Agencies and the Services agreed to a Management Forum to provide management level oversight to the continuing Willamette Project ESA consultation. The participating federal agencies agreed to the following principles:

- Collaborate to develop mutually agreeable outcomes.
- Avoid jeopardy based on best available scientific and commercial information.
- Establish RPA actions that can be implemented and make progress toward improved survivability of listed species.

- Commit to an All-H strategy and prioritization and allocation of resources Willamette as an integral part of the Federal Columbia River Power System (FCRPS) and Columbia Basin fish recovery efforts.
- Seek consistency with other BiOps and policy documents within the region, including approaches and policies already addressed by the federal agencies.
- Development of an acceptable RPA has a higher priority than completing the consultation by an unreasonable deadline.

In February 2003, the Services notified the Action Agencies that, due to differences in internal agency policies and procedures for processing ESA Section 7 consultations, they would no longer attempt to provide a single joint BiOp. The Services would provide separate BiOps specific to the species for which they were responsible under ESA. The Services remained committed to a joint consultation process and would work closely to ensure that the RPAs contained in their respective BiOps would be consistent and compatible.

In June 2003, U.S. District Court Judge James Redden ordered the NMFS to revise its 2000 FCRPS BiOp because the actions in the BiOp by non-federal entities were not certain to occur and provide desired biological benefits. In revising the BiOp, the NMFS reviewed an updated proposed action (UPA) from the Action Agencies and determined it would not jeopardize listed species. The UPA replaced the RPA the Action Agencies agreed to implement following issuance of the 2000 BiOp.

In July 2003, the NMFS submitted a revised draft BiOp, Chapters 1-8, to the Action Agencies for review and comment. This was followed in 2004 by the USFWS draft BiOp, Chapters 1-8, submitted to the Action Agencies for review. On April 26, 2004, the NMFS provided a preliminary revised draft RPA. The revised RPA was not for review and comment at that time; it was provided to establish a basis for understanding the affects assessment in Chapters 1-8.

On December 28, 2004, the Action Agencies provided consolidated comments on the NMFS revised draft BiOp, Chapters 1-8, identifying a number of key areas of concern that the Action Agencies believed should be resolved before consultation is finalized. These key areas included:

- Relationship of the draft Willamette BiOp to the FCRPS BiOp and remand activities.
- Jeopardy analysis framework characterization of baseline environmental conditions as compared to effects of the proposed action.
- Use of properly functioning condition (PFC) approach.
- Application of the jeopardy standard.
- Proposed critical habitat designations.
- Identification of priority impacts, actions and measures.
- Hatchery program effects on natural production.
- Treatment of fish passage as an effect of the proposed action as opposed to environmental baseline condition.
- Development of performance standards and measures.
- Description of cumulative effects.

In June 2005, the NMFS released a final revised Hatchery Listing Policy. The revised policy was developed in response to the September 2001 ruling by Judge Redden of the 9$^{th}$ Circuit Court that any hatchery population that is part of the same Endangered Species Unit (ESU) as a listed wild population must also be listed under ESA. NMFS decided to modify its previous policy to conform to this ruling. The policy applies to ESA listing determinations for Pacific salmon and steelhead including upper Willamette spring Chinook and winter steelhead ESUs.

In October 2005, Judge Redden remanded the 2004 FCRPS BiOp. The Willamette Project consultation experienced some delays due to the uncertainties associated with ESA consultations on operations of existing federal reservoir systems stemming from the ongoing FCRPS consultation.

On January 3, 2006, the USACE notified the Services of the Action Agency decision to prepare a revised proposed action and supplement to the 2000 BA. A key element of the revised proposed action was to integrate hatchery operations and recommendations for hatchery reform associated with development of Hatchery Genetic Management Plans (HGMPs) in coordination with Oregon Department of Fish and Wildlife (ODFW). The ESA coverage for Willamette Basin hatcheries operated by ODFW as mitigation for impacts of the Willamette Project was previously covered under a 2001 NMFS BiOp, which lapsed in 2004. The Action Agencies agreed that since hatchery operations and management of hatchery fish was closely related to project operations, rather than addressing them as separate consultations they should be integrated into the same proposed action.

In addition to hatchery operations, the Supplemental BA would include a revised proposed action that would more accurately reflect current operations of the Willamette Project particularly mainstem and tributary flow modifications implemented subsequent to 1999. Also, the Supplemental BA would identify new measures to address ESA-listed species requirements that the Action Agencies have the authority to implement including:

- Changes to reservoir management implemented subsequent to the 2000 BA, including mainstem and tributary minimum flow objectives.
- Completion of the selective withdrawal tower at Cougar Dam and actions underway to address fish passage and related issues at Cougar and Blue River dams under the Willamette Temperature Control Project.
- Strategies for reform of fish hatchery operations and associated mitigation.
- Habitat restoration actions undertaken on project lands through our natural resources stewardship responsibilities, as well as off site under the USACE General Investigation (GI) and Continuing Authorities Program (CAP).
- Evaluation of the potential feasibility and effectiveness of proposed major structural modifications at the dams to address ESA issues, including improved fish passage and handling, temperature control and hatchery facilities at projects other than Blue River and Cougar dams.
- Strategies for integrating the various operational, structural, habitat, and hatchery measures across the basin that enhance their effectiveness and take advantage of synergies that may exist.
- The water marketing program, including water service supply contracts from the reservoirs.
- Update and accurately describe our ongoing research, monitoring, and evaluation (RM&E) program in the Willamette Basin and develop a comprehensive RM&E plan that better meets ESA requirements.

In a series of recent decisions, the 9th Circuit Court of Appeals has reemphasized that the goal of the ESA is recovery of the listed species; *Gifford Pinchot Task Force v. United States Fish & Wildlife Service*, 378 F.3d 1059 (9th Cir. 2004) and *NWF v. NMFS*, No. 06-35011 (9th Cir. , April 9, 2007, slip opinion).

### 2.1.1. Relationship to the FCRPS Consultation

Throughout the Willamette Project ESA consultation, the Action Agencies and Services have considered the degree to which it should be consistent with other ESA consultations within the region, especially the ongoing ESA activities related to the federal projects on the Columbia and

Snake River mainstems being collectively addressed under the FCRPS BiOp. Although the FCRPS and Willamette system operations are separate actions, they share many similarities and are closely linked. Both involve complex continued operations of systems of multiple purpose reservoirs federally authorized to a meet variety of operating purposes. The ESA species being addressed in the consultations are similar and in some cases involve overlapping ESUs. The parties involved in both consultations, including the Action Agencies and Services, are similar.

The Willamette consultation has trailed behind the FCRPS consultation in that Columbia River ESUs of salmonids received ESA listing earlier than the Willamette ESUs. Since 1999, NMFS has completed four separate BiOps for the FCRPS operation. Both the Action Agencies and Services agreed that the approaches and procedures applied to the FCRPS should generally be adhered to in the Willamette Basin to the extent practicable.

In October 2005, U.S. District Court Judge James Redden found the 2004 FCRPS BiOp invalid and remanded it to NMFS. Judge Redden directed NMFS to work with the sovereign parties (the Action Agencies, tribes, and States of Oregon, Idaho, Washington and Montana) to develop a new BiOp. Since November of 2005, the parties have been working diligently toward completing the new FCRPS proposed action and BiOp as part of a broader overall salmon recovery effort. In indirect response to the FCRPS remand, in January 2006 the Action Agencies decided to revise the proposed action presented in the Willamette 2000 BA to more accurately reflect current operations of the Willamette Project, and to identify new measures to address ESA requirements the Action Agencies have authority to implement.

## 2.2. Willamette Project Authorizations

One of the primary purposes of this Supplemental BA is to present a revised proposed action for addressing ESA concerns associated with continued operation and maintenance of the Willamette Project. The revised proposed action includes potential mitigation measures for ESA species not included in the proposed action in the 2000 BA (USACE 2000), but which are within the scope of the Action Agency's current missions, authorities, and programs. There have been no significant changes in Willamette Project authorizations since the 2000 BA.[1] However, in response to the draft RPA/ITS submitted to the Action Agencies by the Services in 2001 and 2003, the USACE Portland District Office of Counsel undertook a legal review of project authorizations. Some key conclusions and recommendations of that review are provided below.

[1] The Willamette Project was authorized principally by three separate successive Flood Control Acts (FCAs): 1938, 1950 and 1960. The 1938 FCA authorization led to the construction of Fern Ridge, Dorena, Cottage Grove, Detroit and Lookout Point dams. The 1950 FCA authorization greatly expanded the Willamette Project both in numbers of projects and scope, with the Willamette Basin the subject of the entire Volume 5 of the 8-volume Columbia River Basin-wide HD 531 authorization document. The 1950 FCA reauthorized the earlier dams, including Green Peter, which had not been started, and added the following dams: Big Cliff (re-regulating dam for Detroit) on the North Santiam, Cougar and Blue River dams on the McKenzie River, Hills Creek and Dexter (re-regulating for Lookout Point) on the Middle Fork Willamette River, and Fall Creek. The 1950 FCA also authorized four other dams in the basin which were never built and were subsequently deauthorized: Cascadia on the South Fork of the Santiam, Holley on the Calapooia, and Gate Creek and Strube (re-regulating for Cougar) on the McKenzie. The 1960 FCA substituted a larger Foster Dam for two dams on the Middle Fork and South Santiam. The Water Resources Development Act of 1990 added environmental protection as a primary purpose at all USACE water resource projects. The water temperature control tower at Cougar Dam was authorized by the Water Resources Development Act of 1996 and reauthorized in the Water Resources Act of 1999 (which increased the authorization funding limit).

- Although there are multiple project authorities pertaining to development of the Willamette Project, House Document (HD) 531, authorized by the Flood Control Act of May 17, 1950 (81st Congress, 2nd Session), remains the overall guiding legislation pertaining to operation and maintenance of the project. It provides the basic authorization for balancing operations of the system to meet authorized operating purposes.
- The Willamette Project was authorized with the full recognition that it would cut off extensive areas of upstream habitat for migratory salmon and steelhead (HD 531, Appendix J, Willamette River Basin, p. 1732-1734, paragraphs 181-185, especially 181).
- To compensate for this loss of fish habitat, a series of fish hatcheries were authorized; some new, some in replacement of Oregon state hatcheries that would be destroyed by the dams and reservoirs. In addition, HD 531 contained continuing authority for the USACE to construct fish passage facilities at several of the dams in the basin. It also contained language from Congress encouraging the USACE to try to solve the problem of fish passage over high-head dams of the type to be constructed in the Willamette Basin [HD 531, Appendix J, Willamette River Basin; p. 1746-1747, para. 236; p. 1765, para. 305 (Cougar Dam); para. 384 (White Bridge Dam later moved to Foster under the 1960 Rivers and Harbors Act; para. 411 (hatchery summary); and para. 532 (continue efforts at fish passage)].
- There are two essential legal guiding principles in development of the revised proposed action in the Supplemental BA: (1) to determine what the Action Agencies are legally authorized and required to do in regard to ESA mitigation actions; and (2) to determine what the Action Agencies are legally funded to do. Both guiding principles are based upon requirements of the U.S. Constitution in Article I, Sections 8 and 9, as further amplified by federal statutes, regulations, and case law. No federal agency can act without specific statutory authority and without specific Congressional appropriations per the U.S. Constitution.
- The legal principles of "conflict of laws" also apply. The ESA generally requires that federal agencies do all that they can do for listed species – limited by the requirements of the Constitution, treaties, and other federal law. While the ESA in many ways prevails over other legal requirements, the ESA does not repeal any federal statute, treaty, or Constitutional provision, nor does the ESA confer legal authority that an agency did not otherwise have except to protect ESA-listed species.

The Action Agency position with respect to this legal review is that the Action Agencies may not include measures or activities in the revised proposed action for which they do not currently have implementation authority and appropriation. The Action Agencies do generally have broad authorities to evaluate and make recommendations for ESA and related mitigation measures through their agency review and approval procedures. Where there is regional consensus among the Action Agencies, the Services, and other federal and state resource agencies that potential measures would be technically feasible, biologically justified, and cost effective for protecting and recovering ESA-listed species, the Action Agencies are willing to seek the necessary authorization and appropriation for implementation of the potential ESA measures. However, implementation of the measures would be contingent upon favorable administration support and Congressional authorization and funding.

In addition, the original project authorities all contained specifically enumerated purposes for the operation of the projects. While ESA has a priority, ESA does not repeal other statutes, nor does it obviate the need to meet other authorized purposes. Similarly other general statutes such as the 1972 and 1977 Clean Water Act (CWA) do not repeal specific statutes such as the 1938, 1950, and 1960 FCAs for the Willamette Project.

In giving priorities to recovery measures, it must be recognized that the USACE cannot acquire any real estate without specific statutory authority. While this is not particularly an issue for recovery

measures at USACE dams and reservoirs where the original project real estate rights generally cover project needs, it is a major problem for recovery measures proposed for areas outside the dam and reservoir zones owned by the USACE. In the Willamette Valley, generally the largest federal land owner is the U.S. Forest Service (USFS). Otherwise, most of Willamette Valley lands are in private ownership. What this means in effect is that most recovery measures outside the USACE's dam, hatcheries, and reservoir zones require the voluntary participation of private parties.

## 2.3. Operational Flexibility, Coordination and Discretionary Management

The 2000 BA (USACE 2000) provided a description of operating requirements to meet the authorized operating purposes of the Willamette Project as a system and at the individual dams. No changes to basic authorized operating purposes are contemplated in the Supplemental BA. However, the USACE has a high degree of operational flexibility in determining how to meet the authorized operating purposes. Since the 1999 listing of spring Chinook salmon and winter steelhead, particularly from 2001 through 2007, the USACE has demonstrated a concerted effort to apply increasing flexibility to the operation Willamette Project to better meet the life cycle requirements of those and other ESA-listed species. Application of this operational flexibility for ESA species is not reflected in the 2000 BA. Specific examples of ESA-related operational flexibility include:

- Development and implementation of spring mainstem flow targets to support migration of ESA-listed species.
- Modification of tributary targets to better meet downstream ecological requirements.
- Shifting of reservoir storage and release priorities to provide better reservoir habitat conditions during critical life-cycle periods of listed species, such as maintaining Oregon chub (*Oregonichthys crameri*) spawning requirements in Lookout Point Reservoir.
- Shifting reservoir storage and release schedules to better balance downstream ecological needs in the system, such as moving forward the drawdown priority for Green Peter Reservoir to balance mainstem flow augmentation targets across the system.

These and other specific flow management changes are presented in Section 3.3, *Flow Management*. These adjustments were made in coordination with the Willamette Interagency Flow Management Work Group. The Flow Management Work Group is an ad hoc committee with representation from the Services and all other federal and state agencies with water management responsibility in the Willamette Basin. While the USACE has ultimate authority for management decisions associated with operation of the Willamette Project, the agency may not do so unilaterally. The USACE is committed to managing the reservoir system in close collaboration with the Work Group, which provides support in balancing ESA and other operating requirements across the system.

The Flow Management Work Group assists the USACE in developing annual operating plans for the Willamette Project based on long-term water management goals and objectives. The Work Group then collaborates on implementation of those plans through real-time seasonal adjustments based on variations in actual hydrologic conditions. The Work Group has been effective in assisting the USACE to adaptively manage the Willamette Project to meet changing conditions and water needs in the Willamette Basin.

## 2.4. Coordination with Oregon Department of Fish and Wildlife

Because of their role as the primary fisheries co-managing agency in the Willamette River Basin, the development of the revised proposed action has been coordinated with ODFW. The ODFW has had input into most of the major elements of the revised proposed action and will play a key role in its

implementation. Of particular importance, the USACE and BPA fund the ODFW to operate all facilities associated with the Willamette Hatchery Mitigation program. The State of Oregon contributes additional funds to each facility (with the exception of Leaburg Hatchery) based on percentages established in the 1990 Cooperative Agreement between the USACE and the State of Oregon (Table 2-1). At facilities receiving State of Oregon funding, the ODFW often raises fish not associated with the USACE mitigation responsibilities. These programs are not part of the revised proposed action developed in the Supplemental BA.

**Table 2-1. Federal and State Funding Contributions to Hatchery Facilities and Programs in the Willamette Basin**

| Hatchery | Primary Hatchery Program | Funding Contribution * | |
|---|---|---|---|
| | | USACE/BPA | ODFW |
| Marion Forks Hatchery | North Santiam Spring Chinook | 83.75% | 16.25% |
| South Santiam Hatchery | South Santiam Spring Chinook<br>Summer Steelhead | 70% | 30% |
| McKenzie Hatchery | McKenzie Spring Chinook | 50% | 50% |
| Leaburg trout Hatchery | Rainbow Trout | 100% | 0% |
| Willamette Hatchery | Middle Fork Willamette Spring Chinook | 83.75% | 16.25% |

* As identified in the 1990 Cooperative Agreement.

**Hatchery Genetic Management Plans and ESA Coverage**

At the time NMFS issued the 2000 Hatchery BiOp, hatchery fish were not included as part of any ESU. In June 2005, the NMFS listed the USACE's spring Chinook hatchery (i.e., artificial propagation) programs in the Willamette Basin as part of the UWR spring Chinook ESU. The ODFW developed Hatchery and Genetic Management Plans (HGMPs) for these programs that described each program, identified any potential adverse effects on the ESU, and suggested improvements to hatchery practices and facilities. The HGMPs are being revised by USACE and ODFW to be consistent with regional hatchery reform efforts including intentional incorporation of ESA-listed fish of both hatchery and natural-origin into the broodstock. Thus, all spring Chinook programs involve the direct take of ESA-listed fish and must be evaluated by NMFS under Limit 5 of the 4(d) Rule, which allows take of ESA-listed fish by a hatchery program with an approved HGMP. The NMFS will process the four spring Chinook HGMPs for USACE-funded programs concurrently through the National Environmental Policy Act (NEPA) process. Upon approval of the HGMPs, NMFS will issue separate letters to ODFW and the USACE that describe the extent of allowable direct and incidental take permissible under the 4(d) Rule. The effects of these programs will also be incorporated into the analysis of effects in the NMFS BiOp expected as a result of the Supplemental BA.

The summer steelhead and rainbow trout programs involve only incidental take of ESA-listed species and also will addressed in the BiOp. The BiOp will provide direct ESA coverage to the USACE and BPA, and indirect coverage to ODFW who operates the facilities via the Cooperative Agreement with the USACE.

### 2.4.1. Integration of Hatchery and Project Operation Consultations

On March 29, 2000, the USACE and BPA requested initiation of Section 7(a)(2) consultation on the impacts of the artificial propagation programs in the Willamette Basin on listed Upper Willamette River (UWR) spring Chinook salmon and winter steelhead ESUs. Shortly thereafter, the Action

Agencies issued the 2000 BA (USACE 2000) and requested initiation of a separate ESA Section 7 consultation on the impacts of the Willamette Project and maintenance of 42 miles of revetments on ESA-listed species (USACE 2000).

On July 14, 2000, the NMFS issued a *Biological Opinion on the Impacts from Collection, Rearing, and Release of Salmonids Associated with Artificial Propagation Programs in the Upper Willamette Spring Chinook and Winter Steelhead Evolutionarily Significant Units* (NMFS 2000; hereinafter called the 2000 Hatchery BiOp), which provided an ITS to the USACE and BPA for operation of the hatchery mitigation programs in the Willamette Basin through September 30, 2003. The ESA consultation continued between the Action Agencies and the Services regarding the operation of the Willamette Project.

In 2005, the Action Agencies decided to revise the 2000 BA to include the operational and structural modifications implemented in the 5 years of consultation, and to proactively describe the actions to be taken to reduce the likelihood of jeopardizing ESA-listed species (see Section 2.1). Because the 2000 Hatchery BiOp had expired and recent federal policy mandated reform of all federally funded hatcheries to support recovery of ESA-listed species, the USACE and BPA also needed to initiate consultation on the Willamette Basin hatchery programs. Many of the hatchery reform actions necessary in the Willamette Basin are related to the operational and structural components of the proposed action (e.g., rebuilding hatchery collection facilities). The Action Agencies desired to propose a comprehensive, unified suite of actions that reduced the likelihood of jeopardizing ESA-listed species in the Willamette Basin; therefore, the Action Agencies integrated the hatchery and operational actions into this single, consolidated Supplemental BA.

### 2.4.2. Relationship to Recovery Planning

Working collaboratively with ODFW and other regional stakeholders, in 2005 the NMFS initiated development of an Upper Willamette Recovery Plan for the UWR steelhead and salmon ESUs. The USACE is actively involved in the upper Willamette recovery planning process, with representation on several planning entities established to support the process, including the Technical Recovery Team, the Recovery Planning Team, and Stakeholder Committee. Recovery Planning is a critical vehicle for integrating the Action Agencies' actions and measures for mitigating the effects of operating the Willamette Project with all other ESA-related activities in the basin. The Upper Willamette Recovery Plan is expected to be completed in 2008.

The ESA requires that a recovery plan be developed and implemented for listed species. At a minimum, these plans must contain: (1) a description of site-specific management actions necessary to achieve the plan's goal for the conservation and survival of the species; (2) objective, measurable criteria which, when met, would result in a determination that the species should be removed from the list; and (3) estimates of the time required and cost to carry out the measures needed to achieve the plan's goal and to achieve intermediate steps toward that goal [ESA Section 4(f)]. Delisting criteria must include not only biological criteria but also criteria that address the threats to a species [i.e., the listing factors in ESA Section 4(a)(1)].

Recovery under the ESA is the process by which the decline of a listed species is arrested or reversed, and threats to the species removed or reduced, so that the species' survival in the wild can be ensured. The goal is the recovery of listed species to levels where protection under the ESA is no longer necessary—a point where the species is no longer threatened or endangered and can be proposed for removal from the federal ESA list. Recovery under the ESA does not imply restoration of historical or pristine species status.

Species recovery can also be interpreted in a broader sense that goes beyond ESA delisting. For example, goals may be developed that are consistent with ESA delisting but that go beyond delisting to achieve other legislative mandates, treaty obligations, or cultural and social values. This type of goal is referred to as "broad sense recovery goals." Even these broad sense recovery goals, however, do not generally imply restoration of historical conditions.

Recovery plans are guidance documents, not regulatory documents. No agency or entity is required by the ESA to implement the recovery strategy or specific actions in a recovery plan. However, the authors of the ESA clearly saw recovery plans as the central organizing tool for guiding each species' recovery.

The NMFS believes that local support of recovery plans is essential to their success and is committed to involving local agencies and citizens in development of ESA recovery plans. For the Upper Willamette recovery planning process, the ODFW is the lead planning entity. The NMFS and ODFW have established several interagency and interdisciplinary teams to assist in development of the recovery plan that ensure that it meets ESA needs, as well as state, tribal, and local needs. Stakeholder involvement is intended to allow local control of the actions being identified for salmon recovery. In addition, the NMFS hopes to use recovery plans to provide greater certainty and regulatory relief under the ESA for entities implementing recovery actions.

## 2.5. Interrelated and Interdependent Actions

### 2.5.1. Update for Actions Previously Described in the 2000 BA

The 2000 BA described a number of actions being undertaken by the Action Agencies that are interrelated and interdependent and therefore considered a part of this consultation. The purpose of this section is to provide a brief update regarding the status of these actions.

#### 2.5.1.1. Willamette River Bank Protection Program

The status of the Willamette River Bank Protection Program remains unchanged since the 2000 BA. The USACE has constructed no new bank protection projects under this program in the intervening period. Limited funds have been programmed for annual inspections.

#### 2.5.1.2. Willamette River Temperature Control Project

Significant progress has been made on the Willamette River water temperature control (WTC) project since completion of the 2000 BA (USACE 2000). The WTC tower at Cougar Dam was completed and became fully operational in 2005. Water temperatures in the South Fork and mainstem McKenzie rivers are now much more favorable for aquatic species. Construction has not been initiated on the Blue River WTC tower as was envisioned in the 2000 BA. The USACE is currently undertaking a post-authorization review of the project and is recommending installation of permanent fish passage facilities at Cougar Dam as an alternative approach to increasing survival and productivity of ESA-listed species. The status of the project is described in more detail in Section 3.6.2 of the Supplemental BA.

#### 2.5.1.3. Willamette River Basin Review Feasibility Study

The status of the Willamette River Basin Review Feasibility Study remains unchanged since the 2000 BA was completed. The study remains in hiatus pending completion of this ESA consultation. Although no funds are currently programmed for reinitiation and continuation of the feasibility study, the study authority remains in place. The feasibility study may remain a viable vehicle for ultimately revising operation of the Willamette reservoirs for authorized purposes to better meet current and future needs including addressing the needs of ESA-listed species. It could be used to seek Congressional reauthorization for significant changes to operating purposes or criteria outside of current authorized limits. The USACE and the non-federal sponsor, the Oregon Water Resources Department (OWRD), are contemplating using the study to address small-scale needs for municipal and industrial water supply in the upper part of the basin.

#### 2.5.1.4. Willamette River Floodplain Restoration Study

The Willamette River Floodplain Restoration Study has progressed significantly since the 2000 BA was submitted. The study has moved from the reconnaissance phase into the feasibility phase, and is currently focusing on restoration opportunities along the Middle Fork and Coast Fork Willamette rivers below the USACE dams in these subbasins. The study is expected to be an important vehicle for identifying habitat restoration opportunities along these reaches and their possible implementation. The current status of the study is described in more detail in Section 3.5.2 of the Supplemental BA.

#### 2.5.1.5. Santiam River Fish Passage Restoration Project

The status of the Santiam River Fish Passage Restoration Project remains unchanged. In a reconnaissance report completed in 1995, the USACE proposed that the best course of action for addressing fish passage improvements at Green Peter Dam was to construct a prototype model surface collection system for collecting juveniles at the upstream end of the reservoir and transporting them downstream of the dam. Since fish facilities were authorized and constructed at Green Peter Dam as part of the original project, USACE headquarters had directed that the proposed project modifications should be pursued under operations and maintenance programming as a major rehabilitation project. However, no funding to continue the project has been programmed to date.

Section 3.6.4 of the Supplemental BA proposes a Willamette System Review study as a means of addressing the feasibility of fish passage and other related potential structural modifications to USACE dams in the Willamette Basin. Given the time elapsed since the completion of the 1995 reconnaissance report, the change in status of ESA-listed species, and recent technological innovations for fish passage being designed and implemented elsewhere in the region, the USACE believes that the most prudent course of action will be to integrate the findings and recommendations of the 1995 reconnaissance report into the Willamette System Review study for consideration and prioritization, along with other potential fish passage alternatives.

#### 2.5.1.6. Middle Fork Willamette Fish Passage Restoration Project

The status of the Middle Fork Willamette Fish Restoration Project remains unchanged. The USACE completed a reconnaissance report in 1997 that evaluated a series of alternatives for restoring native fish runs in the Middle Fork Willamette above Lookout Point and Hills Creek dams. The study concluded that there was a federal interest in pursuing more detailed study of fish restoration in the Middle Fork Willamette. However, since fish facilities were not authorized and constructed as

original elements of Lookout Point and Hills Creek, USACE policy dictated that further study would need to be conducted under a cost-sharing agreement with a non-federal sponsor. No additional work has been completed to date. As with the Santiam River study, the Action Agencies now propose that the findings and recommendations of the 1997 reconnaissance report be integrated into the Willamette System Review study described in Section 3.6.2 of the Supplemental BA.

### 2.5.2. New Actions Since the 2000 BA

#### 2.5.2.1. Northwest Power and Conservation Council's Subbasin Planning and Fish and Wildlife Program

The Northwest Power and Conservation Council's (NPCC) Columbia River Basin Fish and Wildlife Program helps direct BPA's funding of projects that protect, mitigate, and enhance fish and wildlife that have been adversely impacted by the development and operation of the Columbia River hydropower system. The following BPA wildlife mitigation projects are a part of the fish and wildlife program and are likely to benefit critical habitat or limiting factors within the Willamette Basin, thereby potentially influencing subsequent BiOps by the Services with respect to the current ESA-listed fish, wildlife, and plant species. These projects are a part of the efforts by BPA, the states, and the tribes to negotiate an overall settlement for the FCRPS portion of wildlife mitigation within the Columbia River Basin.

Burlington Bottoms Wildlife Mitigation Project. The Burlington Bottoms property, which is 417 acres in size and located on the Multnomah Channel across from Sauvie Island, was acquired as part of BPA's wildlife mitigation program. Project activities include using moist soil management to mimic to the extent possible historic water regimes in order to control invasive non-native plant species (e.g., reed canarygrass) and restore native plant communities, such as tidal sloughs, seasonal ponds, and emergent wetlands. Additional work will involve planting native species and removal of invasive species in various habitat types including scrub/shrub and riparian forest.

Amazon Basin/Eugene Wetlands. Through BPA's wildlife mitigation program, TNC has acquired 494 acres, which combine to form the Willow Creek Wildlife Mitigation Area. The project proposes to continue habitat enhancement and maintenance activities that mimic or reestablish natural ecological processes, including promoting prairie habitat through prescribed fire and mowing, controlling invasive and predatory species, and monitoring the results of the habitat management actions to allow for an adaptive management approach. Planned habitat restoration activities include continuing ongoing projects to restore species composition and structure to 30 acres of native wet prairie, enhancing 35 acres of oak woodlands, initiating two new restoration projects to restore 65 acres of upland prairie, restoring 25 additional acres of wet prairie, and restoring the confluence of the East and West forks of Willow Creek.

Willamette Basin Wildlife Mitigation. Under the BPA's wildlife mitigation program, the ODFW has acquired the following properties to benefit fish and wildlife in various Willamette subbasins.

- Big Island – 108 acres located on the McKenzie River.
- Green Island – 856 acres located at the confluence of the McKenzie and Willamette rivers.
- Herbert Farms – 222 acres located on Muddy Creek/Mary's River.
- Agencies and groups to protect 2,741 acres of wildlife habitat in the Willamette Through.
- Sorenson – 42 acres located on the Middle Fork of the Willamette River.

For example, there is a known population of Oregon chub located on the Big Island property, and enhancement work on Green Island will increase funding for several planning efforts, such as the floodplain restoration study that is restoring backwater channels and rearing areas for juvenile salmonids. The project proposes to continue acquisition of fish and wildlife habitat, enhancement and maintenance of fish and wildlife habitat on past acquisitions, and enhancement and maintenance of fish and wildlife habitat on state-owned and other public lands.

Acquisition of a Conservation Easement for Upland Prairie and Oak Habitats. In 2007, TNC will acquire an easement on 1,244 acres located outside of Coburg, Oregon that primarily consists of oak savanna, oak woodlands, conifer forests, and upland prairie. Coburg Ridge has been identified as harboring some of the best remaining native prairie and oak habitats in the Willamette Valley. The site is recognized as an important conservation opportunity in the Willamette Subbasin Plan, ODFW's Oregon Conservation Strategy, the Forest Legacy Program Needs Assessment, and TNC's Ecoregional Conservation Assessment. It is also designated critical habitat for Fender's blue butterfly (*Icaricia icaroides fenderi*). Once the conservation easement is in place, TNC will develop a comprehensive management plan for the property with emphasis on protecting and restoring native prairie and oak habitats and expanding habitat for Fender's blue butterfly.

#### 2.5.2.2. Steelhead and Chinook Above Barriers Committee

In 2003, the state and federal agencies involved in managing anadromous fish resources in areas above the USACE dams in the Willamette Basin (USACE, NMFS, USFWS, USFS, and ODFW) formed an ad hoc committee called Steelhead and Chinook above Barriers (SCAB). The committee was formed to address existing and potential access and use of habitat areas upstream of the dams by anadromous fish species. This action was in response to a mutual agreement among the agencies that the need existed for additional coordination of existing ODFW efforts to outplant hatchery Chinook salmon in and above several of the Willamette reservoirs. In the mid-1990s, the ODFW began outplanting (releasing) excess adult hatchery spring Chinook salmon into historic habitat upstream of USACE dams in the Middle Fork Willamette subbasin. The original intent of the outplanting effort was to provide prey for listed bull trout. However, limited monitoring suggested that progeny of the outplanted hatchery fish were surviving passage through some of the dams in relatively high numbers.

The SCAB Committee has been evaluating the potential for using historic habitat above dams as a tool for salmon recovery. Existing high-quality habitat upstream of the Willamette dams may potentially be a cost-effective and biologically beneficial way to increase natural production, avoid jeopardy, and promote recovery of ESA-listed species. Furthermore, the NMFS indicated that the USACE's spring Chinook hatchery programs, when operated as integrated programs as described in the HGMP, will play an important role in recovery of UWR spring Chinook salmon, particularly because the Willamette spring Chinook stocks are suitable for use in outplanting, supplementation, and reintroduction efforts.

To date the SCAB Committee has functioned as an ad hoc committee and their recommendations are informal but important to the planning activities of the involved agencies. The Committee completed a report titled, *A Synopsis of Information Relating to the Success of Adult Hatchery Chinook Salmon Releases above Migration Barriers in the Willamette River System* (Biedler and Knapp 2005) that summarized the spring Chinook outplanting efforts in the Willamette Basin through 2005. Known as "Part I" this report made initial recommendations for continuing the hatchery Chinook outplant program. Subsequently, the SCAB Committee has been working on a series of reports known as "Part II" that will more fully document the goals and protocols associated with the spring Chinook outplanting and reintroduction efforts. The outplanting protocols included

in Part II may ultimately be appended to HGMPs for the five Willamette Basin hatcheries funded by the USACE as mitigation for the Willamette Project. The Part II reports are expected to provide the following information.

- Describe overall program goals and objectives for abundance, productivity, and distribution.
- Establish long-term guidelines including:
  - Proportion of wild and hatchery fish outplanted over time according to run size.
  - Sliding scale for hatchery-wild fish ratios depending on the status of wild fish returns.
  - Appropriate decreases in hatchery fish outplants as more wild fish return in the future.
  - Biological criteria for when and where hatchery fish outplants may be terminated.
- Establish annual guidelines and protocols including:
  - Maximum number of fish outplanted.
  - Desired number of spawners.
  - Sex and age composition of outplanted fish.
  - Run timing of outplanted fish.
  - Collection protocols for outplanted fish at trapping facilities.
  - Holding protocols of outplanted fish.
  - Trucking protocols of outplanted fish.
  - Release protocols of outplanted fish.
- Research, monitoring and evaluation including:
  - Identify performance indicators such as the number of spawners or resulting juvenile fish production.
  - Develop comprehensive spawning or juvenile fish surveys in the areas above the dams.
  - In season recording of fish handled and environmental conditions from collection below the dam to release above the dam including:
    - Density of fish in transporting trucks.
    - Holding, handling, transportation times.
    - Temperature of holding tank, release location.
  - Long-term monitoring of resultant natural production including:
    - Assessment of natural production from above and below the dams.

#### 2.5.2.3. The Nature Conservancy Sustainable Rivers Project Partnership

In 2000, the USACE and The Nature Conservancy (TNC) signed a national Memorandum of Understanding and have collaborated on a variety of projects, including reservoir management, dam removal, floodplain and wetland restoration, and coastal zone work. One of those collaborative efforts is the Sustainable Rivers Project (SRP), an ongoing effort to investigate opportunities to change USACE dam operations ("reoperate") to achieve more ecologically sustainable flows, while maintaining or enhancing project benefits. The Willamette River Flow Project is one of nine national projects, and is being conducted in conjunction with the Willamette Floodplain Restoration Feasibility study (see Section 3.5.2). This feasibility study is designed to identify opportunities to restore natural floodplain function in the Willamette River Basin to provide ecosystem restoration, natural flood storage, and other benefits. The initial study phase has focused on the Coast Fork and Middle Fork of the Willamette River. These subbasins contain 6 of the 13 dams in the Willamette system, and their operation has implications for the operation of the other dams in the system. The project partners anticipate the study will be expanded in the future to encompass the other major tributaries controlled by USACE dams.

The Willamette River Flow Project will build upon the Willamette River Floodplain Restoration Study by developing environmental flow requirements for the reaches downstream of USACE dams and linking those flows to opportunities for stream channel and floodplain restoration, and to improvement in operation of the dams. Given the existing floodplain restoration study, the initial SRP efforts will use the Coast Fork, Middle Fork, and the mainstem Willamette immediately downstream of these tributaries as a pilot study that can be replicated in the rest of the Willamette system. The USACE, TNC, and their partners will use this project to increase their understanding of the physical and ecological relationships between the reservoirs and the Willamette River mainstem and its tributaries, and to use that knowledge adaptively to better balance ecological flow requirements with other operating purposes.

The USACE and TNC have developed and tested a process for identifying and refining environmental flow objectives (Richter et al., 2006). The process utilizes a series of steps to define environmental flow requirements, implement changes in operation of dams to meet those flow objectives, monitor and model the effects of those changes on both the river ecosystem and the operation of the dams, and refine over time.

Literature Review and Summary Report. A key initial step in the process was completion of a Literature Review and Summary Report (Gregory et al., 2007) that synthesized background information on the flow needs for key ecosystems, communities, and exemplar species for the Middle Fork, Coast Fork, and upper mainstem Willamette River. The summary report provided the information basis for a Flow Recommendation Workshop held in January 2007, which was the forum for developing initial recommendations for ecosystem-based flows in the lower Middle and Coast Forks, as well as the mainstem Willamette River immediately downstream of their confluence. The ultimate goals of this workshop was to provide the USACE with recommendations for new flow paradigms incorporating changes to timing, magnitude, and duration of dam discharges. The summary report categorized four major environmental flow regimes to be addressed in the summary report and during the workshop:

- Low flows (seasonal, annual, and extreme low flows.
- High flow pulses (up to bankfull discharge).
- Small floods (overbank flows, approximately 2- to 10-year return period).
- Large floods (floodplain maintenance flows, > approximately 10-year return period).

The report prioritized available information based on its relevance for characterizing the relationship between these four environmental flow components, fluvial geomorphic processes and biotic responses or ecological processes. It includes both key findings of linkages among specific environmental flow components, geomorphic processes, biotic responses, and ecological processes as well as qualitative ecological models illustrating the connection between natural hydrographs and life cycles of exemplar species and ecological processes and functions.

The summary report concluded that, in contrast to the plethora of studies pertaining to the effects of dams, there are comparatively few data with direct measures of flow requirements for the biota of the Willamette River Basin and relatively few studies of the effects of dams on the aquatic ecosystems of the Willamette River and its tributaries. Most of the available information pertains to relationships between the timing of species-specific life history stages and discharge regime and does not explicitly identify flow needs. Additional data on the relationships between discharge parameters such as water quality and geomorphology were included to encompass flow and habitat requirements for some species found in the basin.

Middle Fork and Coast Fork Flow Workshop. In January 2007, the USACE and TNC brought together 43 leading biologists, hydrologists, and engineers from numerous state and federal agencies, academic institutions, and non-governmental organizations to develop environmental flow recommendations for the Middle and Coast Forks. An initial set of recommendations for specific environmental flow components, including summer low flows, winter bankfull flows, and fall and spring pulse flows, to meet key ecosystem functions resulted from the workshop. Participants defined these flow components in terms of magnitude, duration, frequency, and rate of change.

The USACE completed an initial evaluation of the flow recommendations and implementation planning. The recommendations were grouped into three categories for implementation: (1) flow volume and timing adjustments that are within the operational flexibility of the USACE under current project authorizations and water control manuals; (2) larger scale adjustments that may fall within current operational flexibility and authority but will require more detailed evaluation of tradeoffs; and (3) major changes in operation which are clearly outside of the USACE's operational discretion and would require a thorough feasibility evaluation and possible reauthorization action. The recommendations falling into category 1 are currently being integrated into the 2007 Willamette Conservation Plan (WCP), which guides reservoir operations during the conservation storage and release season. The USACE will strive to implement some of the recommendations, including pulsed flows, during annual reservoir drawdown in fall 2007 and during 2008 spring refill. Monitoring and evaluation will be critical to determining the success of the initial flow recommendations. Computer modeling and field monitoring will evaluate the response of the ecosystem to flow changes and will be used to adaptively adjust dam operations, as needed.

Before they can be implemented, the category 2 and 3 recommendations will require more thorough modeling and evaluation of different alternatives on downstream volume and timing of flow, and on reservoir refill and storage conditions. One example of these kinds of recommendations is small-scale flood-like events over bankfull limits. The USACE may also need to complete decision documents, public review, and NEPA compliance prior to implementing these actions.

Implementation of any flow recommendations coming out of the Willamette SRP will be done in accordance with the flow management processes, procedures, and criteria described in Section 3.3, *Flow Management*, particularly working in coordination with the Interagency Flow Management Work Group to adaptively manage the Willamette reservoir system.

#### 2.5.2.4. ESA Recovery Planning

The ESA requires that a recovery plan be developed and implemented for species listed as endangered or threatened under the statute. At a minimum, these plans must contain: (1) a description of site-specific management actions necessary to achieve the plan's goal for the conservation and survival of the species; (2) objective, measurable criteria which, when met, would result in a determination that the species should be removed from the list; and (3) estimates of the time required and cost to carry out the measures needed to achieve the plan's goal and to achieve intermediate steps toward that goal [Section 4(f) of the ESA]. Delisting criteria must include not only biological criteria but also criteria that address the threats to a species [i.e., the listing factors in ESA Section 4(a)(1)]. Recovery plans are guidance documents, not regulatory documents. No agency or entity is required by the ESA to implement the recovery strategy or specific actions in a recovery plan. However, the authors of the ESA clearly saw recovery plans as the central organizing tool for guiding each species' recovery.

The NMFS is the federal agency responsible for ESA recovery planning for salmon and steelhead. In the Willamette and Lower Columbia River basins (as in other parts of the Pacific Northwest), state, and local entities are leading the effort, with NMFS involvement. For UWR Chinook salmon and steelhead, the ODFW is the lead recovery planning entity. The USACE is actively engaged in the ongoing Upper Willamette River Salmon and Steelhead ESA Recovery planning process. USACE staff participates on several committees participating in the recovery planning process, including the Technical Recovery Team, Recovery Planning Team, and Stakeholder Committee.

Recovery planning analysis to date has determined that continued operation and maintenance of the USACE's Willamette Project results in key and secondary limiting factors and/or threats for a number of life history requirements for Chinook salmon and winter steelhead on all the major tributaries in the basin on which the dams are located. The USACE recognizes that measures and actions to address ESA-listed species requirements associated with the Willamette Project will constitute a significant portion of the final Upper Willamette Recovery Plan. The USACE will continue to stay involved with the recovery planning process to ensure that the final recovery plans are closely aligned with the revised proposed action presented in Chapter 3 of the Supplemental BA.

#### 2.5.2.5. TMDL Implementation Planning

In September 2006, the U.S. Environmental Protection Agency (USEPA) approved a final Total Maximum Daily Load (TMDL) for the Willamette Basin that was developed by ODEQ under the requirements of the CWA. A TMDL is a pollution analysis conducted with the primary purpose of determining how much a pollutant must be reduced in order to meet state water quality criteria. The focus of the Willamette TMDL was on the most commonly listed pollutants in the basin, which include bacteria, mercury, and temperature, although other pollutants also were considered. temperature and total dissolved gas (TDG) are the two pollutants of particular relevance to the USACE dams and the life cycle requirements of ESA-listed aquatic species.

The Willamette TMDL established temperature load allocations (target temperatures) target temperatures for each USACE dam in the Willamette Basin. The load allocations were based on estimates of natural thermal potential (NTP) of the individual streams under a without dam condition. In the development of the draft and final TMDL documents, the USACE expressed concerns to ODEQ about the technical and policy approaches used to develop the estimates of NTP and subsequent load allocations, including:

- Inconsistent policy approaches, such as pre-dam baseline conditions for below dam temperature load allocations.
- Technical methods used to estimate NTP based on very limited data.
- Discrepancies between numeric biological requirements and NTP load allocations.
- NTP load allocations for the dams that are not fully attainable.

The USACE concerns included a clear statement that even with the completion of WTC at each of the Willamette projects the temperature load allocations as stipulated in the TMDL cannot be met. For example, while Cougar Dam with the WTC tower in place cannot meet the TMDL targets at all times of the year, it is operated very close to the biologically-driven temperature targets established in conjunction with NMFS, USFWS, and ODFW.

While ODEQ did not adjust the final estimates of NTP or temperature load allocations in response to USACE concerns, the TMDL document does recognize that limited data was used in their development and expresses a willingness to work with the USACE and others to further refine load

allocations and NTP and possibly undertake a Use Attainability Analysis as additional information and data on the effects of the dams on water temperatures becomes available. In recognition of the uncertainties surrounding the effects of the dams on temperatures and potential for meeting the established load allocations, ODEQ makes only one-half of the "temperature reserve capacity" available under the initial TMDL. The remaining half of the reserve capacity will be made available following more detailed analysis of USACE dams and reservoirs when it is demonstrated that significant steps to TMDL implementation have been taken.

The final TMDL identified the USACE dams as non-point sources for temperature. The USACE is identified as a Designated Management Agency for temperature, and as such the ODEQ expects the USACE to prepare a TMDL Water Quality Management Plan (WQMP).

There remain a number of uncertainties regarding the appropriate response of federal dam managing agencies, such as the USACE and Reclamation, to the CWA. These issues are being addressed at a national policy level between the USACE, Reclamation, and USEPA. From November 14-16, 2006, an interagency workshop on a comprehensive regional approach to CWA and ESA compliance at federal dams was held Portland, Oregon. The workshop was attended by representatives of the USACE, Reclamation, USEPA, USFWS, NMFS, and BPA from the headquarters and regional levels, the states of Oregon, Washington, and Idaho, and by several tribes. The workshop concluded that while there is a need and a desire for a regional forum to discuss and coordinate the integration of CWA and ESA compliance issues surrounding federal dams in the Pacific Northwest, there is no clear, uniform approach possible across the different states. Each of the three states has different policies and procedures in place for federal dam compliance with state water quality standards. As an outcome of the workshop, the USACE agreed to coordinate with ODEQ on development of a WQMP to address the Willamette TMDL. The elements of the TMDL WQMP are described in Section 3.7.2. One of the elements requested by ODEQ for inclusion is to "demonstrate compliance and consistency with the BiOp for the Willamette Project."

## 2.6. USACE Actions Not Part of This Consultation

### 2.6.1. Columbia River Estuary Habitat Improvement Actions

Under the ongoing FCRPS ESA consultation process, degradation of Columbia River estuary habitat has been identified as a limiting factor affecting all ESA-listed fish to some extent, although the nature and magnitude of this impact varies by life history type. This includes the upper Willamette River ESUs that make use of the estuary during parts of their life histories including UWR spring Chinook salmon and winter steelhead. Recent studies indicate that protection and improvement of Columbia River 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).

Under the FCRPS, the Action Agencies are proposing to implement an expanded estuary habitat restoration and improvement program to address limiting factors involved in passage and rearing in the estuary. 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.

**Description of Estuary Habitat Actions**

In the Columbia River estuary, both ocean-type (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, such as the UWR spring Chinook salmon, 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-type juveniles, such as UWR winter steelhead, 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 which would provide the greatest habitat benefit to those ESUs expressing ocean-type life histories, such as the UWR spring Chinook 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 UWR spring Chinook and winter steelhead, thereby increasing survival and decreasing predation.

The Action Agencies are committed to implement "on-the-ground" actions to address biological priorities and key limiting factors identified for estuary habitat. These actions are designed to improve function of the limiting factors. This habitat program will be implemented in 3-year increments. The USACE will implement the program under the specific authority of Section 536 of the Water Resources Development Act of 2000, or other authorities as appropriate. The BPA will provide direct funding to support the program. Projects funded to implement this action will be consistent with the Willamette/Lower River Recovery Plan. The effects of the planned estuary habitat improvement program on all ESUs using the Columbia River estuary, including UWR ESUs, will be described in detail in the FCRPS remand BA scheduled for completion in June 2007.

2007-2009: The Action Agencies have ongoing projects and will substantially expand the level of project implementation with a particular focus on projects with greatest biological value. The Action Agencies have identified additional specific projects they will implement based on collaborative efforts with LCREP, local partners, and others. The Action Agencies will provide funding of about an average of $5 million per year for fiscal year (FY) 2007-2009. The BPA will provide funding of about $2.0 million for FY 2007 and $3.5 million per year for FY 2008 and FY 2009 (an average of $3 million per year average), an increase of about $2.4 million average per year above 2000-2006 per year average. The USACE expects to continue funding estuary habitat projects similar to current levels (about $2 million per year) subject to Congressional appropriations.

2010-2017: The Action Agencies will implement continued actions based on biological criteria and limiting factors. The BPA's funding commitment will be increased to about $3.5 million average annual for 2010-2017. Project selection will be done in coordination with the LCREP and others using LCREP's criteria to prioritize actions based on biological priorities, analysis of limiting factors, improvements in habitat quality and ensure consistency with Willamette/Lower River Recovery Plan implementation. Projects will be selected on a 3-year timeframe in cooperation with the LCREP and others.

The USACE will consider limiting factors and the Recovery Plan in working with potential local sponsors under its authorities. The USACE expects to continue funding estuary habitat projects at a similar level to current levels (about $2 million per year) subject to Congressional appropriations. The USACE is seeking funding for a GI study to identify further ecosystem opportunities in the lower Columbia River. If funded, this study could lead to additional authorities and funding for habitat work in the estuary. Types of actions that could be implemented include:

- Acquire, protect, and restore off-channel habitat.
- Restore tidal influence and improve hydrologic flushing.
- Restore floodplain connection by removing/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.
- Pile dike removal.

**Estuary Habitat Actions in 2007-2009**

For 2007-2009, the BPA will implement specific projects funded through the 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. The 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 in this manner provide greater ecological benefit compared to projects implemented in a simple ad hoc manner. The USACE 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 CAP authority for ecosystem restoration.

In the near-term, the Action Agencies plan to implement about 35 key habitat restoration projects, some of which are discussed below. Based on biological needs, a suite of further actions beyond those funded in the 2007-2009 Fish and Wildlife Program 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 $3 million for 2008 and 2009) beyond the 2007-2009 Fish and Wildlife Program decision. Actions will benefit all listed ESUs in the estuary including UWR spring Chinook and winter steelhead.

The LCREP's habitat project is funded in FY 2007 for $1.5 million, FY 2008 for $3 million and FY 2009 for $3 million. The following projects, or projects similar in nature, will be implemented in FY 2007-2009. Specific project details are currently confidential in light of ongoing negotiations.

Acquisition in Reach D 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): 45-acre floodplain reconnection project (tide gate removal).
- Project #2 (Reach A): 45-acre acquisition of floodplain intended for future restoration activities (dike breach).
- Project #3 (Reach A): 50-acre floodplain reconnection project (dike breach).
- Project #4 (Reach A): 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 miles of fencing.
- About 15 to 20 FY07-09 projects that are undergoing preliminary scoping/sponsor development.
- Pile Dike Removal: Preliminary scoping is ongoing and implementation will occur in FY 2008-2009. The Action Agencies are currently working with 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. All projects implemented through LCREP are ranked in a competitive review process by their Science Work Group utilizing the *Criteria for Identifying and Prioritizing Habitat Protection and Restoration Projects on the Lower Columbia River and Estuary* (available at http://www.lcrep.org/pdfs/Criteria2006.pdf). The Action Agencies participate in the Science Work Group.

The Grays River restoration project is targeting Columbia River chum salmon (*Oncorhynchus keta*) and 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 that will rejuvenate historic channel and floodplain processes. Additional restoration measures include reforesting the riparian corridor to enhance future large woody debris (LWD) 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.

The intent of the Chinook River 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 miles of channel access) influenced by the project are unknown. This project is likely to benefit chum salmon.

A proposed project located on the Julia Butler Hanson National Wildlife Refuge will install fish friendly tide gates to restore tidal flow and fisheries access to about 87 acres of slough habitat and restore about 210 acres of native riparian forest habitat. A project at Vancouver Lake is a tide gate retrofit located in Reach F (in the City of Vancouver area). The Dairy Creek project is intended to improve hydrologic flushing and salmonid access to Sturgeon Lake (about 3,200 acres in size) on Sauvie Island, Oregon.

The Ramsey Lake project will reestablish hydrologic connectivity to 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. The 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.

The Sandy River project is located at the confluence of the Sandy and Columbia rivers and 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.

**Estuary Habitat Actions in 2010-2017**

Additional projects for longer-term implementation will be identified based on research and regional coordination and will provide additional future benefits. The Action Agencies will draw on priorities identified through LCREP's Science Work Group and Recovery Plan products to adjust the direction and location for implementing future estuary habitat projects. For 2010-2017, BPA will commit about $3.5 million each year for priority habitat projects. The USACE expects to continue to fund estuary habitat projects at a level similar to current funding (about $2 million per year); actual funding will be dependant on Congressional appropriations.

**Survival Benefits Associated with Action Agency Actions**

To estimate project benefits, each federal project was linked to a recommended recovery action in the final draft *Columbia River Estuary Recovery Plan Module* (NMFS September 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 the *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 LCREP's *Criteria for Identifying and Prioritizing Habitat Protection and Restoration Projects on the Lower Columbia River and Estuary* (LCREP 2006). The second step involved linking federal projects to recovery actions identified in the *Columbia River Estuary Recovery Plan Module* and estimating the relative contribution of each project to implementation. The survival benefits associated with Action Agency actions are qualitative in nature. Table 2-2 summarizes the results in terms of survival benefits for completed, in-progress, and proposed projects.

**Table 2-2. 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% |
| 2007-2009 Projects | Ocean | 9.40 | 2.3% |
| | Stream | 4.27 | 1.4% |
| 2010-2017 Projects | Ocean | 25.07 | 6.7% |
| | Stream | 11.39 | 4/3% |

* Units are a percent of the 20% survival improvement target in the Estuary Recovery Plan Module.
Ocean-type: total survival benefit for 2000-2017 is 9.7%.
Stream-type: total survival benefit for 2000-2017 is 6.0%.

### 2.6.2. Avian Predation Management

In January 2005 the USFWS, in cooperation with the USACE and NMFS, completed the final Environmental Impact Statement (EIS) for Caspian tern (*Hydroprogne caspia*) management to reduce predation of juvenile salmonids in the Columbia River estuary (USFWS 2005). The USFWS and USACE each issued a Record of Decision (ROD) in November 2006. The modified preferred alternative described in the ROD allows for redistribution of the bulk of the Columbia River tern colony through development of six alternate habitat locations. Three alternative nesting sites are located in Oregon and three are located in California. The federal agencies are seeking Congressional authorization for additional funding to implement the preferred alternative and to conduct research, design, implement, monitor, and evaluate potential management actions to reduce juvenile salmonid predation by other populations of Caspian terns and double-crested cormorants (*Phalacrocorax auritus*) in the Columbia River.

Juvenile salmonids, including ESA-listed species, experience high mortality rates in the Columbia River estuary due to substantial predation by Caspian terns and double-crested cormorants that nest and forage in the estuary. In 2004, the combined consumption by these two species was approximately 10 million juvenile salmon. Juvenile salmon survival has been the subject of a major investment in intensive passage improvement measures at FCRPS dams and other regional recovery efforts. Avian predation management represents an important way to aid in improving the survival of fish passing to the ocean.

Management of Caspian tern nesting habitat in the estuary and elsewhere in the region to attain a redistribution of the population appears to be one of the most cost-effective actions that can be done to increase juvenile salmonid survival to the Pacific Ocean. The Caspian tern population at East Sand Island located in the estuary averaged 9,128 pairs annually from 2001 to 2006. This represents a substantial gain from the 1,000 pairs (2,000 birds) that were counted in the estuary in 1984, the first year that Caspian terns nested in the estuary. Their consumption of juvenile salmonids for 2001-2006 averages approximately 5.2 million per year. Roughly concurrent with the population explosion of Caspian terns in the estuary has been a similar population increase by double-crested cormorants. There are now approximately 12,500 pairs (25,000 birds) of cormorants on East Sand Island in 2006 as compared to less than 100 pairs (200 birds) in 1989.

If authorized, research and actions implemented under this program would be carried out under the USACE's Columbia River Fish Mitigation Project and within available funding provided annually to that project. Costs for avian predation management actions undertaken would be apportioned among the eight USACE lower Columbia River and Snake River FCRPS projects as off-site mitigation to address additional salmonid survival improvements under the ESA.

The effects of the planned avian predation management program on all ESUs using the Columbia River estuary, including upper Willamette River ESUs, will be described in detail in the FCRPS remand BA scheduled for completion in June 2007.

# 3. DESCRIPTION OF THE REVISED PROPOSED ACTION

## Summary of the Revised Proposed Action

This chapter presents a revised proposed action for the operation of the Willamette Project. The measures presented in the revised proposed action are not intended to stand alone; they supplement the proposed action contained in the 2000 Biological Assessment (BA; USACE 2000). Unless otherwise stated herein, the base operation for the Willamette Project to meet authorized project purposes as described in the 2000 BA remains in place.

However, the proposed action presented in the 2000 BA (USACE 2000) represented the operation of the Willamette Project at the time of the 1999 listing of Upper Willamette River (UWR) winter steelhead and spring Chinook as threatened under the Endangered Species Act (ESA). The proposed action at that time included very little in the way of actions or measures in place or proposed by the Action Agencies to conserve ESA-listed species or their habitats. Subsequent to that time, the Action Agencies have implemented significant changes in operation of the system.

The Action Agencies have worked closely with the NMFS and USFWS (the Services) and others to adaptively manage operation of the project to provide timing and volume of flow releases that better meet the life cycle requirements of ESA-listed species. In 2002, a protocol for meeting springtime mainstem flow targets was developed and implemented by the USACE in cooperation with the Services and ODFW. The springtime mainstem flow targets are designed to improve movement of juvenile winter steelhead out of the system and adult spring Chinook into the system, and represent a significant change to system operation. In 2005, the USACE completed a major modification to the system with the completion of a water temperature control (WTC) facility at Cougar Dam. The WTC facility resulted in an immediate improvement in downstream temperatures for aquatic species.

Given these and other changes, the Action Agencies decided that the proposed action needed to be revised to more accurately reflect the current operation in operation of the system with respect to the protection of ESA-listed species. In addition, the Action Agencies believe that there are a number of additional measures and activities that could be implemented within their current missions, authorities, and programs that would help to protect ESA-listed species. The synthesis of ongoing measures not accurately portrayed in the 2000 BA plus proposed additional future actions and measures are presented in the following sections of this chapter.

**Section 3.1 – Continuing Coordination and Management**. This section proposes implementation of a regional forum called the Willamette Action Team for Ecosystem Restoration (WATER) and other related mechanisms to coordinate operation of the Willamette Project and implementation of ESA and related conservation measures between the Action Agencies, the Services, and other agencies and entities with water resource management and fish and wildlife responsibilities in the Willamette Basin.

**Section 3.2 – Updated Description of Project Operations**. This section provides an updated description of routine activities associated with operation and maintenance (O&M) of fish collection and handling facilities and presents a proposal for preparing an annual management plan for the facilities in coordination with the Services and ODFW. It also describes routine and non-routine activities associated with outages of turbines and regulating outlets that may have significant implications for aquatic species and habitat, and proposes mechanisms for coordinating with the Services in the event of their occurrence.

**Section 3.3 – Flow Management**. This section describes changes to reservoir storage and downstream flow timing and volume implemented subsequent to the 2000 BA (USACE 2000) including mainstem and tributary minimum flow objectives and ramping rate guidelines.

**Section 3.4 – Hatchery Operations and Reform Actions**. This section describes the operation of the five hatcheries in the Willamette Basin that were constructed and are at least partially funded by the Action Agencies as mitigation for impacts of the construction of the Willamette Project. Measures to reform operation of the hatcheries to better meet the needs of ESA-listed are proposed.

**Section 3.5 – Habitat Restoration and Management Actions**. This section describes current and proposed actions for restoring degraded habitat utilized by ESA-listed species both onsite (on-project) and offsite (downstream of project lands). This includes measures to address restoration of habitat associated with the Willamette Bank Protection Program.

**Section 3.6 –Structural Modifications: Fish Passage, Temperature Control, and Hatcheries**. The Action Agencies have limited authority and funding sources to undertake significant structural modifications of the dams to improve conditions for ESA-listed species, but propose to undertake a series of studies to evaluate the feasibility of large-scale structural modifications; where shown to be technically feasible, biologically justified and cost-effective, the Action Agencies will seek authorization and funding needed to implement those measures.

**Section 3.7 – Water Quality Improvements**. The Action Agencies propose to coordinate with the Services, U.S. Environmental Protection Agency (USEPA), ODFW, and Oregon Department of Environmental Quality (ODEQ) to develop and implement a Water Quality Management Plan (WQMP) that describes how the projects will be operated to better meet key water quality requirements for ESA-listed species consistent with Total Maximum Daily Loads (TMDLs) for temperature and total dissolved gas (TDG) developed by ODEQ in compliance with the Clean Water Act (CWA). The Action Agencies propose to operate the recently completed Cougar Dam WTC facility to better meet downstream water temperature requirements of ESA-listed species. Cougar Dam is the only dam in the Willamette Project with selective withdrawal capability necessary to manage temperatures. The Action Agencies also propose to undertake an extended research, monitoring and evaluation (RM&E) program associated with Cougar Dam. Evaluation of the physical and biological outputs associated with the Cougar Dam facility are critical to the decision-process associated with the potential for structural modification of other dams in the system.

**Section 3.8 – Research, Monitoring and Evaluation Program**. The RM&E activities are integrated throughout the various elements of the proposed actions described in this chapter. Effectiveness monitoring and evaluation will be critical for implementing and adaptively managing activities and measures associated with flow management, habitat restoration, hatchery operations and water quality improvements. In addition, rigorous RM&E efforts of existing baseline and possible future habitat and ESA population conditions under a range of potential structural and operational alternatives will be required to determine the feasibility of those alternatives. A mechanism for developing an integrated comprehensive RM&E program in coordination with the Services and others is proposed.

**Section 3.9 – Contract Water Marketing Program**. The USACE and Reclamation propose to continue marketing irrigation water supply storage program with interim limitations to the amount of storage to be contracted and with proposed revisions water storage contracts designed to protect ESA-listed species.

Table 3-1 presents a summary of the revised proposed action, including current status and key milestones for implementation.

## Implementation Timeframe, Certainty and Milestones

The 2000 BA (USACE 2000) presented the proposed action continuing for the operational life of the Willamette Project. That operational life, while not specifically defined, easily exceeds the foreseeable future. The Action Agencies anticipate that the revised proposed action presented in this Supplemental BA will also continue for the operational life of the Willamette Project. However, many of the actions identified in the proposed action are conservation measures based upon an adaptive management strategy. Many of the revised proposed actions are dependent on several factors: (1) availability of program funds appropriated by Congress or provided by others; (2) completion of more detailed evaluation to determine the feasibility of implementation of significant structural or operational modifications; and (3) continued RM&E resulting in better determining the biological feasibility of the alternatives being considered. Consequently, the measures required to address ESA requirements in the Willamette Basin will evolve and be refined over time. The Action Agencies believe that significant implementation of the critical elements of the revised proposed action particularly potential large-scale structural modifications for fish passage and water temperature control will require close consultation with the Services as feasibility and timelines are determined. Where possible, the Action Agencies have identified "off ramps" with estimated time frames to reflect the feasibility of the proposals and certainty of meeting the biological objectives.

The certainty of program funding for the actions proposed under this ESA consultation is complicated due to the fact that this consultation is for the operation of an existing system. The ESA was written primarily for decisions regarding the construction of new projects where appropriate ESA mitigation measures are integrated into the project as it is being planned and developed, and total projects costs are specifically appropriated. For existing operational projects such as the Willamette Project, funding for ESA actions must be programmed and appropriated annually. The President's proposed 2008 budget now includes Willamette Basin ESA actions within the Columbia River Fish Mitigation Project. Assuming those funds are appropriated by Congress, the Action Agencies will have a funding mechanism in place to pursue implementation of many of the actions described in this Supplemental BA. If appropriate resources are not be provided for the measures described in this Supplemental BA, then the Action Agencies will consider reopening formal consultation with the Services (i.e., the off-ramp approach).

As further described in the revised proposed action, the Action Agencies intend to conduct investigations to determine the feasibility of measures proposed. Again, the situation where a consultation revolves around an existing system creates issues for ESA compliance. For new projects the feasibility of measures being proposed would be determined prior to project construction, whereas for an operating system the engineering, economic, and biological feasibility need to be developed. For this reason, the revised proposed action, again, contains off ramps with the possibility of reconsultation should the measures proposed prove to not be practicable.

On that basis, the Action Agencies recommend that the Biological Opinions produced by the Services resulting from the revised proposed action be for a period of at least 15 years. Wherever possible in the revised proposed action, the Action Agencies have attempted to define key steps or milestones in the individual actions to be used by the Action Agencies and the Services to determine relative progress toward implementation. Due to the uncertainties associated with the revised proposed action, the Action Agencies are willing to work with the Services to identify milestones or

decision points within shorter timeframes that may be used as off ramps into reinitiating consultation if certain defined actions are not implemented.

For example, the most significant decision point facing the Action Agencies and Services in the process of implementing the revised proposed action is determining the feasibility of fish passage and related WTC improvements to potentially restore fish access to historic habitat above the Willamette dams. The ongoing ESA Recovery Planning Process for Upper Willamette River Salmon and Steelhead appears to be pointing to the restoration of access to habitat determined as critical for recovery of those species. The Action Agencies are committed to making an initial determination regarding the feasibility of passage improvements at the highest priority projects within 5 years of completion of the BiOp. Section 3.6.6 and Plate 1 provide more detail on a conceptual time frame for integrating feasibility studies and decision documents. The Action Agencies are willing to consider reinitiating formal consultation at that time if a determination is made that fish passage is not a feasible alternative at the Willamette dams.

**Table 3-1. Summary of Revised Proposed Action**

| Section | Summary of Revised Proposed Action | Current Status | Milestones/Implementation Schedule |
|---|---|---|---|
| | Base project operation described in 2000 BA (USACE 2000) remains in place unless otherwise specified. | Operation & Maintenance (O&M) | Ongoing |
| 3.1 | **Continuing Coordination and Management** | | |
| | Establish a formalized collaborative regional forum (WATER) for coordination of ESA activities. | Ongoing on an ad hoc basis through ESA Manager's Forum, Interagency Flow management Work Group, and Steelhead and Chinook Above Barriers (SCAB) Committee. | Establish charter and implement forum within 1 year of completion of the BiOp. |
| 3.2 | **Updated Description of Project Operations** | | |
| | Describes routine and non-routine O&M activities for outages (turbine, regulating outlets & spillway gates) | Ongoing - occurs informally on an ad hoc basis through the Interagency Flow Management Work Group. | Ongoing |
| | Prepare Willamette Fish Passage and Management Plan: (1) identify optimal criteria for operating existing fish passage facilities; (2) describe scheduled and unscheduled maintenance of existing infrastructure that could impact listed fish; and (3) identify protocols for handling, sorting, and releasing fish collected a USACE-funded fish collection facilities. Updated annually; similar to Fish Passage Operations and Maintenance Committee process. | Proposed Action | Prepare plan within 2 months of completion of the BiOp. |
| 3.3 | **Flow Management** | | |
| | Establish a formal Flow Management Committee under the WATER to coordinate and collaborate with the Services and other federal, state, and tribal entities. | Ongoing - occurs informally on an ad hoc basis through the interagency Flow Management Work Group. | Tied to WATER; establish charter within 1 year of completion of the BiOp. |
| | Establish a protocol for notifying Services of deviations from flow targets and related coordination. | " | Tied to WATER; establish charter within 1 year of completion of the BiOp. |
| | Make every effort to meet or exceed minimum mainstem flow objectives as measured at Salem and Albany. | " | Existing targets; ongoing management activity. |
| | Make every effort to meet or exceed minimum tributary flows that ensure adult fish access to existing spawning habitat below USACE dams, protect eggs deposited during spawning, and provide rearing habitat for listed juvenile salmonids and other fish. | " | Existing targets; ongoing management activity. |

**Table 3-1 (continued). Summary of Revised Proposed Action**

| Section | Summary of Revised Proposed Action | Current Status | Milestones/Implementation Schedule |
|---|---|---|---|
| 3.3 | Adopt and follow specific hourly and daily ramp-down rates under normal operating conditions to reduce stranding and desiccation of juvenile fish, redds, and aquatic invertebrates resulting from unnatural flow fluctuations associated with operations of USACE dams. | " | Implement interim guidance immediately; complete a detailed Ramping Rate Study within 2 years of BiOp completion. |
| | Continue Foster Dam spring fish spill operation. | " | Existing operation; ongoing management activity. |
| | Flow-related research, monitoring, and evaluation (RM&E) program. | Partially ongoing at low level; future comprehensive RM&E funding contingent on obtaining funds from variety of sources. | Develop a comprehensive RM&E program within 12 months of completion of BiOp; tied to WATER RM&E Committee to develop program. |
| 3.4 | **Hatchery Operations and Reform Actions** | | |
| | Hatchery facilities - ongoing: operate and maintain four spring Chinook hatcheries (Marion Forks, South Santiam, McKenzie, and Willamette) and associated collection facilities. | Ongoing activities with new goal (hatchery reform): combination of mitigation and conservation hatchery program to supplement natural production. | Ongoing |
| | Hatchery facilities - proposed future: (1) rebuild collection facilities (Minto, Foster, Dexter); (2) resolve outstanding infrastructure needs; (3) develop long-term hatchery maintenance plans; (3) complete Environmental Review Guide for Operations (ERGO) assessments. | Proposed future actions contingent on funding. | Initiate modification of Minto fish collection facility in fiscal year (FY) 2008. Implementation of other modifications contingent on findings of system configuration evaluations. |
| | Hatchery operations - ongoing: continue use of current broodstock - most suitable for conservation purposes. | Ongoing activities | Ongoing |
| | Hatchery operations - proposed: (1) increase % wild fish in broodstock; (2) ensure broodstock collected throughout the run; (3) insert coded wire tags into all releases in addition to adipose fin clip and otolith mark to ensure prompt ID of hatchery fish and mechanical sorting; (4) experimental release of smaller fish at Marion Forks to mimic natural life history pattern. | Proposed future actions | Initiate in FY 2008 pending increase in hatchery monitoring budget. |

**Table 3-1 (continued). Summary of Revised Proposed Action**

| Section | Summary of Revised Proposed Action | Current Status | Milestones/Implementation Schedule |
|---|---|---|---|
| 3.4 | Spring Chinook Outplant Program – Goal is to increase natural production and increase availability of natural-origin fish for broodstock. Methods: (1) continue to release spring Chinook into habitat upstream of Detroit, Foster, Cougar, Lookout Point, and Hills Creek dams; (2) use new protocols for collection, handling, transporting, and releasing fish to increase likelihood of successful spawning; (3) work with USFS and BLM to develop suitable release sites; (4) protocols updated annually by Fish Passage and Hatchery Management Committee and included in Willamette Fish Passage and Management Plan; attached to Hatchery and Genetic Management Plans. | Ongoing activities coordinated through the ad hoc SCAB Committee. Future evaluation and implementation will be integrated into the system configuration feasibility studies. | Potential Columbia River Fish Mitigation (CRFM) funding for studies: RM&E critical to adaptively manage the program with co-managers. |
| | Reducing straying of hatchery-origin McKenzie spring Chinook; evaluate options for constructing a trap at Leaburg Dam; combine with other efforts (including reducing mitigation production). | Proposed Action | Timing uncertain; will require coordination through EWEB and others. |
| | Summer steelhead: segregated program (minimize interactions with wild winter steelhead). | | |
| 3.5 | **Habitat Restoration and Management Actions** | | |
| 3.5.1 | Onsite habitat restoration and management activities: continue to use existing authorities and programs for land and water resource stewardship on USACE-administered lands to manage onsite habitat to benefit and protect ESA-listed species. | O&M environmental stewardship | Ongoing activities |
| 3.5.2 | Offsite habitat restoration | Continuing Authorities Program (CAP) and GI are the only authorized USACE programs for offsite habitat restoration; strategic implementation with Services. | Some studies and construction ongoing; implementation of others is uncertain. |
| | General Investigations (GI) Program:<br>a. Willamette Floodplain Restoration Study<br>b. Eugene/Springfield Metro Area Study<br>c. Lower Willamette Ecosystem Restoration | GI (CG for implementation)<br>Ongoing; complete by FY 2009.<br>Ongoing; complete by FY 2010.<br>Ongoing; complete by FY 2011. | Ongoing activities; implementation uncertain. |
| | CAP Sections 1135 and 206 | Construction General (CG) | |

**Table 3-1 (continued). Summary of Revised Proposed Action**

| Section | Summary of Revised Proposed Action | Current Status | Milestones/Implementation Schedule |
|---|---|---|---|
| 3.5.3 | Willamette River Bank Protection Program: Comprehensive evaluation of habitat and biological impacts of revetments placed or funded by USACE bank protection program: (1) inventory and analyze; (2) identify sites where removal or modification may be feasible; (3) evaluate cumulative effects; (4) provide estimate of areas threatened by future erosion and bank protection; (5) procedures and criteria for justifying new bank protection projects; (6) identify and evaluate current and alternative measures; and (7) recommend and establish criteria for future bank protection and maintenance, repair and rehabilitation of existing sites. | Proposed future action | FY 2008 pending availability of funds |
| | Implement future bank protection modification or removal projects. | Proposed future action | Uncertain; implementation may occur through ongoing or future CAP/GI efforts. |
| 3.5.4 | Habitat restoration RM&E. | Partially ongoing | Integrated into ongoing GI, CAP, and Willamette Bank Protection Program measures (offsite) and/or O&M stewardship (onsite). |
| 3.6 | **Structural Modifications: Fish Passage, Temperature Control and Hatcheries** | | |
| 3.6.1 | Complete Post-authorization Change (PAC) report for the Willamette River Temperature Control Project. | Ongoing | FY 2007 ongoing |
| | Implement PAC report recommendations: (1) add fish passage facilities at Cougar; (2) undertake detailed post-construction monitoring and evaluation program. | Willamette Temperature Control Project | Initiate implementation FY 2008 |
| 3.6.2 | Upgrade Minto Fish Collection and Handling Facility | Proposed future action | Complete Detailed Design Report (DDR) in FY 2008; P&S in FY 2009; Implementation in FY 2010. |
| | Work with the Services and ODFW to establish priorities and implement upgrades to remaining fish collection and handling facilities | Proposed future action | Integrate decision process into System Configuration studies. |

**Table 3-1 (continued). Summary of Revised Proposed Action**

| Section | Summary of Revised Proposed Action | Current Status | Milestones/Implementation Schedule |
|---|---|---|---|
| 3.6.3 | System Review Feasibility Studies: Undertake a series of studies looking comprehensively at the entire basin and then systematically at the key subbasins to evaluate the feasibility and relative benefits of structural and related operational modifications to the Willamette dams designed to improve survival and productivity of ESA-listed aquatic species. Collectively called the System Review Study, these studies will include evaluation of: (1) the technical feasibility; (2) biological justification; and (3) cost-effectiveness of these and other potential measures so that the relative effectiveness and efficiency of potential federal actions can be compared. In addition to addressing ESA, System Review would also address structural and operational needs associated with CWA compliance. The studies will be conducted in close coordination with the Services and other state/federal agencies and tribes. The studies will result in decision documents stating agency positions on individual measures. For those measures determined to be feasible and recommended, the Action Agencies will seek authorization and funds for implementation through normal budget and program procedures. | Proposed future action | |
| 3.6.3 | Phase I: Reconnaissance | Proposed future action | Reconnaissance in FY 2008; $750,000 |
| | Phase II: Comprehensive Overview Systemwide Feasibility Study | Proposed future action | FY 2009 and outyears; Program CRFM |
| | Phase III: Detailed Subbasin System Configuration Studies | Proposed future action | Uncertain depending on funds. Goal is to complete the first Phase III study with Decision Document by FY 2011. |
| | Phase IV: Pre-construction Engineering and Design | Proposed future action | Uncertain depending on funds. Goal is to complete the first Phase IV study with Decision Document by FY 2012. |
| | Phase V: Implementation | Proposed future action | Uncertain depending on funds. Goal is to initiate construction of first Phase V project by FY 2013. |

**Table 3-1 (continued). Summary of Revised Proposed Action**

| Section | Summary of Proposed Action | Current Status | Milestones/Implementation Schedule |
|---|---|---|---|
| 3.6.4 | Construction Activities Environmental Coordination and Management: Establish a WATER Technical Committee to coordinate construction activities based on Cougar Environmental Coordinating Committee (ECC). | | Tied to WATER; establish charter within 1 year of completion of BiOp. |
| | Adopt Best Management Practices (BMPs) for construction of all structural modifications to the dams and assoc. facilities, including fish collection and handling, fish passage improvements, and water temperature control (WTC) implemented to improve conditions for ESA-listed species. | | Patterned on BMPs established and followed for Cougar Temperature Control Project implementation. |
| 3.7 | **Water Quality Improvements** | | |
| 3.7.1 | Cougar Dam WTC Project: Continue to operate the Cougar WTC Project to meet downstream temperature targets for protection of Chinook salmon. | Ongoing | Ongoing |
| | Provide an extended biological RM&E program for Cougar WTC. The RM&E program will include effects of the WTC operation on downstream ecosystem and fish entrainment in the tower. Program objectives are to determine most effective protocols to implement WTC and trap-and-haul program, and to document the biological benefits realized from these protective and restorative measures. | Proposed future action | Initiate in FY 2008 |
| | Develop a Cougar WTC Monitoring and Evaluation Plan in coordination with the Services and other members of the Cougar ECC. | Proposed future action | Complete by FY 2008 |
| 3.7.2 | TMDL Water Quality Management Plan (WQMP): Coordinate with the Services and ODEQ, and USEPA to prepare a WQMP to address the TMDL for temperature and other water quality parameters consistent with the needs of ESA-listed species. | Proposed future action | Develop plan in FY 2008 |
| | Participate in an Interagency Management Process for temperature-related improvements in Willamette Basin. | " | Integrated into WATER's Water Quality/Temperature Control Committee |
| | Assist with collection and analysis of data necessary to support ODEQ revisions of load allocations for each of the 13 dams and reservoirs. | " | Develop plan in FY 2008; implementation in FY 2009 and outyears in conjunction with specific projects. |

**Table 3-1 (continued). Summary of Revised Proposed Action**

| Section | Summary of Proposed Action | Current Status | Milestones/Implementation Schedule |
|---|---|---|---|
| 3.7.2 | Demonstrate compliance and consistency with the BiOp for the Willamette Project. | " | " |
| | Develop a temperature management plan to show temperature improvements needed to achieve load allocations. | " | " |
| | Develop a data and information strategy that may be used for future Use Attainability Analyses for the dams. | " | " |
| 3.7.3 | Ongoing water quality RM&E program. | Ongoing action | Ongoing |
| | Future water quality RM&E program. | Proposed future action | |
| | Develop/implement multi-year water quality RM&E plan. | | |
| | Develop/implement Water Temperature study. | | |
| | Develop/implement total dissolved gas monitoring plan. | | |
| 3.8 | **Research, Monitoring and Evaluation Program** | | |
| 3.8.1 | Collaborate closely with the Services, ODFW, and others in developing and managing the comprehensive Willamette Basin RM&E program. The coordinating mechanism is the WATER RM&E Committee. | Proposed future action | Develop the RM&E program in FY 2008; implement beginning in FY 2009. |
| 3.8.2 | Guiding principles and Strategic questions | | |
| 3.9 | **Contract Water Marketing Program** | | |
| 3.9.1 | Reclamation and USACE propose to continue the existing irrigation water marketing program for the Willamette Project. | Ongoing | . |
| | No identified future cap on irrigation water marketing from the Project; water marketing of up to 95,000 acre-feet can be supported by current reservoir operations. | " | |
| | In the event that future irrigation demand exceeds 95,000 acre-feet, Reclamation and USACE will reevaluate the availability of water from conservation storage for the water marketing program and consult with the Services. | " | |
| 3.9.6 | New form of long-term contract to specify ESA protections. | " | |

## 3.1. Continuing Coordination and Management

This section summarizes existing and proposed mechanisms for continuing coordination and consultation in regard to ESA-listed species and related resource issues in the Willamette Basin. It recognizes that effective implementation of ESA conservation measures proposed herein has been and will continue to be dependent on effective coordination and collaboration between the Action Agencies and Services engaged in ESA Section 7 consultation for continued operation and maintenance of the Willamette Project, as well as with agencies of the State of Oregon with responsibility for managing fish, wildlife and water resources, and other local entities and agencies.

**Proposed Action**: ***The Action Agencies recognize that a need exists for establishment of a formalized, collaborative body to assist in the coordinated implementation of the ecosystem restoration measures described in this revised proposed action. Within one year of the completion of this Supplemental BA, the Action Agencies, in coordination with the Services and other federal and state agencies and tribes with fisheries and water resource management responsibilities in the Willamette River Basin, will develop and implement a Charter for a collaborative body to be known at the Willamette Action Team for Ecosystem Restoration (WATER).***

The basic purpose and goals of WATER will be to:

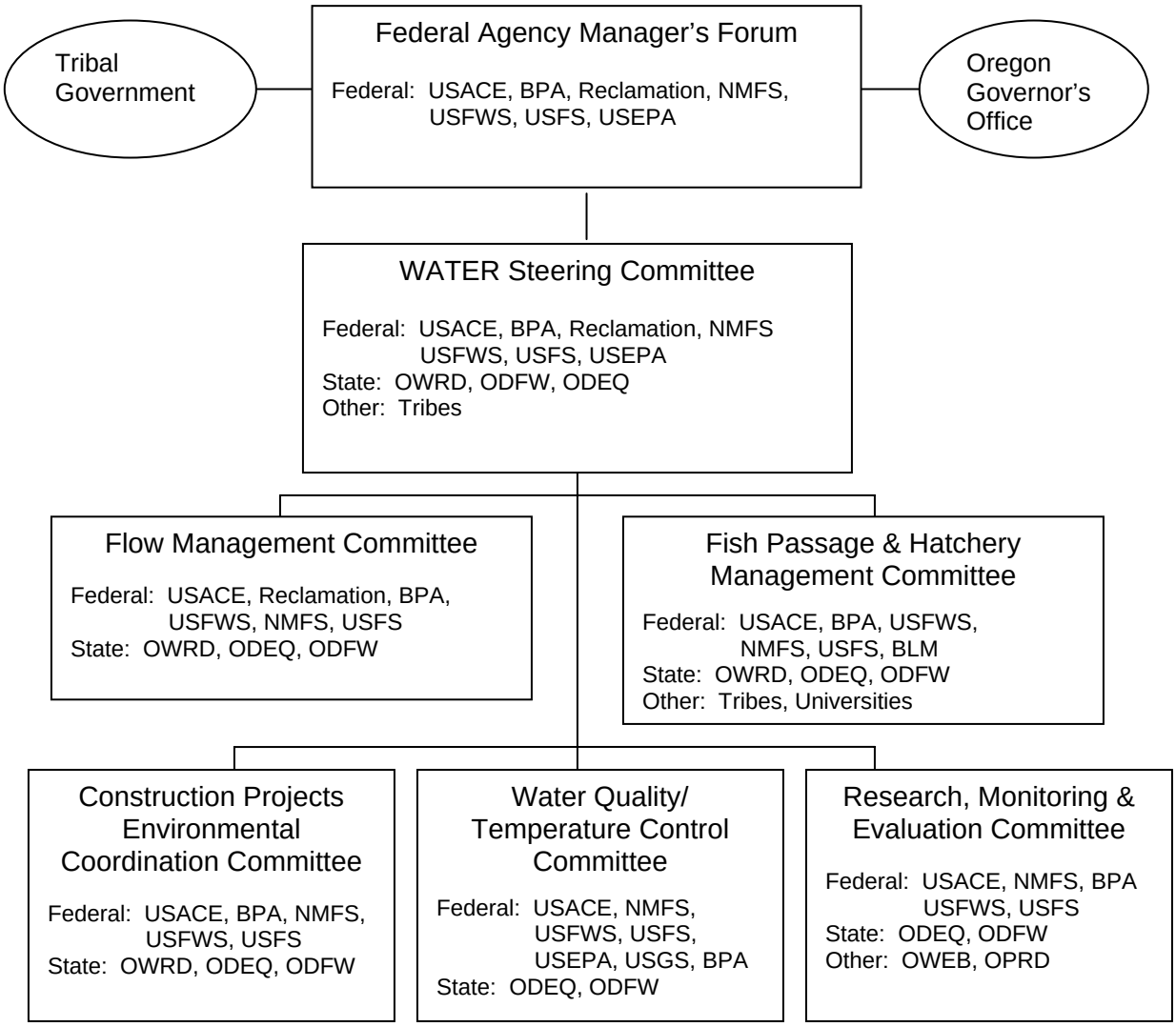
- Facilitate a long-term partnership among the Action Agencies and the Services for implementation of measures for recovery of ESA-listed species.
- Provide a forum for coordination and decision-making among the sovereign governments (federal/state/tribal) working to implement strategies for ESA compliance and related missions and authorities, including Clean Water Act (CWA) compliance associated with the 13 federal dams operated and maintained by the USACE in the Willamette River Basin.
- Provide an opportunity for input and thorough discussion amongst the federal and state agencies and tribes actively engaged in these efforts.
- Increase the transparency of decisions on operation and configuration of the Willamette Basin dams as they relate to ESA and CWA compliance.
- Clearly define decision authority and provide a vehicle for elevating decision-making and conflict resolution associated with those efforts to appropriate levels of the involved governmental bodies.

The details of WATER will be worked out during development of the Charter to include the following elements:

- ✓ organizational structure and membership
- ✓ purpose and objectives
- ✓ participation and representation guidelines and procedures
- ✓ decision authority
- ✓ decision making processes
- ✓ dispute resolution processes
- ✓ planning activities
- ✓ conduct and frequency of meetings
- ✓ reporting and oversight
- ✓ annual review of procedures

As currently envisioned by the Action Agencies, WATER will follow the hierarchical structure shown in Figure 3-1. The suggested structure is discussed in the following sections.

**Figure 3-1. Proposed Organizational Structure, Willamette Action Team for Ecosystem Restoration (WATER)**



### 3.1.1. Federal Agency Manager's Forum

This group would evolve from the existing Manager's Forum established to provide federal agency senior management level oversight to the Willamette Project ESA consultation. The Forum would act as a regional policy and management level body representing the key participating federal agencies with responsibility for operating and maintaining the federal dams in the Willamette Basin (USACE, Reclamation, BPA), and implementation and compliance with ESA (the Services). The existing Forum would be expanded to include federal agencies with responsibility for CWA compliance [U.S. Environmental Protection Agency (USEPA)], and other agencies with closely related land and water management responsibilities [U.S. Forest Service (USFS)]. While the Forum would be limited to federal managers, they would coordinate with executives of the other governmental sovereigns (Oregon governor's office, tribal organizations), as needed. The Forum would meet infrequently (annually or less, or as-needed) at critical milestones, to establish or confirm priorities, or to resolve issues elevated from the WATER Steering Committee level.

### 3.1.2. WATER Steering Committee

The WATER Steering Committee would be composed of senior project and program managers representing the federal agencies involved in the ESA Section 7 consultation for the Willamette Project, as well as other key federal agencies with land and water resource management responsibilities critical to implementation of ESA measures. The Steering Committee will provide project management oversight. It will also be the level at which the participating entities will seek to resolve most disputes and conflicts. The Steering Committee will provide oversight to the work of the five technical coordinating committees (see Figure 3-1). The Steering Committee will be responsible for overseeing and coordinating the activities of the technical coordinating committees engaged in implementation of the separable elements for ESA and CWA compliance and recovery.

### 3.1.3. Technical Coordinating Committees

Five technical coordinating committees would be established to oversee implementation of the different elements of the proposed action and related resource management activities. The Steering Committee would provide oversight for the technical committees, but the technical committees are the level at which much of the detailed work of implementing ESA and CWA compliance activities will be staffed, planned, scoped, designed, and implemented.

The technical committees will be populated by key functional area technical experts from each of the involved federal and state agencies and tribes including the Action Agencies, NMFS, USFWS and other key participants including other federal agencies [USFS, USEPA, U.S. Geological Survey (USGS)], state agencies [ODFW, Oregon Water Resources Department (OWRD), ODEQ, and others], tribal organizations, and other entities. Experts from academia and consulting firms may also become engaged as members of the technical committees, as needed. The makeup of the committees would be reflective of the scope of their respective areas of responsibility.

The number, scope, and responsibilities of the technical committees will be established by the Action Agencies working in collaboration with the Services. The ultimate number, responsibilities, and scopes of the technical committees formed will be determined by the Action Agencies working with the Services through development of a charter for WATER.

#### 3.1.3.1. Flow Management Committee

The Flow Management (FM) Committee will evolve from the existing ad hoc interagency Flow Management Work Group that has been assisting the USACE in managing the operation of the Willamette Project since the 1990s. The function and responsibilities of the FM Committee are described in detail in Section 3.3. The FM Committee will be chaired by a representative of the USACE (Portland District Reservoir Regulation and Water Quality Section). Other members will include key federal and state agencies with water management authorities and responsibilities in the Willamette Basin including the Services, BPA, Reclamation, USEPA, OWRD, ODEQ, and ODFW. The FM Committee will continue to act in an advisory capacity to the USACE, which will retain ultimate authority for operating reservoir elevations and downstream flows to meet authorized project purposes. However, more formalized rules, guidelines, and procedures will be established for ensuring that the agencies have adequate opportunity for providing input and coordination into flow management operations and for elevating and resolving disputes that may arise.

The FM Committee will meet frequently throughout the year including monthly meetings during the development and implementation of the annual conservation storage and release plan, and almost weekly (via conference calls) during real-time operations and will assist the USACE with:

- Reviewing and evaluating reservoir operating criteria including mainstem and tributary flow targets, and revising operating manuals where appropriate.
- Designing and implementing flow monitoring and evaluation studies needed to determine the effects of reservoir operations on downstream habitat conditions, aquatic species, and water quality conditions.
- Developing the annual operating plan for the conservation storage and release season.
- Providing advice and consultation during real-time operations, particularly but not limited to the conservation storage and release season.
- Conducting annual reviews of Willamette Project operations and documenting issues, concerns and opportunities associated with improving operations to better meet ESA and CWA compliance requirements where possible.

#### 3.1.3.2. Fish Passage and Hatchery Management Committee

Fish passage around several USACE dams currently uses hatchery collection facilities, and initial efforts to reestablish populations of salmon upstream of the dams involves the use of hatchery fish produced by USACE-funded hatcheries. Therefore, fish passage and hatchery-related issues will be addressed by one committee in the short term. Within the context of the Willamette System Review system configuration feasibility studies described in Section 3.6, the Fish Passage and Hatchery Management (FPHM) Committee would assist the USACE in addressing issues related to fish passage at USACE dams, to ensure that operation of USACE-funded hatcheries minimizes impacts and supports recovery of ESA-listed species, and to coordinate efforts to evaluate the feasibility of reintroduction in areas upstream of the dams. A major responsibility of the FPHM Committee would be to assist the USACE in annually developing updating the Willamette Fish Passage and Management Plan (FPMP) as described in Section 3.2.2. The Action Agencies envision the FPHM Committee as an interagency team with similar organization and function as the Fish Passage Operations and Maintenance Team on the Columbia River.

To date, most fish passage and hatchery management issues in the Willamette Basin have been addressed informally through the ad hoc Steelhead and Chinook above Barriers (SCAB) Committee. The roles and responsibilities of the SCAB Committee were described in Section 2.6.2.2 and would

be adopted by the FPHM Committee. The SCAB Committee was formed to address existing and potential access and use of habitat upstream of the dams by anadromous species. This action was in response to a mutual agreement among the agencies that the need existed for additional coordination of existing ODFW efforts to outplant hatchery spring Chinook in and above several of the Willamette reservoirs. The committee has developed initial guidelines and protocols for hatchery outplants which have been informally adopted by the agencies involved. The committee also has been evaluating the potential for using historic habitat above dams as a tool for salmon recovery, in which case evaluation of existing and potential fish passage past the dams is a critical issue.

The FPHM Committee will also evaluate the results of fish passage and hatchery-related RM&E efforts (and refine RM&E efforts accordingly), as well as annually update the Willamette FPMP including broodstock collection protocols and disposition of hatchery- and natural-origin fish, based on the results of RM&E, run size predictions, or structural changes, such as new fish collection facilities, passage facilities, or WTC structures. Because all hatcheries funded by the Action Agencies are partially funded by the State of Oregon (via ODFW), the Action Agencies, and the State of Oregon are responsible for effective hatchery operation and monitoring. Thus, the FPHM Committee will serve as forum for developing a thorough implementation plan for the hatchery monitoring program that specifies which RM&E tasks will be funded and/or carried out by the State of Oregon, the Action Agencies, or other entities.

#### 3.1.3.3. Construction Projects Environmental Coordinating Committee

The Action Agencies propose to establish a Construction Projects Environmental Coordinating (CPEC) Committee. The roles and responsibilities of the CPEC Committee are described in Section 3.6.5. Modeled after the Environmental Coordination Committee (ECC) established for construction of the Cougar Dam WTC with NMFS, USFWS, and other key agencies and entities, the purpose of the CPEC Committee will be to ensure that a mechanism exists for coordinating implementation of all future structural modifications undertaken at the Willamette dams to address ESA fish and related needs including fish collection and handling, fish passage, hatchery and WTC facilities.

#### 3.1.3.4. Water Quality/Temperature Control Committee

The primary responsibility of the Water Quality and Temperature Control (WQTC) Committee would be to ensure integration of water quality improvement requirements undertaken by the Action Agencies to address the needs of ESA-listed species with the requirements undertaken to address CWA requirements. In addition to the Action Agencies and Services, other key members of the WQTC Committee would include USEPA, USGS, and ODEQ.

In October 2006, ODEQ released a final Total Maximum Daily Load (TMDL) for temperature and other pollutants in the Willamette Basin. The Willamette TMDL was approved by USEPA in November 2006. Chapter 14 of the TMDL, *Water Quality Management Plan*, recommends that the USACE prepare an Implementation Plan to show how it will address the TMDL load allocations for temperature, including compliance and consistency with the pending BiOp for operating the Willamette dams. The ODEQ also recommended that the USACE establish and coordinate TMDL implementation planning through an interagency work group.

Activities and responsibilities of the WQTC Committee may include:

- Assisting in the development of study plans for water quality RM&E.
- Assisting in development of uniform water quality criteria and standards for CWA and ESA compliance.
- Reviewing and evaluating water quality RM&E results.
- Assisting in development of criteria for prioritizing WTC proposals.

#### 3.1.3.5. Research, Monitoring and Evaluation Committee

A RM&E Committee will be established to oversee development and management of the Willamette RM&E program. In addition to the Action Agencies and Services, other participants of the RM&E Committee may include ODFW, USGS, USEPA, tribes, universities, and others. The Action Agencies foresee this committee overseeing an annual planning process for developing the Willamette RM&E program that is similar to the FCRPS Regional Forum that develops and manages the USACE Anadromous Fish Evaluation Program. The RM&E Committee, consisting of technical representatives from each resource management agency, will function as a technical review group. This committee's role will be to identify RM&E needs and priorities, develop research summaries, provide peer review for research proposals and reports, and provide recommendations on ongoing and future actions based on research results. The RM&E Committee will be chaired by a USACE representative who will convene meetings, record minutes, and assure that action items are completed. Based on the recommendations of the RM&E Committee, the Action Agencies will solicit study proposals, oversee study completion, and facilitate peer review of study proposals and research reports to ensure results are based on sound science. Section 3.8 provides additional information regarding the RM&E Committee.

## 3.2. Updated Description of Project Operations

The 2000 BA (USACE 2000) presented a comprehensive description of operation of the Willamette Project for authorized operating purposes. The Willamette Project has a combined infrastructure totaling 15 turbine units, 30 regulating outlets, 39 spillway gates, 3 fish facilities, and 5 mitigation hatcheries. These facilities are primarily operated by the USACE with the mitigation hatcheries and associated collection facilities operated by ODFW. Operation of these facilities is critical to management and survival of ESA-listed fish at the projects. It is important that all parties understand the operation procedures at USACE-owned infrastructure, including the protocols for handling, sorting, and transporting ESA-listed fish collected at facilities. This infrastructure has a range of operating criteria and requires scheduled and unscheduled maintenance. Lack of maintenance can result in poor attraction/passage conditions, facility closures during migration, and/or injury to ESA-listed fish. Timing of maintenance is also important. Turbine outages scheduled during spawning can result in elevated levels of TDG downstream of the dams that harm listed fish.

The primary purpose of this section is to: (1) outline the Willamette Fish Passage and Management Plan (FPMP), which will thoroughly describe the operation of all USACE infrastructure that handles or impacts ESA-listed fish, including existing fish collection and passage; (2) describe the kinds of routine scheduled and non-routine unscheduled maintenance activities associated with project operations; and (3) propose mechanisms for coordinating and consulting with the Services and other key stakeholders in the event that unscheduled outages occur.

### 3.2.1. Routine and Non-routine Operations and Maintenance Activities

Each calendar year turbine units, regulating outlets, and spillway gates at the Willamette Project are placed out of service for routine and non-routine maintenance. All turbine units are placed out of service for 1-2 weeks each year for annual maintenance. In almost all cases, this requires the units to be completely dewatered. The units are inspected, cleaned, and lubricated. Each unit is also on a rotating schedule for a more rigorous inspection and cavitation repair approximately every 5 years. This requires the unit to be completely dewatered and placed out of service for 4-8 weeks. In addition to routine maintenance, turbine units are placed out of service for non-routine maintenance. Each turbine unit undergoes a unit rewind every 25-50 years. Each rewind is about 5 months in duration. Turbine units may also be replaced every 25-50 years. Routine and non-routine maintenance on turbine units is always scheduled; however, each year turbine units and regulating outlets may malfunction or be placed out of service for an emergency which results in an unscheduled outage. Timing of these outages is unpredictable and the durations are uncertain. Turbine outages result in a number of potential effects to ESA-listed fish including:

- Maintenance of turbines involves dewatering of draft tubes that can trap fish in areas that are dewatered.
- Increased spill can result in increased TDG concentrations downstream of the dams depending on spill patterns, duration, and quantity. Total dissolved gas can negatively affect all life stages of fish. Juvenile fish held at Dexter Ponds have exhibited symptoms of gas bubble disease during high spill levels.
- Flow fluctuations are unscheduled outages can result in unnaturally rapid changes in flow over periods of minutes, hours, and days. These fluctuations can be immediately lethal or result in delayed or indirect effects including stranding, interference with spawning, redd dewatering, changes in migration, and increased predation, as well as reductions in invertebrate diversity, biomass, and species composition.

### 3.2.2. Willamette Fish Passage and Management Plan

**Proposed Action**: ***To minimize impacts to listed fish in the Willamette Basin resulting from the operations and maintenance of the existing infrastructure, the Action Agencies propose to develop a Willamette Fish Passage and Management Plan (FPMP) within two months of the completion of the Willamette Project Biological Opinion. The Willamette FPMP will: (1) identify optimal criteria for operating existing fish passage facilities while still meeting authorized project purposes; (2) describe scheduled and unscheduled maintenance of existing infrastructure that could potentially negatively impact listed fish; and (3) identify protocols for handling, sorting, and releasing fish collected a USACE- funded fish collection facilities. The FPMP will also describe mechanisms and procedures for coordinating and consulting with federal and state resource agencies in the event of scheduled or unscheduled maintenance. With guidance from the WATER FPHM Committee, the USACE will update the FPMP annually to provide ODFW and USACE operators and managers with clear guidance on how to operate each facility. The FPMP will clearly identify the number, origin, and species of fish to be released into habitat upstream of USACE dams (consistent with the hatchery outplant program described in Section 3.4.4.5) incorporated into the hatchery broodstock, or taken to other destinations. Annual updates will be based on results of RM&E activities, construction of new facilities, recovery planning guidance, predicted annual run size, and changes in hatchery management.***

The Willamette FPMP will be developed by the USACE in coordination with the Services, ODFW, BPA, and other participants through the FPHM Committee described in Section 3.1. The FPMP will

describe project operations necessary to protect and enhance anadromous and resident fish species listed as threatened or endangered under the ESA at USACE dams in the Willamette Basin. The FPMP will guide USACE actions and be used by responsible personnel to adhere to guidelines, principles, and actions established under the BiOp including release of fish collected at USACE-funded facilities into areas upstream of USACE dams. It will be an evolving document that is revised annually by the FPHM to incorporate changes to project operations and maintenance as a result of new facilities, changes in operational procedures, results of RM&E activities, or changes in management of hatchery fish or facilities. Revisions will incorporate changes adopted through coordination with the Services as part of the ESA Section 7 consultation, recovery planning, or Section 10 incidental take permit processes, and through consideration of other WATER agencies.

A draft outline for the Willamette FPMP and an "example" section for the Fall Creek project are provided in Appendix A, *Outline of Fish Passage and Management Plan*.

## 3.3. Flow Management

### 3.3.1. Recent History and Background

The proposed action contained in the 2000 BA (USACE 2000) described project operations, including flow management criteria, prior to the 1999 UWR listings of Chinook salmon and winter steelhead. In response to those listings, the USACE has made substantial changes in the management of flows in the Willamette Basin not reflected in the 2000 BA. In general, the Action Agencies have taken a more adaptive approach to working closely and collaboratively with state and federal resource management agencies to plan and implement annual strategies for balancing the storage and use of water in the Willamette Basin. This collaboration has reduced impacts to ESA-listed fish species while allowing the Action Agencies to meet other authorized water uses and to learn more about the interplay of alternative water management decisions and their impacts on listed species. This revised proposed action incorporates changes to flow management that have occurred subsequent to the ESA listings.

The most significant specific adaptation to reservoir system operations has been the adoption of spring mainstem flow targets. Since 2000, mainstem Willamette Basin flows have been substantially higher during the spring migration periods for juvenile and for adult spring Chinook salmon and winter steelhead. In addition, tributary specific flow and storage conditions important to local populations of spring Chinook salmon, winter steelhead, and Oregon chub have been closely monitored and adjusted, when necessary.

From 2000 through 2003, the USACE worked with other federal and state agencies to develop a flow management strategy for the Willamette Basin. This strategy established a framework for meeting mainstem Willamette River flow objectives as recommended by NMFS and ODFW (Friesen and Buckman 2003) based on the mid-May system-wide storage forecast, and makes adjustments based on ambient hydrologic conditions. This strategy is described in the following sections and in Appendix B, *Willamette Mainstem Flow Operations Strategy*. This collaboration has been tested under periods of extreme dryness (2001) and ample rainfall (2006.) It has provided the basis for building consensus among the Action Agencies and the Services concerning a balanced flow management approach that effectively meets necessary authorized uses while avoiding unnecessary impacts to ESA-listed fish species.

### 3.3.2. Flow Management Proposed Action

The Action Agencies will manage water storage and releases at the Willamette Project for system purposes to avoid or minimize adverse effects on listed fish species by implementation of the following measures:

**Measure A – WATER Flow Management Committee**. Establish a formal Flow Management (FM) Committee under WATER to coordinate and collaborate with the Services and with other federal, state, and tribal entities in the operation of the Willamette reservoirs and in the implementation of Measures C-G. The USACE will take a leadership role in the administration of this committee, providing for coordination, administration costs, and meeting space. The committee will serve the purpose of providing for development and implementation of the annual Willamette Conservation Plan, including continued coordination with the Services and with other official agencies and entities throughout the flow management season.

**Measure B – Protocol for Notification of Deviations**. The FM Committee will be notified by e-mail or phone if conditions or circumstances (e.g., flood damage reduction, emergency operating conditions, etc) might result in deviations from Measures C, D, E, or F. If the FM Committee is not e-mailed prior to the deviation event, the USACE will notify the Services within 48 hours of the action taken and will coordinate with the Services within 30 days thereafter. A brief summary report explaining the action taken and the circumstances requiring it will be prepared within the 30-day period following the action. This approach will be taken only if it is not possible to coordinate with the FM Committee or the Services prior to the event.

**Measure C – Minimum Mainstem Flows**. Operate to make every effort to meet or exceed minimum mainstem flow objectives (see Table 3-2) as measured at Salem and Albany, Oregon, following the framework described in Appendix B and in collaboration with the Services and other official parties as indicated under Section 3.3.3 (Measure A).

**Measure D – Minimum Tributary Flows**. Operate to make every effort to meet or exceed minimum tributary flows (see Table 3-2) that ensure adult fish access to existing spawning habitat below USACE dams, protect eggs deposited during spawning, and provide rearing habitat for listed juvenile salmonids and other fishes. During winter steelhead and spring Chinook salmon spawning seasons, maintain flows below the specified maximum flow rate (see Table 3-3) under normal operating conditions. Flood damage reduction actions are not considered to be "normal operating conditions" for purposes of the flow management actions described under Section 3.3 of this revised proposed action.

**Measure E – Ramping Rates**. Adopt and operate to follow specific hourly and daily ramp-down rates under normal operating conditions (see Table 3-4) to reduce stranding and desiccation of juvenile fish, redds, and aquatic invertebrates resulting from unnatural flow fluctuations associated with operations of USACE dams. Flood damage reduction actions are not considered to be "normal operating conditions" for purposes of the flow management actions described under Section 3.3 of this revised proposed action.

**Measure F – Foster Spring Spill**. Continue to operate to spill between 0.5 and 1.5 feet of water (approximately 92 to 238 cfs), depending upon inflow and forebay elevation

fluctuations, from Foster Reservoir over the spillway fish weir from 0600 through 2100 hours daily during the fish passage operation at Foster Dam from April 15 through May 15 each year to increase survival of juvenile salmonids emigrating from above Foster Dam.

**Measure G – Research, Monitoring and Evaluation**. The Action Agencies will develop and implement a comprehensive research, monitoring and evaluation program to determine compliance with, and effectiveness of, these measures and to better discern and evaluate the relationships between flow management operations and the resulting dynamics of ecosystem function and environmental conditions downstream of Willamette Project dams.

These measures, their purposes and objectives, are presented and discussed further in the following sections.

### 3.3.3. Measure A – Flow Management Committee

***Section 3.1 describes the Action Agency's proposal to establish a collaborative interagency body, called the Willamette Action Team for Ecosystem Restoration (WATER), which will work as a collaborative regional forum with responsibility for assisting the Action Agencies in the coordinated and collaborative implementation of the ESA and related measures described in this revised proposed action. The Action Agencies propose to work collaboratively with the Services and with other federal, state, and tribal organizations with water resource management responsibilities in the Willamette River Basin to establish and implement a charter for WATER within 1 year of completion of the BiOp.***

The WATER organization features a series of interagency technical committees with responsibility for implementing separable elements of the revised proposed action. The technical committees will report upward through a hierarchical structure representing management and policy levels of each of the key federal agencies involved in this consultation. One of the key technical committees within WATER will be the Willamette FM Committee. The FM Committee will evolve from the existing ad hoc Willamette Interagency Flow Management Work Group. This work group has been a highly effective forum for coordinating management of the Willamette Basin projects. However, the Action Agencies recognize that with increasing demands placed on water management activities in the basin in conjunction with ESA, CWA compliance, and other requirements and needs, the reservoir management coordination needs to occur in a more formalized setting with established rules, guidelines and procedures pertaining to membership, decision-making, issue resolution and other responsibilities.

The FM Committee will be chaired by the USACE Portland District and staffed principally by representatives of the USACE (i.e., the Portland District Environmental Resources Branch, the Portland District Reservoir Regulation and Water Quality Section, and the Northwest Division Reservoir Control Center). Other members will include key federal and state agencies with water or related resource management authorities and responsibilities in the basin including NMFS, USFWS, BPA, USBR, USEPA, OWRD, ODFW, and ODEQ. The committee will continue to act in an advisory capacity to the USACE, which will retain ultimate authority for operating reservoir elevations and downstream flows to meet authorized project purposes. However, procedures will be established for ensuring that the Services and other agencies have adequate opportunity for providing recommendations on flow management operations, and for elevating and resolving disputes that may arise. The FM Committee will convene frequently throughout the year including monthly meetings during the development and implementation of the annual conservation storage and release plan, and weekly conference calls (as necessary) during real-time operations. It will assist the USACE in:

a. Developing the annual operating plan for the conservation storage and release season.
   - The draft Willamette Conservation Plan (WCP) is developed by the USACE by mid-January each year and issued to the FM Committee for review. Included are planned outages or project construction activities that are expected to interfere with normal flow and ramping operations.
   - The FM Committee meets in February (or before) to discuss, comment on, and make recommendations to the Action Agencies regarding flow modeling results and the draft WCP, including comments related to modeling parameters used, proposals for minimum flows in mainstem and tributary areas, ramping rates, spill, special operations, etc.
   - The Action Agencies will identify specific concerns, guidance, or priorities for FM Committee consideration during these discussions.
   - The draft WCP will be edited as necessary by the Action Agencies for use beginning in April, including a discussion of (and rationale for) how recommendations from the FM Committee were addressed.
   - The WCP will note that it provides the basis for operations throughout the ensuing water management season, and that the FM Committee will meet weekly during April through June (or more often or longer, as needed), to discuss any necessary adjustments to, or changes in, the WCP.
   - The Action Agencies will develop draft meeting minutes to document decisions and rationale, and will provide participants the opportunity to comment on these draft minutes prior to their finalization.

b. Providing recommendations during real-time operations, particularly during (but not limited to) the conservation storage and release season. This includes prioritizing the, at times, contradictory mainstem or tributary flows and providing recommended operations accordingly.

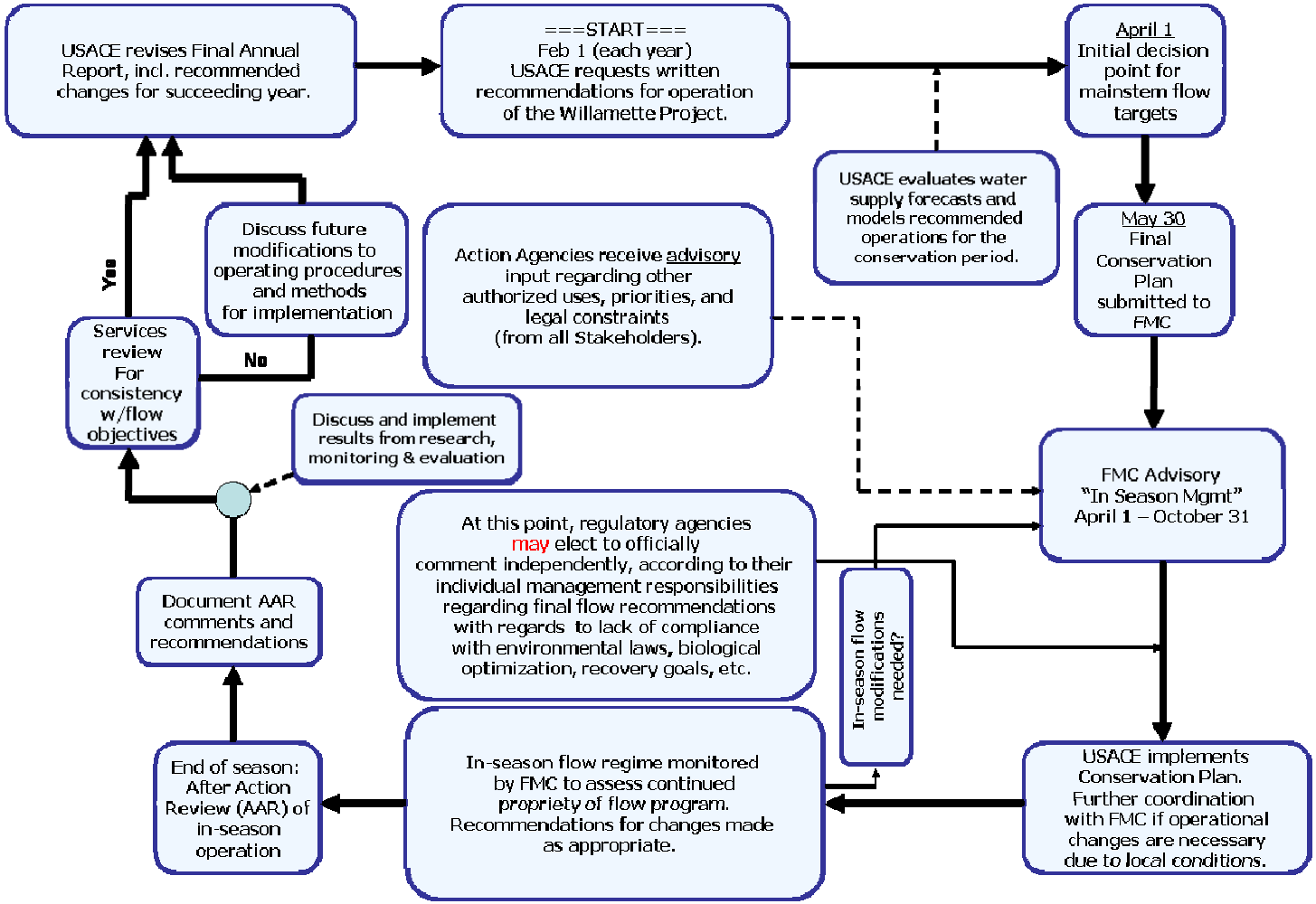
c. Conducting annual reviews of Willamette Basin reservoir operations and documenting issues, concerns and opportunities associated with improving operations to better meet ESA and CWA compliance requirements where possible.

d. Designing and implementing biological and flow management research, monitoring and evaluation studies needed to better define the effects of reservoir operations on downstream ecosystem function, habitat conditions, water quality conditions, and aquatic species.

e. Reviewing and evaluating reservoir operating criteria, including mainstem and tributary flow objectives, and revising operating protocol (e.g., manuals or guidelines) where appropriate to achieve more effective protection and recovery of ESA-listed species.

Figure 3-2 shows the planned annual cycle of Willamette Basin reservoir operation planning, implementation and review, highlighting opportunities for the Services' input in the process for adequately ensuring appropriate ESA considerations. The process of developing the annual WCP for the Willamette reservoirs will integrate plans for addressing mainstem flow objectives (Measure C), tributary flow objectives (Measure D), and ramping rates (Measure E) annually based on forecasted and actual hydrologic conditions.

**Figure 3-2. Example Diagram: Yearly Water Cycle, USACE Willamette Project Flow Release Decision Logic**




**FMC – Flow Management Committee comprised of Action Agencies, NMFS, USFWS, OWRD, ODFW, USFS, and others.**
**WCP - Water Conservation Plan developed by USACE**

### 3.3.4. Measure B – Protocol for Emergency Operations

***The Action Agencies propose that long-term, seasonal, and real-time planning and implementation of the Willamette Basin reservoirs will occur within the Flow Management Committee under the WATER framework. However, the Action Agencies recognize that under certain circumstances, it will be necessary to deviate from established criteria and protocol for mainstem or tributary flows or ramping rates (see Measures C, D and E below). Those circumstances may occur during times of drought, unplanned outages of turbines, and other unplanned emergency operating conditions.***

The charter for the FM Committee will include provisions for emergency coordination during unplanned events and outages when operational deviations are necessary. The Action Agencies will make every attempt to coordinate these events with the full FM Committee, when possible. However, in the event that it is not possible, the protocol will designate points-of-contact within the Action Agencies and the Services for emergency ESA coordination.

In the event of such deviations, the Action Agencies commit to notify the Services within 48 hours of the action taken and will coordinate with the Services within 30 days thereafter. A report explaining the action taken and the circumstances requiring it will be prepared within the 30-day period following the action. This approach will be taken only if it is not possible to coordinate with the WATER FM Committee or the Services prior to the event.

### 3.3.5. Measure C – Mainstem Willamette River Flow Objectives

***The Action Agencies propose to make every effort to meet or exceed the mainstem minimum flow objectives listed in Table 3-2 during April through October in abundant and adequate flow years as defined in Appendix B. Reduced flow targets will be met in drier years (Appendix B). The USACE will implement these flow objectives according to the protocol described in Section 3.3.3 (Measure A).***

**Table 3-2. Mainstem Willamette Flow Objectives**

| Time Period | 7-Day Moving Average [1] Minimum Flow at Salem (cfs) | Instantaneous Minimum Flow at Salem (cfs) | Minimum Flow at Albany (cfs) [2] |
|---|---|---|---|
| April 1 - 30 | 17,800 | 14,300 | --- |
| May 1 - 31 | 15,000 | 12,000 | --- |
| June 1 - 15 | 13,000 | 10,500 | 4,500 [2] |
| June 16 - 30 | 8,700 | 7,000 | 4,500 [2] |
| July 1 - 31 | --- | 6,000 [1] | 4,500 [2] |
| August 1 - 15 | --- | 6,000 [1] | 5,000 [2] |
| August 16 - 31 | --- | 6,500 [1] | 5,000 [2] |
| September 1 - 30 | --- | 7,000 [1] | 5,000 [2] |
| October 1 - 31 | --- | 7,000 | 5,000 |

[1] An average of the mean daily flows in cubic feet per second (cfs) observed over the prior 7-day period.
[2] Congressionally authorized minimum flows (House Document 531). September flows were extended into October.

The flow objectives in Table 3-2 combine the statutorily authorized minimum flows (House Document 531) as measured at Albany and Salem for the June through October period, which the projects were historically operated to meets, with new mainstem "fish flow" objectives for April through June. The June through October mainstem flow objectives were described in the Action Agencies' original BA (USACE 2000). The spring targets are a new measure contained in this revised proposed action even though they were first initiated in 2000 and have been primary operating criteria since then. From 2000 through 2003, the USACE worked with other federal and state agencies to develop a flow management strategy for the Willamette Basin. This strategy established a protocol for meeting mainstem Willamette River flow objectives as recommended by NMFS and ODFW (Friesen and Buckman 2003) based on the mid-May system-wide storage forecast, and makes adjustments based on ambient hydrologic conditions. The strategy is described in detail in Appendix B and will be implemented annually in conjunction with the flow management process coordinated through the WATER FM Committee.

#### 3.3.5.1. Background and Rationale

The purpose of the flow objectives presented in Table 3-2 is to aid juvenile and adult salmon and steelhead migration and survival, while maintaining adequate conditions in tributary areas for spawning and rearing. These flow objectives also preserve the Action Agencies' ability to meet other authorized and necessary uses, such as maintaining acceptable water quality conditions, generating hydropower, and providing flood damage reduction. While it is not possible to achieve all flow objectives in every month of every year because of natural limitations in the availability of water and reservoir storage, the intent of this proposal is to make every effort to meet or exceed the flow objectives taking into consideration flood damage reduction, human safety, and water quality. Appendix C, *Willamette Mainstem and Tributary Flow Summary*, provides statistical details on the probabilities of meeting these mainstem flow targets based on the 66-year period of record from 1936-2001. When water supply is less than optimal the WATER FM Committee will be tasked with recommending allocation of available water to the USACE. The USACE will implement the flow objectives in Table 3-2 according to the protocol described in Section 3.3.3 (Measure A).

The flow objectives shown in Table 3-2 are based on an analysis completed by Friesen and Buckman (2003). They examined the run size of adult winter steelhead returning to the Willamette River (recruit spawners) that resulted from the number of parent spawners that produced the 2-year-old smolts emigrating from the Willamette River under varying mainstem flow conditions during May. The ratio of recruit spawners per parent spawner was highly variable and exhibited both positive and negative residual values (i.e., above and below the average recruits per parent curve, respectively) under nearly all types of mainstem flow conditions, as measured at Salem, Oregon. However, the data showed that below a threshold at approximately 15,000 cubic feet per second (cfs) all observations of recruit spawners per parent spawner had negative residual values, suggesting a consistently negative population growth trend. While this analysis represents the best currently available scientific information, the management strategy developed using it is subject to modification based on the acquisition and application of more definitive biological information.

Friesen and Buckman (2003) used their data to define a minimum flow objective for mainstem flows during May and reviewed the natural hydrograph for the Willamette Basin to estimate threshold flows that may be applicable to the first half and latter half of both April and June. In recent years, the Action Agencies have attempted to meet a minimum mainstem flow objective of 20,500 cfs during the first half of April and a subsequent flow objective of 17,800 cfs after April 15th.

The Action Agencies have benefited from experience gained during the recent flow management period from 2000 through 2006. During this 7-year period, the Action Agencies have been making every effort to meet or exceed the mainstem flow objectives recommended by NMFS and ODFW. The Willamette Basin has experienced several very dry winter periods, especially during 2001 and 2004. In these years and in some others, the reservoirs were often unable to meet early April flow objectives. Hydrologic modeling of meteorological forecasts and ambient flow conditions indicated that attempting to meet the early April flow objective put at risk our ability to meet flow objectives later in the year when water temperatures, and associated health risks to juvenile winter steelhead, were significantly higher. As a result, there was a consensus among agencies to reduce mainstem, and some tributary, flow management targets to below the originally stated flow objectives.

On the basis of this recent past experience, the Action Agencies propose a uniform mainstem flow objective of 17,800 cfs throughout April. This change will avoid, in most cases, the need to draft reservoir storage in April on a system-wide basis to meet mainstem minimum flows. Depending on inflow, it will permit additional system-wide storage of up to 80,331 acre-feet of water (2,700 cfs per day for 15 days) that can be used later in the season under warmer water temperature conditions.

Instantaneous or rapid transitions between mainstem flow objectives are beyond the Willamette Project's operational capabilities. There is a delay of from one to two days for flow adjustments implemented at dams in the upper Willamette Basin to result in subsequent changes in flow rate as measured at Salem. All flow regulation changes are made based on best available forecasts which are intrinsically subject to error and natural changes in unregulated flow can dampen or exaggerate the affects of changes made at the dams. As a result, flows will typically be transitioned between flow objectives over a multi-day period beginning several days before the end of one flow objective period and extending several days into the next flow objective period.

The USACE will coordinate operations to meet the flow objectives in Table 3-2 whenever possible according to the protocol described in detail in Section 3.3.3 (Measure A) and in Appendix B. This protocol was developed in coordination and cooperation with NMFS and ODFW. The Action Agencies will develop a WCP each year, which outlines the Action Agencies' approach to achieve the best possible flow conditions, recognizing the priorities established in this document and the need to balance available water and storage resources among a mix of authorized and necessary uses.

As described in detail in Appendix B, the flow management protocol characterizes available flow and water storage during each flow year as "abundant," "adequate," "insufficient" or "deficit" based on the forecasted system-wide storage available by mid-May (Table 3-3). The frequency of occurrence for each type of flow year was calculated over the 66-year period of record from 1936-2001 (Appendix C).

The "insufficient" threshold volume is based on results of water management actions implemented in 2001 to carefully balance risks associated with the multiple uses for Willamette Basin flow and storage, including the needs of ESA-listed fish species. Attempts to balance these concerns have not previously been undertaken in drier years. The "deficit" years will require diligent evaluations of flow management alternatives and coordination during development of the annual WCP using adaptive management. Reservoir-specific draft limits will be used throughout the flow management season in "insufficient" and in "deficit" years to balance flows among tributaries and to avoid loss of all the usable storage and control of minimum flow discharge below any one project.

**Table 3-3. Characterization and Historic Frequency (N=64; 1936-1999) of Water Year Types in the Willamette River Basin**

| Characteristics of Water Year Types | Abundant | Adequate | Insufficient | Deficit |
|---|---|---|---|---|
| Mid-May Storage (MAF) [1] | ≥ 1.48 | 1.20 to 1.47 | 0.90 to 1.19 | < 0.90 |
| Frequency | 58% | 17% | 9% | 16% |
| Meet All Mainstem Flow Objectives? | Yes | Yes | No | No |
| Alternative Flow Targets below Objectives | N/A | N/A | Linear sliding scale based on flow targets used during 2001 water year [2] | Balance seasonal flows to retain some control of discharge [2] |
| Likely Status of Priority Recreational Reservoirs [3] | Full throughout most or all of recreation season | Full through most of recreation season | May fill; unlikely to remain full throughout season | Unlikely to fill |
| Likely Status of Other Reservoirs | Likely to fill; drafted as necessary to meet mainstem flows | May fill; unlikely to remain full throughout season | Unlikely to fill | Unlikely to fill |

[1] Forecasted useable system-wide reservoir storage accumulated by May 10-20 in millions of acre-feet (MAF).
[2] Reservoir-specific draft limits will be used to ensure projects can meet minimum flows through the fall.
[3] Detroit, Fern Ridge, and Foster are considered the high-priority reservoirs. "Full" designation means that the project is at an acceptable level for recreation, but physically may not be at maximum conservation pool, or normal summer levels.

In the mainstem Willamette River and the major tributaries affected by the USACE dams, the Action Agencies will plan and implement studies to characterize functional relationships between anadromous fish migration and flows, as part of the revised proposed action (refer to Section 3.3.9, Measure G). The Action Agencies, in cooperation with the Services and with the WATER FM Committee, will use this information to better inform and balance tributary and mainstem flow management. Based on relevant findings, the FM Committee may recommend to the Action Agencies modifications to the mainstem flow objectives.

### 3.3.6. Measure D – Meet Tributary Flow Objectives

***The Action Agencies propose to manage minimum and maximum tributary flows, as described in Table 3-4, to protect various life history stages of ESA-listed species and the other aquatic organisms and habitat upon which they depend. The USACE proposes to make every effort to meet or exceed the minimum flow levels depending upon available storage and inflow into each of the associated reservoirs and consistent with flood damage reduction and public safety requirements. The USACE will implement these flow objectives according to the protocol described in Section 3.3.3 (Measure A).***

**Table 3-4. Minimum and Maximum Tributary Flow Objectives below Willamette Dams**

| Dam | Period | Primary Use | Minimum Flow (cfs) [1] | Chance of Not Meeting Flow | Maximum Flow (cfs) [2] | Chance of Not Meeting Flow | |
|---|---|---|---|---|---|---|---|
| Hills Creek | Sep 1 - Jan 31 | Migration & rearing | 400 | 12% | | | |
| | Feb 1 - Aug 31 | Rearing | 400 | 3% | | | |
| Fall Creek | Sep 1 - Oct 15 | Chinook spawning | 200 | 10% | 400 through Sep 30, when possible | 43% | Sep |
| | Oct 16 - Jan 31 | Chinook incubation | 50 [3] | 1% | | | |
| | Feb 1 - Mar 31 | Rearing | 50 | 0% | | | |
| | Apr 1 - May 31 | Rearing | 80 | 0% | | | |
| | Jun 1 - Jun 30 | Rearing/adult migration | 80 | 0% | | | |
| | Jul 1 - Aug 31 | Rearing | 80 | 10% | | | |
| Dexter | Sep 1 - Oct 15 | Chinook spawning | 1,200 | 8% | 3,500 through Sep 30, when possible | 14% | Sep |
| | Oct 16 - Jan 31 | Chinook incubation | 1,200 [3] | 5% | | | |
| | Feb 1 - June 30 | Rearing | 1,200 | 0% | | | |
| | Jul 1 - Aug 31 | Rearing | 1,200 | 3% | | | |
| Big Cliff | Sep 1 - Oct 15 | Chinook spawning | 1,500 | 17% | 3,000 through Sep 30, when possible | 0% | Sep |
| | Oct 16 - Jan 31 | Chinook incubation | 1,200 [3] | 5% | | | |
| | Feb 1 - Mar 15 | Rearing/adult migration | 1,000 | 2% | | | |
| | Mar 16 - May 31 | Steelhead spawning | 1,500 | 0% | 3,000 | 11% | Mar 16 - May 31 |
| | Jun 1 – Jul 15 | Steelhead incubation | 1,200 [3] | 0% | | | |
| | Jul 16 - Aug 31 | Rearing | 1,000 | 1% | | | |
| Foster | Sep 1 - Oct 15 | Chinook spawning | 1,500 | 71% | 3,000 through Sep 30, when possible | 0% | Sep |
| | Oct 16 - Jan 31 | Chinook incubation | 1,100 [3] | 13% | | | |
| | Feb 1 - Mar 15 | Rearing | 800 | 3% | | | |
| | Mar 16 - May 15 | Steelhead spawning | 1,500 | 1% | 3,000 | 44% | Mar 16 - May 15 |
| | May 16 - Jun 30 | Steelhead incubation | 1,100 [3] | 9% | | | |
| | Jul 1 - Aug 31 | Rearing | 800 | 74% | | | |

**Table 3-4 (continued).**

| Dam | Period | Primary Use | Minimum Flow (cfs) [1] | Chance of Not Meeting Flow | Maximum Flow (cfs) [2] | Chance of Not Meeting Flow | |
|---|---|---|---|---|---|---|---|
| Blue River | Sep 1 - Oct 15 | Chinook spawning | 50 | 67% | | | |
| | Oct 16 - Jan 31 | Chinook incubation | 50 | 1% | | | |
| | Feb 1 - Aug 31 | Rearing | 50 | 3% | | | |
| Cougar | Sep 1 - Oct 15 | Chinook spawning | 300 | 24% | 580 through Sep 30, when possible | 38% | Sep |
| | Oct 16 - Jan 31 | Chinook incubation | 300 | 6% | | | |
| | Feb 1 - May 31 | Rearing | 300 | 0% | | | |
| | Jun 1 - Jun 30 | Rearing/adult migration | 400 | 5% | | | |
| | Jul 1 - Jul 31 | Rearing | 300 | 13% | | | |
| | Aug 1 - Aug 31 | Rearing | 300 | 19% | | | |

Exceedence of maximum flow objective over a 66-year record from 1936-2001 (probability figures are approximate).
[1] Minimum flow will equal inflow or Congressionally authorized minimum flows, whichever is higher, when the reservoir is at a minimum conservation pool elevation. This avoids drafting the reservoir below minimum conservation pool and, where applicable, into the power pool.
[2] Maximum flows are intended to minimize the potential for spawning to occur at stream elevations that might subsequently be dewatered at the specified minimum flow during incubation. It may not be possible to stay below these maxima, especially in the fall when drafting reservoirs in preparation for the flood damage reduction management period. Project operations will be managed to minimize the frequency and duration of necessary periods of exceedence.
[3] When feasible, incubation flows should be no less than ½ the maximum 72-hour average discharge observed during the preceding spawning season. Efforts will be made to avoid prolonged releases in excess of the recommended maximum spawning season discharge to avoid spawning in areas that would require high incubation flows that would be difficult to achieve and maintain throughout the incubation period.

The Action Agencies will meet these flow levels whenever sufficient water storage and inflow is available, subject to flood damage reduction operational demands. Hydraulic modeling and draft limits will be used (see Appendix B) to adjust discharge rates to below the minimum flow levels in Table 3-4 when necessary to avoid depletion of reservoir storage and subsequent loss of ability to regulate flows. Note the "chance of not meeting flow" in Table 3-4 for an indication of the frequency with which the Action Agencies are likely to fall below these minimum flows based on the 66-year period of record from 1936-2001 (Appendix C). In very dry years, the Action Agencies will refer to the current *Oregon Chub Drought Contingency Plan* (ODFW 2005), or an updated version of this plan, in considering appropriate actions that may need to be taken to protect this endangered species. These actions will be coordinated through the WATER FM Committee according to the protocol described in Section 3.3.3 (Measure A).

Reservoirs operated for flood damage reduction are maintained at a minimum conservation pool (i.e., minimum rule curve) elevation during the winter flood damage reduction season. When at this elevation, inflow may fall below the preferred minimum flow levels depicted in Table 3-4. Under these conditions, discharge from the reservoir will be approximately equivalent to inflow down to the project authorized minimum flows. The Action Agencies expect to be able to forecast and or evaluate the potential for these incidences relatively far in advance and will coordinate them through the FM Committee in accordance with Section 3.3.3 (Measure A).

Maximum flows during spawning periods will be observed depending on current and predicted levels of inflow, the elevation of each reservoir in relation to its rule curve, and the need to effectively manage high flow events that could result in flood damage. Likewise, the Action Agencies will attempt to manage flows during incubation periods to be no less than ½ the maximum 72-hour average discharge observed during the preceding spawning season. The need to evacuate a reservoir in preparation for the flood damage reduction season, or to bring it back into compliance with its rule curve following storage of a high water event, is likely to result in discharges that are in excess of the maximums in Table 3-4. The frequency of historic exceedences over the 66-year period of record from 1936-2001 (Appendix C) is included in the last column of the table under "chance of not meeting flow." The Action Agencies will strive to keep these occurrences and their durations at a minimum, while continuing to provide for flood damage reduction, as necessary. Exceedences will be coordinated and reported in accordance with the protocol outlined under Section 3.3.3 (Measure A).

During spring and summer, hydrologic modeling of flows and storage in the Santiam River will be used to balance rates of discharge that occur during the winter steelhead spawning season with subsequent flows needed during the incubation period to protect natural production of winter steelhead. Use of storage will also consider, and balance with, the need to meet mainstem Willamette River minimum flow objectives and the need to meet minimum tributary flow objectives in the fall during the spring Chinook salmon spawning season.

The Action Agencies are less able to balance spawning period flows (approximately September 1 through October 15) and subsequent incubation period flows (currently through approximately January 31) during fall and winter to protect spring Chinook salmon. This is because the reservoirs are evacuated in September and October (often exceeding maximum spawning flow rates) prior to the onset of the flood damage reduction season, leaving little or no storage in reservoirs for use in maintaining incubation flows above levels of reservoir inflow. The Action Agencies will avoid unnecessarily high flows during the spawning season for spring Chinook salmon, especially through 30 September, as a means of reducing the risk of redd desiccation due to uncontrollably low flows during the subsequent incubation period. However, our ability to do so is limited by operational requirements associated with providing effective flood damage reduction capability.

The 66-year flow record from 1936-2001 (Appendix C) demonstrates that some of the maximum tributary flow objectives for September and October are not achievable in many or most years when measured against the historic average bi-weekly rates of flow. For example, at Fall Creek Dam the maximum flow objective of 400 cfs is exceeded approximately 43% of the time during September and approximately 71% of the time during the first half of October. At Dexter Dam our recommended maximum flow objective of 3,500 cfs is exceeded approximately 45% of the time during the first half of October, while an even lower maximum flow objective of 2,400 cfs would likely be exceeded 69% of the time in early October. Below Big Cliff Dam, the maximum flow objective of 3,000 cfs is exceeded approximately 14% of the time during the first half of October. This flow objective is exceeded approximately 44% of the time below Foster Dam in the spring (mid-Mar through mid-May). The maximum flow objective of 580 cfs at Cougar Dam is exceeded 38% of the time in September and 52% of the time in early October.

The Willamette tributary reservoirs operate under rule curves established for flood damage reduction. The reservoirs are evacuated in preparation for the flood damage reduction season in September and October and also managed during September to meet Congressionally authorized mainstem flow objectives at Salem and Albany. The need to operate for flood damage reduction and

to meet the Congressionally authorized mainstem flow objectives may make it difficult to maintain flows below the maximum tributary biological flow objectives. Because most of the spring Chinook spawning ends before October 1, the Action Agencies will attempt to operate the projects to assure that the maximum flows during September are not exceeded. This could require us to begin drafting reservoirs earlier in the year, or it could make high flows during October more likely.

#### 3.3.6.1. Background and Rationale

The proposed flows below USACE dams are intended to protect spawning, incubation, and rearing of winter steelhead in the North and South Santiam rivers and of spring Chinook salmon in these rivers and in the McKenzie and Middle Fork Willamette rivers. Maximum flow recommendations during spawning are intended to avoid potential loss of redds from bed erosion and to constrain spawning activity into areas that can be provided with appropriate levels of flow throughout the subsequent incubation period.

In the Action Agencies' 2000 BA (USACE 2000), Table 2.1, the Action Agencies specified operational data for the individual Willamette reservoirs, including authorized minimum flow releases based on House Document 531 and the individual project operating manuals. Since that time, the Action Agencies have continued to work with the Services, ODFW, and other members of the Willamette Interagency Flow Management Work Group, to adaptively manage flow releases from the Willamette reservoirs to better meet the ecological needs of listed species downstream in balance with other authorized purposes.

The revised proposed action depicted in Table 3-4 is, in general, consistent with the preferred flow levels based on the biological needs of ESA-listed fishes as identified by NMFS following discussions with ODFW (NMFS 2004). The Action Agencies' proposal has modified these flow needs from those cooperatively developed by NMFS and ODFW based primarily upon hydrologic modeling over period-of-record flows and associated operational constraints.

The USACE will coordinate operations to meet the flow objectives in Table 3-4 according to the protocol described in detail in Section 3.3.3 (Measure A) and in Appendix A. This protocol was developed in coordination with NMFS and ODFW. As in past years, the Action Agencies will develop a WCP each year, which outlines the Action Agencies' approach to achieve the best possible flow conditions, recognizing the priorities established in this document and the need to balance available water and storage resources among a mix of authorized and necessary uses. The WATER FM Committee will use monitoring and evaluation results and adaptive management to determine priorities between meeting mainstem and tributary flow objectives if, and when, hydrologic conditions do not allow for meeting both.

In the tributaries affected by USACE dams, the Action Agencies will plan and implement studies to characterize channel configuration, flow-habitat relationships and flow dynamics below the USACE Willamette dams, as part of the proposed action (refer to Section 3.3.9, Measure G). The Action Agencies, in cooperation with the Services and with the WATER FM Committee, will use this information from research, monitoring, and evaluation (RM&E) to better inform and balance tributary flow management, including minimum and maximum flow levels and ramping rates. As a result of these studies or if modeling indicates that tributary flow objectives are not physically feasible to achieve as proposed, the Action Agencies will modify, with the approval of the Services, the tributary flow objectives presented in Table 3-4 based on relevant findings.

As better information is obtained the USACE will continue to work with the Services and with the FM Committee to improve the biological effectiveness of tributary flow management and, where possible, to achieve greater management flexibility. For example, it is anticipated that better information and more extensive management experience will allow the agencies to move away from the rigid calendar dates and flow rates presented in Table 3-4 and toward real-time flow management scenarios that provide flow rates appropriate for ambient conditions during the peak or tails of spawning activity. Likewise, it may be possible to base incubation season operations on the actual accumulation of thermal units or other appropriate conditions, rather than on set calendar dates.

### 3.3.7. Measure E – Maximum Ramping Rate Evaluations and Changes

***In the tributaries affected by USACE dams, the Action Agencies will work with the WATER FM Committee to plan and implement studies to characterize channel configuration, ramping rates, flow-habitat relationships, and flow dynamics below Willamette Project dams. Those evaluations will be conducted in the context of the broader flow-related research, monitoring, and evaluation program described in Section 3.3.9. In the interim, the Action Agencies will use hourly and daily ramp-down rates depicted in Table 3-5 for decreasing the flow levels below Willamette Project dams whenever possible consistent with project purposes, to avoid or minimize adverse impacts to ESA-listed species. The USACE will implement the flow objectives in Table 3-4 according to the protocol described in Section 3.3.3 (Measure A).***

The Action Agencies recognize that ramping rates associated with reservoir operations can have significant effects on the ecological function of habitat downstream, and on ESA-listed species. Ramp-down rates are considered especially important in conjunction with operation of Big Cliff, Foster, Blue River, Cougar, Fall Creek, Dexter, and Hills Creek dams. The NMFS's draft Revised Proposed Action (NMFS 2004) suggested that descending flows at ramping rates in excess of 0.2 foot per hour generally exceed natural conditions and the ability of aquatic life to safely adjust. Maximum descending ramping rates of 0.1 foot per hour (at night) and 0.2 foot per hour (during daylight), as depicted in Table 3-5, were recommended for use at Willamette Basin projects by NMFS based on the findings of Hunter (1992). However, some of the ramping rates at low rates of flow are beyond current physical capabilities of existing Willamette Basin equipment (see footnote 3 in Table 3-5). This is especially true at a ramping rate of 0.1 foot per hour.

Where practical (i.e., given equipment limitations) and under normal operating conditions (i.e., given ambient operational circumstances), the Action Agencies will follow the hourly and daily ramping rates depicted in Table 3-5. When it is impractical to reduce flows at a rate of 0.1 foot per hour, the Action Agencies will reduce flows at a rate of 0.2 foot per hour, under normal operating conditions. Flood damage reduction actions are not considered to be "normal operating conditions" for purposes of the flow management actions described under Section 3.3 of this revised proposed action.

Additionally, prescribed ramping rates may not be achievable in instances where actual hydrologic conditions turn out to be significantly different from the forecasted conditions. For example, the rate of change in outflows may have to be accelerated to avoid dropping below the minimum pool elevation with a prolonged ramp-down if inflow drops off faster than expected following a storm event. This typically occurs during recessions following significant rain events that require evacuation of flood storage.

**Table 3-5. Maximum Ramping Rates During Flow Level Changes Below Upper Willamette Basin Dams (cfs)**

**NIGHTTIME RAMPDOWN RATES TO ACHIEVE 0.1 FT/HOUR 1/ 2/ 4/ 6/**

| HCR [5] | | LOP [5] | | FAL [5] | | DOR | | COT | | CGR [5] | | BLU [5] | | FRN | | FOS [5] | | DET [5] | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HCRO | | DEXO | | FALO | | DORO | | COTO | | CGRO | | BLUO | | FRNO | | SSFO | | BCLO | |
| Q | Flow diff for 0.1' change | Q | Flow diff for 0.1' change | Q | Flow diff for 0.1' change | Q | Flow diff for 0.1' change | Q | Flow diff for 0.1' change | Q | Flow diff for 0.1' change | Q | Flow diff for 0.1' change | Q | Flow diff for 0.1' change | Q | Flow diff for 0.1' change | Q | Flow diff for 0.1' change |
| 400 | | 1200 | | 50 | | | | 50 | | 400 | | 50 | | 30 | | 800 | | 1000 | |
| 600 | 60 [3] | 1500 | 125 | 100 | 20 [3] | 100 | | 300 | 30 [3] | 500 | 80 [3] | 250 | 30 [3] | 80 | 20 [3] | 900 | 100 | 1200 | 100 |
| 1000 | 75 [3] | 2000 | 145 | 300 | 40 [3] | 500 | 50 [3] | 500 | 40 [3] | 1200 | 100 [3] | 500 | 50 [3] | 150 | 30 [3] | 1900 | 150 | 1500 | 110 |
| 1500 | 90 [3] | 2500 | 150 | 500 | 50 | 1000 | 60 [3] | 800 | 50 | 2400 | 150 | 700 | 60 [3] | 300 | 40 | 2000 | 155 | 2000 | 130 |
| 1700 | 100 | 3000 | 170 | 700 | 60 | 3700 | 100 | | | | | 2300 | 100 | 1000 | 50 | | | | |

Highlighted flows are higher than the minimum flows needed to protect ESA species, but are included to represent the lowest flow rate at which a 0.1 ft/hr ramp rate is currently possible at these dams.

**DAYTIME RAMPDOWN RATES TO ACHIEVE 0.2 FT/HOUR 1/ 2/ 6/**

| HCR [5] | | LOP [5] | | FAL [5] | | DOR | | COT | | CGR [5] | | BLU [5] | | FRN | | FOS [5] | | DET [5] | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HCRO | | DEXO | | FALO | | DORO | | COTO | | CGRO | | BLUO | | FRNO | | SSFO | | BCLO | |
| Q | Flow diff for 0.2' change | Q | Flow diff for 0.2' change | Q | Flow diff for 0.2' change | Q | Flow diff for 0.2' change | Q | Flow diff for 0.2' change | Q | Flow diff for 0.2' change | Q | Flow diff for 0.2' change | Q | Flow diff for 0.2' change | Q | Flow diff for 0.2' change | Q | Flow diff for 0.2' change |
| 400 | | 1200 | | 50 | | | | 50 | | 400 | | 50 | | 30 | | 800 | | 1000 | |
| 600 | 120 | 1500 | 250 | 100 | 40 [3] | 100 | | 300 | 60 | 500 | 160 | 250 | 60 [3] | 80 | 40 | 900 | 200 | 1200 | 200 |
| 1000 | 150 | 2000 | 290 | 300 | 80 | 500 | 100 | 500 | 80 | 1200 | 200 | 500 | 100 | 150 | 60 | 1900 | 300 | 1500 | 220 |
| 1500 | 180 | 2500 | 300 | 500 | 100 | 1000 | 120 | 800 | 100 | | | 700 | 120 | 300 | 80 | 2000 | 310 | 2000 | 260 |
| | | 3000 | 340 | 700 | 120 | | | | | | | | | 1000 | 100 | | | | |

1/ Avoid a flow volume reduction of more than 50% per hour or the lesser of 1 foot or 50% per 24 hours.

2/ Listed are decrements in release that approximately yield the resulting change in flow of 0.1 foot/hour or 0.2 foot/hour.
The accuracy of any flow change is subject to the variability of the equipment and instrumentation.

3/ Small listed decrements in flow are impractical to achieve under current equipment capability.

4/ From 1 January - 31 March a nighttime ramp is preferable. A rate of 0.2 ft/hour is acceptable for protecting juvenile spring Chinook salmon.

5/ Higher priority because of the presence of ESA listed salmon and steelhead.

6/ Change in flow at flows higher than those listed are less critical for protecting ESA species because of small overall flow volume change.

#### 3.3.7.1. Background and Rationale

Since 2004, the Action Agencies have generally attempted to operate the projects to meet ramp-down rate targets of 0.1 foot per hour during the nighttime and 0.2 foot per hour during daylight hours. The flow adjustments needed to achieve those targets are shown on Table 3-5. This table provides ramping rate guidance at lower levels of flow, which are the most critical in terms of potential impacts on ESA-listed fish species and their habitats. At higher flows, ramping rates are less critical and (consistent with FM Committee guidance and with Measure G) the Action Agencies will experiment with a variety of flow management options (e.g., pulsed flows) that are intended to enhance normative ecosystem function and to restore or rejuvenate critical fish habitat (TNC 2007). However, in the interim period before completion of tributary flow and ramping rate studies intended to provide more definitive operational information (Measure G), flow rating curves applicable to each location will generally be used at flows above those in Table 3-5 to continue ramping at a nighttime rate of 0.1 foot per hour or a daytime rate of 0.2 foot per hour below Willamette Project dams whenever possible consistent with essential project purposes (e.g., flood damage reduction or emergency power supply needs), to avoid or minimize adverse impacts to ESA-listed species.

When decreasing flows, the Action Agencies intend to follow the hourly and daily ramping rate restrictions (i.e., the reduction in flow releases during any one hour or 24-hour period) depicted in Table 3-5. Variation in ambient flow conditions and in the response of equipment to adjustments limits the extent to which the USACE is capable of making some adjustments, especially at small increments of change. With the exception of Lookout Point, Green Peter, and Detroit dams, the Action Agencies will avoid a decrease in flow volume of the lesser of 1 foot measured at the downstream gage or 50% flow volume reduction over a 24-hour period to give aquatic organisms an opportunity to adjust to the change in flow. Lookout Point, Green Peter, and Detroit dams are power peaking projects that have re-regulating dams below them. In most instances modeled, the re-regulating dams of Foster, Dexter, and Big Cliff can achieve the desired flow changes, but some situations may warrant faster ramping to avoid going below the minimum pool elevations at the re-regulating reservoirs themselves. Specific research under Section 3.3.9 (Measure G) will be targeted at discerning the potential site-specific impacts associated with this level of change at key Willamette Basin projects (e.g., Big Cliff, Foster, Cougar, Dexter, and Hills Creek dams).

The rate of increase in flow is less likely than the rate of decrease in flow to negatively impact aquatic ecosystems and listed species. The USACE will avoid, where possible, large instantaneous increases in flow that may result in the scouring of substrate in the stream channel below USACE dams or in exceedingly high levels of displacement of organisms downstream. However, the USACE is not proposing any specific biologically based limits to ramp-up rates other than that specified in the Congressional authorization for human safety.

The USACE will implement the flow objectives in Table 3-5 according to the protocol developed under Section 3.3.3 (Measure A). As in past years, the Action Agencies will develop a Willamette Conservation Plan each year, which outlines the Action Agencies' approach to achieve the best possible flow conditions, recognizing the priorities established in this document and the need to balance available water and storage resources among a mix of authorized and necessary uses. The WATER FM Committee will use results from RM&E studies (Measure G) and adaptive management to determine priorities between mainstem and tributary flows if, and when, hydrologic conditions do not allow for both.

In the tributaries affected by USACE dams, the Action Agencies will work with the FM Committee to plan and implement studies to characterize channel configuration, ramping rates, flow-habitat relationships, and flow dynamics below Willamette Project dams, as part of the revised proposed action under Section 3.3.9 (Measure G). The Action Agencies, in cooperation with the Services and with the FM Committee, will use this information to better inform and balance tributary flow management, including minimum and maximum flow levels and ramping rates. As a result of these studies, the Action Agencies may modify, with the approval of the Services, the ramping rates presented in Table 3-5 based on relevant findings.

### 3.3.8. Measure F – Foster Dam Spring Spill

***The Action Agencies proposed to continue the operation described in Section 2.3.2.3 (Chapter 2, page 2-32) of the Action Agencies' 2000 BA (USACE 2000) without change.***

Approximately 92 to 238 cfs (0.5 to 1.5 feet of water depth), depending upon reservoir elevation and inflow, is spilled daily from 0600 through 2100 hours from April 15 through May 15 each year to facilitate passage of juvenile and kelt winter steelhead and juvenile spring Chinook salmon that may be passing from the reservoir near its surface.

### 3.3.9. Measure G – Flow Related Research, Monitoring & Evaluation

***The Action Agencies, in coordination and collaboration with the Services and the WATER FM Committee, will develop and implement a comprehensive RM&E program to determine compliance with, and effectiveness of, the measures in Section 3.3. The RM&E program is intended to better discern and evaluate the relationships among flow management operations, the resulting dynamics of ecosystem function and environmental conditions upstream and downstream of Willamette Project dams, and related effects on ESA-listed fish species. The recommendations for a Flow Management RM&E Program must be integrated into the comprehensive program overseen by the RM&E Committee (see Section 3.8) and following the principles and strategic questions developed by the committee.***

In the mainstem Willamette River and its major tributaries affected by USACE dams, the Action Agencies will plan and implement studies to characterize functional relationships between anadromous fish migration and flows. These studies will focus on the aspects of fish distribution (e.g., habitat use) and behavior (e.g., migration timing) in relation to rates of discharge by time of year. The Action Agencies, in cooperation with the Services and with the FM Committee, will use this information to better inform and balance tributary and mainstem flow management. If warranted, the Action Agencies will modify, with the approval of the Services, the mainstem flow objectives presented in Table 3-2 based on relevant findings.

In the tributaries affected by USACE dams, the Action Agencies will plan and implement studies to characterize channel configuration, the effects of ramping, flow-habitat relationships, and flow dynamics below the Willamette dams. Where appropriate, the Action Agencies will experiment with a variety of flow management options (e.g., pulsed flows) that are intended to enhance normative ecosystem function and to restore or rejuvenate critical fish habitat (TNC 2007). This will include an evaluation of relationships between tributary flow rates and critical habitat for Oregon chub, especially under low flow conditions. The Action Agencies, in cooperation with the Services and with the FM Committee, will use information from these research, monitoring and evaluation studies to better inform and balance tributary flow management, including minimum and maximum flow levels, ramping rates, and special actions (e.g., pulsed flows). The Action Agencies will also attempt

to more clearly define the impacts of contractual irrigation and withdrawals on tributary flows. As a result of these studies, or if modeling indicates that tributary flow objectives are not physically feasible to achieve as proposed, the Action Agencies may modify, with the approval of the Services, the tributary flow objectives presented in Table 3-4 or the ramping rates presented in Table 3-5 based on relevant findings.

The Action Agencies do not currently have a clearly established source of funding available for implementing a comprehensive flow related RM&E program. Funding will likely need to be derived from a variety of potential sources. The earliest that significant funding may be available for this program is FY 2010 (i.e., beginning September 1, 2009).

## 3.4. Hatchery Operations and Reform Actions

### 3.4.1. Overview of the Hatchery Mitigation Program

The USACE funds several hatcheries and collection facilities in the Willamette Basin as mitigation for construction of the 13 Willamette dams (Figure 3-3). The USACE funds the State of Oregon via ODFW to manage and operate all facilities associated with the Willamette Hatchery Mitigation Program. Hatchery facilities are distributed throughout the Willamette Basin in tributaries with USACE dams that contained large historical populations of spring Chinook salmon and winter steelhead. Most of the hatcheries also operate satellite fish collection facilities for broodstock collection and as collection sites for fish that are released into areas upstream of USACE dams.

**Figure 3-3. Location of USACE-funded Dams, Hatcheries, and Collection Facilities**

**Willamette Hatchery Mitigation Program Facilities**

- North Santiam
  - Marion Forks Hatchery
  - Minto Ponds Fish Facility
- South Santiam
  - South Santiam Hatchery
  - Foster Dam Fish Facility
- McKenzie
  - McKenzie Hatchery
  - Leaburg Hatchery
- Middle Fork
  - Willamette Hatchery
  - Dexter Ponds Fish Facility

The State of Oregon contributes additional funds to each hatchery facility based on a percentage described in the 1990 Cooperative Agreement as described in Table 3-6. The percentage of state funds varies with each facility, and the USACE intends to continue funding each facility in according to these percentages until a new agreement is negotiated.

**Table 3-6. Summary of Cost-sharing Arrangements for USACE-funded Hatcheries and Collection Facilities**

| Subbasin | Hatchery Program | Hatchery Facility | Operation and Maintenance | Funding Percentages** | |
|---|---|---|---|---|---|
| | | | | USACE/BPA | ODFW |
| North Santiam | North Santiam Spring Chinook | Marion Forks Hatchery | ODFW | 83.75% | 16.25% |
| | | Minto Pond Fish Facility | ODFW | | |
| South Santiam | South Santiam Spring Chinook | South Santiam Hatchery | ODFW | 70% | 30% |
| | Summer Steelhead | Foster Dam Fish Facility | ODFW/USACE | | |
| McKenzie | McKenzie Spring Chinook | McKenzie Hatchery | ODFW | 50% | 50% |
| | | Leaburg Dam* | EWEB | 0% | 0% |
| Middle Fork Willamette | Middle Fork Willamette Spring Chinook | Willamette Hatchery | ODFW | 83.75% | 16.25% |
| | | Dexter Pond Collection Facility | ODFW/USACE | | |
| McKenzie | Rainbow Trout | Leaburg Hatchery | ODFW | 100% | 0% |

* Leaburg Dam is owned and operated by the Eugene Water & Electric Board (EWEB). The USACE does not own, fund, or operate Leaburg Dam, but the ladder is used to collect wild hatchery broodstock and to remove hatchery spring Chinook from the wild fish sanctuary upstream of Leaburg Dam.
** Cost sharing is based on the 1990 Cooperative Agreement.

The mitigation production requirements for each facility are described in the 1990 Cooperative Agreement and are discussed in more detail in the following sections. Currently, the program funds production of spring Chinook salmon, summer steelhead, and rainbow trout at several facilities throughout the Willamette Basin.

### 3.4.2. Relationship of Proposed Action to Hatchery and Genetic Management Plans

Hatchery and genetic management plans are described in the final salmon and steelhead 4(d) rule (July 10, 2000; 65 FR 42422) as a mechanism for addressing the take of certain listed species that may occur as a result of artificial propagation activities. The primary goal of the HGMP is to devise biologically based artificial propagation management strategies that ensure the conservation and recovery of listed ESUs.

The ODFW developed HGMPs for the six hatchery programs in the Willamette Basin funded by the USACE. These HGMPs summarized all aspects of hatchery operation from broodstock collection to juvenile releases. The HGMPs also described issues/adverse impacts associated with the current

hatchery management practices and recommend alternatives. The USACE and ODFW have discussed the issues identified in the HGMPs for each hatchery program and jointly developed alternative actions that are consistent with the long-term hatchery reform principles discussed in the next section. The USACE will implement the recommended alternatives identified in the HGMPs, to the extent practical, within the time period covered by the subsequent Biological Opinion. The following sections summarize the primary actions that are described in more detail in the HGMPs.

### 3.4.3. Hatchery Reform and the Columbia River Basin Hatchery Reform Project

In 2000 with bipartisan support, Congress created and funded the Puget Sound and Coastal Washington Hatchery Reform Project, a systematic, science-based redesign of hatchery programs to achieve two goals: help conserve wild salmon and steelhead populations; and support sustainable fisheries.

In 2005, Congress directed the NMFS to replicate the Puget Sound and Coastal Washington Hatchery Reform Project in the Columbia River Basin. The Columbia River Basin Hatchery Reform Project (CRHRP) will include a collaborative review of how harvest and hatcheries—particularly federally-funded hatcheries—are affecting the recovery of salmon and steelhead fisheries listed under the ESA. The purpose of the CRHRP is to, ". . . help put in place a management approach which allows tribal, state and federal managers to effectively manage hatcheries to meet conservation and harvest goals consistent with their respective legal responsibilities." Hatcheries in the Columbia Basin are funded and managed by a variety of agencies and organizations including the tribes, the Services, USACE, state departments of fisheries and wildlife, and private entities. Each faces challenges in the form of defining goals and objectives, managing data, and adjusting operations to fit new circumstances. The CRHRP is designed to develop a plan that can aid managers in meeting those challenges.

As part of the CRHRP, Congress established the Hatchery Scientific Review Group (HSRG) as the independent scientific panel at the heart of the reform process, and designated Long Live the Kings as the project's independent, third-party facilitator. The role of Long Live the Kings included providing facilitation and project coordination to the HSRG and the Hatchery Reform Coordinating Committee, and helping the managers communicate hatchery reform progress to Congress, state legislators, stakeholder groups, and the public. To accomplish the CRHRP, the Pacific States Marine Fisheries Commission hired a Facilitation and Policy Team, led by Jim Waldo of Gordon Thomas Honeywell to facilitate this open, thorough, and independent scientific review informed by the Hatchery Scientific Review Group and its results in the Puget Sound region.

Over all the project will be conducted by an independent science team in conjunction with a Steering Committee comprised of representatives from fisheries agencies in Washington, Oregon, and Idaho; the USFWS; NMFS; and tribal agencies in Washington, Oregon, and Idaho. In the Columbia Basin, this review will lead to a series of decisions that are based on broad policy agreements and supported by consistent technical information about hatcheries, habitat, and harvest. This review process is broken into phases, with each phase leading into the next. Major components of the project include:

- Development of a data base to be shared among all hatchery managers in the project region, including adapting and applying the All-H analytical approach to the Columbia Basin.
- Enhancement of new tools to aid managers in information management and decision-making, as well as monitoring and analysis.
- Review of all hatchery programs and wild populations in the Columbia Basin.

Based on knowledge of the science that preceded them and their experience reviewing hundreds of hatchery programs and developing recommendations, the HSRG has concluded that the following three principles should guide hatchery management and operations. The HSRG has developed a set of system-wide recommendations as strategies for achieving each principle. These principles and system-wide recommendations are presented in the Principles and System-wide Recommendations section of the HSRG's report.

1. Clear goals
2. Scientifically defensible programs
3. Informed decision making

Hatchery reform fundamentally requires evaluating hatcheries based on how they affect the watershed in which they are located. This means a hatchery program, whether for harvest or conservation purposes, cannot be successful unless it serves the needs of the wild populations it is derived from and/or encounters outside the hatchery. The size of the hatchery program (i.e., number of fish released) must be considered in light of what the available habitat can sustain, and the habitat needs of other fish in the watershed.

Hatchery fish must be managed either as part of a wild population (in which case the size and health of that wild population will determine how large the hatchery population can be) or as a wholly separate population (in which case strict guidelines must be met to ensure the hatchery fish do not influence or alter the wild population). In either scenario, the HSRG's guidelines ensure that the wild population is "in charge" of genetic and behavioral adaptation.

The Willamette Basin hatchery mitigation programs will be reviewed by the CRHRP during summer 2007. The Action Agencies and ODFW have collaborated to incorporate principles of hatchery reform established by the Puget Sound HRSG in efforts to anticipate recommendations from the Columbia Basin HSRG. The USACE proposes the following general hatchery reform actions:

- Clearly identify genetic goals for each facility and species (i.e., is it a genetically "integrated" program or a genetically "segregated/separated" program) to promote the overall reform goal. Develop an appropriate genetic management protocol.
- For integrated programs (i.e., hatchery broodstock is extension of wild population), incorporate a high percentage of wild/unmarked adults into broodstock. Ensure genetic integrity by implementing a comprehensive broodstock collection program with respect to run timing, size, gender, and age.
- To minimize straying, rear juveniles only within their natal watershed and ensure acclimation.
- Allow juveniles to emigrate volitionally from the hatchery or acclimation site.
- Determine (and implement) the appropriate size of release to support the goals of the program and address interactions with wild populations.
- Fin clip and coded wire tag all released fish to allow mechanical sorting and provide information on straying, release strategies, movements, etc.
- Minimize injury/mortality particularly to 'wild' fish associated with operation of collection facilities.
- Following protocols established by the SCAB Committee, continue using the Willamette spring Chinook hatchery outplant program for purposes of providing a prey base for bull trout, ocean-derived nutrients into streams above dams, and RM&E.

- Within the framework of the Willamette System Review feasibility studies, evaluate using the Willamette spring Chinook hatchery program to outplant fish for the purpose of reestablishing naturally spawning populations of salmon in habitat above dams predicated on a determination that such reintroduction is feasible.
- Promote harvest opportunities where consistent with ESA conservation and recovery principles.

These goals are also consistent with ODFW's Hatchery Management Policy and Native Fish Conservation Policy and have been incorporated into the HGMPs. The actions described for each species and program in Sections 3.4.5 to 3.4.11 of this chapter support these general principles. The Action Agencies, ODFW, and the Services will participate in the Columbia Basin HSRG's review of Willamette Basin hatcheries, which will be based on the "reformed" program described in this proposed action and the accompanying HGMPs. All of the HSRG's recommended changes to the programs will be discussed with the Fish Passage and Hatchery Management (FPHM) Committee of WATER. The Action Agencies and ODFW will consider modifying components of this proposed action based on the recommendations of both the HSRG and FPHM Committee.

### 3.4.4. Summary of Hatchery Actions

This section describes the revised proposed action for the spring Chinook, summer steelhead, and rainbow trout hatchery mitigation programs.

#### 3.4.4.1. Implementation Oversight and Coordination

The Action Agencies will establish the WATER FPHM Committee. This committee will be responsible for implementation of hatchery reform actions including changes to production and release strategies, and the Spring Chinook Outplant Program, as needed, based on RM&E. The FPHM Committee will also be responsible for developing and annually updating the Willamette FPMP for each basin, including disposition plans and operational protocol for fish arriving at all USACE-funded collection facilities.

#### 3.4.4.2. Hatchery Facilities – Operation and Maintenance

Operation and maintenance of hatcheries and collection facilities is necessary to ensure the USACE meets its mitigation responsibilities and spawns, rears, and releases hatchery fish in a manner that meet hatchery goals, including minimizing impacts of the mitigation program on ESA-listed fish. The Action Agencies will continue to maintain and operate the following hatchery facilities in the Willamette Basin:

- Marion Forks Fish Hatchery and Minto Pond Fish Facility (North Santiam)
- South Santiam Fish Hatchery and Foster Dam Fish Facility (South Santiam)
- McKenzie Fish Hatchery (McKenzie)
- Willamette Hatchery (Middle Fork Willamette)

Specifically, for each facility, the Action Agencies will:

- Maintain the hatchery water supplies including diversion dams, intakes, and wells to the extent described in the 1990 Cooperative Agreement.
- Resolve hatchery infrastructure maintenance needs and develop long-term Hatchery Maintenance Plans.

- Complete regular Environmental Review Guide for Operations (ERGO) assessments and safety inspections, and promptly correct violations.
- Operate hatcheries in compliance with the Integrated Hatchery Operations Team (IHOT) fish health guidelines.
- Ensure hatcheries comply with National Pollutant Discharge Elimination System (NPDES) permits.

#### 3.4.4.3. Hatchery Facilities – Modifications and Construction

The hatchery collection facilities in the Willamette Basin were designed to collect fish for egg and sperm harvest; they were not designed to accommodate safe handling, sorting, and loading of ESA-listed fish that must survive to spawn in the wild. At existing facilities, ESA-listed fish are directly injured or physically handled in a manner that likely contributes to the high levels of pre-spawning mortality observed in the basin. The Action Agencies will modify and/or reconstruct the following hatchery collection facilities to comply with NMFS collection and handling guidance by minimizing impacts associated with collection and sorting (see Sections 3.4.5-3.4.8 for priorities and timelines).

1. Minto Ponds Fish Facility (reconstruction; highest priority).
2. Foster Dam Fish Facility (significant modification, likely including relocating adult holding ponds and spawning area from South Santiam Hatchery).
3. Dexter Ponds Collection Facility (significant modification).

#### 3.4.4.4. Hatchery Operations

The Action Agencies propose to continue use of the same hatchery stocks, with some changes in broodstock collection, marking, and release protocol to meet hatchery reform goals. Research, monitoring, and evaluation will define further modifications to meet hatchery management goals and to minimize impacts on ESA-listed species.

**Broodstock**

- Continue use of the North Santiam (stock 021), South Santiam (stock 024), McKenzie (stock 023), and Middle Fork Willamette (stock 022) spring Chinook stocks (as identified by basin of origin).
- Incorporate conservation into all spring Chinook hatchery management goals.
- Continue use of the South Santiam (stock 024) summer steelhead stock.
- Continue collection of broodstock at existing facilities.
- Change spring Chinook broodstock collection at South Santiam/Foster Fish Facility and Dexter Ponds Fish Facility to include collection of broodstock throughout the entire run.
- Incorporate a higher percentage of unmarked (i.e., natural origin) fish into all spring Chinook broodstock (see Tables 3-8, 3-11, 3-14, 3-17).

**Holding, Mating, Incubation, and Rearing**

- Continue adult holding at existing locations until facilities are improved or reconstructed.
- Continue random spawning protocol with a 1:1 male-to-female ratio for spring Chinook.
- Continue current incubation and rearing practices; investigate options to rear all spring Chinook within natal watershed through entire life cycle (South Santiam).
- Investigate options to increase homing of adults to all hatcheries particularly at McKenzie Hatchery.

**Production Levels, Marking, and Release**

- Continue to adipose fin-clip and otolith mark all hatchery releases.
- Begin inserting CWTs into all spring Chinook hatchery releases (priority basins are North Santiam and McKenzie), unless other means of identifying origin are more feasible.
- Continue all current spring Chinook releases.
- Add an experimental release of juvenile spring Chinook in the North Santiam Basin that are of a smaller size and more similar to natural-origin counterparts; monitor appropriately.

**Reducing Direct Interactions with ESA-listed Species**

- Develop and implement plans for reducing the number of hatchery spring Chinook spawning upstream of Leaburg Dam in the area designated as a wild fish sanctuary. Options include increasing homing and attraction to McKenzie Hatchery, reducing hatchery releases in McKenzie subbasin, and construction of fish trap at the fish ladders at EWEB's Leaburg Dam.
- Develop strategies for reducing the incidence of hatchery spring Chinook spawning in areas where removal of hatchery fish would increase effectiveness of natural-origin spawners.
- Investigate options for removal of non-native summer steelhead from areas where winter steelhead are spawning.

#### 3.4.4.5. Spring Chinook Outplant Program and the Potential for Reintroduction into Historical Habitat

**Program History and Background**

For the past 15 years, the ODFW has been releasing excess adult hatchery spring Chinook collected at USACE facilities into historical habitat, including areas upstream of USACE dams. Initially, these releases were intended to provide nutrient transfer from the ocean to freshwater and juvenile fish to serve as a prey base for native resident fish (bull trout) and wildlife. While supplementing natural production of spring Chinook was not one of the original goals, field observations indicated that some juvenile fish were being produced upstream of the dams and passing downstream successfully (Taylor 2000, Beidler and Knapp 2005). Thus, ODFW expanded releases, and currently ODFW and the USACE release (outplant) excess hatchery adults above USACE dams in the North Santiam, South Santiam, McKenzie, and Middle Fork Willamette subbasins. Operation of the outplant program has been overseen by the interagency SCAB Committee (see Section 2.6.2.2). Details of these past releases, including summaries of the limited data regarding juvenile production, are described in Beidler and Knapp (2005). The Spring Chinook Outplant Program is a critical component of operation of Willamette Basin hatcheries and in management of all four spring Chinook programs. Not only does the program provide a mechanism for disposition of excess hatchery broodstock, but also serves as a mechanism for increasing natural production in all subbasins, which will increase the availability of natural-origin adult spring Chinook to incorporate into the hatchery broodstock. Incorporation of natural-origin adults into the broodstock is a key component of managing an integrated hatchery program.

**Action Agency Philosophy and Approach to Outplanting and Reintroduction**

For the purposes of this Supplemental BA and future related consultations, the Action Agencies draw a clear distinction between the terms "outplanting" versus "reintroduction" as they relate to hatchery operations. Outplanting refers to the release of hatchery spring Chinook (or in some cases, natural-

origin fish) into river reaches upstream of USACE dams for various fishery management purposes, including providing ocean-derived nutrients to the ecosystem, providing a prey base for bull trout, and for experimentally evaluating the natural production potential of historic habitat. Furthermore, the Willamette spring Chinook hatchery programs are integrated programs, which by definition rely upon the incorporation of natural-origin adults into the hatchery broodstock (HRSG 2004). Successful natural production in habitat upstream of USACE dams may be an effective means to increase the percentage of natural-origin returns. The Action Agencies acknowledge that natural production resulting from outplanted fish is critical towards evaluating the feasibility of reintroduction, and support the outplanting program for this purpose. However, while supplementing natural production above the dams may benefit listed species; it does not constitute a long-term commitment of the Action Agencies to reintroduction at this time.

The Action Agencies view reintroduction as a long-term program of moving hatchery-origin or natural-origin fish into reaches upstream of the dams for the specific objective of reestablishing a naturally self-sustaining population in those areas. It is not presently clear that self-sustaining populations in the tributary reaches above the dams are feasible or reasonable. Additional research, monitoring and evaluation, will be necessary to make that determination. Reintroduction of spring Chinook as a specific management objective of the Action Agencies is predicated on the outcome of the proposed Willamette System Review, a series of system configuration studies designed to determine the feasibility of reestablishing naturally self-sustaining populations in river reaches above the USACE Willamette dams.

Until the feasibility studies are completed, the Action Agencies consider the outplanting program, including any increase of natural production that may occur, to be experimental. Support of the interim outplanting program does not imply Action Agency concurrence with a presumptive path toward construction of fish passage facilities or temperature control at those dams. However, the Action Agencies will make a good faith effort to evaluate the feasibility of those potential modifications and, where determined feasible, seek necessary authorization for implementation.

In the interim, the Action Agencies support continuation of the outplanting program to provide nutrients, a bull trout prey base, and supplemental natural production to help meet broodstock collection goals for natural-origin returns. Further, the Action Agencies recognize that the monitoring and evaluation associated with the outplanting program, particularly directed at determining the capacity of the existing habitat to support production of juvenile progeny of outplanted fish, and the ability of those juveniles to successfully migrate downstream through the reservoirs and dams, is instrumental to determination of the feasibility of fish passage, reestablishment of naturally self-sustaining populations, and long-term success of an integrated hatchery program. Accordingly, the Action Agencies will conduct appropriate monitoring and evaluation to address those research questions in conjunction with the feasibility studies.

The Action Agencies expect the Services to provide incidental take coverage for mortality of juvenile progeny from the outplanting program resulting from passage through the dams and reservoirs. Furthermore, the Action Agencies believe that if the reintroduction efforts are successful, then the USACE would eventually reduce its mitigation production accordingly (although that action is likely outside of the timeframe of this consultation).

**Relationship of Outplanting and Potential Reintroduction to System Configuration Studies**

The system configuration studies, collectively called the Willamette System Review, are described in detail in Section 3.6.4. In summary, the Action Agencies propose to evaluate a suite of actions

focusing on alternative potential structural and related operational modifications that may be needed at USACE Willamette dams to address the adverse impacts of those projects (both known and at this time unknown) upon the survival and recovery of ESA-listed species. The intent of the Willamette System Review Study is for the Action Agencies, working collaboratively with the Services and other stakeholders to evaluate the technical, biological, and economic merits of those measures. For those measures determined to be biologically and economically justified in terms of avoiding jeopardizing the continued existence of the ESA-listed species and potentially assisting in their recovery, the Action Agencies will seek to implement such actions (including seeking authorization and funding as needed).

**Importance of Research, Monitoring, and Evaluation to Successful Outplanting**

The outplanting program and related RM&E will be developed and managed in coordination with ODFW, the Services, and other entities (including USFS and BLM). The details of the monitoring program will be developed with these partners, but the scope will include: monitoring pre-spawning mortality of outplanted adults; determining habitat production potential, monitoring the extent of natural production resulting from the outplants; determining the appropriate outplanting strategy (life-stage, numbers, sex ratio, etc); evaluating effects of changes in handling, transport, and release protocols; and determining the feasibility of downstream passage through or around the reservoir environment and dams. These monitoring activities will be adaptively managed to guide annual development of fish disposition plans and protocols and ultimately to inform the system configuration studies and the feasibility of long-term reintroduction. As further considerations in implementing the outplanting program, the Action Agencies will:

- Establish the interagency FPHM Committee, which will oversee, coordinate, and guide implementation of the USACE hatchery mitigation programs (as it pertains to ESA-listed fish), including outplanting of spring Chinook and evaluation of reintroduction potential, as informed by RM&E and completion of the system configuration studies. This committee will effectively adopt many of the responsibilities of the existing SCAB Committee.
- Develop and annually update the Willamette FPMP including the "Fish Disposition and Outplant Protocol" sections of each chapter (through the FPHM Committee).
- Ensure that outplanted fish represent the life history characteristics of the natural population (to the extent possible) and promote successful production.
- Collect, hold, transport, and release outplants in a manner that increases the likelihood for spawning success by using appropriate protocol.
- Employ safe release methods for transported fish by using appropriate protocol.
- Develop and implement a thorough RM&E program in collaboration with state and federal partners. The details of the monitoring program will be developed with these partners, but the scope will include monitoring pre-spawning mortality of outplanted adults; determining habitat production potential; determining the extent of natural production resulting from the outplants; and evaluating the effects of existing and potential downstream fish passage through or around the reservoir environment and dams.
- These monitoring activities will be adaptively managed to guide annual development of fish disposition plans, the system configuration studies, and the feasibility of long-term reintroduction.

#### 3.4.4.6. Research, Monitoring and Evaluation

Operation of the USACE hatchery mitigation program requires extensive RM&E to ensure that hatchery operation and production goals are achieved; that integrated programs (e.g., spring Chinook) support natural production and conservation of the UWR spring Chinook ESU; and that segregated programs (summer steelhead and rainbow trout) minimize impacts to ESA-listed species while meeting mitigation responsibilities. These activities will be carried out with other entities including the ODFW because of the cost-sharing responsibilities for operation and maintenance of the hatchery programs and the fish management responsibility of the State of Oregon. The Action Agencies will:

1. Develop a detailed Hatchery RM&E Plan in collaboration with other entities through the FPHM Committee. Section 3.4.11 lists the strategic questions that will frame hatchery-related RM&E and suggests research objectives to answer these questions. The RM&E plan should specify the hypotheses to be tested to answer the conceptual questions in Section 3.4.12.1, and to meet the objectives in Section 3.4.12.2 and the following RM&E activities discussed in that section: Genetic and Life History Characteristics Monitoring; Monitoring the Conservation of Wild/Naturally Spawning Populations; Feasibility of Reintroduction of Spring Chinook into Historical Habitat; and Segregated Hatchery Program Research, Monitoring, and Evaluation.

2. The strategic questions and RM&E objectives in Section 3.4.12 are based on the following hatchery management goals identified in the HGMPs:
   - Develop and maintain an integrated broodstock for the North Santiam, South Santiam, McKenzie, and Willamette spring Chinook hatchery programs.
   - Maintain an appropriate level of interbreeding between hatchery and naturally produced fish; protect natural production sanctuary areas from an over influence of stray hatchery origin spawners.
   - Use the spring Chinook artificial propagation programs to evaluate the feasibility of developing self-sustaining, natural-spawning populations above USACE dams as part of the spring Chinook outplant program.
   - Manage the summer steelhead and rainbow trout programs as segregated hatchery programs with minimal impacts on native fish populations, including ESA-listed species.
   - Operate each hatchery program in accordance with applicable federal and state laws, and cooperative agreements governing safe operation of hatchery facilities.

The hatchery RM&E program will be closely tied to the system configuration feasibility studies conducted under the Willamette System Review. Some elements of the RM&E program related to determining the feasibility of fish passage and other alternatives for reintroduction of naturally self-sustaining populations of spring Chinook into habitat areas upstream of the dams will be conducted as part of the feasibility studies, while other elements will be funded out of hatchery operations and maintenance.

### 3.4.5. Upper Willamette Spring Chinook Hatchery Programs

#### 3.4.5.1. Relationship to the UWR Spring Chinook ESU

All Willamette spring Chinook artificial propagation programs were derived from local populations with minimal influence from out-of-basin hatchery programs. The NMFS evaluated the effects of each hatchery population on wild fish populations in the UWR spring Chinook ESU by assessing the impacts of each program on the four attributes of a viable salmonid population (VSP): abundance,

productivity, spatial structure, and diversity. These effects are described in the NMFS 2005 updated *Listing Determination and Hatchery Listing Policy* (70 FR 37160) and summarized in Table 3-7.

As of 2005, the UWR spring Chinook hatchery programs benefited several VSP parameters by serving as a genetic reserve for the populations with very little natural production (North Santiam, South Santiam, and Middle Fork Willamette), primarily because the hatchery programs were developed from the local stocks. The other primary benefit of the hatchery programs to the ESU has been the increase in spatial structure and abundance due to the outplanting program into historical habitat, including areas with quality habitat above USACE dams. The primary negative effects of the spring Chinook hatchery programs have included high pre-spawning mortality on the spawning grounds, hatchery-origin fish spawning in the few remaining areas of high natural production (McKenzie), and moderate differences in some life history characteristics between hatchery fish and natural origin fish.

**Table 3-7. Summary of Effects of Willamette Artificial Production Programs on VSP Attributes of UWR Spring Chinook Salmon**

| VSP Parameter | Effect of Existing Hatchery Program on Viability of the UWR Spring Chinook ESU | Net Effect on Viability (from NMFS) |
|---|---|---|
| Abundance | Benefit from hatchery fish on total abundance (+) | Benefit/ decreases risk |
| | Benefit from hatchery fish being outplanted as live adults upstream of impassable dams and producing smolts (+) | |
| | Stable returns to all hatcheries ensures continuation of a genetic reserve (+) | |
| Productivity | High pre-spawning mortality of hatchery and natural fish on spawning grounds limits number of spawners (-) | Neutral/ uncertain |
| | No information that hatchery programs increase productivity (R/S) of natural spawners (?) | |
| | Replacement rates of fish to hatcheries (spawner-spawner) have averaged greater than 1 (+) | |
| | Hatchery fish provide carcass nutrients in historic habitat upstream of dams (+) | |
| Spatial Structure | Benefit from hatchery fish released into historic habitat above dams by expanding spatial distribution within species' historical range (+) | Benefit/ decreases risk |
| | Benefits from adults outplanted into historic habitats below dams (Calapooia River, Little North Fork Santiam) by expanding spatial distribution within species' historical range (+) | |
| | Substantial outplant of spring Chinook into historic habitat will likely benefit the ESU by expanding spatial distribution within species' historical range. This will likely increase productivity and reduce the risk of catastrophic events adversely affecting the entire ESU (+) | |
| Diversity | Potential negative effects from high incidence of hatchery fish spawning naturally in the Clackamas and McKenzie (the two areas with the most remaining habitat and natural production) (-) | Neutral/ uncertain |
| | Hatchery fish have some different life history characteristics than natural fish (smolt release timing, size, age at return, etc) (-) | |
| | Potential positive effects in areas where dams have blocked the majority of historical habitat and hatchery stocks are the only remnants of the historic run (North Santiam, South Santiam, Middle Fork Willamette) (+) | |

After NMFS 2005 listing determination (70 FR 37160)

### 3.4.5.2. Long-term Strategy and Hatchery Management

The Action Agencies propose to continue those components of the hatchery program identified above that already benefit the UWR spring Chinook ESU. Likewise, the Action Agencies will reduce or minimize the negative impacts associated with the current program by implementing hatchery reform actions. This approach should minimize adverse impacts of the hatchery mitigation program on the natural-origin components of each population and ensure consistency with ESA recovery efforts. In general terms, the Action Agencies propose to:

- Implement hatchery reform actions to improve the quality of the hatchery releases by incorporating wild fish into the broodstock, rearing fish within their natal watershed, volitionally releasing fish at an appropriate size and time, etc.
- Minimize stress and mortality of fish handled at hatchery facilities by constructing a new fish trap at Minto Pond Collection Facility (and elsewhere) and instituting new handling protocol.
- Within the framework for spring Chinook outplanting and potential reintroduction described in Section 3.4.4.5, continue to outplant fish into existing quality habitat in areas upstream of USACE dams to increase the percentage of natural-origin fish returning to the subbasins, while evaluating the feasibility of reintroducing naturally self-sustaining populations above the dams.
- Reduce USACE mitigation requirements should natural production above the dams sufficiently increase (likely beyond the lifetime of this consultation).

Success of this approach, which depends on increasing natural production upstream of USACE dams, is integrally linked with the proposed system configuration studies that will investigate the feasibility of structural modifications to USACE dams to improve conditions for ESA-listed species (see Section 3.6). Thus, the benefits of an above-the-dams approach would be realized for a population and the spring Chinook ESU only if:

- Adult fish (or other life stages) can be safely collected, sorted, transported, and released into the upstream environment.
- Habitat upstream of the dam is capable of supporting the holding, spawning, and (to the extent necessary) rearing life stages of spring Chinook.
- The reservoir environment is capable of sustaining juveniles (in terms of productivity and predation), or juveniles can safely bypass the reservoir environment.
- Juvenile survival through the dam is sufficient to provide a benefit to the population.
- Habitat conditions downstream of the dams support juvenile rearing/outmigration, and adult upstream migration.

In the interim, increasing the number of natural-origin returns by using the habitat above the dams would ensure the availability of naturally adapted fish to be incorporated into the broodstock, which is an integral component of a conservation-oriented genetic protocol for an integrated hatchery program consistent with HSRG guidance. Success of this approach also hinges on implementing numerous reform actions in the short-term to ensure that the hatchery population is similar to the natural-origin population.

### 3.4.5.3. Spring Chinook Outplant Program

**Proposed Action**: ***Consistent with the "Action Agency Policy and Philosophical Approach to Outplanting and Reintroduction" described in Section 3.4.4.5, the Action Agencies will continue the Spring Chinook Outplant Program and will use the program to evaluate the long-term***

***feasibility of establishing viable spring Chinook salmon populations in existing habitat in the North Santiam above Detroit Dam, South Santiam above Foster Dam/Green Peter Dam, South Fork McKenzie above Cougar Dam, and into the Middle Fork Willamette above Lookout Point and Hills Creek dams.***

Implement and evaluate these activities for 15 years (3 generations) to increase the percentage of natural-origin fish returning to the Willamette Basin. Outplanting protocols will employ techniques and strategies to collect, hold, and release outplants in a manner that increases the likelihood for spawning success and ensures that outplanted fish represent the range of life history characteristics of the natural population (to the extent possible with the current temperature regime). The releases will be conducted in accordance with the Willamette FPMP, which specifies the operating schedule for each fish facility, the number and origin of adult fish released from each fish facility above the dams, and handling, transport, and release protocols for the reintroduced fish. The Willamette FPMP will be updated annually.

The Spring Chinook Outplant Program involves the cooperation of the State of Oregon (acting through ODFW), the Services, and the land management agencies (primarily the USFS and the BLM); the effective coordination of outplanting efforts among these entities is necessary for success. The program is also related to many sections of this Supplemental BA, including structural modifications, updated project operations, water quality, hatchery operations, and RM&E. As described in Section 3.4.3, the CRHRP will review the UWR spring Chinook hatchery programs and evaluate the benefits of the outplant program towards meeting hatchery management goals. The Action Agencies will consider modifying the outplant program based on the results of the HSRG's review, or subsequent hatchery review efforts. The management goals and protocols would be adjusted accordingly in both the HGMPs and the Willamette FPMP.

Details regarding the management goals and protocols for releasing fish into historical habitat within each subbasin, as they relate to hatchery management and operation of fish collection facilities, are described in Sections 3.4.6 to 3.4.9 and will be included in the Willamette FPMP (see Section 3.2.2). Details regarding the relationship of the outplant program to structural modifications are described in Section 3.6. The following paragraphs summarize the major components of the Spring Chinook Outplant Program that are part of the revised proposed action in this Supplemental BA.

**Willamette FPMP: Fish Disposition and Outplant Protocol Development**

To date, there has been no formal fish passage or outplant plan to guide spring Chinook fish passage and feasibility of reintroduction in the Willamette Basin – these activities have been overseen on an as needed basis by the interagency SCAB Committee and implemented by hatchery and USACE staff. In 2005, the SCAB Committee developed improved protocols for collecting, sorting, handling, transporting, and releasing spring Chinook, which were implemented in 2006 to various extents based on a letter from NMFS to ODFW and the USACE dated May 15, 2006.

**Proposed Action**: ***Develop and annually update the Willamette Fish Passage and Management Plan, including the "Fish Disposition and Outplant Protocol" sections of each chapter.***

The WATER FPHM Committee will finalize and annually update the Willamette FPMP, in a process similar to that conducted by the Columbia Basin's Fish Passage Operations and Maintenance (FPOM) Committee as described in Section 3.2.2. The Fish Disposition and Outplant Protocol section of the Willamette FPMP will serve as an annual outplanting plan that describes the number, timing, origin, and destination of adult spring Chinook to be outplanted upstream of USACE dams

and into other accessible habitat. These chapters will also be attached as Section 15 of the each HGMP. The Action Agencies and ODFW, through the FPHM Committee, will adjust these protocols annually based on expected run size, recent RM&E results, structural changes at the facilities, run timing/size, and strategies identified in the ESA-recovery planning process or hatchery reform efforts, such as the CRHRP. Table 3-10 describes the current management goals for disposition of hatchery and wild fish in the North Santiam Basin, Table 3-13 for the South Santiam Basin, Table 3-16 for the McKenzie Basin, and Table 3-19 for the Middle Fork Willamette Basin. These tables provide a management framework only. More detailed, annual, on-the-ground protocols for disposition of fish arriving at each facility by month (including numbers of fish to transport to various release locations) will be described in the Fish Disposition and Outplant Protocol sections of the Willamette FPMP.

Rationale: Development of annual outplant plans currently occurs informally through the interagency SCAB Committee. By formally developing and updating these protocols annually, all agencies at all levels (i.e., policymakers to hatchery technicians) will have written explanation of the outplanting program for the coming year, including timing, numbers, and location of fish releases; and the specific protocols for conducting the releases. This will also enable Federal land management agencies (USFS and BLM) to appropriately allocate resources for ESA consultations on their land based on known presence of ESA-listed species released in the vicinity of their land.

Implementation Timeframe: Complete Fish Passage and Management Plan within 2 months of issuance of the Willamette Hatchery Biological Opinion. Update annually beginning in 2008.

**Current Outplant Protocol**

The following actions describe protocols listed in the May 15, 2006 letter from NMFS to the USACE and ODFW. These protocols were developed and agreed upon by the interagency SCAB Committee. The SCAB Committee also developed preliminary guidelines regarding the location and frequency of collect fish for outplanting; and guidance on when and where to release fish at the various release locations to increase the likelihood of spawning success.

**Proposed Action:** ***The Action Agencies will work to ensure that outplanted fish represent the life history characteristics of the natural population (to the extent possible) and promote successful production.***

The Action Agencies will work with ODFW and other collaborating agencies to ensure that all outplanted fish are of a suitable stock (i.e., UWR spring Chinook, see Section 3.4); fish represent the full range of life history characteristics exhibited by the naturally spawning populations; and that the specific fish are selected to improve the likelihood of producing juveniles. The Action Agencies will ensure consideration of age/size distribution, condition, and sex ratio of outplanted fish. The Action Agencies will also consider the use of other life history stages (e.g., juveniles) in outplant efforts, if the recommended by the FPHM Committee to increase productivity.

Rationale: A successful outplant and supplementation program will depend on the use of fish that represent the range of genetic diversity and life history characteristics of the natural-origin portion of the UWR spring Chinook ESU. The Action Agencies will balance these needs with considerations for ensuring that collection and release timing of outplants are planned to ensure the greatest likelihood of seeding available habitat and improving spawning success.

**Proposed Action**: ***Collect, hold, transport, and release outplants in a manner that increases the likelihood for spawning success.***

Until new fish collection facilities are constructed, the Action Agencies (often through ODFW) will operate fish facilities in a manner that minimizes harm and stress to adult spring Chinook by implementing new handling, transport, and release protocols. These protocols will be described in more detail in the Fish Disposition and Outplant Protocol section of the FPMP (and attached as Section 15 of the HGMP). In general, the USACE will implement the following practices to reduce stress on adult Chinook handled at Minto Pond, Foster, Dexter, and Cougar fish facilities, and at other locations where fish may be collected (e.g., McKenzie Hatchery or Leaburg Dam), when appropriate:

- Whenever possible, use MS-222 or Aqui-S/Clove oil as an anesthetic instead of $CO_2$ (not always possible if fish are released into areas with allowable harvest).
- Transport adults at a loading density of at least 25 gallons/fish (i.e., 50 fish/1,500-gallon tank).
- Treat outplanted fish with erythromycin and oxytetracycline as appropriate.
- Use Nov-Aqua in transport tank to reduce stress during transport.
- Minimize the difference in water temperature between the truck and receiving waters.

Rationale: These activities should reduce stress on adult fish as they are handled, transported, and released. Reducing stress should reduce the susceptibility of outplanted fish to various diseases; ultimately reducing the high rates of pre-spawning mortality that have been documented in some years. Reductions in pre-spawning mortality are necessary to ensure successful production upstream of USACE dams or in other historical habitat (e.g., Little North Santiam River).

Implementation Timeframe: Ongoing/immediate. New protocols were implemented in 2006. Ongoing/immediate; make improvements annually based on RM&E. Describe in Willamette FPMP.

**Proposed Action**: ***Employ safe release methods for transported fish.***

Until new release sites are developed, increase the likelihood that outplanted fish will survive to spawn by:

- Minimizing the distance between the truck and the receiving waters.
- Avoiding the use of collapsible hoses.
- Releasing fish into low-velocity water with adequate depth and proximity to holding habitat.
- Attempting to avoid releasing fish in close proximity (spatially or temporally) to recreational use.

Rationale: Release locations in the many subbasins were selected opportunistically at locations where managers could get the liberation trucks relatively close to the river. Release sites were not selected based on the suitability of surrounding habitat for providing recovery, holding, and spawning habitat for released adults. Many of the current release sites have relatively poor river access, forcing drivers to release fish using methods that elevate stress or cause direct or delayed injury or mortality. These release practices (e.g., use of collapsible hoses, sliding on tarps, direct release from bridges, etc) have likely contributed to high pre-spawning mortality of outplanted fish. Furthermore, some sites are located at river access points that experience heavy recreational pressure that leads to disturbance, harassment, or poaching of outplanted fish. Implementation of new release

protocols should reduce the incidence of stress, injury, and mortality, which would translate to higher spawning success.

Implementation Timeframe: Ongoing/immediate. Modify release site to comply with these criteria as soon as possible.

**Proposed Action**: ***Work with fishery co-managers and land management agencies to develop suitable release sites for adult spring Chinook above Detroit, Foster, Lookout Point, Hills Creek, and Cougar reservoirs.***

The Action Agencies will work with state and federal co-managers and landowners (through the FPHM Committee) to identify potential new release sites for spring Chinook salmon upstream of several reservoirs. The USACE will provide information on the quality and quantity of holding and spawning habitat in the vicinity of potential sites using the database developed in the habitat assessment completed by R2 Resource Consultants and available https://www.nwp.usace.army.mil/home.asp The FPHM Committee will select sites based on proximity to suitable holding and spawning habitat and the ability to develop suitable infrastructure necessary to safely release UWR spring Chinook (and potentially UWR winter steelhead) into quality habitat as part of the spring Chinook outplant program.

Rationale: Previously used poor release site conditions likely increase the incidence of pre-spawning mortality in adult releases. New release sites will be developed to allow safe transfer of fish from the truck, adequate recovery in pools without recreational pressure or poaching, and reasonable proximity to quality holding and spawning habitat. Improving release conditions should reduce stress and associated pre-spawning mortality.

Implementation Timeframe: Work with the FPHM Committee to identify small fixes to current sites in 2008, but ensure that any new facilities are developed based on monitoring efforts associated with the outplant program (i.e., ensure that release sites are strategically located based on future management of outplants). When suitable sites are identified, work with land management agencies (e.g., USFS and BLM), or private landowners to develop infrastructure.

**Research, Monitoring, and Evaluation**

**Proposed Action**: ***Develop and implement a thorough RM&E program to monitor the progress of the outplant program.***

The hatchery RM&E program will be closely tied to the system configuration feasibility studies conducted under the Willamette System Review. Some elements of the RM&E program related to determining the feasibility of fish passage and other alternatives for reintroduction of naturally self-sustaining populations of spring Chinook into habitat areas upstream of the dams will be conducted as part of the feasibility studies while other elements will be funded out of hatchery operations and maintenance.

The RM&E program will be used to verify that adult fish (or other life stages) can be safely collected, sorted, transported, and released into the upstream habitat; habitat upstream of the dam is capable of supporting the holding, spawning, and (to the extent necessary) rearing life stages of spring Chinook; the reservoir environment is capable of sustaining juveniles (in terms of productivity and predation) or if juveniles can safely migrate through the reservoir environment; juvenile survival through the dam is sufficient to provide a benefit to the population; and habitat conditions

downstream of the dams support juvenile rearing/outmigration, and adult upstream migration. The data collected will result in recommendations on: (1) locations where it is feasible to re-establish self sustaining populations (short term and long term); (2) potential population size for each subbasin; (3) operational methods for higher juvenile and adult survival; (4) infrastructure needs (i.e., structural modifications) to ensure long term viability of populations; and (5) genetic considerations for broodstock in each subbasin. This program must be integrated into the comprehensive program overseen by the RM&E Committee (see Section 3.8) and following the principles and strategic questions developed by the committee.

### 3.4.6. North Santiam Spring Chinook Program

The USACE proposes to continue funding 83.75% of the O&M costs of Marion Forks Hatchery, the primary rearing facility for the North Santiam spring Chinook program, and the Minto Pond facility, the broodstock collection and juvenile acclimation facility. In accordance with the 1990 Cooperative Agreement, the annual funding level will be based on what is required to rear no more than 84,000 pounds of juvenile spring Chinook and steelhead, which is the USACE mitigation responsibility for lost salmon and steelhead spawning and rearing habitat on the North Santiam River upstream of Detroit and Big Cliff dams. Currently, the North Santiam spring Chinook program releases about 61,000 pounds of spring Chinook smolts annually. The goals of the North Santiam spring Chinook program are to:

- Mitigate the loss of spring Chinook catch in sport and commercial fisheries caused by construction and operation of Big Cliff and Detroit dams.
- Provide adequate fish to the hatchery to maintain the broodstock to perpetuate program goals as outlined in the *Santiam River Subbasin Fish Management Plan* (OAR 635-500-1666).
- Maintain a suitable conservation broodstock for ongoing and future population recovery efforts throughout the subbasin, including potential reintroduction efforts above the Big Cliff/Detroit dam and reservoir complex.

Because of the conservation role of this hatchery program, the USACE proposes to operate the North Santiam spring Chinook program as an integrated hatchery program with conservation-oriented genetic protocol. The operation of the program is described in detail in the North Santiam spring Chinook HGMP. Chapter 1 of the Willamette FPMP (see Section 3.2 and Appendix A) will describe the management goals and disposition plan for fish arriving at the Minto Pond Fish Facility.

#### 3.4.6.1. Hatchery Facilities and Operation

**Minto Pond Fish Facility**

Collection of adults for the North Santiam spring Chinook program occurs at the Minto Pond facility (Figure 3-4). The USACE owns the facility and the 21.32 acres surrounding it. The facility was designed as an adult salmon collection facility and was not designed to accommodate live sorting of adult fish. This facility also handles adult winter and summer steelhead, which are returned to the river to spawn naturally, recycled downstream to increase harvest opportunities, or given to local food banks. Migrating adults are blocked by the barrier dam and guided to the fish ladder entrance. Attraction water is provided from an intake and 36-inch in diameter pipe located upstream of the barrier dam. The trap consists of a short fish ladder, pre-sort holding pool, a fish lock and brail, an anesthetic tank, and a sorting table. Sorted fish are routed via PVC tubes to various locations, including a concrete post-sort holding pond that measures 164-feet long by 32-feet wide, and is 6-feet deep. The holding pond was constructed in 1975, but was recently divided into four alleyways

with vertical aluminum poles. The roof of the sorting and spawning facility has been retrofitted to facilitate transfer of fish from the anesthetic tank to the rooftop where they are loaded via a tube onto a truck for transportation.

**Figure 3-4. Minto Pond Fish Facility, North Santiam River near Niagara, Oregon**

**Proposed Action**: ***Operate and rebuild the Minto Pond Fish Facility.***

The Action Agencies will rebuild and upgrade the existing fish collection facility at Minto Pond to comply with NMFS criteria for upstream passage/collection facilities. The facility will provide adequate attraction of fish into the trap, automated sorting (when possible), and water-to-water transfer of fish into transport trucks. The facility will also serve as an effective juvenile acclimation facility that allows for volitional release. In the short term, the USACE proposes to continue operating Minto Pond in its current condition (with minor safety upgrades) while it completes designs for a new facility.

Rationale: The Minto Pond Facility was designed as a broodstock collection facility, but it now collects, handles, and sorts ESA-listed UWR spring Chinook and winter steelhead that are: (1) released upstream of the Minto barrier; (2) transported upstream of Detroit Dam (hatchery-origin spring Chinook only); or (3) transported to another stream in efforts to improve production of naturally produced UWR spring Chinook. The facility was not designed to accommodate safe handling, sorting, and loading of ESA-listed fish that must survive to spawn in the wild. At the existing facility, ESA-listed fish are often directly injured or physically handled in a manner that likely contributes to the high levels of pre-spawning mortality observed in the North Santiam basin. The existing facility does not meet many of NMFS criteria for trapping and is unable to acclimate juveniles during higher flows. Rebuilding the facility to safely handle, sort, and load adult fish will likely decrease pre-spawning mortality of all fish handled at the facility. This should result in significant improvements in survival (of fish released upstream of the Minto Barrier, upstream of Detroit Reservoir, or into the Little North Santiam River.

Implementation Timeframe: Preliminary designs were completed in 2005 and are described in the *South Willamette Valley Fish Facilities Improvements Report* (McMillen Engineering 2005). The timeline for reconstruction of Minto Pond is described in Section 3.6. The FY 2008 budget contains $200,000 for preliminary design work.

**Marion Forks Hatchery**

Marion Forks Hatchery is located on land owned by the USFS, Willamette National Forest (Figure 3-5). A 1949 Memorandum of Understanding between the USACE and the Forest Service granted the USACE use of the 40-acre parcel associated with Marion Forks Hatchery. All structures associated with Marion Forks are the property of the USACE.

**Figure 3-5. Marion Forks Fish Hatchery, Detroit Ranger District, Willamette National Forest**

Marion Forks Hatchery has 34 stacks of heath stack vertical incubators. Because of the hatchery's cold water supply, it is equipped with a water heating system that enables the operators to increase growth rates in attempts to meet target sizes. Marion Forks Hatchery is equipped with 12 Canadian-style troughs and 48 circular ponds. There are no spawning facilities at Marion Forks; all spawning occurs at Minto Pond. The ODFW also raises Clackamas (011 stock) and Sandy (019 stock) spring Chinook; South Santiam River (024 stock) summer steelhead; and rainbow trout at Marion Forks, but the majority of the production is North Santiam (021 stock) spring Chinook.

**Proposed Action**: ***Operate and maintain the Marion Forks Fish Hatchery.***

The Action Agencies propose to continue funding 83.75% of the operation and maintenance of Marion Forks Fish Hatchery as the primary hatchery facility used to meet the North Santiam spring Chinook mitigation requirements.

Rationale: Marion Forks Hatchery has proven to be a reliable facility for rearing spring Chinook salmon. Being located within the North Santiam subbasin, using Marion Forks Hatchery is ideal for maintaining consistency with hatchery reform principle #3 that reduces straying among basins by rearing hatchery fish within their natal watershed.

Implementation Timeframe: Immediate/ongoing.

**Proposed Action:** ***Maintain the diversions and intakes on Marion Creek and Horn Creek to provide a suitable water supply to Marion Forks Hatchery.***

The Action Agencies will work with ODFW and other entities (e.g., the USFS) to ensure proper maintenance of intakes and diversion structures necessary to supply water to Marion Forks. Ensure that ODFW develops emergency response plans in the case of intake failure and maintains the capability to implement the plan.

Rationale: The 1990 Cooperative Agreement requires the USACE to ensure that Marion Forks Hatchery has a viable water supply of 21 cfs. This water supply is currently met using two separate surface water intakes, one on Marion Creek and the other on Horn Creek. In 2006, the diversion dam on Marion Creek began to fail. The USACE and ODFW corrected the problem in September 2007, but the dam must be monitored regularly to ensure its structural integrity. Failure of the Marion Creek diversion dam would result in immediate loss of the hatchery's primary water supply. Depending on the time of year, this could result in loss of fish necessary to meet the USACE mitigation responsibility.

Implementation Timeframe: Ongoing/immediate. Emergency response plan 3 months post-issuance.

**All Facilities**

**Proposed Action:** ***Resolve hatchery infrastructure maintenance needs and develop a long-term Hatchery Maintenance Plan.***

The USACE and ODFW are developing a prioritized list and database of maintenance needs at each hatchery facility, including Marion Forks Hatchery and the Minto Pond Fish Facility. The Action Agencies and ODFW will use this list to develop a Hatchery Maintenance Plan that identifies long-term maintenance needs for each facility. The Action Agencies and ODFW will develop a strategy to address these needs through annual budget requests or other processes. The Action Agencies and ODFW will continue to implement actions identified in the Minto Pond safety inspection report.

Rationale: Failure to properly maintain and update fish production and handling facilities could cause failure of major equipment or facility components. Equipment, water supply, or facility failure could result in an inability of the USACE to meet its mitigation requirements or effectively implement the actions in the HGMP. The Action Agencies are responsible for 83.75% of the operations and maintenance of the Minto Pond and Marion Forks Hatchery. Most of the hatchery infrastructure was constructed or purchased over 40 years ago and is in need of major repair or maintenance. Complications with state and federal funding restrictions and budget processes have hindered the ability of the state to keep pace with needed repairs and upgrades. In 2006, the USACE and ODFW completed safety inspections at the Minto Pond facility, which identified numerous violations and recommended correction actions. These recommended actions are described in a

report dated March 2006. Not addressing current maintenance needs, and failure to adequately plan for future needs may affect human safety of hatchery workers and visiting members of the public.

Implementation Timeframe: Safety upgrades immediate/ongoing. Complete Hatchery Maintenance Plan in September 2007; implement according to schedule in the plan.

**Proposed Action:** ***Complete regular environmental compliance and safety inspections at Marion Forks Hatchery and Minto Pond Fish Facility, and promptly correct violations.***

According to the schedule identified in ER 200-2-3, the USACE will complete environmental compliance and safety inspections at Marion Forks Fish Hatchery and the Minto Pond Fish Facility. The USACE will ensure prompt correction of violations.

Rationale: Improper storage and use of hazardous chemicals can cause damage to environmental resources including ESA-listed fish, particularly due to the proximately of hatchery facilities to numerous water bodies. Regular environmental compliance assessments, in combination with regulatory agency inspections and environmentally sensitive day to day operations are a means of attaining, sustaining, and monitoring compliance with applicable federal, state, interstate, and local environmental regulation.

Implementation Timeframe: Conduct inspections according to schedule mandated by ER 200-2-3, beginning in 2007.

**Proposed Action:** ***Operate Marion Forks Hatchery in compliance with the Integrated Hatchery Operations Team (IHOT) fish health guidelines.***

All lots of fish will be monitored daily in the hatchery for signs of disease. The ODFW Fish Pathology team will conduct periodic sampling of the fish in the hatchery, especially if any increase in mortality is observed by hatchery personnel. Whenever diseased fish are detected, the diseased fish will be treated according to IHOT protocols. Lots that cannot be certified as disease free prior to release will be destroyed or otherwise disposed of according to IHOT protocols. Diseased fish are not released into the North Santiam River.

Rationale: Adhering to IHOT standards for fish health is critical to maintaining hatchery operations. Excessive disease can impact ODFW's ability to produce the USACE mitigation requirements and implement the actions in the HGMP. Periodic review of the fish health monitoring results and disease history is necessary to identify trends or areas where operations could be modified to improve fish health.

Implementation Timeframe: Immediate/ongoing.

**Proposed Action:** ***Comply with NPDES permits.***

Marion Forks Hatchery's water discharges will comply with prescribed 330j general NPDES permit as required by the ODEQ.

Rationale: Compliance with NPDES permits ensures that hatchery operations do not exceed water quality criteria that could create conditions harmful to ESA-listed species.

Implementation Timeframe: Immediate/ongoing.

### 3.4.6.2. Broodstock

**Broodstock Origin and Identity**

The ODFW uses North Santiam spring Chinook (stock 21) to meet USACE mitigation requirements.

**Proposed Action: *Continue use of the North Santiam (stock 21) spring Chinook.***

The Action Agencies propose to continue using North Santiam spring Chinook (stock 21) to meet its mitigation responsibilities.

Rationale: Broodstock for the North Santiam spring Chinook (stock 21) were derived from the local wild population. Because the North Santiam spring Chinook Program is both a mitigation and conservation hatchery program, this is the most suitable stock to propagate.

Implementation Timeframe: Ongoing/immediate.

**Broodstock Collection Location**

All broodstock for the North Santiam spring Chinook program are collected at the Minto Pond Fish Facility located about 3 miles downstream of Big Cliff Dam. A 12-foot high barrier weir at the Minto Pond facility spans the North Santiam River and serves as a barrier to upstream-migrating fish, directing them into the trap.

**Proposed Action: *Continue collecting all North Santiam spring Chinook broodstock at Minto Pond.***

The Action Agencies propose to continue collecting North Santiam spring Chinook (stock 21) broodstock at the Minto Pond facility (see proposed reconstruction of the facility above). Any changes in broodstock collection location, including collection at Upper or Lower Bennett Dam (owned by the Santiam Water Control District and the City of Salem), would be discussed in the FPHM Committee.

Rationale: The Minto Pond facility is a suitable location for broodstock collection. Upper and Lower Bennett dams, located farther downstream near the city of Stayton, may serve as future broodstock collection location. The use of Upper and Lower Bennett dams (or any other facility) as a site for broodstock collection will be discussed with the FPHM Committee.

Implementation Timeframe: Ongoing/immediate.

**Broodstock Collection Timing**

The Minto Pond Fish Facility is usually opened in March to collect and pass UWR winter steelhead. Adult spring Chinook are collected at the trap between mid-May and October. However, due to cold temperature releases from Detroit and Big Cliff dams, spring Chinook typically do not arrive at Minto Pond until mid-July, with the majority arriving in August. Early-arriving fish are held in the river below the barrier at Minto and are assumed to mix prior to the trap opening in July. Broodstock are collected throughout the run until early October and held at the Minto Pond facility until spawning in September or October. In 2006, warm surface water releases from Detroit Reservoir prompted early arrival of spring Chinook at Minto Pond (as early as mid-May). Some of

these fish were experimentally held throughout the summer at Minto Pond and experienced low pre-spawning mortality rates.

**Proposed Action**: ***Continue to collect broodstock throughout the run to ensure the hatchery population is similar to the naturally spawning population.***

The Action Agencies propose to continue the current practice of collecting allowing broodstock to hold in the river below Minto and be collected between August and October. If water temperature control is installed at Detroit Dam (see Section 3.6), then the Action Agencies and ODFW, through the FPHM committee, will revisit this practice, as fish will likely return to the facility earlier. Likewise, reconstruction of the Minto Pond Fish Facility may warrant or enable modifications to the broodstock collection protocol to ensure that the broodstock represents the entire range of run timing. If RM&E indicates differences in run timing of hatchery and wild fish is substantially different, then modifications to the broodstock collection protocol should be made. Potential modifications include collection of early-run fish from Upper Bennett Dam. Any changes in broodstock collection timing, including collection at Upper or Lower Bennett Dam, would be discussed in the FPHM Committee.

Rationale: Collection of broodstock throughout the run ensures that the hatchery brood represents the full diversity in run timing as the natural-origin population. While collection of fish throughout the run at Minto Pond is challenging due to cold water releases from Detroit and Big Cliff dams, the current practice of allowing the fish to mix in the river below Minto Pond likely enables collection of the full range of run timing. This assumption should be tested with RM&E and adjusted accordingly.

Implementation Timeframe: Ongoing/immediate. Annual review by the FPHM Committee.

**Numerical Goals and Incorporation of Natural Origin Fish**

The annual broodstock collection goal for the North Santiam spring Chinook program at Marion Forks Fish Hatchery is 600 adult fish (300 males, 300 females). Beginning in 2003, natural origin recruits (NOR) have been incorporated into the hatchery broodstock at a rate designed to improve compatibility between hatchery origin recruits and natural origin spawners. The 2000 NMFS BiOp limited the percentage of non-adipose fin-clipped fish that could be incorporated into the brood to 10%. Due to a high incidence of mismarked fish, the actual percentage of wild fish incorporated into the broodstock has been much less.

**Proposed Action**: ***Incorporate an appropriate percentage of natural-origin fish incorporated into the broodstock to ensure the hatchery population is similar to the naturally spawning population.***

In the short-term, NMFS recommends incorporating as many natural origin fish into the broodstock as possible, approaching 30% to 40% non-adipose, fin-clipped fish. The Action Agencies and ODFW will increase the percentage of natural origin fish into the North Santiam spring Chinook broodstock in order to achieve the management goal of operating the program as an integrated program with a conservation-oriented genetic protocol. The percentage of non-adipose, fin-slipped fish incorporated into the brood will follow the guidance in Table 3-8. The Action Agencies will modify these guidelines based on recommendations from the HSRG and/or the FPHM Committee.

**Table 3-8. Proposed Broodstock Collection Guidelines for the North Santiam Spring Chinook Hatchery Program**

| North Santiam Spring Chinook | Hatchery Broodstock | | | Outplants Above Detroit Reservoir Proportion of Wild & Hatchery Fish | |
|---|---|---|---|---|---|
| **Returns of Chinook to North Santiam (hatchery and wild) as indexed by Bennett Dam counts** | **Max. % wild fish in hatchery broodstock (600 fish goal)** | **Corresponding max. # wild fish in broodstock** | **Max. % of wild pop. taken for brood** | **Wild fish** | **Hatchery fish** |
| <3,000 (low run) | 30 | 180 | 50 | ensure wild fish incorporated into broodstock | As needed to have minimum spawning escapement of at least 500 fish |
| 3,000-7,000 (medium run) | 40 | 240 | 30 | none at this time | |
| >7,000 (high run) | 50 | 300 | 20 | none at this time | |

Rationale: For integrated hatchery programs, the HSRG recommends ensuring that an average of 10% to 20% of the hatchery broodstock is comprised of natural-origin adults each year. The 2000 NMFS BiOp specified that a maximum of 10% of the North Santiam spring Chinook broodstock could be of natural origin, with the additional restriction that no more than 10% of the wild population could be taken for brood. Natural-origin fish have comprised from 3% to 14% of adults on the spawning grounds since monitoring began in 2001 (and hatchery fish were distinguishable by an adipose fin clip). Since the 2000 BiOp, very few natural-origin fish have been incorporated into the broodstock (Table 11 in Schroeder et al., 2006). After review of these data regarding the actual number of wild fish incorporated into the broodstock, NMFS recommended incorporating up to 40% non-adipose, fin-clipped fish into the North Santiam broodstock (letter dated May 15, 2006 from Rob Jones, NMFS, to Suzanne Knapp, ODFW and Randy Bailey, USACE). Increasing the percentage of natural-origin fish in the brood should ensure that the hatchery population and naturally spawning population are similar. This is essential if it is determined feasible to use this program to reintroduce fish into habitat upstream of USACE dams.

Implementation Timeframe: Began with 2006 brood year; continue annually with review by FPHM Committee. Consider changes based on recommendations based on the HRSG review. Specific annual guidance will be updated annually the FPHM Committee in the North Santiam/Minto Pond chapter of the FPMP.

### 3.4.6.3. Adult Transport, Holding, and Prophylactic Treatment

Spawning/mating occurs on-site at the Minto Pond Fish Facility; no transport of broodstock is necessary. With the current temperature regime, most broodstock are held in the river below Minto Dam and are retained in the holding ponds at Minto Pond beginning with collections in mid-July.

**Proposed Action**: ***Continue to spawn North Santiam spring Chinook on-site at the Minto Pond Fish Facility.***

The Action Agencies do not propose any changes to the holding protocol for broodstock. In 2006, ODFW experimented with holding early-arriving adults at Minto Pond between July and September, and these adults experienced relatively low pre-spawning mortality. The Action Agencies support

continued evaluations of the holding potential of early-arriving brood, if possible, given the current water temperature regime (or of brood collected at Bennett Dam).

Rationale: Allowing fish to hold in the river below Minto Barrier Dam reduces holding of broodstock in the holding ponds and eliminates the need to treat broodstock with antibiotics. The Minto Pond facility causes excessive stress and injury on fish that are cycled through the fish lock.

Implementation Timeframe: Immediate/ongoing; specific annual guidance will be updated annually the FPHM Committee in the North Santiam/Minto Pond Chapter of the FPMP.

#### 3.4.6.4. Mating

Fish are selected and paired at random in order to minimize selective pressures from hatchery practices. The typical sex ratio of returning adults is almost 2:1 male to female, but the typical spawning sex ratio for this program is a 1:1 male-to-female. Jacks are used in approximately the same proportion as they occur in the return. Males are not reused. Collection of 300 males and 300 females allows for an annual egg take of around 1.1 to 1.3 million eggs.

If the hatchery reduces the number of eggs retained, a representative sample of each male/female cross is culled. Exceptions may occur if there is a high degree of disease or epidemics associated with certain parents; if this occurs, offspring of diseased parents may be culled, in order to maximize long-term survival of the brood.

**Proposed Action**: ***Continue to use random spawning protocol with a 1:1 male-to-female ratio.***

The Action Agencies do not propose any changes to the spawning protocol, unless results of RM&E indicate that spawning is not truly random with respect to run representation, age, and size of broodstock.

Rationale: Random mating should minimize the likelihood of selective pressures and promote genetic diversity of hatchery population, which is consistent with the goals of this hatchery program.

Implementation Timeframe: Immediate/ongoing; potentially informed by RM&E that tests the assumption of equal run-timing representation.

#### 3.4.6.5. Incubation and Rearing

Eggs are transferred immediately to Marion Forks Hatchery for incubation and rearing. All North Santiam spring Chinook are reared at Marion Forks Hatchery. Egg take typically ranges from 900,000 eggs to 1.5 million eggs, which allows surplus for bacterial kidney disease (BKD) culling. Fish are ponded at 1650-1850 temperature units (TUs), which usually occurs between mid-February and mid-march. Egg to fry survival averages around 83%; fry to smolt survival averages around 95%, and overall egg to smolt survival is around 85%. Due to cold water temperatures, fish raised at Marion Forks Hatchery grow relatively slowly. Details regarding incubation, rearing, and growth rates are described in Chapter 9 of the HGMP.

**Proposed Action**: ***Continue to incubate and rear all North Santiam spring Chinook at Marion Forks Hatchery.***

The Action Agencies do not propose any changes to the incubation and rearing protocol, with the exception of changes necessary to accommodate experimental changes in release size or timing.

Rationale: Marion Forks Hatchery has proven to be a reliable facility for rearing UWR spring Chinook, and its location within the North Santiam watershed (combined with in-basin acclimation) reduces the likelihood that the adult returns will straying to another basin.

Implementation Timeframe: Immediate/ongoing; potentially informed by RM&E regarding most appropriate size and timing of juvenile releases.

#### 3.4.6.6. Marking

Currently all hatchery juveniles are adipose fin-clipped and otolith marked to allow visual identification of hatchery-origin fish.

**Proposed Action:** ***Continue to adipose fin-clip and otolith mark all North Santiam spring Chinook at Marion Forks Hatchery.***

The Action Agencies propose to continue the current practice of adipose fin-clipping and otolith marking all North Santiam spring Chinook.

Rationale: Adipose fin-clipping ensures immediate visual identification of hatchery-origin fish in the fishery, at the hatchery, and on the spawning grounds. However, returning North Santiam spring Chinook hatchery fish have a high incidence of mismarking (i.e., partially or fully regenerated adipose fins) which poses several management problems. Otolith marking allows after-the-fact determination of the true origin of an adult fish and is critical for determining the incidence of mismarking and the true percentage of natural-origin fish that were incorporated into the broodstock. Continuing these two marking procedures are critical for effective hatchery and fishery management.

Implementation Timeframe: Ongoing/immediate.

**Proposed Action:** ***Insert coded wire tags (CWTs) into all juvenile hatchery fish in addition to current practice of adipose fin-clipping and otolith marking.***

In addition to the current practice of adipose fin-clipping and otolith marking all hatchery releases, the Action Agencies propose to insert CWTs into all hatchery releases. Tag codes should be assigned according to releases in order to evaluate alternative release strategies.

Rationale: This practice will allow for automatic enumeration and sorting of returning adults upon their return when Minto Pond Fish Facility is reconstructed. Automated sorting will greatly reduce stress, injury, and mortality of fish that are collected and sorted at the facility, particularly natural-origin fish that are transported upstream of Minto Barrier Dam and Detroit Dam. Use of CWTs will enable thorough evaluation of straying patterns and alternative release strategies. It will also enable real-time determination of hatchery-origin fish upon return to the hatchery, which will enable managers to more successfully meet targets for incorporation of natural origin fish into the broodstock as described in Table 3-8. Because spring Chinook have a 4-5 year life cycle, and the Minto Pond facility will likely be constructed within 5 years, this action is a higher priority in the North Santiam subbasin.

Implementation Timeframe: Purchase CWTs for all fish in experimental releases in FY 2008. Include purchase of CWTs for all North Santiam releases in FY 2009 budget request and out years.

#### 3.4.6.7. Acclimation and Release

In previous years, some North Santiam spring Chinook have been directly released into the North Santiam River. However, in recent years, all North Santiam spring Chinook releases have been acclimated at Minto Pond. Typical acclimation (when releases from Big Cliff Dam permit) lasts at least 3-4 weeks depending on the physiological readiness of the fish. The fish are held in the pond for 3-4 weeks and then the screens are pulled to allow the fish to emigrate when they are ready, which may take up to two weeks. High spring flows can sometimes render the pond unusable for acclimation because flow-through is reduced.

**Proposed Action:** ***Continue acclimating and releasing the majority of North Santiam Spring Chinook at Minto Pond Facility.***

The Action Agencies propose to continue acclimating and releasing the majority of smolts at Minto Pond and allowing for volitional release. The Action Agencies will provide flows that allow acclimation and volitional release whenever possible until a new facility is built that functions throughout a wider range of river levels.

Rationale: Acclimation of smolts at Minto Pond reduces the likelihood of straying among basins and onto the spawning grounds, which is consistent with the management objectives of the program.

Implementation Timeframe: Ongoing/immediate.

**Proposed Action:** ***Experimentally release a portion of hatchery juveniles at a size and time more similar to natural-origin fish.***

The Action Agencies, through ODFW, will shift production to release a group of juveniles at a size and time that more closely approximates the life history pattern of natural-origin juveniles. The Action Agencies propose an experimental release in Table 3-9, but will thoroughly discuss the details of this release with the FPHM Committee. The Action Agencies propose to initiate the experimental release in the North Santiam Basin due to the relatively low risk to natural production and the ability of Marion Forks Hatchery to produce fish of a smaller size. However, the Action Agencies seek input from FPHM on the most appropriate subbasin for the release, and also seek review of the potential action by the HSRG/CRHRP. The Action Agencies will finalize details of the release with the FPHM committee, develop a monitoring and evaluation process, and determine if the releases are worth implementing on a larger scale in other basins.

**Table 3-9. Proposed Release Schedule for North Santiam Spring Chinook**

| Life Stage | Release Location | Release Date | Mean Size at Release (#fish per lb) | Number of Fish Released* | Total Pounds Released |
|---|---|---|---|---|---|
| Eyed Eggs | | | | | |
| Unfed Fry | | | | | |
| Fry | Big Lake | | | 1,500 | |
| Fingerling | Detroit Reservoir | June | 200 | 100,000 | 500 |
| Subyearling | | March | 20 | 200,000** | 10,000 |
| Yearling (age-1 smolts) | North Santiam River (at Minto) | March | 11 | 500,000*** | 45,455 |
| TOTALS | | | | 701,500 | 55,955 |

* New releases are highlighted in green; changes in historical releases are in yellow. Proposal to be finalized by the FPMP Committee within one year post-issuance, targeting an initial experimental release in 2009.
** Subyearling release would be implemented experimentally in 2009.
*** 667,000 smolts were released annually until and including 2007. 500,000 smolts represent a target smolt release in years after 2007 when the subyearling release is implemented.

Rationale: Theoretically, releasing juveniles that are closer in size to their natural-origin counterparts should increase the percentage of adults that return as 5-year-old fish, which would shift the age distribution of hatchery adults towards that of the natural-origin fish. It should also increase overall fecundity (and thus productivity) of hatchery-origin fish, which could increase productivity from hatchery fish released into habitat upstream of USACE dams.

Implementation Timeframe: The FPHM Committee will develop the scope and details of the experimental release within 1 year of issuance, targeting release in 2009. The FPHM Committee will also develop a suitable evaluation to accompany the release (e.g., pit tag), which may be combined with objectives of other studies.

### 3.4.6.8. Spring Chinook Hatchery Outplant Program and Disposition of Fish Arriving at Minto Pond

Several species of fish arrive at the Minto Pond Facility throughout the year, including spring Chinook, winter steelhead, and non-native hatchery summer steelhead. In addition to collection for broodstock needs, fish are transported to various locations based on management priorities (Table 3-10). Priorities for disposition of excess broodstock and non-hatchery species arriving at the Foster Trap are determined by balancing goals for natural production, the Spring Chinook Outplant Program, hatchery management, and harvest opportunities; while ensuring that tribal obligations are satisfied. The Action Agencies and ODFW balance these goals with the physical limitations of the existing facility and the associated demands on hatchery personnel. In recent years, the majority of excess spring Chinook broodstock have been collected and transported to unseeded, historical habitat areas (see Section 3.4.4.5, *Spring Chinook Outplant and Potential for Reintroduction into Historical Habitat*). In the North Santiam subbasin, adult spring Chinook have been released at three locations along the North Santiam upstream of Detroit Reservoir and at Cleator Bend on the Breitenbush River. Unmarked spring Chinook have been released into the Little North Santiam River (a tributary located downstream of Big Cliff Dam). Fish are also passed over the barrier dam at Minto and into

the 4 miles of habitat between Minto and Big Cliff Dam. A summary of these releases is found in Beidler and Knapp (2005).

### Table 3-10. Management Goals for Fish Collected at Minto Pond

| Species | Destination | Target # of Adult Fish | | Maximum % of Wild Run |
|---|---|---|---|---|
| | | Clipped | Unclipped | |
| Spring Chinook | Broodstock | 420 | 180 | 30* |
| | North Santiam above Minto Pond | As needed to meet unclipped goal, after broodstock target met | 500 | |
| | North Santiam above Detroit Dam | 2000* (1,200 in short-term) | None at this time given downstream survival uncertainty; Long-term goal is to use wild fish. | |
| | Breitenbush above Detroit Dam | 1000* (600 in short-term) | None at this time given downstream survival uncertainty; Long-term goal is to use wild fish. | |
| | Little North Santiam at The Narrows | 0 | 400 | |
| Winter Steelhead | North Santiam above Minto | 0 | All | |
| | Remove from system | All | 0 | |
| Summer Steelhead | Recycling below Minto | Any excess to brood | 0 | N/A |
| | Remove from system | Excess to brood and recycling | All | N/A |

* Sliding scale based on run size.
** These targets are for actual spawners. May need to adjust for prespawning mortality.

**<u>Fish Disposition and Outplant Protocols – South Santiam/Foster Dam Fish Passage and Management Plan</u>**

Current general management goals for the spring Chinook outplant program and potential for reintroduction are described in Section 3.4.4.5. Consistent with the philosophy and approaches described in that section, detailed protocols for disposition of excess hatchery broodstock, wild fish, and other species collected at Minto Pond will be contained in the "Fish Disposition and Outplant Protocols" section of the Willamette FPMP. The FPMP will contain detailed, on-the-ground disposition protocols for all species of fish (clipped/unclipped) arriving at Minto Pond including excess adult hatchery fish. Organized by date, it will specify priorities for disposition of wild/unclipped fish; and establish numerical goals (and perhaps minimum number of females) for release at each release site. These numerical goals will updated annually by the FPHM Committee.

#### 3.4.6.9. Research, Monitoring and Evaluation Needs for the North Santiam Spring Chinook Hatchery Program

The following RM&E questions are specific to the North Santiam Basin and the spring Chinook program. Any RM&E recommendations must be integrated into the comprehensive program overseen by the RM&E Committee (see Section 3.8) and following the principles and strategic questions developed by the committee.

1. Investigate options for increasing North Santiam spring Chinook.
2. Reduction of hatchery fish spawning in the wild.
3. Testing assumptions about fish mixing the river below fish traps.
4. Experimental release of smaller spring smolts or fall?
5. Potential to collect early-run fish at Bennett dams and hold at Minto Pond to ensure incorporation of early run fish into the broodstock.
6. Potential to collect early-run fish at Minto for potential passage upstream of Detroit.
7. Investigate improvements to fin-clipping - try using automated trailer?

### 3.4.7. South Santiam Spring Chinook

The USACE proposes to continue funding 70% of the operations and maintenance costs of South Santiam Hatchery, the primary rearing facility for the South Santiam spring Chinook program; and the Foster Fish Facility, the broodstock collection facility. In accordance with the 1990 Cooperative Agreement, the annual funding level will be based on what is required to rear no more than 71,000 pounds of juvenile spring Chinook and steelhead, which is necessary to mitigate for the 1400 lost spring Chinook spawners that historically spawned in the areas upstream of Foster Dam, and the areas inundated by and between Foster and Green Peter dams. Currently, the South Santiam spring Chinook program releases about 87,833 pounds of spring Chinook smolts annually. The goals of the South Santiam spring Chinook program are to:

- Mitigate the loss of spring Chinook catch in sport and commercial fisheries caused by construction and operation of Foster Dam.
- Provide adequate fish to the hatchery to maintain the broodstock to perpetuate program goals as outlined in the *Santiam River Subbasin Fish Management Plan* (OAR 635-500-1666).
- Maintain a suitable conservation broodstock for ongoing and future population recovery efforts throughout the subbasin, including evaluating the feasibility of reintroducing naturally self-sustaining populations in habitat above the Foster/Green Peter dam and reservoir complex.

Because of the conservation role of this hatchery program, the USACE proposes to operate the South Santiam spring Chinook program as an integrated hatchery program with conservation-oriented genetic protocol. The operation of the program is described in detail in the South Santiam spring Chinook HGMP. Chapter 4 of the Willamette FPMP (see Section 3.2 and Appendix A) will describe the management goals and disposition plan for fish arriving at the Foster Fish Facility.

#### 3.4.7.1. Hatchery Facilities and Operation

**Foster Fish Facility**

Collection of adults for the South Santiam spring Chinook program occurs at the Foster Fish Facility (Figure 3-6), located on the south side of Foster Dam near river mile (RM) 37 on the South Santiam

River. The USACE owns the facility and the many acres surrounding it. The facility was designed as an adult salmon collection facility and was not designed to accommodate live sorting of adult fish.

**Figure 3-6. Foster Fish Facility**

**Fish ladder leading to the trap-and-fish elevator**

**Adults holding in the existing trap at the Foster Fish Facility**

This facility also handles adult winter and summer steelhead, which are returned to the river to spawn naturally, passed over Foster Dam (winter steelhead only), recycled downstream to increase harvest opportunities, or given to local food banks. A fish ladder provides access to the approximately 12-foot by 40-foot trap which has a mechanical sweep to crowd fish into an anesthetic

tank. From the anesthetic tank ($CO_2$ is used), fish are manually placed into a mechanical loading bell or slid down 10-inch plastic pipes for placement into the transport trucks. A grate can be lowered to close the ladder to fish passage and is used to control the numbers of adults migrating into the trap during peak run times. Overloading of the trap is possible without this device. Broodstock are transported approximately 10 minutes to the adult holding pond at South Santiam Hatchery; other fish are transported to release sites upstream or downstream of Foster Dam.

**Proposed Action**: ***Operate and modify the Foster Fish Facility.***

The Action Agencies will significantly modify the fish collection facility at Foster Dam to comply with NMFS criteria for upstream passage/collection facilities. The facility will provide adequate attraction of fish into the trap, automated sorting (when possible), and water-to-water transfer of fish into transport trucks. The preliminary design also included construction of natural holding pools on the south bank of the river adjacent to the trap, which would replace or augment the holding ponds currently used at South Santiam Hatchery. In the short term, the USACE proposes to continue operating the Foster Fish Facility in its current condition (with minor upgrades) while it completes designs and prioritizes funding for the modifications.

Rationale: The Foster Fish Facility was designed as to collect broodstock and to pass fish upstream of Foster Dam via a fish bell/elevator, but it has no sorting capability. The fish bell/elevator is no longer used to directly release fish into the forebay of Foster Dam due to issues with fallback of adults. Currently, ESA-listed spring Chinook and winter steelhead, as well as hatchery summer steelhead are manually netted out of the anesthetic tank and slid into PVC pipes (with very little water) that route them to truck that transport them to various destinations including: (1) release sites upstream of Foster Dam (spring Chinook and winter steelhead only); (2) South Santiam Hatchery (spring Chinook and summer steelhead); or (3) transported to another stream in efforts to improve natural production (spring Chinook only).

The facility was not designed to accommodate safe handling, sorting, and loading of ESA-listed fish that must survive to spawn in the wild. At the existing facility, ESA-listed fish are directly injured or physically handled in a manner that likely contributes to the high levels of pre-spawning mortality observed in the South Santiam subbasin. Fish are often overly crowded in the small holding area and must be physically lifted into PVC pipes that slide them (with little water) to trucks. Modifying the facility to safely handle, sort, and load adult fish will likely decrease pre-spawning mortality of all fish handled at the facility. This should result in significant improvements in survival of fish released upstream of Foster Reservoir or into other tributaries of the South Santiam River where they are expected to increase natural production.

Implementation Timeframe: Operation of the current facility is ongoing/immediate. Preliminary designs for the modifications were completed in 2005 and are described in the *South Willamette Valley Fish Facilities Improvements Report* (McMillen Engineering 2005). The timeline for constructing significant modifications to the Foster Fish Facility is described in Section 3.6.

**South Santiam Hatchery**

South Santiam Hatchery is located about 2 miles east of Sweet Home, Oregon at the base of Foster Dam on 12.6 acres along the north shore of the South Santiam River at RM 37 (Figure 3-7). The hatchery consists of a dividable adult holding pond, a small incubation room, and ten Burrows raceways equipped with 24-inch in diameter pipes to allow for juvenile release. The facility was recently retrofitted with a mechanism to transport broodstock from the adult holding pond to a level

area for spawning. The primary hatchery water supply is from Foster Reservoir and the secondary water supply is from a well (primarily used for summer steelhead egg incubation from December through April). Due to high turbidity in Foster Reservoir, incubation past the eyed egg stage is completed at other hatchery facilities, primarily Willamette Hatchery. The South Santiam Hatchery is used primarily for holding, spawning, rearing, and acclimation of the USACE-funded South Santiam Spring Chinook (stock 024) and South Santiam Summer Steelhead (stock 024) programs. The facility is also used for rearing Cape Cod rainbow trout (stock 072).

**Figure 3-7. Foster Dam and South Santiam Hatchery near Sweet Home, Oregon**

**Proposed Action**: ***Operate and maintain the South Santiam Fish Hatchery.***

The Action Agencies propose to continue funding 70% of the operation and maintenance of South Santiam Fish Hatchery as the primary hatchery facility used to meet its South Santiam spring Chinook mitigation requirements. Due to water quality issues, South Santiam spring Chinook are moved to Willamette Hatchery (or other facilities) for a portion of their life cycle. The Action Agencies propose to continue late rearing and incubation of South Santiam spring Chinook at South Santiam Hatchery.

Rationale: South Santiam Hatchery has proven to be a reliable facility for holding, early incubation, and acclimation of spring Chinook salmon. While transport of eyed eggs is to facilities outside of the South Santiam subbasin, the practice is acceptable given South Santiam Hatchery's current water supply and potential for disease. Being located within the South Santiam subbasin and adjacent to the collection location, using South Santiam Hatchery for rearing and acclimation remains a desirable practice.

Implementation Timeframe: Immediate/ongoing.

**Proposed Action**: ***Maintain the intakes in Foster Reservoir and the hatchery well to provide a suitable water supply to South Santiam Hatchery.***

The Action Agencies will work with ODFW to ensure proper maintenance of the intakes in Foster Reservoir that are necessary to supply water to South Santiam hatchery and the Foster Fish Facility.

The Action Agencies will ensure that ODFW develops emergency response plans in the case of intake or well failure and maintains the capability to implement the plan.

Rationale: The 1990 Cooperative Agreement requires the USACE to ensure that South Santiam Hatchery has a viable water supply of 13 cfs. There are two water intake pipes in Foster Reservoir, one located at elevation 630 feet and the other at elevation 576 feet in the dam structure. The low pool level commonly maintained from November through May is near elevation 596 feet. Mixing of these two water intakes is possible and is commonly done from late May through October, as water temperatures from the upper intake can reach 70°F during summer. Water temperatures from the lower intake rarely exceed 50°F. The ODFW does not currently hold a water right for withdrawal from Foster Reservoir and these intakes do not meet NMFS screening criteria.

Implementation Timeframe: Ongoing/immediate. Emergency response plan will be completed 3 months post-issuance.

**Proposed Action:** ***Resolve hatchery infrastructure maintenance needs and develop a long-term Hatchery Maintenance Plan.***

The USACE and ODFW are developing a prioritized list and database of maintenance needs at each hatchery facility, including South Santiam Hatchery and the Foster Fish Facility. The Action Agencies and ODFW will use this list to develop a Hatchery Maintenance Plan that identifies long-term maintenance needs for each facility. The Action Agencies and ODFW will develop a strategy to address these needs through annual budget requests or other processes. Significant needs at South Santiam Hatchery include replacement of incubation stacks and expansion of the incubation building.

Rationale: Failure to properly maintain and update fish production and handling facilities could cause failure of major equipment or facility components. Equipment, water supply, or facility failure could result in an inability of the USACE to meet its mitigation requirements or effectively implement the actions in the HGMP. The Action Agencies are responsible for 70% of the operations and maintenance of the South Santiam Hatchery and the Foster Fish Facility. Furthermore, USACE Willamette Valley Project staff performs routine maintenance on the Foster Fish Facility due to its location within/near Foster Dam. Most of the hatchery infrastructure was constructed or purchased over 40 years ago and is in need of major repair or maintenance. Complications with state and federal funding restrictions and budget processes have hindered the ability of the state to keep pace with needed repairs and upgrades. Not addressing current maintenance needs and failure to adequately plan for future needs may affect human safety of hatchery workers and visiting members of the public.

Implementation Timeframe: Safety inspection September 2007. Complete Hatchery Maintenance Plan September 2007; implement according to schedule in the plan.

**Proposed Action:** ***Complete regular environmental compliance and safety inspections at South Santiam Hatchery and Foster Fish Facility, and promptly correct violations.***

According to the schedule identified in ER 200-2-3, the USACE will complete environmental compliance and safety inspections at South Santiam Fish Hatchery and the Foster Fish Facility. The USACE will ensure prompt correction of violations.

Rationale: Improper storage and use of hazardous chemicals can cause damage to environmental resources including ESA-listed fish, particularly due to the proximately of hatchery facilities to numerous water bodies. Regular environmental compliance assessments, in combination with regulatory agency inspections and environmentally sensitive day to day operations are a means of attaining, sustaining, and monitoring compliance with applicable federal, state, interstate, and local environmental regulation.

Implementation Timeframe: Conduct inspections according to the schedule indicated by ER 200-2-3 beginning in 2007.

**Proposed Action:** ***Operate South Santiam Hatchery in compliance with the Integrated Hatchery Operations Team (IHOT) fish health guidelines.***

All lots of fish will be monitored daily in the hatchery for signs of disease. The ODFW Fish Pathology team will conduct periodic sampling of the fish in the hatchery, especially if any increase in mortality is observed by hatchery personnel. Whenever diseased fish are detected, the diseased fish will be treated according to IHOT protocols. Lots that cannot be certified as disease free prior to release will be destroyed or otherwise disposed of according to IHOT protocols. Diseased fish are not released into the North Santiam River.

Rationale: Adhering to IHOT standards for fish health is critical to maintaining hatchery operations. Excessive disease can impact ODFW's ability to produce the USACE mitigation requirements and implement the actions in the HGMP. Periodic review of the fish health monitoring results and disease history is necessary to identify trends or areas where operations could be modified to improve fish health.

Implementation Timeframe: Immediate/ongoing.

**Proposed Action:** ***Comply with NPDES permits.***

South Santiam Hatchery's water discharges will comply with prescribed 330j general NPDES permit as required by the ODEQ.

Rationale: Compliance with NPDES permits ensures that hatchery operations do not exceed water quality criteria that could create conditions harmful to ESA-listed species.

Implementation Timeframe: Immediate/ongoing.

#### 3.4.7.2. Broodstock

**Broodstock Origin and Identity**

The ODFW uses South Santiam spring Chinook (stock 024) to meet USACE mitigation requirements.

**Proposed Action:** ***Continue use of South Santiam (stock 024) spring Chinook.***

The Action Agencies propose to continue using South Santiam spring Chinook (stock 024) to meet its mitigation responsibilities.

Rationale: Broodstock for South Santiam spring Chinook (stock 024) were derived from the local wild population. Because the South Santiam spring Chinook Program is both a mitigation and conservation hatchery program, this is the most suitable stock to propagate.

Implementation Timeframe: Ongoing/immediate.

**Broodstock Collection Location**

All broodstock for the South Santiam spring Chinook program are collected at the Foster Fish Facility located at Foster Dam (RM 37). Fish are attracted into the fish trap by a fish ladder with an entrance near the powerhouse on the south side of Foster Dam.

**Proposed Action:** ***Continue collecting all South Santiam spring Chinook broodstock at Foster Fish Facility.***

The Action Agencies propose to continue collecting South Santiam spring Chinook (stock 24) broodstock at the Foster Fish Facility (see proposed reconstruction of the facility above). Any changes in broodstock collection location, including collection at Lebanon Dam, would be discussed in the FPHM Committee.

Rationale: The Foster Fish Facility is a suitable location for broodstock collection. Lebanon Dam, a low-head diversion dam owned by the City of Albany, located farther downstream, may serve as future broodstock collection location. The use of Lebanon Dam (or any other facility) as a site for broodstock collection will be discussed with the FPHM Committee.

Implementation Timeframe: Ongoing/immediate.

**Broodstock Collection Timing**

The Foster Fish Facility is usually operated year-round (but checked less frequently) to collect summer steelhead and ESA-listed UWR winter steelhead. Adult spring Chinook are collected at the trap between mid-May and October, with the exception of an annual shut-down period from July 15 to August 15. The trap is checked approximately 3 times per week. Brood are collected throughout the run until September and held in the holding pond at South Santiam Hatchery until spawning in September or October. Broodstock are marked with a color-coded floy tag according to arrival date.

**Proposed Action:** ***Collect broodstock throughout the run to ensure the hatchery population is similar to the naturally spawning population, including between July 15 and August 15 when the trap has been shut down.***

The Action Agencies propose to continue the current practice of collecting broodstock throughout the run between mid-May and October. However, the Action Agencies propose to also collect broodstock (and pass spring Chinook over Foster Dam) between July 15 and August 15, when the trap has typically been shut down. This will ensure collection of brood throughout the entire run, and also ensure prompt passage of unmarked spring Chinook over Foster Dam. Reconstruction of the Foster Fish Facility may warrant or enable modifications to the broodstock collection protocol to ensure that the broodstock represents the entire range of run timing. If RM&E indicates that run timing of hatchery origin and natural origin fish is substantially different, then modifications to the broodstock collection protocol should be made. Any changes in broodstock collection timing, including collection at Lebanon Dam, would be discussed in the FPHM Committee.

Rationale: Collection of broodstock throughout the run (including July 15-August 15) ensures that the hatchery brood represents the full diversity in run timing as the natural-origin population. This assumption should be tested with RM&E and adjusted accordingly.

Implementation Timeframe: Ongoing/immediate. Operate trap periodically throughout July and August 2007, if planned maintenance can be postponed to an off-season winter maintenance period. Broodstock collection protocol will be annually reviewed by the FPHM Committee.

**Numerical Goals and Incorporation of Natural Origin Fish**

The annual broodstock collection goal for the South Santiam spring Chinook program at South Santiam Hatchery is a spawning population of 500 or more females. Actual spawning population has been around 1,200, with a 1:1 ratio, which allowed for an egg take needed to accommodate culling of BKD-infected eggs. However, due to the relatively low incidence of BKD in recent years, this practice has resulted in a surplus of eggs that must be destroyed. Thus, in 2007, ODFW plans to decrease the spawning population to 900, which will provide a more reasonable number of eggs. Beginning in 2003, natural origin recruits have been incorporated into the hatchery broodstock at a rate designed to improve compatibility between hatchery origin recruits and natural origin spawners. The 2000 NMFS BiOp limited the percentage of non-adipose fin-clipped fish that could be incorporated into the brood to 10%. Due to a high incidence of mismarked fish, the actual percentage of wild fish incorporated into the broodstock has been much less.

**Proposed Action**: ***Incorporate an appropriate percentage of natural origin fish incorporated into the broodstock to ensure the hatchery population is similar to the naturally spawning population.***

The Action Agencies and ODFW will increase the percentage of natural origin fish into the South Santiam spring Chinook broodstock in order to achieve the management goal of operating the program as an integrated program with a conservation-oriented genetic protocol. In the short-term, NMFS recommends incorporating more natural origin fish into the broodstock as possible, approaching 30% natural origin fish. The percentage of non-adipose, fin-clipped fish incorporated into the brood will follow the guidance in Table 3-11. The Action Agencies will modify these guidelines based on recommendations from the HSRG and/or the FPHM Committee.

### Table 3-11. Proposed Broodstock Collection Guidelines for the South Santiam Spring Chinook Hatchery Program

| South Santiam Spring Chinook | Hatchery Broodstock | | | Above Foster Dam Proportion of Wild & Hatchery Fish | |
|---|---|---|---|---|---|
| **Returns of Chinook to South Santiam (hatchery & wild) as indexed by May 31 Willamette Falls Counts** | **Max. % wild fish in hatchery broodstock (900 fish goal)** | **Corresponding max. # wild fish in broodstock** | **Max. % of wild pop. taken for brood** | **Wild fish** | **Hatchery fish** |
| <30,000 (low run) | 30 | 300 | 50 | Ensure wild fish incorporated into broodstock | As needed to have minimum spawning escapement of at least 500 fish |
| 3,000-50,000 (medium run) | 30 | 300 | 30 | Outplant above and below Foster* | |
| >50,000 (high run) | 30 | 300 | 20 | | |

* All of the wild fish collected at Foster after broodstock needs are fulfilled.

Rationale: For integrated hatchery programs, the HSRG recommends ensuring that an average of 10% to 20% of the hatchery broodstock is comprised of natural-origin adults each year. The 2000 NMFS BiOp specified that a maximum of 10% of the North Santiam spring Chinook broodstock could be of natural origin, with the additional restriction that no more than 10% of the wild population could be taken for brood. Since the 2000 BiOp, few natural-origin fish have been incorporated into the brood, partially because of the high incidence of non-adipose fin-clipped fish that are of hatchery origin (Table 11 in Schroeder et al., 2006). After review of data regarding the actual number of wild fish incorporated into the broodstock, NMFS recommended incorporating up to 30% non-adipose, fin-clipped fish into the South Santiam broodstock (letter dated May 15, 2006 from Rob Jones, NMFS, to Suzanne Knapp, ODFW and Randy Bailey, USACE). Increasing the percentage of natural-origin fish in the brood should ensure that the hatchery population and naturally spawning population are similar. This is essential if this program will be used to reintroduce fish into habitat upstream of USACE dams.

Implementation Timeframe: New protocol began with 2006 brood year; continue with annual review by FPHM Committee, with input from RM&E. Consider changes based on recommendations based on the HRSG review. Specific annual guidance will be updated annually the FPHM Committee in the South Santiam/Foster Fish Facility Chapter of the FPMP.

#### 3.4.7.3. Adult Transport, Holding, and Prophylactic Treatment

Fish have been anesthetized with $CO_2$ at the Foster Fish Facility; other approved anesthetics cannot be used due to recycling of summer steelhead and hatchery spring Chinook in the fishery below Foster Dam. From the anesthetic tank, fish are manually placed into a mechanical loading bell or slid down 10-inch plastic pipes for placement into the transport trucks and transported approximately 10 minutes to the adult holding pond at South Santiam Hatchery.

An oval concrete broodstock holding pond measuring 148-feet by 47-feet (199,000-gallon capacity) is used for all spring Chinook adult holding. Approximately 1,400 adult spring Chinook are held along with 1,300 adult summer steelhead in this pond. A center divider allows the separation of species and a cross divider allows a separation of male and female Chinook. Approximately 5,000 gallons per minute (gpm) flows through this pond during heavy loading.

Adults held for broodstock are inoculated with erythromycin and oxytetracyclene twice - first at collection and again approximately one month prior to spawning. Bacterial kidney disease and furunculosis are the diseases of concern. Flow-through treatments of formalin (prior to 2000) or hydrogen peroxide (since 2001) occur in the adult holding pond for one to two hours, three days per week, throughout the holding period. Spring Chinook and summer steelhead are often held together in the same holding pool.

**Proposed Action**: ***Continue to hold South Santiam spring Chinook at South Santiam Hatchery; replace with new holding facility adjacent to the Foster Fish Facility.***

The Action Agencies do not propose any changes to the holding protocol for broodstock unless minor improvement can be made to the existing holding pond. The Action Agencies propose modifying the Foster Fish Facility to include construction of new broodstock holding pond on the south bank of the river that simulates a natural holding environment (sinuous banks, overhangs, and

deeper water), as described in Section 6.5.8 of the *South Willamette Fish Facilities Improvements Report* (McMillen Engineering 2005).

Rationale: The holding ponds at South Santiam Hatchery are currently the only viable holding location for spring Chinook brood. However, the current pond is shallow, exposed to the sun, and has sloped walls that make collection of fish challenging and dangerous. Furthermore, it is not desirable to hold spring Chinook in the same holding area as summer steelhead.

Implementation Timeframe: Immediate/ongoing; specific annual guidance will be updated annually the FPHM Committee in the South Santiam/Foster Dam and Fish Facility Chapter of the FPMP. Timeline for construction of the new holding ponds is discussed in Section 3.6. Modifications to Foster Fish Facility would warrant changes to the transport and holding protocol.

#### 3.4.7.4. Mating

**Proposed Action:** ***Continue to use random spawning protocol with a 1:1 male-to-female ratio.***

The Action Agencies do not propose any changes to the spawning protocol, unless results of RM&E indicate that spawning is not truly random with respect to run representation, age, and size of broodstock.

Rationale: Random mating should minimize the likelihood of selective pressures and promote genetic diversity of the hatchery population, which is consistent with the goals of this hatchery program.

Implementation Timeframe: Immediate/ongoing; conduct RM&E that tests the assumption of equal run-timing representation by using color-coded floy tags that are recorded at time of spawning.

#### 3.4.7.5. Incubation and Rearing

Egg collection typically ranges from 2.1 to 2.3 million, which has allowed a surplus for BKD culling. No ponding occurs at South Santiam Hatchery. All eggs are transferred to Willamette Hatchery at the eyed stage, because the primary water source from Foster Reservoir can be turbid in the winter months. Fry are transferred back to South Santiam beginning in March. Although fingerling to smolt survival has been above 90%, it has declined in recent years. Details regarding incubation, rearing, and growth rates are described in Chapter 9 of the HGMP.

**Proposed Action:** ***Continue to incubate and rear all South Santiam spring Chinook at South Santiam Hatchery, with temporary rearing (eyed egg to fry) at Willamette Hatchery. Investigate options to allow complete rearing at South Santiam Hatchery.***

The Action Agencies do not propose any immediate changes to the incubation and rearing protocol.

Rationale: South Santiam Hatchery has proven to be a reliable facility for rearing spring Chinook and its location within the South Santiam watershed (combined with in-basin acclimation) reduces the likelihood that the adult returns will stray to another basin. The transfer of eggs to Willamette Hatchery is not ideal, but the risk of transfer and potential to increase stray rates is less than the risk of losing production due to high turbidity in the water.

Implementation Timeframe: Immediate/ongoing; potentially informed by RM&E regarding most appropriate size and timing of juvenile releases. In FY 2008 evaluate stray rate of South Santiam adults; investigate options for filtration of the South Santiam's water supply.

#### 3.4.7.6. Marking

Currently, all hatchery juveniles are adipose fin-clipped and otolith marked to allow visual identification of hatchery-origin fish.

**Proposed Action:** ***Continue to adipose fin-clip and otolith mark all South Santiam spring Chinook at South Santiam Hatchery.***

The Action Agencies propose to continue the current practice of adipose fin-clipping and otolith marking all hatchery spring Chinook.

Rationale: Adipose fin-clipping ensures immediate visual identification of hatchery-origin fish in the fishery, at the hatchery, and on the spawning grounds. However, returning South Santiam spring Chinook hatchery fish have a high incidence of mismarking (i.e., partially or fully regenerated adipose fins) which poses several management problems. Otolith marking allows after-the-fact determination of the true origin of an adult fish and is critical for determining the incidence of mismarking and the true percentage of natural-origin fish that were incorporated into the broodstock. Continuing these two marking procedures are critical for effective hatchery and fishery management.

Implementation Timeframe: Ongoing/immediate.

**Proposed Action:** ***Insert coded wire tags into all juvenile hatchery fish in addition to current practice of adipose fin-clipping and otolith marking.***

In addition to the current practice of adipose fin-clipping and otolith marking all hatchery releases, the Action Agencies propose to insert CWTs into all hatchery releases. Tag codes should be assigned according to releases in order to evaluate alternative release strategies.

Rationale: This practice will allow for automatic enumeration and sorting of returning adults upon their return when the Foster Fish Facility is modified, or if enumeration and/or trapping capability is installed downstream at Lebanon Dam. Automated sorting will greatly reduce stress, injury, and mortality of fish that are collected and sorted at the facility, particularly natural-origin fish that are transported upstream of Foster Dam (and potentially Green Peter Dam). Use of CWTs will enable thorough evaluation of straying patterns and alternative release strategies. It will also enable real-time determination of hatchery-origin fish upon return to the hatchery, which will enable managers to more successfully meet targets for incorporation of natural-origin fish into the broodstock as described in Table 3-11.

Implementation Timeframe: Include purchase of CWTs for all South Santiam releases in FY 2009 budget request and out years.

#### 3.4.7.7. Acclimation and Release

The majority of South Santiam spring Chinook releases have been into the South Santiam. In previous years, some South Santiam spring Chinook have been directly released into Thomas and Crabtree creeks in the South Santiam subbasin. Some South Santiam spring Chinook are also

released into the Molalla River. The majority of South Santiam spring Chinook releases are acclimated and released at South Santiam Fish Hatchery. Prior to 2002, two groups (421,000 smolts total) were transferred from Willamette Hatchery in February and March and acclimated at South Santiam Hatchery for one month, before being released into the South Santiam River. Currently 153,000 are transferred from Willamette Hatchery in late February for a three-week acclimation in the adult holding pond, and then released into the South Santiam via a 24-inch in diameter pipe. The remaining 268,000 are now trucked from Willamette Hatchery and direct released into the South Santiam. A small portion of production is released into Quartzville Creek upstream of Green Peter Reservoir and 20,000 eggs are given to the STEP program for release within the Santiam subbasin.

**Proposed Action**: ***Continue acclimating and releasing the majority of South Santiam spring Chinook at Foster Fish Facility; investigate options for acclimating all smolts on-site and allowing for direct release.***

The Action Agencies propose to continue acclimating and releasing as many smolts as possible at the Foster Fish Facility. The Action Agencies also propose to investigate operations or structural modifications that would enable acclimation and volitional release of all South Santiam releases (Table 3-12). The Action Agencies recommend continuing the fingerling release into Quartzville Creek, pending annual recommendation and coordination with the FPHM committee (including the USFS and BLM).

Rationale: Acclimation and volitional release at South Santiam Hatchery minimizes the risk of returning hatchery adults straying onto the spawning grounds or into other subbasins.

Implementation Timeframe: Ongoing/immediate.

**Table 3-12. Proposed Release Schedule for South Santiam Spring Chinook**

| Life Stage | Release Location | Release Date | Number Released | Mean Size at Release | Approx. Total Pounds Released |
|---|---|---|---|---|---|
| Unfed Fry | Santiam Basin Release (STEP) | May | 20,000 | | |
| Fingerling | Quartzville Creek | June | 100,000 | 100 | 1000 |
| 1+ Yearling | South Santiam River | February/ March | 721,000 | 8.5 | 84,800 |
| Yearling | South Santiam River | November | 300,000 | 8.1 | 37,000 |
| 1+ Yearling* | Molalla River | March | 67,000 | 9.5 | 7,050 |
| Yearling* | Molalla River | November | 33,000 | 8.3 | 3,975 |

*The USACE does not have a mitigation responsibility in the Mollalla River , but these releases, which are part of an ODFW program, are included for consistency with the overall HGMP. The Action Agencies understand that the Mollalla River spring Chinook releases are being examined in the Recovery Planning process and support these discussions.

### 3.4.7.8. Spring Chinook Outplant Program and Disposition of Fish Arriving at Foster Fish Facility

Several species of fish arrive at the Foster Fish Facility throughout the year, including spring Chinook, winter steelhead, and non-native hatchery summer steelhead. In addition to collection for broodstock needs, fish are transported to various locations based on management priorities. Priorities for disposition of excess broodstock and non-hatchery species arriving at the Foster Trap

are determined by balancing goals for natural production, the Spring Chinook Outplant Program, hatchery management, and harvest opportunities; while ensuring that tribal obligations are satisfied. The Action Agencies and ODFW balance these goals with the physical limitations of the existing facility and the associated demands on hatchery personnel.

In recent years, the majority of excess spring Chinook broodstock have been collected and transported to unseeded, historical habitat (see Section 3.4.4.5, *Spring Chinook Outplant and Potential for Reintroduction into Historical Habitat*). In the South Santiam, the Action Agencies and ODFW have transported fish collected at the Foster Fish Facility into several locations throughout the South Santiam subbasin, including Thomas Creek, Crabtree Creek, Wiley Creek, the Calapooia River, and the South Santiam River upstream of Foster Dam. Adult spring Chinook have not been transported into the Middle Santiam River or Quartzville Creek upstream of Green Peter Dam. A summary of these releases is found in Beidler and Knapp (2005).

**Fish Disposition and Outplant Protocols – South Santiam/Foster Dam Fish Passage and Management Plan**

Current general management goals for the spring Chinook outplant program are described in Table 3-13. Implementation will follow the philosophy and approaches for outplanting and potential reintroduction described in Section 3.4.4.5.

### Table 3-13. Management Goals for Fish Collected at the Foster Fish Facility

| Species | Destination | Target # of Adult Fish * | | Maximum % of Wild Run |
|---|---|---|---|---|
| | | Clipped | Unclipped | |
| Spring Chinook | Broodstock | 600 | 300 | 30* |
| | South Santiam above Foster Dam (Riverbend and Gordon Road release sites) | As needed to meet unclipped goal | 800 (in excess of broodstock collection goal of 4,000 females) | 10 |
| | Recycled into South Santiam below Foster Dam | | None | 0 |
| | Crabtree, Thomas, and Wiley creeks | Any excess (approx. 100 to Crabtree; 150 to Thomas) | None | 0 |
| Winter Steelhead | South Santiam above Foster Dam | 0 | All | 100 |
| | Remove from system | All | 0 | 0 |
| Summer Steelhead | Broodstock | 1,700 | 0 | N/A |
| | Recycling below Foster | Any excess to brood | 0 | N/A |
| | Remove from system | Excess to brood and recycling | All | N/A |

*These numbers reflect management targets, and are not intended to provide annual on-the-ground direction to personnel operating the fish facilities.

Detailed protocols for disposition of excess hatchery broodstock, wild fish, and other species collected at Foster Fish Facility will be contained in the "Fish Disposition and Outplant Protocols" section of the Willamette FPMP. The FPMP will contain detailed, on-the-ground disposition protocols for all species of fish (clipped/unclipped) arriving at the Foster Fish Facility, including excess adult hatchery fish. Organized by date, it will specify priorities for disposition of wild/unclipped fish; and establish numerical goals (and perhaps minimum number of females) for release at each release site. These numerical goals will updated annually by the FPHM Committee.

#### 3.4.7.9. Research, Monitoring and Evaluation Questions Specific to South Santiam Spring Chinook Program

The following RM&E questions are specific to the South Santiam Basin and the spring Chinook program. Any RM&E recommendations must be integrated into the comprehensive program overseen by the RM&E Committee (see Section 3.8) and following the principles and strategic questions developed by the committee.

1. Are mitigation requirements for habitat upstream of Green Peter being fully realized?
2. Evaluate benefits and effects of closure of Foster Fish Facility in July for maintenance.
3. Determine spawning timing and arrival date.
4. Management of Hatchery Strays on the spawning grounds?
5. Experiment with transporting brood at outplant protocol and compare survival; could reduce incidence of disease and necessity of treatment?
6. Evaluate stray rate among facilities for fish reared at South Santiam.
7. Investigate options for complete acclimation of all releases at South Santiam – why use direct release from Willamette into the South Santiam?
8. Could mechanisms for volitional release at South Santiam be designed into the Foster Facility?

### 3.4.8. McKenzie Spring Chinook

The USACE proposes to continue funding 50% of the operations and maintenance costs of McKenzie Hatchery, the primary rearing facility for the McKenzie spring Chinook program. The 1990 Mitigation Agreement with ODFW requires the USACE to fund production of a maximum of 80,800 pounds of juvenile spring Chinook to mitigate for the 4,060 lost Chinook spawners that returned to the areas above Cougar and Blue River dams. Currently, the McKenzie spring Chinook program releases about 120,000 pounds (1,199,000 smolts) of spring Chinook smolts annually. The goals of the South Santiam spring Chinook program are to:

1. Mitigate the loss of spring Chinook catch in sport and commercial fisheries caused by construction and operation of Cougar and Blue River dams.
2. Provide adequate fish to the hatchery to maintain the broodstock to perpetuate program goals as outlined in the *McKenzie Subbasin Fish Management Plan* (OAR 635-500-1666).
3. Maintain a suitable conservation broodstock for ongoing and future population recovery efforts throughout the subbasin, including evaluating the feasibility of reintroduction efforts above Cougar Dam and Reservoir.

Because of the conservation role of this hatchery program, the USACE proposes to operate the McKenzie spring Chinook program as an integrated hatchery program with conservation-oriented genetic protocol. McKenzie Hatchery produces the USACE entire mitigation requirement for spring

Chinook salmon in the McKenzie subbasin. The McKenzie population of Upper Willamette River spring Chinook is one of the healthiest populations in the ESU. However, hatchery fish still comprise a large percentage of the run returning to the McKenzie. Poor attraction of adults to McKenzie Hatchery and poor trapping facilities at the Eugene Water & Electric Board's (EWEB) Leaburg Dam limit the USACE ability to prevent hatchery fish from spawning in the "wild fish sanctuary" established upstream of Leaburg Dam. The operation of the program is described in detail in the McKenzie spring Chinook HGMP. The Willamette FPMP (see Section 3.2 and Appendix A) will describe the management goals and disposition plan for fish arriving at McKenzie Hatchery.

#### 3.4.8.1. Hatchery Facilities and Operation

**McKenzie Hatchery**

The majority of the broodstock for the McKenzie spring Chinook program is collected at McKenzie Hatchery, located on 16 acres adjacent to the McKenzie River near Leaburg, Oregon (Figure 3-8). The fish ladder at McKenzie Hatchery is located on the north bank of the McKenzie River. Broodstock enter the McKenzie Hatchery fish ladder from the river and enter a collection channel located at the downstream end of the holding ponds. From the holding ponds, the fish are crowded into the spawning building using a power crowder. A lift brings the fish up to two anesthetic tanks. The fish then can be handled for sorting, inoculation, transport, or placement into the holding ponds for broodstock. The adult holding ponds consist of two concrete ponds that are divided into two separate holding areas with aluminum fencing.

**Figure 3-8. McKenzie Hatchery on the McKenzie River near Leaburg, Oregon**

**Proposed Action**: ***Operate and maintain McKenzie Hatchery.***

The Action Agencies propose to continue funding 50% of the operation and maintenance of McKenzie Hatchery as the primary hatchery facility used to meet its McKenzie spring Chinook mitigation requirements.

Rationale: McKenzie Hatchery has proven to be a reliable facility for rearing spring Chinook salmon. Being located within the McKenzie subbasin, using McKenzie Hatchery is ideal for maintaining consistency with hatchery reform principle #3 that reduces straying among basins by rearing hatchery fish within their natal watershed.

Implementation Timeframe: Immediate/ongoing.

**Leaburg Dam (EWEB)**

The 2000 Hatchery BiOp required the USACE and ODFW to remove all adults that swim past the McKenzie Hatchery ladder at the Leaburg Dam fish ladder, which is owned by EWEB. However, the trap at Leaburg Dam consists of a blocked-off pool in the left bank ladder and does not meet ESA handling requirements. All fish have been manually netted out of the ladder, and during the peak of the passage season this trapping method results in unacceptable levels of take of natural origin adult UWR spring Chinook. Thus during peak passage, all Chinook have been allowed to pass over Leaburg Dam. The EWEB recently constructed a new fish ladder on the right bank without a fish trap. This allows all fish to pass unimpeded over Leaburg Dam via this ladder throughout the run. A fish trap is needed on both ladders in order to achieve the objective of removing 100% of the hatchery fish at Leaburg Dam.

**Proposed Action:** ***Develop and implement alternatives to using the existing fish trap in the left bank ladder of Leaburg Dam as the primary means of reducing the incidence of spring Chinook on the spawning grounds. Alternatives include increasing homing and attraction back to McKenzie Hatchery; working with EWEB, ODFW, and other entities to construct a fish trap at Leaburg Dam, and consideration of reducing hatchery production in the McKenzie subbasin to reduce the number of returning hatchery fish. The Action Agencies will undertake this analysis within the context of the Phase III System Configuration Study for the McKenzie subbasin (see Section 3.6).***

Rationale: Complete removal of adult Chinook at Leaburg Dam is not possible with the current infrastructure, but the USACE has no immediate authority to construct a fish trap (or traps) at Leaburg Dam. Special federal legislation may be needed to fix this problem. The Action Agencies understand that reducing the incidence of hatchery strays on the spawning grounds is necessary to protect natural production in the McKenzie subbasin upstream of Leaburg and to preserve the genetic integrity of the McKenzie population. Thus, the Action Agencies are committed to resolving the problem in collaboration with ODFW and EWEB.

Implementation Timeframe: Develop a strategy for reducing the incidence of hatchery strays on the spawning grounds within 6 months of issuance.

**Proposed Action:** ***Maintain the intake on Leaburg Canal and Cogswell Creek to provide a suitable water supply to the McKenzie Hatchery.***

The Action Agencies will work with EWEB and ODFW to ensure delivery of water to McKenzie Hatchery. The Action Agencies will ensure that ODFW develops emergency response plans in the case of intake failure and maintains the capability to implement the plan.

Rationale: The 1990 Cooperative Agreement requires that the USACE provide 50% of the water supply required by McKenzie Hatchery (approximately 35 cfs). Water rights for McKenzie Hatchery total 31,500 gpm from two sources: the McKenzie River and Cogswell Creek. Cogswell Creek use normally does not surpass 5% of total use throughout the year, including during adult collection. Water obtained from the McKenzie River is diverted off the Leaburg canal, which is owned and operated by EWEB. This water source is screened 2 miles upstream at Leaburg Dam on the McKenzie River before reaching the hatchery intake. Risk to listed fish is low because the screens comply with NMFS fish screening criteria.

Implementation Timeframe: Ongoing/immediate.

**Proposed Action:** ***Resolve hatchery infrastructure maintenance needs and develop a long-term Hatchery Maintenance Plan.***

The USACE and ODFW are developing a prioritized list and database of maintenance needs at each hatchery facility, including McKenzie Hatchery. The Action Agencies and ODFW will use this list to develop a Hatchery Maintenance Plan that identifies long-term maintenance needs for each facility. The Action Agencies and ODFW will develop a strategy to address these needs through annual budget requests or other processes. Significant needs at McKenzie Hatchery include resurfacing of the pond walls and floors and replacement of header gates on the raceways.

Rationale: Failure to properly maintain and update fish production and handling facilities could cause failure of major equipment or facility components. Equipment, water supply, or facility failure could result in an inability of the USACE to meet its mitigation requirements or effectively implement the actions in the HGMP. The Action Agencies are responsible for 50% of the operations and maintenance of McKenzie Hatchery. Complications with state and federal funding restrictions and budget processes have hindered the ability of the state to keep pace with needed repairs and upgrades. Not addressing current maintenance needs and failure to adequately plan for future needs may affect human safety of hatchery workers and visiting members of the public.

Implementation Timeframe: Develop long-term maintenance plan by January 2008.

**Proposed Action:** ***Complete regular environmental compliance and safety inspections at McKenzie Hatchery and promptly correct violations.***

According to the schedule identified in ER 200-2-3, the USACE will complete environmental compliance and safety inspections at South McKenzie Hatchery. The USACE will ensure prompt correction of violations.

Rationale: Improper storage and use of hazardous chemicals can cause damage to environmental resources including ESA-listed fish, particularly due to the proximately of hatchery facilities to numerous water bodies. Regular environmental compliance assessments, in combination with regulatory agency inspections and environmentally sensitive day to day operations are a means of attaining, sustaining, and monitoring compliance with applicable federal, state, interstate, and local environmental regulation.

Implementation Timeframe: Conduct inspections according to schedule mandated by ER 200-2-3, beginning in 2007.

**Proposed Action**: ***Operate McKenzie Hatchery in compliance with the Integrated Hatchery Operations Team (IHOT) fish health guidelines.***

All lots of fish will be monitored daily in the hatchery for signs of disease. The ODFW Fish Pathology team will conduct periodic sampling of the fish in the hatchery, especially if any increase in mortality is observed by hatchery personnel. Whenever diseased fish are detected, the diseased fish will be treated according to IHOT protocols. Lots that cannot be certified as disease free prior to release will be destroyed or otherwise disposed of according to IHOT protocols. Diseased fish are not released into the North Santiam River.

Rationale: Adhering to IHOT standards for fish health is critical to maintaining hatchery operations. Excessive disease can impact ODFW's ability to produce the USACE mitigation requirements and implement the actions in the HGMP. Periodic review of the fish health monitoring results and disease history is necessary to identify trends or areas where operations could be modified to improve fish health.

Implementation Timeframe: Immediate/ongoing.

**Proposed Action**: ***Comply with NPDES permits.***

McKenzie Hatchery's water discharges will comply with prescribed 330j general NPDES permit as required by the ODEQ.

Rationale: Compliance with NPDES permits ensures that hatchery operations do not exceed water quality criteria that could create conditions harmful to ESA-listed species.

Implementation Timeframe: Immediate/ongoing.

#### 3.4.8.2. Broodstock

**Broodstock Origin and Identity**

The ODFW uses McKenzie spring Chinook (stock 023) to meet USACE mitigation requirements.

**Proposed Action**: ***Continue use of McKenzie (stock 023) spring Chinook.***

The Action Agencies propose to continue using McKenzie spring Chinook (stock 023) to meet its mitigation responsibilities.

Rationale: Broodstock for the McKenzie spring Chinook (stock 023) were derived from the local wild population. Because the McKenzie spring Chinook Program is both a mitigation and conservation hatchery program, this is the most suitable stock to propagate.

Implementation Timeframe: Ongoing/immediate.

**Broodstock Collection Location**

The majority of spring Chinook for the McKenzie spring Chinook program is collected at McKenzie Hatchery. Fish are attracted into the fish ladder on the left bank of the McKenzie River. There is no channel-spanning barrier to guide fish into the ladder. In 2006, implementation of new protocols for

incorporation of unmarked fish into the brood required that ODFW collect a portion of the unclipped broodstock at Leaburg Dam.

**Proposed Action**: ***Collect the majority of McKenzie spring Chinook broodstock at McKenzie Hatchery; supplement the unclipped portion with fish from Leaburg Dam, if necessary.***

The Action Agencies propose to continue collecting McKenzie spring Chinook (stock 23) broodstock at the McKenzie Hatchery, and potentially at Leaburg Dam to ensure incorporation of natural-origin fish into the brood. Any changes in broodstock collection location, including collection at Cougar Dam, would be discussed in the FPHM Committee.

Rationale: McKenzie Hatchery is a suitable location for broodstock collection and can be operated throughout the season with minimal impact to wild fish. Incorporation of wild fish into the brood is a primary management objective for this facility, so obtaining fish at Leaburg Dam, despite the crude collection methodology, is acceptable.

**Broodstock Collection Timing**

Spring Chinook adults returning to McKenzie Hatchery are collected throughout the entire run between May and October and mixed in the dividable holding pond where they are held until ripening.

**Proposed Action**: ***Continue to collect broodstock throughout the run to ensure the hatchery population is similar to the naturally spawning population.***

Rationale: Collection of broodstock throughout the run ensures that the hatchery brood represents the full diversity in run timing as the natural-origin population.

Implementation Timeframe: Ongoing/immediate. Annual review by the FPHM Committee.

**Numerical Goals and Incorporation of Natural Origin Fish**

The annual broodstock collection goal for the McKenzie spring Chinook program is a spawning population of 800 fish; 400 males and 400 females. Beginning in 2003, natural origin recruits have been incorporated into the hatchery broodstock at a rate designed to improve compatibility between hatchery origin recruits and natural origin spawners. The 2000 NMFS BiOp limited the percentage of non-adipose fin-clipped fish that could be incorporated into the brood to 10%. Due to a high incidence of mismarked fish, the actual percentage of wild fish incorporated into the broodstock has been much less.

**Proposed Action**: ***Incorporate an appropriate percentage of natural-origin fish incorporated into the broodstock to ensure the hatchery population is similar to the naturally spawning population.***

The Action Agencies and ODFW will increase the percentage of natural origin fish into the McKenzie spring Chinook broodstock in order to achieve the management goal of operating the program as an integrated program with a conservation-oriented genetic protocol. In the short-term, NMFS recommends incorporating more natural origin fish into the broodstock as possible, approaching 20% natural origin fish. The percentage of non-adipose, fin-clipped fish incorporated into the brood will follow the guidance in Table 3-14. The Action Agencies will modify these guidelines based on recommendations from the HSRG and/or the FPHM Committee.

**Table 3-14. Proposed Broodstock Collection Guidelines for the McKenzie Spring Chinook Hatchery Program**

| McKenzie Spring Chinook | Hatchery Broodstock | | | Above Cougar and Trail Bridge Dams | |
|---|---|---|---|---|---|
| **Returns of Chinook to South Santiam (H & W) as indexed by May 31 Willamette Falls Counts** | **Max. % wild fish in hatchery broodstock (900 fish goal)** | **Corresponding max. # wild fish in broodstock** | **Max. % of wild pop. taken for brood** | **Wild fish** | **Hatchery fish** |
| <30,000 (low run) | 20 | 160 | 10-20 | Ensure wild fish incorporated into broodstock | As needed to have minimum spawning escapement of at least 500 fish |
| 3,000-50,000 (medium run) | 30 | 240 | 10-20 | No outplanting of wild fish, pass over Leaburg Dam | |
| >50,000 (high run) | 40 | 320 | 10-20 | | |

**Proposed Action**: ***Incorporate an appropriate percentage of natural origin fish incorporated into the broodstock to ensure the hatchery population is similar to the naturally spawning population.***

Rationale: For integrated hatchery programs, the HSRG recommends ensuring that an average of 10% to 20% of the hatchery broodstock is comprised of natural-origin adults each year. The 2000 NMFS BiOp specified that a maximum of 10% of the North Santiam spring Chinook broodstock could be of natural origin, with the additional restriction that no more than 10% of the wild population could be taken for brood. Since the 2000 BiOp, despite collection of unmarked fish few natural-origin fish have been incorporated into the brood (Table 11 in Schroeder et al., 2006). After review of these data regarding the actual number of wild fish incorporated into the broodstock, NMFS recommended incorporating up to 20% non-adipose, fin-clipped fish into the McKenzie broodstock (letter dated May 15, 2006 from Rob Jones, NMFS, to Suzanne Knapp, ODFW and Randy Bailey, USACE). Increasing the percentage of natural-origin fish in the brood should ensure that the hatchery population and naturally spawning population are similar. This is essential if this program will be used to reintroduce fish into habitat upstream of USACE dams, and to maintain the genetic integrity of the McKenzie stock, which is considered the only genetic legacy population in the UWR spring Chinook ESU.

Implementation Timeframe: Began with 2006 brood year; continue annually with review by FPHM Committee. Consider changes based on recommendations from the HRSG review. Specific annual guidance will be updated annually by the FPHM Committee in the McKenzie Chapter of the FPMP.

#### 3.4.8.3. Adult Transport, Holding, and Prophylactic Treatment

Spawning and mating occurs on site at McKenzie Hatchery; no transport of brood is necessary. Broodstock are held in the dividable adult holding pond at McKenzie Hatchery until spawning. Brood are injected with antibiotics and treated with hydrogen peroxide for fungus control.

**Proposed Action**: ***Continue to hold and spawn McKenzie spring Chinook on-site at the McKenzie Hatchery.***

The Action Agencies do not propose any changes to the holding protocol for broodstock unless minor improvement can be made to the existing holding pond.

Rationale: The holding ponds at McKenzie Hatchery are suitable for spring Chinook brood.

Implementation Timeframe: Immediate/ongoing; specific annual guidance will be updated annually the FPHM Committee in the McKenzie Chapter of the FPMP.

#### 3.4.8.4. Mating

Adults used for brood are mixed as they return to the hatchery and are randomly selected for each spawn.

**Proposed Action**: ***Continue to use random spawning protocol with a 1:1 male-to-female ratio.***

The Action Agencies do not propose any changes to the spawning protocol, unless results of RM&E indicate that spawning is not truly random with respect to run representation, age, and size of broodstock.

Rationale: Random mating should minimize the likelihood of selective pressures and promote genetic diversity of the hatchery population, which is consistent with the goals of this hatchery program.

Implementation Timeframe: Immediate/ongoing; potentially informed by RM&E that tests the assumption of equal run-timing representation.

#### 3.4.8.5. Incubation and Rearing

All fish are reared from egg to smolt at McKenzie Hatchery. Button up happens at 1500-1550 TUs, and ponding normally occurs from mid-December through January. About 2.2 million eggs are taken annually. Fry to smolt survival is typically greater than 96%.

**Proposed Action**: ***Continue to incubate and rear all McKenzie spring Chinook at the McKenzie Hatchery.***

The Action Agencies do not propose any changes to the incubation and rearing protocol, with the exception of changes necessary to accommodate experimental changes in release size or timing.

Rationale: McKenzie Hatchery has proven to be a reliable facility for rearing UWR spring Chinook, and its location within the McKenzie watershed (combined with in-basin acclimation) reduces the likelihood that the adult returns will straying to another subbasin.

Implementation Timeframe: Immediate/ongoing; potentially informed by RM&E regarding most appropriate size and timing of juvenile releases and potential reductions in production.

Implementation Timeframe: Immediate/ongoing; potentially informed by RM&E.

#### 3.4.8.6. Marking

Currently, all hatchery juveniles are adipose fin-clipped, and otolith marked to allow visual identification of hatchery-origin fish.

**Proposed Action:** ***Continue to adipose fin-clip and otolith mark all McKenzie spring Chinook at the McKenzie Hatchery.***

Rationale: Adipose fin-clipping ensures immediate visual identification of hatchery-origin fish in the fishery, at the hatchery, and on the spawning grounds. However, returning McKenzie spring Chinook hatchery fish have a high incidence of mismarking (i.e., partially or fully regenerated adipose fins) which poses several management problems. Otolith marking allows after-the-fact determination of the true origin of an adult fish and is critical for determining the incidence of mismarking and the true percentage of natural-origin fish that were incorporated into the broodstock. Continuing these two marking procedures are critical for effective hatchery and fishery management.

Implementation Timeframe: Ongoing/immediate.

**Proposed Action:** ***Insert coded wire tags into all juvenile hatchery fish in addition to current practice of adipose fin-clipping and otolith marking.***

In addition to the current practice of adipose fin-clipping and otolith marking all hatchery releases, the Action Agencies propose to insert CWTs into all hatchery releases. Tag codes should be assigned according to releases in order to evaluate alternative release strategies.

Rationale: This practice will allow for automatic enumeration and sorting of returning adults upon their return when the Cougar Dam Trap is constructed (and potentially a sorting facility at Leaburg Dam). Automated sorting will greatly reduce stress, injury, and mortality of fish that are collected and sorted at the facility, particularly natural-origin fish that are transported upstream of Cougar Dam. Use of CWTs will enable thorough evaluation of straying patterns and alternative release strategies. It will also enable real-time determination of hatchery-origin fish upon return to the hatchery, which will enable managers to more successfully meet targets for incorporation of natural-origin fish into the broodstock as described in Table 3-14. Because spring Chinook have a 4-5 year life cycle, and the Cougar Dam Fish Trap will likely be constructed within 5 years, this action is a high priority in the McKenzie subbasin.

Implementation Timeframe: Purchase CWTs for all fish released in experimental releases in FY 2008. Include purchase of CWTs for all McKenzie releases in FY 2009 budget request and out years.

#### 3.4.8.7. Acclimation and Release

Throughout the 1990s, a portion of the production was used in a series of acclimation experiments in the lower Willamette River, but these studies have been completed. Recently, all production has been released at McKenzie Hatchery on the McKenzie River. To release fish from McKenzie Hatchery, screens are pulled to initially allow fish to leave the ponds volitionally prior to being forced from the ponds into the fingerling release pipe traveling underground to the fish ladder emptying into the McKenzie River. There is no acclimation procedure, as all fish are reared at McKenzie Hatchery.

**Proposed Action**: ***Continue releasing all McKenzie spring Chinook at McKenzie Hatchery, experiment with acclimation techniques that could improve homing to McKenzie Hatchery.***

The Action Agencies propose to continue releasing the smolts from McKenzie Hatchery and allowing for volitional release (Table 3-15). The Action Agencies support ODFW's fingerling release into Mohawk River, pending annual recommendation and coordination with the FPHM committee.

**Table 3-15. Proposed Release Schedule for McKenzie Spring Chinook**

| Life Stage | Release Location | Release Date | Mean Size at Release (#fish per lb) | Number of Fish Released | Total Pounds Released |
|---|---|---|---|---|---|
| Fingerling | Mohawk River | June | 100 | 75,000 | 750 |
| Yearling | McKenzie Hatchery | November | 8 | 350,000 | 43,750 |
| 1+ Yearling | McKenzie Hatchery | February | 12 | 400,000 | 33,333 |
| 1+ Yearling | McKenzie Hatchery | March | 11 | 449,000 | 40,818 |
| TOTALS | | | | 1,199,000 | 118,651 |

Rationale: Rearing and release at South Santiam Hatchery minimizes the risk of returning hatchery adults straying onto the spawning grounds or into other basins. Eliminate the direct release of smolts from Willamette Hatchery into the South Santiam Hatchery.

Implementation Timeframe: Ongoing/immediate.

**Proposed Action**: ***Examine the potential impacts of reducing production at McKenzie Hatchery to decrease the incidence of hatchery fish spawning in the area above Leaburg Dam, which is a wild fish sanctuary.***

Should reintroduction efforts above Cougar Dam produce a self-sustaining population of spring Chinook, then the Action Agencies will propose to further reduce mitigation production.

Rationale: See action regarding removal of hatchery fish at Leaburg Dam.

Implementation Timeframe: Examine alternatives with ODFW within 1 year of issuance.

#### 3.4.8.8. Spring Chinook Outplant Program and Disposition of Fish Arriving at McKenzie Hatchery

Several species of fish arrive at McKenzie Hatchery throughout the year, including spring Chinook and non-native hatchery summer steelhead. In addition to collection for broodstock needs, fish are transported to various locations based on management priorities. Priorities for disposition of excess broodstock and non-hatchery species arriving at the McKenzie Hatchery are determined by balancing goals for natural production, the Spring Chinook Outplant Program, hatchery management, and harvest opportunities; while ensuring that tribal obligations are satisfied. The Action Agencies and ODFW balance these goals with the physical limitations of the existing facility and the associated demands on hatchery personnel.

In recent years, the majority of excess spring Chinook broodstock have been collected and transported to unseeded, historical habitat in efforts to re-establish natural production of spring Chinook (see Section 3.4.4.5, *Spring Chinook Outplant and Potential for Reintroduction into Historical Habitat*). In the McKenzie subbasin, the Action Agencies and ODFW have transported fish collected at the McKenzie Hatchery into several locations throughout the McKenzie subbasin, including the Mohawk River, the McKenzie River upstream of Trailbridge Dam (owned by EWEB), and the South Fork McKenzie River upstream of Cougar Dam. A summary of these releases is found in Beidler and Knapp (2005).

**Fish Disposition and Outplant Protocols – McKenzie Fish Passage and Management Plan**

Current general management goals for the spring Chinook outplant program are described in Table 3-16. Implementation will follow the philosophy and approaches for outplanting and potential reintroduction described in Section 3.4.4.5. Detailed protocols for disposition of excess hatchery broodstock, wild fish, and other species collected at McKenzie Hatchery (and Cougar Dam) will be contained in the "Fish Disposition and Outplant Protocols" section of the Willamette FPMP. The FPMP will contain detailed, on-the-ground disposition protocols for all species of fish (clipped/unclipped) arriving at McKenzie Hatchery, including excess adult hatchery fish. Organized by date, it will specify priorities for disposition of wild/unclipped fish; and establish numerical goals (and perhaps minimum number of females) for release at each release site. These numerical goals will updated annually by the FPHM Committee.

### Table 3-16. Management Goals for Fish Collected at McKenzie Hatchery

| Species | Destination | Target # of Adult Fish * | | Maximum % of Wild Run |
|---|---|---|---|---|
| | | Clipped | Unclipped | |
| Spring Chinook | Broodstock | 640 | 160 | 10-20 |
| | South Fork above Cougar Dam | 3,000 (short-term goal of 2,000) | None at this time given downstream survival uncertainty; long-term goal is to use wild fish. | 0 |
| | McKenzie above Trailbridge | 120 * | None at this time | |
| | Mohawk River | 100 | 0 | 0 |
| | Remove from system | Excess to brood and outplanting | 0 | 0 |
| Summer Steelhead | Recycling below Leaburg | All | 0 | N/A |
| | Remove from system | Excess to brood and recycling | All | N/A |

* Future outplants will come from fish passed over Trailbridge via ladder or trap and haul by EWEB.

#### 3.4.8.9. Research, Monitoring and Evaluation Needs Specific to McKenzie Spring Chinook Program

The following RM&E questions are specific to the McKenzie Basin and the spring Chinook program. Any RM&E recommendations must be integrated into the comprehensive program overseen by the RM&E Committee (see Section 3.8) and following the principles and strategic questions developed by the committee.

1. Experiment with acclimation procedures (chemical/scent tracers) at McKenzie Hatchery to increase homing and decrease straying onto spawning grounds.
2. Evaluate production levels at McKenzie Hatchery to decrease the incidence of hatchery spawners on the spawning grounds. This is a high priority for NMFS.

### 3.4.9. Middle Fork Willamette Spring Chinook

The USACE proposes to continue funding 83.75% of the operations and maintenance costs of Willamette Hatchery, the primary rearing facility for the Middle Fork Willamette spring Chinook program. The 1990 Mitigation Agreement with ODFW requires the USACE to fund production of a maximum of 235,000 pounds of juvenile spring Chinook and steelhead to mitigate for lost production above Dexter, Lookout Point, and Hills Creek dams. Currently, the Middle Fork Willamette spring Chinook program releases about 120,000 pounds (1,199,000 smolts) of spring Chinook smolts annually. The goals of the Middle Fork spring Chinook program are to:

1. Mitigate the loss of spring Chinook catch in sport and commercial fisheries caused by construction and operation of Dexter, Lookout Point, and Hills Creek dams.
2. Provide adequate fish to the hatchery to maintain the broodstock to perpetuate program goals as outlined in the Middle Fork Willamette chapter of the FPMP (OAR 635-500-1666).
3. Maintain a suitable conservation broodstock for ongoing and future population recovery efforts throughout the subbasin, including evaluation of the feasibility of reintroduction efforts above the Dexter, Lookout Point, and Hills Creek dams.

Because of the conservation role of this hatchery program, the USACE proposes to operate the Middle Fork Willamette spring Chinook program as an integrated hatchery program with conservation-oriented genetic protocol. Willamette Hatchery produces the USACE's entire mitigation requirement for spring Chinook salmon in the Middle Fork Willamette. Very few natural-origin adults have returned to the Middle Fork Willamette (i.e., less than 100 fish), and the hatchery program in the Middle Fork Willamette subbasin will be used to rebuild the naturally-spawning population. The operation of the program is described in detail in the Middle Fork Willamette spring Chinook HGMP. When completed, the Willamette FPMP (see Section 3.2 and Appendix A) will describe the management goals and disposition plan for fish arriving at Willamette Hatchery.

#### 3.4.9.1. Hatchery Facilities and Operation

**Dexter Pond Fish Facility**

The Dexter Pond Facility, located at the base of Dexter Dam, is a satellite facility associated with Willamette Hatchery and is used to capture adult fish, provide juvenile rearing capacity, and serve as an acclimation facility for juvenile releases (Figure 3-9). In addition, both summer and winter steelhead are reared at this facility for a short period of time. All Middle Fork Willamette spring

Chinook salmon broodstock are collected at Dexter Pond and transported to a holding pond at Willamette hatchery until spawning.

**Figure 3-9. Dexter Pond Fish Facility and Adult Pre-sort Holding Pond**

The facility was designed as a collection and acclimation facility and was not designed to accommodate sorting adult fish. Migrating adults are blocked by Dexter Dam and guided to the fish ladder entrance. The broodstock collection facility consists of a fish ladder, pre-sort holding pool, two fish locks and brails, an anesthetic tank, and a sorting table. Sorted fish are routed via PVC tubes to various locations.

**Proposed Action**: ***Operate and rebuild the Dexter Pond Fish Facility.***

The Action Agencies will build a new fish collection facility at Dexter Pond that complies with NMFS criteria for upstream passage/collection facilities. The facility will provide adequate attraction of fish into the trap, automated sorting (when possible), and water-to-water transfer of fish into transport trucks. The facility will also serve as an effective juvenile acclimation facility that allows for volitional release. In the short term, the USACE proposes to continue operating Dexter Pond in its current condition while it completes designs for a new facility.

Rationale: The Dexter Pond Facility was designed as a broodstock collection facility for Willamette Hatchery, but it now collects, handles, and sorts UWR spring Chinook and winter steelhead that are (1) recycled downstream, (2) transported upstream of Lookout Point, Dexter, and Hills Creek Dams, or (3) transported to another stream in efforts to improve production of naturally produced UWR spring Chinook. The facility was not designed to accommodate safe handling, sorting, and loading of ESA-listed fish that must survive to spawn in the wild. At the existing facility, ESA-listed fish are directly injured or physically handled in a manner that likely contributes to the high levels of pre-spawning mortality observed in the Middle Fork subbasin. The existing facility violates many of NMFS criteria for trapping and is unable to acclimate juveniles during higher flows. Rebuilding the facility to safely handle, sort, and load adult fish will likely decrease pre-spawning mortality of all

fish handled at the facility. This should result in significant improvements in survival of fish released into habitat where they are expected to survive until spawning.

Implementation Timeframe: Preliminary designs were completed in 2005 and are described in the *South Willamette Valley Fish Facilities Improvements Report* (McMillen Engineering 2005). The timeline for reconstruction of Dexter Ponds Fish Facility is described in Section 3.6.

**Willamette Hatchery**

The Willamette Hatchery is situated on 75 acres near the town of Oakridge, Oregon. The hatchery is composed of the original trout hatchery, situated near the entrance and the old salmon hatchery which is immediately adjacent to the trout facility (Figure 3-10). Willamette Hatchery is also used for rearing South Santiam spring Chinook, summer steelhead, and rainbow trout. Willamette Hatchery has 1,005 total incubators, which allow for the incubation of 9 million eggs. All incubators are equipped with alarms. All adult spring Chinook are spawned under a covered deck adjacent to the earthen channel adult holding pond at Willamette Hatchery.

**Figure 3-10. Willamette Hatchery near Oakridge, Oregon**

**Proposed Action: *Operate and maintain the Willamette Hatchery.***

The Action Agencies propose to continue funding 83.75% of the operation and maintenance of Willamette Fish Hatchery as the primary hatchery facility used to meet its Middle Fork Willamette spring Chinook mitigation requirements.

Rationale: Willamette Hatchery has proven to be a reliable facility for rearing spring Chinook salmon. Being located within the Middle Fork Willamette subbasin, using the facility is ideal for maintaining consistency with hatchery reform principle #3 that reduces straying among basins by rearing hatchery fish within their natal watershed. It is also a suitable location for holding adult broodstock.

Implementation Timeframe: Immediate/ongoing.

**Proposed Action:** ***Maintain the diversions and intakes on Salmon Creek and the Willamette Hatchery well to provide a suitable water supply to Willamette Hatchery. Investigate options and correct problems with the decreased capacity and supersaturated water from the Willamette Hatchery well. Maintain the intake for the Dexter Pond Facility located in Dexter Reservoir.***

Rationale: The 1990 Cooperative Agreement requires that the USACE provide an acceptable water supply of 33.5 cfs at Willamette Hatchery and 85 cfs at the Dexter Ponds Facility. Willamette Hatchery has two sources of water. The first and primary water supply is surface water from Salmon Creek. This water is gravity flow and the facility has water rights for up to 82.5 cfs. Based on the current water delivery system, water flow available to the hatchery ranges from a low of 29,623 gpm to a high of 37,028 gpm. During the winter, Salmon Creek water fluctuates in water quality and temperature. Water temperature fluctuates between 36°F and 45°F. During the summer, Salmon Creek water temperature fluctuates from 45°F to 65°F.

The second source of water is a well, which is used in the hatch house and to cool the brood pond. The well water is a constant 54°F. It is used for otolith marking and in times of high muddy water hatchery staff can switch incubators and starter troughs over to it. Well volume has decreased from 400 gpm to 160 gpm over the years, and problems with supersaturation have led to decreases in production. The decreased capacity of the well inhibits the ability of the hatchery manager to cool the broodstock holding ponds and provide a reliable water supply to incubating eggs.

The Dexter Pond Facility receives its water from an intake in Dexter Reservoir. Water flows by gravity through a 36-inch in diameter pipe that feeds the raceways. Water flows by gravity from the upper raceways into the pre-sort adult holding pond, acclimation ponds, and the fish ladder. The intake is not screened.

Implementation Timeframe: Immediate/Ongoing. The USACE is working with ODFW to develop a reliable water source at Willamette Hatchery. Potential solutions include UV filtration of a portion of the Salmon Creek water or replacement of the well at the hatchery.

**Proposed Action:** ***Resolve hatchery infrastructure maintenance needs and develop a long-term Hatchery Maintenance Plan.***

The USACE and ODFW are developing a prioritized list and database of maintenance needs at each hatchery facility, including Willamette Hatchery and the Dexter Pond Fish Facility. The Action Agencies and ODFW will use this list to develop a Hatchery Maintenance Plan that identifies long-term maintenance needs for each facility. The Action Agencies and ODFW will develop a strategy to address these needs through annual budget requests or other processes.

Rationale: Failure to properly maintain and update fish production and handling facilities could cause failure of major equipment or facility components, such as the hatchery well. Equipment, water supply, or facility failure could result in an inability of the USACE to meet its mitigation requirements or effectively implement the actions in the HGMP. The Action Agencies are responsible for 83.75% of the operations and maintenance of Willamette Hatchery and the Dexter Pond. Furthermore, USACE Willamette Valley Project staff performs routine maintenance on the Dexter Ponds Facility and intake due to its location within/near Dexter Dam. Most of the hatchery

infrastructure was constructed or purchased over 40 years ago and is in need of major repair or maintenance. Complications with state and federal funding restrictions and budget processes have hindered the ability of the state to keep pace with needed repairs and upgrades. Not addressing current maintenance needs and failure to adequately plan for future needs may affect human safety of hatchery workers and visiting members of the public.

Implementation Timeframe: Safety inspection September 2007. Complete Hatchery Maintenance Plan September 2007; implement according to schedule in the plan.

**Proposed Action:** ***Complete regular environmental compliance and safety inspections at Dexter Pond and Willamette Hatchery, and promptly correct violations.***

According to the schedule identified in ER 200-2-3, the USACE will complete environmental compliance and safety inspections at Dexter Pond and Willamette Hatchery. The USACE will ensure prompt correction of violations.

Rationale: Improper storage and use of hazardous chemicals can cause damage to environmental resources including ESA-listed fish, particularly due to the proximately of hatchery facilities to numerous water bodies. Regular environmental compliance assessments, in combination with regulatory agency inspections and environmentally sensitive day to day operations are a means of attaining, sustaining, and monitoring compliance with applicable federal, state, interstate, and local environmental regulation.

Implementation Timeframe: Conduct inspections according to schedule mandated by ER 200-2-3, beginning in 2007.

**Proposed Action:** ***Operate Willamette Hatchery in compliance with the Integrated Hatchery Operations Team (IHOT) fish health guidelines.***

All lots of fish will be monitored daily in the hatchery for signs of disease. The ODFW Fish Pathology team will conduct periodic sampling of the fish in the hatchery, especially if any increase in mortality is observed by hatchery personnel. Whenever diseased fish are detected, the diseased fish will be treated according to IHOT protocols. Lots that cannot be certified as disease free prior to release will be destroyed or disposed of according to IHOT protocols. Diseased fish are not released into the Middle Fork Willamette River.

Rationale: Adhering to IHOT standards for fish health is critical to maintaining hatchery operations. Excessive disease can impact ODFW's ability to produce the USACE mitigation requirements and implement the actions in the HGMP. Periodic review of the fish health monitoring results and disease history is necessary to identify trends or areas where operations could be modified to improve fish health.

Implementation Timeframe: Immediate/ongoing.

**Proposed Action:** ***Comply with NPDES permits.***

Water discharges from Willamette Hatchery and Dexter Pond will comply with prescribed 330j general NPDES permit as required by the ODEQ.

Rationale: Compliance with NPDES permits ensures that hatchery operations do not exceed water quality criteria that could create conditions harmful to ESA-listed species.

Implementation Timeframe: Immediate/ongoing.

#### 3.4.9.2. Broodstock

**Broodstock Origin and Identity**

The ODFW uses Middle Fork spring Chinook (stock 022) to meet USACE mitigation requirements.

**Proposed Action:** ***Continue use of Middle (stock 022) spring Chinook.***

The Action Agencies propose to continue using Middle Fork spring Chinook (stock 022) to meet its mitigation responsibilities.

Rationale: Broodstock for the Middle Fork spring Chinook (stock 022) were derived from the local wild population. Because the Middle Fork spring Chinook program is both a mitigation and conservation hatchery program, this is the most suitable stock to propagate.

Implementation Timeframe: Ongoing/immediate.

**Broodstock Collection Location**

**Proposed Action:** ***Continue collecting all Middle Fork spring Chinook broodstock at Dexter Pond Fish Facility.***

Rationale: Dexter Ponds is the only location in the Middle Fork for obtaining Middle Fork Willamette spring Chinook. Fall Creek Dam is located on Fall Creek, a tributary of the Middle Fork Willamette River.

Implementation Timeframe: Ongoing/immediate.

**Broodstock Collection Timing**

**Proposed Action:** ***Collect broodstock throughout the run (including the early part of the season) to ensure the hatchery population is similar to the naturally spawning population.***

The Action Agencies propose opening the trap periodically at the Dexter Pond Fish Facility in the early part of the season to ensure collection of broodstock and fish for outplanting during the early part of the season (Table 3-17).

Rationale: Currently, fish are held in the Middle Fork Willamette River downstream of Dexter Dam until the trap opens in mid-June. Fish holding in this area are subjected to a heavy (and valuable) recreational fishery. These fish are assumed to mix while holding, such that that when the trap is opened in June, the sample is representative. However, this assumption has never been tested.

Implementation Timeframe: Develop plan for implementing early season collection for 2008 brood year. Attempt to make two collections in the early season in 2007. Annual review will occur by the FPHM Committee.

**Table 3-17. Proposed Broodstock Collection Guidelines for the Middle Fork Spring Chinook Hatchery Program**

| Middle Fork Spring Chinook | Hatchery Broodstock | | | Above Dexter, Lookout Point and Hills Creek Dams | |
|---|---|---|---|---|---|
| **Returns of Chinook to Dexter Pond (hatchery & wild) as indexed by May 31 Willamette Falls Counts** | **Max. % wild fish in hatchery broodstock (1600 fish goal)** | **Corresponding max. # wild fish in broodstock** | **Max. % of wild pop. taken for brood** | **Wild fish** | **Hatchery fish** |
| <30,000 (low run) | 30 | 480 | 100* | Ensure wild fish incorporated into broodstock | As needed to have minimum spawning escapement of at least 500 fish |
| 3,000-50,000 (medium run) | 30 | 480 | 100* | All after brood needs fulfilled | |
| >50,000 (high run) | 30 | 480 | 100* | | |

* Wild fish production is so poor that if all of the wild fish captured are taken for broodstock, it will be far less than the 30% wild fish in the broodstock. This criteria will be reevaluated if and when wild fish returns increase due to reintroduction efforts.

**Numerical Goals and Incorporation of Natural Origin Fish**

Returning adults are collected and spawned for broodstock. At this time the program goal is to spawn 835 females and 835 males (or about 1,670 fish total), as needed for egg production. Because of adult loss during holding, numbers collected may vary.

**Proposed Action**: ***Incorporate an appropriate percentage of natural origin fish incorporated into the broodstock to ensure the hatchery population is similar to the naturally spawning population.***

Rationale: Acclimation and volitional release at Dexter Pond minimizes the risk of returning hatchery adults straying onto the spawning grounds or into other subbasins.

Implementation Timeframe: Ongoing/immediate.

### 3.4.9.3. Adult Transport, Holding, and Prophylactic Treatment

The original adult holding ponds at Dexter Pond are no longer used. All adults collected at Dexter are hand-loaded onto trucks to be recycled downstream into the fishery, released upstream of Lookout Point Dam, or transported to Willamette hatchery where they are held until spawning. The adult Chinook holding facility at Willamette Hatchery was constructed in 1940 in a former side channel of Salmon Creek and still resembles a cobble-bottomed river channel. It is shaded by trees and is an excellent adult Chinook holding facility. Flow rate through the channel is approximately 1,500 gpm.

**Proposed Action**: ***Continue to transfer adult Middle Fork spring Chinook collected at Dexter Ponds to Willamette Hatchery for holding and spawning.***

Investigate improvements to the collection/crowding location. It is difficult to remove fish from this area.

Rationale: The adult holding pond at Willamette hatchery functions very well, due to its natural location, water supply, and shading.

Implementation Timeframe: Ongoing/immediate.

#### 3.4.9.4. Mating

**Proposed Action**: ***Continue to use random spawning protocol with a 1:1 male-to-female ratio.***

The Action Agencies do not propose any changes to the spawning protocol, unless results of RM&E indicate that spawning is not truly random with respect to run representation, age, and size of broodstock.

Rationale: Random mating should minimize the likelihood of selective pressures and promote genetic diversity of the hatchery population, which is consistent with the goals of this hatchery program.

Implementation Timeframe: Immediate/ongoing; potentially informed by RM&E that tests the assumption of equal run-timing representation.

#### 3.4.9.5. Incubation and Rearing

About 4 million eggs are collected annually at Willamette Hatchery. The majority of production is reared at the hatchery before being transferred to Dexter Ponds (1.3 million fish at 100/pound in June and 207,000 fish at 25/pound in November); 90,000 are retained at Willamette Hatchery until release into Fall Creek in February. Button up happens at 1700 TUs (approximately 1,400 fish/pound), and ponding normally occurs in late December. Eyed to ponding survival is typically greater than 96%. Willamette Hatchery also rears South Santiam spring Chinook, summer steelhead, and rainbow trout.

**Proposed Action**: ***Continue to incubate and rear all Middle Fork spring Chinook at the Willamette Hatchery.***

The Action Agencies do not propose any changes to the incubation and rearing protocol, with the exception of changes necessary to accommodate experimental changes in release size or timing.

Rationale: Willamette Hatchery is located in the Middle Fork Willamette subbasin and is a reliable facility for rearing juvenile spring Chinook. Issues with the declining well water supply have caused concern and must be resolved.

Implementation Timeframe: Immediate/ongoing; potentially informed by RM&E regarding most appropriate size and timing of juvenile releases.

#### 3.4.9.6. Marking

Currently, all hatchery juveniles are adipose fin-clipped, and otolith marked to allow visual identification of hatchery-origin fish.

**Proposed Action:** ***Continue to adipose fin-clip and otolith mark all Middle Fork Willamette spring Chinook at Willamette Hatchery.***

The Action Agencies propose to continue the current practice of adipose fin-clipping and otolith marking all Middle Fork spring Chinook.

Rationale: Adipose fin-clipping ensures immediate visual identification of hatchery-origin fish in the fishery, at the hatchery, and on the spawning grounds. However, returning spring Chinook hatchery fish have a high incidence of mismarking (i.e., partially or fully regenerated adipose fins) which poses several management problems. Otolith marking allows after-the-fact determination of the true origin of an adult fish and is critical for determining the incidence of mismarking and the true percentage of natural-origin fish that were incorporated into the broodstock. Continuing these two marking procedures are critical for effective hatchery and fishery management.

Implementation Timeframe: Ongoing/immediate.

**Proposed Action:** ***Insert coded wire tags into all juvenile hatchery fish in addition to current practice of adipose fin-clipping and otolith marking.***

In addition to the current practice of adipose fin-clipping and otolith marking all hatchery releases, the Action Agencies propose to insert CWTs into all hatchery releases. Tag codes should be assigned according to releases in order to evaluate alternative release strategies.

Rationale: This practice will allow for automatic enumeration and sorting of returning adults upon their return when Dexter Pond Fish Facility is reconstructed. Automated sorting will greatly reduce stress, injury, and mortality of fish that are collected and sorted at the facility, particularly natural-origin fish that are transported upstream of Lookout Point Dam or to other destinations, including Willamette Hatchery. Use of CWTs will enable thorough evaluation of straying patterns and alternative release strategies. It will also enable real-time determination of hatchery-origin fish upon return to the hatchery, which will enable managers to more successfully meet targets for incorporation of natural-origin fish into the broodstock as described in Table 3-17.

Implementation Timeframe: Include purchase of CWTs for all Middle Fork releases in FY 2009 budget request and out years.

#### 3.4.9.7. Acclimation and Release

Proposed Action: *Continue acclimating and releasing the majority of Middle Fork Willamette Spring Chinook at Dexter Pond Fish Facility.* The Action Agencies propose to continue acclimating and releasing the majority of smolts at Dexter Pond and allowing for volitional release (Table 3-18). The Action Agencies will provide flows that allow acclimation and volitional release whenever possible until a new facility is built that functions throughout a wider range of river levels. The Action Agencies support continuing the release of fingerlings in Fall Creek to mitigate for failed downstream passage at Fall Creek Dam.

**Table 3-18. Proposed Release Schedule for Middle Fork Spring Chinook**

| Life Stage | Release Location | Release Date | Mean Size at Release (#fish per lb) | Number of Fish Released | Total Pounds Released |
|---|---|---|---|---|---|
| Unfed Fry | Various STEP locations | Dec | | 10,000 | |
| Yearling | MF Willamette @ Dexter Ponds | Nov | 8 | 300,000 | 37,500 |
| 1+ Yearling | MF Willamette @ Dexter Ponds | Feb | 11 | 538,000 | 48,909 |
| | MF Willamette @ Dexter Ponds | Mar | 9 | 657,240 | 73,027 |
| 1+ Yearling | Below Fall Creek Reservoir | Feb | 9 | 90,000 | 10,000 |
| *1+ Yearling* | *Columbia River** | *March* | *12* | *855,000** | *71,250** |
| TOTALS | --- | --- | --- | 1,595,240 | 169,436 |

* Refer to the spring Chinook HGMP for more information, not included in total.

Rationale: The majority of Middle Fork Willamette spring Chinook are acclimated and released at the Dexter Ponds Fish Facility at the base of Dexter Dam, which should minimize the incidence of hatchery fish straying into other basins and ensure that adults return to the Dexter Ponds facility. Any changes to the release location would be discussed with the FPHM committee of WATER.

Implementation Timeframe: Immediate/ongoing.

### 3.4.9.8. Spring Chinook Hatchery Outplant Program

**Overview of Spring Chinook Hatchery Outplant Program**

Several species of fish arrive at the Dexter Ponds Facility throughout the year, including hatchery and wild UWR spring Chinook and non-native hatchery summer steelhead. In addition to collection for broodstock needs, fish are transported to various locations based on management priorities. Priorities for disposition of excess broodstock and non-hatchery species arriving at the Dexter Trap are determined by balancing goals for natural production, the Spring Chinook Outplant Program, hatchery management, and harvest opportunities; while ensuring that tribal obligations are satisfied. The Action Agencies and ODFW balance these goals with the physical limitations of the existing facility and the associated demands on hatchery personnel.

In recent years, the majority of excess spring Chinook broodstock have been collected and transported to unseeded, historical habitat (see Section 3.4.4.5, *Spring Chinook Outplant and Potential for Reintroduction into Historical Habitat*). In the North Santiam subbasin, adult spring Chinook have been released into the North Fork Middle Fork upstream of Lookout Point Reservoir, into the Middle Fork Willamette upstream of Hills Creek Reservoir, and into Salt Creek. Unmarked spring Chinook have also been released into various tributaries located downstream of Big Cliff Dam. Fish are also passed over the barrier dam at Minto of the Middle Fork downstream of Dexter Dam and into the Coast Fork Willamette subbasin. A summary of these releases is found in Beidler and Knapp (2005).

**Fish Disposition and Outplant Protocols – Middle Fork Fish Passage/Dexter Ponds Fish Passage and Management Plan**

Current general management goals for the spring Chinook outplant program are described in Table 3-19.

**Table 3-19. Management Goals for Fish Collected at Dexter Ponds Fish Facility**

| Species | Destination | Target # of Adult Fish * | | Maximum % of Wild Run |
|---|---|---|---|---|
| | | Clipped | Unclipped | |
| Spring Chinook | Broodstock | 1,200 | 500 | 100 * |
| | North Fork Middle Fork Willamette | 2,000 | Any in excess of broodstock | |
| | Salt Creek | 1,000 | 0 | |
| | Middle Fork above Hills Creek Dam | 3,000 | 0 | |
| Summer Steelhead | Recycle – Middle Fork Willamette below Dexter Dam | All | 0 | N/A |
| | Remove from system | Excess to brood and recycling | All | N/A |

The Middle Fork spring Chinook outplant program will follow the general philosophy and approach outlined in Section 3.4.4.5. Detailed protocols for disposition of excess hatchery broodstock, wild fish, and other species collected at Dexter Pond will be contained in the Fish Disposition and Outplant Protocols section of the Willamette FPMP. The FPMP will contain detailed, on-the-ground disposition protocols for all species of fish (clipped/unclipped) arriving at the Dexter Pond Fish Facility, including excess adult hatchery fish. Organized by date, it will specify priorities for disposition of wild/unclipped fish and establish numerical goals (and perhaps minimum number of females) for release at each release site. These goals will updated annually by FPHM Committee.

#### 3.4.9.9. RM&E needs specific to the Middle Fork Spring Chinook Program

Research, monitoring, and evaluation conducted in conjunction with the Middle Fork spring Chinook program will be integrated into the comprehensive program overseen by the RM&E Committee (see Section 3.8) and following the principles and strategic questions developed by the committee.

### 3.4.10. Upper Willamette Summer Steelhead Hatchery Program

The Upper Willamette Summer Steelhead Hatchery Program is managed to provide fish for sport fisheries and to replace lost fisheries caused by habitat and passage loss/degradation in the Willamette Basin and other lower Columbia basins. Summer steelhead are not native to the Willamette Basin upstream of Willamette Falls, and winter steelhead were historically not found in the Willamette Basin upstream of the Santiam River subbasin. The ODFW first introduced summer

steelhead into the upper Willamette Basin in the latter 1960s. Initially summer steelhead were brought into the South Santiam River as mitigation for lost winter steelhead production in areas inundated by the Foster and Green Peter reservoirs. This hatchery program was expanded to include annual smolt releases into the North Santiam, McKenzie, Middle Fork Willamette, and Molalla rivers as well, with the Molalla summer steelhead program being discontinued in 1997.

Winter steelhead were not used for mitigation in the South Santiam system for several reasons: (1) Constraints on the ability to raise a quality smolt in the hatchery environment within the necessary timeframe; (2) Because trap-and-haul and bypass facilities were incorporated into the dams, it was believed that production above the reservoirs would occur as it had in the past; and (3) Fisheries managers wanted to develop expanded steelhead angling opportunities.

Summer steelhead are reared at a variety of hatchery facilities throughout the state. Production of summer steelhead in the Willamette Basin is funded from many other sources, including ODFW's Sport Fish Restoration Program and general fund, the NMFS, Portland General Electric, and BPA. Details regarding funding allocations are provided in Section 1.3 of the Upper Willamette Summer Steelhead HGMP.

#### 3.4.10.1. Hatchery Management Goals

Specific adult summer steelhead harvest goals are established in ODFW subbasin management plans and are listed in Table 1.7 of the Upper Willamette Summer Steelhead HGMP. The summer steelhead program is managed as a segregated program (or isolated harvest), with the intent that summer steelhead will not spawn in the wild or adversely interact with ESA-listed species, such as UWR winter steelhead and UWR spring Chinook.

#### 3.4.10.2. Proposed Management Strategy

Because summer steelhead are not native to the upper Willamette Basin and could interact negatively with ESA-listed species, the NMFS 2000 BiOp required the USACE to collect information to describe the nature and extent of these potential effects. Among other activities, the USACE and ODFW have recently estimated the incidental catch of ESA-listed species in the summer steelhead recreational fisheries, determined the incidence of summer steelhead spawning in the wild, and estimated the predation rate of summer steelhead smolts on juvenile UWR spring Chinook. Results of these efforts are discussed in Chapter 6, *Analysis of Effects* and are described in ODFW's annual and final reports (Firman et al., 2005; Schroeder et al., 2006). In summary, ODFW determined that: (1) approximately 10%-30% of all summer steelhead passing Willamette Falls spawn naturally; (2) summer steelhead are spawning in the same areas used by ESA-listed winter steelhead; (3) summer steelhead smolts likely consume juvenile UWR spring Chinook salmon; and (4) some naturally produced summer steelhead smolts successfully outmigrate in the McKenzie Basin. Furthermore, research on summer steelhead in the Clackamas Basin has indicated a negative impact of summer steelhead on winter steelhead production (Chilcote 1998).

Because these results indicate that there are impacts of the summer steelhead program on ESA-listed species, the Action Agencies propose to implement changes to the program. However, because the USACE funds only a portion of the overall production of the upper Willamette summer steelhead hatchery program, the Action Agencies cannot unilaterally implement full-scale modifications to the entire summer steelhead program. Thus, the Action Agencies propose a phased approach to addressing reform of the upper Willamette summer steelhead that allows for interaction with other funding entities, ODFW, the Services, and non-governmental entities (including recreational fishing

groups and conservation groups) that have an interest in changes to production or hatchery management strategy. This allows an opportunity for all entities to develop an approach to reducing the impacts of the entire program on ESA-listed species, and not just address that portion of the program that is funded by the USACE. The upper Willamette summer steelhead HGMP identifies a full range of alternatives to current management. Furthermore, the CRHRP (see Section 3.4.3) will be reviewing the impacts of the upper Willamette summer steelhead on ESA-listed species in 2007 and will provide recommendations for alternatives to the current program operation. The Action Agencies believe it is prudent for this effort to inform of any potential changes to the program, particularly given the importance of the program to harvest opportunities in the State of Oregon.

Therefore, the Action Agencies propose the following:

- Continue current operations, production schedules, and releases as described in the Upper Willamette Summer Steelhead HGMP and summarized in Section 3.4.10.3. However, the Action Agencies propose to work with ODFW and the FPHM Committee of WATER to develop potential changes in the release strategies or production levels that could reduce impacts of the summer steelhead program on wild winter steelhead, such as scatter-planting smolts to increase harvest opportunities.
- To the extent feasible (given infrastructure constraints), remove "non-migrants" from hatchery release groups to reduce residualism of fish that do not volitionally emigrate and potentially reduce adverse interactions with rearing winter steelhead.
- Beginning no later than 2008, scale back summer steelhead recycling efforts in the North Santiam Basin where the potential for adverse interactions with ESA-listed UWR winter steelhead are most significant.
  - Incorporate recycling protocol into the North Santiam/Minto Pond FPMP.
- Assess the recycling program in the South Santiam basin to determine the extent to which early cessation of the recycling program would alleviate impacts to winter steelhead populations and impact fishery opportunities.
  - Incorporate current protocol for recycling into the South Santiam/Foster Dam FPMP.
  - Incorporate any changes in recycling protocol into the FPMP and implement changes beginning in 2009.
- Conduct short-term RM&E (in collaboration with other funding entities) to further define effects of the Upper Willamette Summer Steelhead Program on ESA-listed species. RM&E activities will focus on the following objectives:
  - Determine the extent of natural production of summer steelhead (potentially by collecting genetic sampled from juvenile steelhead).
  - Determine the extent to which juvenile summer steelhead and winter steelhead compete for resources, and ultimately determine if naturally produced summer steelhead are impacting productivity of winter steelhead.
  - Continue monitoring returns of summer steelhead and the incidence of summer steelhead spawning in the wild.
  - RM&E activities will be incorporated into the overall RM&E plan.
- Convene an interagency Summer Steelhead Working Group (as a subcommittee of the WATER FPHM Committee) to discuss options for long-term management of the summer steelhead program in light of ESA requirements and harvest goals. This group should seek input from non-governmental entities, such as sport fishing groups, and contain representation from other funding entities. This effort should also be informed by the Columbia Basin Hatchery Reform Project. The Summer Steelhead Working Group will:
  - Discuss feasibility of implementing changes to the program as identified in the HGMP.

- Review results from the Columbia Basin Hatchery Reform Project.
- Review additional RM&E results that will inform priorities for shifts in management.
- Prioritize implementation of hatchery reform actions.
- Strive to develop a reform implementation plan that all funding entities agree to implement. If the entities cannot agree, then the USACE will propose reform actions for its portion of the production and reinitiate consultation.
- The Action Agencies will begin programming funding for hatchery reform efforts according to the implementation plan and implement actions as fund become available.

The Action Agencies propose a 5-year check-in evaluation to verify with the Services that the implementation plan meets the requirements of the ESA. Should the plan (and any activities conducted to date) not be sufficient to avoid jeopardy to the UWR winter steelhead and spring Chinook ESUs, then the Action Agencies would reinitiate consultation. The following section summarizes the current program, which is described in detail in the Upper Willamette Summer Steelhead HGMP.

#### 3.4.10.3. Broodstock, Production and Release

**Broodstock**

The Upper Willamette Summer Steelhead Program uses Skamania summer steelhead (stock 024), originating with eggs collected on the Washougal River. Beginning in 1973, all brood have been collected at the Foster Dam Fish Facility associated with South Santiam Hatchery. Only known hatchery fish are used for broodstock propagation.

**Fish Disposition**

Surplus hatchery fish are recycled through the downstream fishery until October when fish arriving at the collection facilities are removed from the system.

**Collection Goals**

Adult collection goals vary depending upon annual broodstock needs. To satisfy a cumulative smolt production goal of approximately 900,000, the current green-egg take goal is approximately 1.8 million (2003-2004 ODFW Hatchery Production schedules) from returning hatchery fish. From 1994 to 2002, the average number of broodstock collected annually was 455 males and 550 females, resulting in an average egg take of 1,849,000 (see Table 7.4.2 in the South Santiam HGMP).

**Rearing Strategies**

While all broodstock collection occurs at South Santiam Hatchery, summer steelhead are reared at several hatcheries throughout Oregon. The USACE-funded hatcheries include South Santiam, Marion Forks, McKenzie, Leaburg, and Willamette (see Table 1.5 in the HGMP); fish are often moved throughout their lifecycle.

**Acclimation and Release**

Acclimation and release procedures vary among basins and are described in Chapters 9 and 10 of the HGMP. All releases are adipose-fin clipped. Table 3-20 summarizes the release levels for each major subbasin in the Willamette Basin as described in the HGMP.

**Table 3-20. Proposed Annual Fish Release Levels by Life Stage and Location**

| Life Stage | Release Location | Annual Release Level (maximum number) |
|---|---|---|
| Yearling | North Santiam River/Minto Pond (April Release) | 161,500 |
| | South Santiam River (April Release) | 144,000 |
| | Willamette River @ Eugene (April Release) | 42,000 |
| | Middle Fork Willamette (April Release) | 115,000 |
| | McKenzie River (April Release) | 108,000 |

### 3.4.11. Rainbow Trout Mitigation Program

The goal of this program is to mitigate for trout harvest opportunities lost as a result of the construction and operation of Big Cliff, Detroit, Green Peter and Foster in the Santiam River subbasin, Fern Ridge in the Long Tom River subbasin, Blue River and Cougar in the McKenzie River subbasin, and Fall Creek, Lookout Point, Dexter, Dorena, Cottage Grove and Hills Creek in the upper Willamette River subbasin. The mitigation agreement calls for the production of no more than 277,000 pounds of *Oncorhynchus mykiss* (rainbow trout and steelhead) and *O. clarki* (cutthroat trout) annually. Rainbow trout comprise approximately 243,300 pounds of this amount. A stock of cutthroat that originated from the Long Tom River was discontinued because of poor performance. Cutthroat trout are no longer produced as part of the mitigation agreement.

#### 3.4.11.1. Hatchery Management Goals

The hatchery rainbow trout program is a segregated, or "isolated harvest" program, where the fish are produced for harvest and are not intended to spawn in the wild or be genetically integrated with any specific natural population.

#### 3.4.11.2. Proposed Management Strategy

The primary ESA-related concerns with the rainbow trout program are predation on wild juvenile spring Chinook and incidental harvest of ESA-listed fish associated with the popular rainbow trout fishery, particularly in the McKenzie River. As required by the NMFS 2000 BiOp, the USACE funded ODFW to assess these impacts. The results of these assessments are described in Firman and others (2006) and are summarized in Section 2 of the upper Willamette rainbow trout program HGMP.

An incidental effect of the rainbow trout program is that the program has increased the prevalence of IHN virus in the natural environment, a disease that can also affect native species. The IHN virus has caused large losses of rainbow trout at Leaburg Hatchery. To reduce the risk of loss, ODFW has devised rearing strategies that involve incubation of eggs and rearing of fry at other hatcheries, including Willamette Hatchery, to minimize hatchery losses (see Section 1.5 of the HGMP). Despite these actions, large losses of rainbow trout persist at Leaburg Hatchery. The changes in production strategies have taxed the capabilities of staff at other facilities and decreased ODFW's flexibility in managing other hatchery programs, including USACE-funded UWR spring Chinook program in the Middle Fork Willamette, which is managed for conservation purposes (see Section 3.4.9). Fish stocked from Leaburg Hatchery may be causing amplification of IHN virus in the natural

environment. The impacts of IHN virus on ESA-listed salmon and steelhead are unknown, but could be substantial.

Because there are impacts of the rainbow trout program on ESA-listed species, the Action Agencies propose to implement changes to the program. However, because the primary purpose of the rainbow trout program is to provide a harvestable trout fishery, the Action Agencies do not wish to unilaterally implement full-scale modifications rainbow trout program without involvement of other entities, including ODFW. Thus the Action Agencies propose a phased approach to addressing reform of the Upper Willamette Rainbow Trout Program that allows for interaction with ODFW, the Services, and non-governmental entities (including recreational fishing groups and conservation groups) who would have an interest in changes to production or hatchery management strategy. Section 1.16 of the HGMP summarizes the key issues associated with the current program and poses several potential modifications to address these issues. Furthermore, the CRHRP (see Section 3.4.3) will be reviewing the impacts of the rainbow trout program on ESA-listed species in 2007 and will provide recommendations for alternatives to the current program operation. The Action Agencies believe it is prudent for this effort to inform any potential changes to the program, particularly given the importance of the program to harvest opportunities in the State of Oregon. This approach also allows the USACE and ODFW to develop a strategy to meet its mitigation requirements for rainbow trout, given the uncertainty regarding the production capability of Leaburg Hatchery and other USACE-funded hatcheries in their current condition. Therefore, the Action Agencies propose the following:

- Continue current operations, production schedules, and releases as described in the Upper Willamette Rainbow HGMP and summarized in sec 3.4.11.3.
- Work with ODFW to develop a strategy for long term production of fish to meet the USACE's mitigation responsibility (i.e., including addressing IHN virus outbreaks at Leaburg Hatchery). Alternatives include installation of a UV filtration system at Leaburg, shifting production of rainbow trout to other facilities, and purchasing a portion (or all) of the fish required to meet the mitigation requirement.
- Conduct short-term RM&E (in collaboration with other funding entities) to further define effects of the Upper Willamette Rainbow Trout Program on ESA-listed species. RM&E activities will focus on the following objectives:
  - Determine the spatial distribution of rainbow trout after release. Angler evidence indicates that releases migrate within basins to areas used heavily by rearing UWR spring Chinook.
  - Determine the impact of rainbow trout predation on juvenile ESA-listed species in 2008. The original study involved several assumptions that were likely invalid. Combine this study effort with results regarding the spatial and temporal distribution of rainbow trout. Use these results to develop changes in management strategy for rainbow trout, including potential changes to harvest regulations.
  - RM&E activities will be incorporated into the overall RM&E plan.
- Convene an interagency Rainbow Trout Working Group (as a subcommittee of the WATER FPHM Committee) to discuss options for long-term management of the rainbow trout program in light of ESA-requirements and harvest goals. This group should seek input from non-governmental entities, such as sport fishing groups, and contain representation from other funding entities. The group will:
  - Discuss feasibility of implementing changes to the program as identified in the HGMP or to change the type and species of release to meet the USACE mitigation responsibility.
  - Review results from the Columbia Basin Hatchery Reform Project.
  - Review additional RM&E results that will inform priorities for shifts in management.

- Prioritize implementation of reform actions, including changes to harvest regulations.
- The Action Agencies will begin programming funding for hatchery reform efforts according to the implementation plan and implement actions as fund become available.

The Acton Agencies propose a 5-year check-in evaluation to verify with the Services that the implementation plan meets ESA requirements. Should the plan (and any activities conducted to date) not be sufficient to avoid jeopardy to the UWR winter steelhead and spring Chinook ESUs, then the Action Agencies would reinitiate consultation. The following section summarizes the current program, which is described in detail in the Upper Willamette Rainbow Trout HGMP.

#### 3.4.11.3. Production Levels, Rearing and Releases

**Broodstock**

The program uses Cape Cod stock (072) rainbow trout, an out-of-basin stock that was selected because of its spawn timing. The Cape Cod stock differs from native rainbow trout in the Willamette basin in that the Cape Cod stock spawn in the fall (November-December), whereas native rainbow trout spawn in the spring (March-May). Also, it has been theorized that the genetic tendency for migration is more suppressed in the Cape Cod stock (Moring 1975) than in natural stocks. The broodstock is composed entirely of hatchery fish; all brood are maintained at Roaring River Hatchery. No wild trout are included in the broodstock.

**Rearing and Incubation**

Rainbow trout are currently raised primarily at two USACE-funded hatcheries – Leaburg Hatchery on the McKenzie River and Willamette Hatchery in the Middle Fork Willamette Basin. Rainbow trout are also reared at Roaring River Hatchery, which is funded by ODFW.

**Release**

Rainbow trout are released throughout the entire Willamette Basin, primarily at a size of 3-4 fish per pound (Table 3-21). Section 10 of the HGMP describes the releases in more detail. All fish released into water bodies inhabited by ESA-listed species are adipose fin-clipped. Excess fish are released as fingerlings into lakes.

### 3.4.12. Hatchery Mitigation Program Research, Monitoring and Evaluation

The Action Agencies, in coordination and collaboration with the Services and the WATER FPHM Committee, will develop and implement a RM&E program to determine compliance with, and effectiveness of, the hatchery-related actions described in Section 3.4. The RM&E program is intended to evaluate the effectiveness of the mitigation program in meeting legal mitigation requirements, supporting natural production of ESA-listed fish, and related effects on ESA listed fish species. The recommendations must be integrated into the comprehensive program overseen by the RM&E Committee (see Section 3.8) and following the principles and strategic questions developed by the committee.

The Action Agencies envision the following framework for a comprehensive Flow Management RM&E Program. The framework includes a set of strategic planning questions and key RM&E program elements.

## Table 3-21. Releases of Rainbow Trout and Presence of ESA-listed Species in Release Areas

| South Willamette Area | | | | | | |
|---|---|---|---|---|---|---|
| **Waterbody** | **ODFW Waterbody Code** | **ESA-listed Fish Present [2]** | **Mark** | **Legal-size releases [3]** | **Fingerling Releases [4]** | **Total Releases** |
| Alton Baker Canal | 0200100000 | ChS | | 17000 | | 17000 |
| Big Cliff Res. | 0270600000 | ChS | | 5500 | | 5500 |
| Blue River | 0201520000 | BuT, ChS | | 6500 | | 6500 |
| Blue River Res. | 0271600000 | --- | | 13000 | | 13000 |
| Breitenbush R. | 0201110000 | ChS | | 20000 | | 20000 |
| Carmen Res. | 0270900000 | BuT, ChS | | 24000 | | 24000 |
| Clear Lk. | 0208600000 | --- | | 29000 | | 29000 |
| Cottage Grove Pd. | 0263900000 | --- | | 5000 | | 5000 |
| Cottage Grove Res. | 0270000000 | --- | | 16500 | | 16500 |
| Creswell Pd. | 0250000000 | --- | | 4500 | | 4500 |
| Detroit Res. | 0270200000 | ChS | | 124500 | 300000 | 424500 |
| Dexter Res. [1] | 0270500000 | ChS | | 19800 | | 19800 |
| Dorena Res. [1] | 0270100000 | --- | | 18300 | | 18300 |
| E E Wilson Pd. | 0251200000 | --- | | 12125 | | 12125 |
| Fall Cr. | 0200310000 | ChS | | 10000 | | 10000 |
| Foster Res. | 0271400000 | ChS. StW | ad | 43500 | | 43500 |
| Freeway Lk. E. | 0230400000 | ChS | | 4350 | | 4350 |
| Green Peter Res. | 0271500000 | ChS | | 22000 | | 22000 |
| Hatchery Outlet | 0200410000 | --- | | 1500 | | 1500 |
| Hills Cr. | 0200430000 | ChS | | 1500 | | 1500 |
| Hills Creek Res. | 0270200000 | BuT, ChS | | | 200000 | 200000 |
| Junction City Pd. [1] | 0276200000 | --- | | 14725 | | 14725 |
| Leaburg Lk. | 0271700000 | BuT, ChS | ad | 28000 | | 28000 |
| McKenzie R-1 | 0201500000 | BuT, ChS, OC | ad | 35750 | | 35750 |
| McKenzie R-2 | 0201600000 | BuT, ChS | ad | 79500 | | 79500 |
| Quartzville Cr. | 0201310000 | --- | | 12000 | | 12000 |
| Roaring R Park Pd. | 0277700024 | --- | | 1080 | | 1080 |
| Salmon Cr. | 0200410000 | ChS | | 12000 | | 12000 |
| Salt Cr. | 0200420000 | ChS | | 3000 | | 3000 |
| Santiam R, N Fk. | 0201100000 | ChS | | 33000 | | 33000 |
| Smith Res. | 0271000000 | --- | | 15000 | | 15000 |
| Timber Linn Lk. | 0246900000 | --- | | 1725 | | 1725 |
| Trail Br Res. | 0271100000 | BuT, ChS | ad | 14085 | | 14085 |
| Walling Pd. [1] | 0261500000 | --- | | 5700 | | 5700 |
| Walter Wirth Lk. [1] | 0255000000 | --- | | 24600 | | 24600 |
| Waverly Lk. | 0246500000 | --- | | 910 | | 910 |
| Will R, Coast Fk. | 0200200000 | ChS, OC | | 2700 | | 2700 |
| Will R, Middle Fk. | 0200300000 | BuT, ChS | ad | 6335 | | 6335 |
| TOTALS | | | | 688,685 | 500,000 | 1,188,685 |

[1] Some or all of the fish stocked in this waterbody come from Desert Springs Trout Farm instead of, or in addition to, an ODFW hatchery.
[2] BuT = bull trout, ChS = Willamette spring Chinook, OC =Oregon chub, StW = Willamette winter steelhead.
[3] Legal sized releases vary from 0.5 to 3 fish/pound. [4] Fingerling sized releases vary from 30 to 100 fish/pound.

### 3.4.12.1. Hatchery Mitigation Program Strategic Questions

**Hatchery Program Structural Features and Management**

1. What is the production-area specific genetic distance between local populations of naturally produced and hatchery fish in the Willamette Basin and how does it change over time?
2. How do the phenotypic expressions associated with local populations of naturally produced and hatchery fish differ and change over time?
3. What hatchery practices contribute to results observed under questions 1 and 2 above? How and to what extent do they contribute to these results?
4. What current structural components, operational procedures or program consequences adversely affect, or have the potential to adversely affect, ESA-listed fish species (i.e., in terms of genetic fitness or survival)? How and to what extent are they affected?
5. Are there structural or operational changes that could result in an improvement (i.e., elimination, reduction, or minimization) in conditions identified as adversely affecting ESA-listed fish species?
6. Are there changes in structural features, program management, or operations that could be pursued to significantly reduce the long-term need for hatchery fish production, while meeting the USACE mitigation obligations and potentially supporting listed species recovery?
7. Is there any preliminary analysis, research, monitoring, or evaluation that must be completed before a particular corrective action is implemented?
8. Is there any post-implementation analysis, research, monitoring, or evaluation that must be undertaken to document the effectiveness of a particular corrective action or set of actions?

**Protection of Production below Federal Dams and Restoration of Production above Federal Dams (overlaps with "Fish Passage" below)**

1. What portion of naturally spawning populations is composed of native, naturally produced fish?
2. In what way and to what extent do naturally produced and hatchery fish interact in the natural environment?
3. What are the results of interactions between naturally produced and hatchery fish within the natural environment?
4. Should adult salmon and steelhead returning to below a dam or hatchery be transported and released above the dam or left below the dam? Proposed actions should consider:
   - Production goals, objectives, and strategy.
   - Local population dynamics and hatchery broodstock needs.
   - Place of fish's origin.
   - Effect of straying on natural production.
   - Likelihood of adult survival to spawning and of offspring survival.
5. Are habitat conditions (e.g., quantity, quality, connectivity) below dams for each species and life history stage suitable to assure persistence and allow for recovery? What is the level of self-sustainable natural production that can reasonably be achieved below each dam, considering the effects of interaction with hatchery strays?
6. Are habitat conditions (e.g., quantity, quality, connectivity) above dams for each species and life history stage likely to aid in reducing risks associated with persistence and in allowing for recovery? What is the level of self-sustainable natural production that can reasonably be achieved above each dam? How can it best be developed (i.e., most effective strategy)?

### 3.4.12.2. Specific Hatchery-related RM&E Objectives

Goals for each hatchery program are described in detail in Section 1 of each Hatchery and Genetic Management Plan (HGMP). These plans are dynamic and will change over time as a result of new information acquisition and in response to changes in the status of listed fish species or related programmatic adjustments (e.g., restoration of natural production above reservoirs). The performance standards and indicators in Section 11 of each HGMP will be used to evaluate if these goals are being achieved. The following sections describe the monitoring and evaluation program necessary to measure the standards and indicators. Information from these evaluations will inform specific management decisions related to operation of each hatchery program, including the Chinook salmon outplant program. The Action Agencies will implement some components of this monitoring and evaluation program jointly with ODFW as components of routine hatchery operations, through other ongoing ODFW projects, (e.g., the spring Chinook salmon in the Willamette and Sandy rivers project), or through other arrangements.

The following general headings are similar to the HGMPs for consistency. Specific monitoring activities and tasks will be added to each performance standard and objective, pending discussions regarding scope of the RM&E program, including discussions with co-managers, such as ODFW. The USACE also needs to develop mechanisms for using the results of the RM&E program for making management decisions. This list is not a comprehensive list, but rather serves as a starting point for development of a thorough RM&E program.

**Genetic and Life History Characteristics Monitoring**

***Hatchery Management Goal:* Develop and maintain an integrated broodstock for the North Santiam, South Santiam, McKenzie, and Willamette spring Chinook hatchery programs.**

*Performance Standard: Wild adults will be incorporated into the hatchery broodstock each year to provide genetic variability within the hatchery stock, to maintain it as a reserve population, and to ensure that fish used for the outplant program and efforts to evaluate the feasibility for reintroduction are genetically similar to the naturally spawning population. The number of wild adults incorporated into the broodstock will follow the guidelines described in Section 6 of each HGMP.*

Objective: Determine if wild fish have been incorporated into the broodstock in accordance with the protocol described in Section 6 (i.e., the protocol developed with NMFS/ODFW).

*Performance Standard: Spring Chinook broodstock will be collected in a manner that approximates the life history characteristics (e.g., distribution of timing, age, and size of the population) of the naturally spawning population in order to maintain genetic and life history diversity of the hatchery population.*

Objective: Determine if run timing, spawn timing, and spawning distribution of both the hatchery and natural-spawning populations are similar.

*Indicators:*

- Number and timing of hatchery and natural-origin returns to each river basin (e.g., Bennett Dams, Leaburg Dam, etc).
- Number and timing of hatchery and natural-origin returns to each hatchery facility.
- Date of spawning activity of naturally spawning population.

*Monitoring Activities:*

- Counts of hatchery and natural-origin fish entering each tributary system.
- Repeated spawning surveys to document extent and timing of spawning of natural and hatchery-origin fish on the spawning grounds.
- Collection and analysis of otoliths from all carcasses without adipose fin clips to identify true natural-origin fish.
- Counts of fin-clipped and non-fin-clipped fish returning to each hatchery/collection facility.

Objective: Determine if the size distribution, age distribution, male to female ratio, and fecundity of the hatchery and naturally spawning populations are similar. (i.e., monitor broodstock biometrics)

*Indicators:*

- Scale and otolith analysis.
- CWT analysis.
- Record the date, number, length, sex, origin (hatchery vs. wild) of Chinook salmon spawned by each hatchery.
- Fecundity (number and size), body size (length and weight), sex ratio, adult run timing, and adult-to-jack ratio.

Monitoring Objective: Determine if the stray rate of hatchery spring Chinook is below the levels necessary to maintain genetic variation among stocks (as identified in HGMP).

*Indicators:*

- Number and origin of CWTs in adult fish returning to each hatchery.
- CWT recoveries from spawning ground surveys.
- Number of marked adult fish on the spawning grounds.

Objective: Determine the genetic composition of the hatchery and naturally spawning spring Chinook populations in each basin. Evaluate genetic composition of broodstock and natural population periodically to detect genetic divergence or convergence.

*Indicators:*

- Tissue samples from hatchery and naturally spawning populations.
- Analysis of tissue samples (DNA or allozyme frequencies).
- Comparison of genetic signatures with life history characteristics (i.e., determine if genetic differences correspond to life history/behavioral characteristics).

**Monitoring the Conservation of Wild/Naturally Spawning Populations**

***Hatchery Management Goal*: Maintain an appropriate level of interbreeding between hatchery and naturally produced fish; protect natural production sanctuary areas from an over influence of stray hatchery origin spawners.**

*Performance Standard: Manage programs to maintain an appropriate level of interbreeding among hatchery and natural-origin fish, as defined by basin and program objectives in the HGMPs.*

Objective: Determine if the percentage of hatchery fish in each naturally spawning spring Chinook salmon population is consistent with guidance from ODFW's native fish conservation policy and ESA recovery plans.

*Indicators:*

- Number and percentage of hatchery-origin adults returning to basin
- Number and percentage of hatchery-origin spawners on the spawning grounds

Objective: Determine if hatchery spring Chinook spawning in the wild originate from hatcheries (i.e., identify hatchery of origin).

*Indicators:*

- CWT tag recoveries from carcasses on spawning grounds

Objective: Eliminate, or reduce to the maximum extent practicable, naturally spawning fish of hatchery-origin in the McKenzie River above Leaburg Dam.

*Performance Standard: Minimize negative impacts on native resident and anadromous fishes resulting from the release of juvenile hatchery fish.*

Objective: Determine the outmigration timing of spring Chinook hatchery releases and document the extent of overwintering of each type of hatchery release based on size and time of release.

Objective: Determine if juvenile hatchery spring Chinook and naturally produced spring Chinook juveniles interact in the wild and/or compete for resources.

*Indicators:*

- Temporal and spatial distribution of naturally produced juvenile spring Chinook.
- Temporal and spatial distribution of juvenile hatchery spring Chinook in rearing areas occupied by naturally produced spring Chinook.
- Habitat overlap between naturally produced and hatchery spring Chinook salmon.
- Size of naturally produced spring Chinook salmon and hatchery releases.
- Documentation of competitive interactions between varying sizes of spring Chinook in a laboratory setting.
- Documentation of hatchery fish and naturally produced fish competing for resources (e.g., prey).

**Feasibility of Reintroduction of Spring Chinook into Historical Habitat**

The following RM&E elements specifically pertaining to evaluating the feasibility of reintroducing spring Chinook into historical habitat areas upstream of USACE dams with the objective of establishing naturally self-sustaining populations will be integrated into the overall Willamette System Review configuration feasibility studies described in Section 3.6.

***Hatchery Management Goal:* *Use the spring Chinook artificial propagation programs to develop self-sustaining, natural-spawning populations above USACE dams as part of the spring Chinook Outplant Program.***

*Performance Standard: Release live spring Chinook in locations and numbers as described in the Willamette Fish Passage and Management Plan.*

*Performance Standard: Collect, handle, load, transport, and release live adult spring Chinook in accordance with the protocols described in Appendix A.*

*Indicator*: (# fish outplanted, male/female, etc).

Objective: Monitor the movement of adult spring Chinook released in areas upstream of USACE dams until spawning.

Objective: Determine the extent of prespawning mortality of adult spring Chinook released upstream of USACE dams. Evaluate the effects of various prophylactic treatments, changes in handling/transport protocol, and/or anesthetics on pre-spawning mortality. Evaluate the effects of new collection facilities on the stress levels, the incidence of disease, and pre-spawning mortality.

Objective: Determine locations of spawning adult Chinook salmon in areas upstream of USACE dams. Document the spawning success of adult Chinook salmon released into habitat upstream of USACE dams.

Objective: Develop and monitor effectiveness new, safe release locations for adult spring Chinook salmon in areas upstream of USACE dams. Select sites based on proximity to suitable holding and spawning habitat. Develop infrastructure at release sites in collaboration with landowners (e.g., USFS, private landowners).

Objective: Evaluate juvenile production resulting from adult spring Chinook salmon released in habitat upstream of USACE dams. Document distribution and migration timing of juveniles out of each tributary into the reservoir environment.

**Segregated Hatchery Program Research, Monitoring, and Evaluation**

***Hatchery Management Goal: Manage the summer steelhead and rainbow trout programs as segregated hatchery programs with minimal impacts on native fish populations, including ESA-listed species.***

Objective: Determine the extent of hatchery rainbow trout and non-native hatchery summer steelhead predation on juvenile spring Chinook.

Objective: Determine if and where non-native hatchery summer steelhead are spawning in the wild and if interbreeding is occurring.

Objective: Determine the percentage of the non-native hatchery summer steelhead that spawn in the wild.

Objective: Describe (in a laboratory setting) potential competitive interactions among non-native hatchery summer steelhead smolts and juvenile winter steelhead. Determine if hatchery non-native summer steelhead smolts compete with naturally produced winter steelhead juveniles in the wild. Determine if these interactions occur naturally.

Objective: Determine if naturally spawning, non-native, hatchery summer steelhead adversely impact wild winter steelhead production.

**Evaluating the Operation of Artificial Production Facilities**

***Hatchery Management Goal:* Operate each hatchery program in accordance with applicable federal and state laws, and cooperative agreements governing safe operation of hatchery facilities. (Note: This section needs to be fleshed out with ODFW based on operational protocol at each facility and based on discussions regarding appropriate size and timing of hatchery releases)**

*Performance Standard: Each hatchery program will be operated to meet the mitigation requirements established in the 1990 Cooperative Agreement between the State of Oregon and the USACE (or most recent agreement).*

Objective: Determine if hatchery fish were released at the programmed size and number as defined in the HGMP.

Objective: Determine if hatchery fish are externally distinguishable from naturally produced fish.

Objective: Ensure that all hatchery fish are distinguishable from naturally produced fish by otolith marks and coded wire tags.

*Performance Standard: Operate each facility in compliance with the Integrated Hatchery Operations Team (IHOT) fish health guidelines*

*Performance Standard: All hatchery water discharges will comply with prescribed NPDES permits as required by the ODEQ.*

*Performance Standard: All hatchery and satellite facilities' water withdrawals will comply with NMFS juvenile fish screening criteria.*

*Performance Standard: Wild spring Chinook or other native fishes that enter the hatchery and satellite facilities will be handled and released in a manner that minimizes stress, injury, mortality and delay in migration.*

## 3.5. Habitat Restoration and Management Actions

This section describes measures ongoing and proposed by the Action Agencies to address management and restoration of habitat directly or indirectly used by ESA-listed species. The measures are broken down into the following categories:

- Habitat actions conducted onsite (on USACE-administered project lands).
- Habitat actions offsite (off of USACE-administered project lands) upstream and downstream of the basin dams and reservoirs.
- Measures to address habitat restoration associated with potential removal or modification of bank revetments and other forms of protection constructed and managed by the USACE under the Willamette Bank Protection Program.
- Ongoing and proposed research, monitoring and evaluation efforts by the Action Agencies related to aquatic habitat conditions.

### 3.5.1. Onsite Habitat Restoration and Resource Stewardship Actions

**Proposed Action:** ***The USACE will continue to use existing authorities and programs for land and water resource stewardship on USACE-administered lands at the 13 Willamette projects to manage onsite habitat to benefit and protect ESA-listed species.***

Section 2.1 of the 2000 BA (USACE 2000) describes habitat management and natural resource stewardship actions undertaken by the Action Agencies on lands owned by the Federal Government and managed by the USACE and other entities at the 13 Willamette dams. In summary, within the Willamette Basin the USACE administers over 30,000 acres of project lands. In accordance with USACE regulations, those lands are managed for authorized project purposes within a system of land use allocation and classification. The USACE land use classifications define resource management and development practices, which may be either appropriate or inappropriate for that parcel of land. There are five land use categories into which lands at USACE projects may be classified: Project Operations, Recreation, Mitigation, Environmental Sensitive Areas, and Multiple Resource Management. The latter can be further subdivided into Low-density Recreation Use, General Wildlife Management, Vegetative Management, Inactive and/or Future Recreation Areas, and Easement Lands. The extent of these lands on each of the projects is summarized in Table 2-10 of the 2000 BA. There have been no changes in land use classification at any of the projects since the 2000 BA.

However, since 2000 the USACE has undertaken some changes in specific habitat management and resource stewardship practices that are directly or indirectly related to ESA-listed species at a number of projects. Changes in management practices and status of ESA-listed species, as well as other species of interest are described in the following sections.

#### 3.5.1.1. South Santiam Subbasin – Green Peter and Foster Lakes

Listed and proposed threatened or endangered wildlife and plant species documented at Foster Lake include the bald eagle and northern spotted owl. Species of concern and candidate species documented at Foster Lake include northwestern pond turtle (*Emmys marmorata marmorata*), tall bugbane (*Cimicifuga elata*), Howell's montia (*Montia howellii*), dotted water-meal (*Wolfia borealis*), and Columbia water-meal (*Wolffia columbiana* Karst). The foothill yellow-legged frog (*Rana boylii*), also a species of concern, has been extirpated from Foster Lake; however, an important

population (the last extant in the Willamette Valley) occurs just above full pool (and off project lands) on the South Santiam River.

Listed and proposed threatened or endangered wildlife and plant species documented at Green Peter Lake include bald eagle (*Haliaeetus leucocephalus*) and northern spotted owl (*Strix occidentalis*). Species of concern or candidate species documented at Green Peter include the northern red-legged frog (*Rana aurora aurora*) and northwestern pond turtle.

A major false-brome (*Brachypodium sylvaticum*) infestation along the north shore threatens to convert understory habitat in the South Santiam subbasin. This infestation is being aggressively treated in a cooperative effort between the USACE, Oregon Department of Agriculture, and the Salem District of the Bureau of Land Management (BLM).

The 2000 BA (USACE 2000) indicates that Canada lynx was thought to be using habitat in the greater area around Foster and Green Peter lakes. That is no longer thought to be the case. Also as noted in the 2000 BA, forested lands within the project areas are generally managed for wildlife diversity. Since then, the USACE has undertaken a program to create snags for wildlife use by topping and heart-rot inoculation.

#### 3.5.1.2. McKenzie River Basin – Blue River and Cougar Lakes

The bald eagle is the only listed threatened or endangered wildlife or plant species documented at Blue River Lake. An eagle nest is located on a small peninsula on the lake's southern shoreline; this pair has been active and productive since at least 1996 and in 2006 they fledged two young. The lands around this nest are managed by the USFS. The USACE monitors osprey nesting and production at Blue River Lake. The northern spotted owl and other listed, proposed, candidate, and species of concern may occur in the broader resource area surrounding Blue River Lake.

Wave action, fluctuating pool levels, and steep banks affect the shoreline of Cougar Lake. This combination of conditions precludes significant vegetation establishment on the banks of the lake, however an a large native sedge (*Carex aperta*) bed exists at the upper end of the reservoir near Smith Creek; this area was the focus of intensive maintenance efforts during the construction of the WTC tower from 2003 through 2005, when the lake was dry for 3 years. An extensive irrigation system pumping from the river was set up to water the sedge beds along with 15 acres of planted willows designed to take advantage of absence of a full lake, which limits establishment of woody species.

#### 3.5.1.3. Middle Fork Basin – Fall Creek Lake

Northwestern pond turtles also occur in the Fall Creek and Winberry Creek arms of the lake, especially in the areas above the road bridges and in the Tufti Wildlife Area Management Unit, downstream of the Fall Creek Dam. Other species of concern documented at the Fall Creek project include the northern red-legged frog, long-legged myotis (*Myotis volans*), long-eared myotis (*Myotis evotis*), fringed myotis (*Myotis thysanodes*), Townsend's big-eared bat (*Corynorynus townsendii*), western gray squirrel (*Sciurus griseus*), mountain quail (*Oreortyx pictus*), willow flycatcher (*Empidonax traillii*), western bluebird (*Sialia mexicana*), and the yellow-breasted chat (*Icteria virens*). Howell's montia is the only plant species of concern or candidate plant documented at the Fall Creek project.

Remnant Oregon white oaks (*Quercus garryana*) occur below the dam; efforts to release oaks from impacts of conifer encroachment were initiated in 2005 and will continue. In addition, Oregon white oaks have been planted in some grassland areas that were probably oak savannah prior to conversion to pasture before dam construction.

Steep shorelines preclude the growth of emergent vegetation along much of the shoreline. However, wetlands persist as fringe marshes of reed canarygrass (*Phalaris arundinacea*), such as the small wetland located at the upper end of the Winberry Creek Arm where a shallow flat exists between the creek channel and the shoreline. A 0.5-acre beaver pond is found in the Douglas-fir (*Pseudotsuga menziesii*) stand within the Tufti Wildlife Area Unit downstream of Fall Creek Dam. This site supports and is actively managed for western pond turtles and is a potential Oregon chub introduction site.

Grasslands are primarily non-native. A sizable area situated below the dam and another grassland area is found on the north shore of the lake. Two additional sites are at Sky Camp, located on the south shore of the Fall Creek Arm, and at Cascara Campground, located at the upstream end of the Fall Creek Arm. These grasslands are mowed in areas developed for public use. Upland grass-forb-shrub communities are present only below the dam. They include non-native grasses, teasel, bull thistle (*Cirsium vulgare*), field thistle (*Cirsium discolor*), and Queen Anne's lace (*Daucus carota*). Blackberry (*Rubus armeniacus*) has invaded the fields. These areas have been the focus of an intensive effort in recent years to reduce cover of exotic shrubs and restore native shrubs and trees to both riparian and upland areas. With repeated treatment substantial progress has been made in recent years; lands that were disturbed and highly degraded are currently on the path to better condition.

Bald eagles are routinely observed at Fall Creek and a nest site was located in 2000. The BLM manages a bald eagle nest area on the ridge between the Fall Creek and Winberry Creek arms of the lake. This site has been occupied consistently since 2000 but failed in 2004-2006. The reservoir presumably provides the primary foraging area for this pair. A northern spotted owl activity center has been identified near Fall Creek Lake. One nest site has been located within one mile of Cascara Campground, with the home range of the pair including the campground and upper tip of the Fall Creek arm of the lake. Other spotted owls activity centers occur on adjacent forest lands.

Prior to the early 1990s, the Fall Creek spillway channel was routinely if infrequently "cleared" of woody vegetation, primarily by excavator, to achieve maintenance standards for constructed channels. In the early 1990s, when this activity was proposed to reoccur, the channel had not been cleared in 10 years, and beavers had created a series of wetland impoundments along the length of the channel. These ponds were identified as providing unique and valuable wetland habitats; the ponds have slightly different depths and each is dominated by a different native emergent wetland plant species. After almost 20 years, the ponds are free of reed canarygrass and other exotic species that plague most wetland habitats, including exotic fish which are damaging to Oregon chub (*Oregonichthys crameri*) and amphibian populations. Northwestern pond turtles were observed in the ponds; subsequent trapping led to a population estimated to be approximately 30 individuals. Since that time, a fairly large breeding red-legged frog population has also been identified and monitored.

In recognition of the unique and very valuable habitat provided, Willamette Valley Projects proposed that the spillway ponds be maintained as wetlands, and used to establish a population of Oregon chub in accordance with our participation and support of the *Recovery Plan for the Oregon Chub* (USFWS 1998). A BA was prepared and a concurrence letter was received from USFWS in September 1996. In the BA, the USACE stated that the spillway gates had never been used, but that they could and

would be used if necessary in the course of flood-control operations. The USFWS concurrence recognized the risks and supported the action.

In 1996, 500 Oregon chub were transferred from two Middle Fork Willamette chub sites to the first pond in the spillway channel closest to the dam. The population quickly increased and in 2005, the Fall Creek spillway chub population was the fourth largest in Oregon (6,250 fish). These Oregon chub management activities at Fall Creek were not described in the 2000 BA (USACE 2000).

Northwestern pond turtles inhabit the entire spillway and nest on the sloped banks of the channel near its confluence with Fall Creek. A portable electric fence is set up every year to deter nest predators. With nest protection, this site is capable of producing 50-60 hatchlings per year, and is one of only three or four managed nesting sites in Oregon. As such, this is a regionally significant site for northwestern pond turtles.

A major false-brome infestation centered downstream of Fall Creek Lake and including sites at Fall Creek, Dexter, and Lookout Point threatens understory and riparian habitat throughout the Middle Fork watershed. A cooperative effort to contain and control this infestation has been initiated. Participants include the USACE, Eugene District BLM, Willamette National Forest, the Middle Fork Watershed Council, Lane County, and a number of private land owners including Giustina and Weyerhaeuser.

#### 3.5.1.4. Middle Fork Basin – Hills Creek Lake

A 20-acre pond and wetland was constructed below the Hills Creek Dam in the late 1980s. This pond provides habitat for a small but reproductive population of northwestern pond turtles and large breeding populations of red-legged frogs and northwestern salamanders (*Amybstoma gracile*), in addition to numerous other wetland flora and fauna. Bald eagles routinely perch in the tall snags within the pond. This site was nominated and accepted for recognition in the Oregon Cascades Birding Trail; the deciduous vegetation and wetland attract many birds during migration – 116 species have been confirmed at the site to date and another 34 are probable.

The upland areas below the dam that are managed by the USACE have been the focus of an intensive effort in recent years to reduce cover of exotic shrubs and restore native shrubs and trees to both riparian and upland areas. With repeated treatment substantial progress has been made in recent years; lands that were disturbed and highly degraded are currently on the path to better condition. Native shrubs and trees will enhance the area's value to migrating birds and other native fauna.

One to two bald eagle nests are active most years on lands adjacent to the reservoir; there are two established Bald Eagle Management Areas, one at the upper end of the lake and one near Bull Creek on the eastern shoreline. The bald eagle is the only listed threatened or endangered wildlife or plant species documented at Hills Creek Lake. Two peregrine falcon (*Falco peregrinus*) protection areas are identified near the Hills Creek arm and potentially constrain activities during the breeding season. Several northern spotted owl breeding sites near the reservoir have been identified. Canada lynx (*Lynx canadensis*) and other listed, proposed, candidate, and species of concern may occur in the broader resource area surrounding the project. Special status species that occur on project lands include western pond turtle, red-legged frog, long-legged myotis, western bluebird, and yellow-breasted chat.

The USFS and USACE have cooperatively studied western pond turtle use of the reservoir since 2000. A large and important population of turtles inhabits the reservoir, using the coves along both

shorelines and the lake area above the upper road bridge in the summer when the lake is full. This upper area (known as Upper Crossing) has the highest percentage of juvenile turtles documented in the Middle Fork drainage and is a regionally significant site for western pond turtles in the Willamette (personal communication, Kat Beal, USACE). The USACE and USFS are developing a Public Use Plan as directed by the 1988 Memorandum of Understanding that will address recreational use and environmental protection of the lake's resources, including pond turtle habitats.

#### 3.5.1.5. Middle Fork Basin – Lookout Point and Dexter Lakes

The daily water level fluctuation that may approach 5 feet in magnitude at Dexter Lake limits wildlife habitat. Dexter Lake supports beds of aquatic vegetation, including *Potamogeton crispus*, which provides a significant amount of forage for waterfowl, but lacks emergent aquatics that provide food and cover for wildlife. Dexter does provide habitat for wintering waterfowl and is used extensively by waterfowl in drier winters.

Coniferous forests are the predominant vegetation community on project lands surrounding Lookout Point Lake, encompassing approximately 2,400 acres within the project area. These stands are managed for wildlife diversity; recent management has included creation of snags by topping, girdling, and heart-rot inoculation, creation of live wildlife trees by girdling or topping, and thinning to enhance understory development and increase coarse wood on the forest floor.

Large stands of black cottonwood (*Populus deltoids*) and western redcedar (*Thuja plicata*) forests on either side of the river below Dexter Dam are remnants of a once more typical Middle Fork Willamette ecotype. The southern stand, managed by Oregon Parks and Recreation Department is highly degraded and has been neglected with respect to exotic species management. This area includes a large side channel and a pair of ponds that support a fairly large and young population of northwestern pond turtles.

Shrub vegetation predominates upstream from Lowell along the north shoreline of Dexter Lake, where large stands of blackberry and Scotch broom have succeeded the grass-forb community in many sites and have been aggressively removed, and the area replanted with native shrubs and trees. The narrow cottonwood forest mixed with willow and other native shrubs and trees that parallels the shoreline has been managed to remove exotics shrubs in recent years.

The USACE, BPA, USFS, and numerous partners including ODFW and the Rocky Mountain Elk Foundation are engaged in a cooperative project to enhance the BPA power line easement along Dexter Lake's north shore for big game and non-game wildlife species. Approximately 16 acres of exotic shrubs will be treated and replaced with native shrubs and grasses, improving winter range forage for deer and elk and providing berries and mast for native songbirds.

The only known listed and proposed threatened or endangered wildlife and plant species documented at Dexter Lake is the bald eagle. However, the northern spotted owl may occur in the broader resource area surrounding the project. The USACE manages a 220-acre forest north of Lookout Point Dam known as Eagle Rock, which has supported multiple nests for bald eagles for over 20 years. In 2002 a new nest was discovered below Dexter Dam in the riparian forest. Species of concern and candidate species documented at Dexter include red-legged frog, northwestern pond turtle, western rattlesnake (*Crotalus viridis helleri*), western grey squirrel (*Sciurus griseus*), thin-leaved pea vine (*Lathyrus holochlorus*), and Howell's montia.

Listed and proposed threatened or endangered wildlife and plant species documented at Lookout Point Lake include bald eagle and northern spotted owl. Species of concern or candidate species documented at Lookout Point include northern red-legged frog, northwestern pond turtle, Brazilian free-tailed bat (*Tadarida brasiliensis*), western grey squirrel, mountain quail, thin-leaved pea vine, and Howell's montia.

In 2000, following the listing of UWR Chinook salmon and winter steelhead under the ESA (64 FR 14308, March 24, 1999), flow management in the Willamette River was modified. New minimum conservation flows at Albany and Salem were recommended during April through June of each year (Mamoyac et al., 2000). Management of tributary flows was also altered to balance the demand for water for recreation in the Willamette subbasins with flow levels at Albany and Salem. Because Lookout Point has some of the lowest recreational use and the highest storage volume of the Willamette reservoirs, the demand to draft this reservoir to provide spring flows increased. Under the new management regime, Lookout Point Reservoir was not projected to fill, or if it filled it was not projected to remain full through the chub spawning season (May through mid-July), in most years. In 2000 the USACE initiated a study to determine the feasibility of modifying Hospital Pond to provide managers the ability to independently regulate pond elevation. The ODFW was contracted to collect life history and population data to assess the effects of these modifications on Oregon chub abundance and recruitment (Scheerer and McDonald 2001; Scheerer and Terwilliger 2002; 2003; 2004; Scheerer et al., 2005).

Hospital Pond is a long (~300 meters), narrow (6-10 meters), and deep (2-5 meters) spring-fed pond that was created during the construction of the North Shore Road near Lookout Point Reservoir. A culvert connects the pond to Lookout Point Reservoir at elevations exceeding 916 feet (full pool elevation is 926 feet). Prior to 2001, the availability of suitable Oregon chub spawning habitat in Hospital Pond was dependent on the flooding of the vegetated terrace. Pond elevation was determined solely by reservoir elevation. When the reservoir elevation exceeded 921 feet, the vegetated terrace was flooded. This occurred over a 9-10 week period from early May to mid-July. Hatch date analyses showed that successful spawning of Oregon chub occurred only when the reservoir elevation exceeded 921 feet and the vegetated terrace was flooded (Scheerer et al., 1998; Scheerer and McDonald 2000). After the reservoir level dropped in mid-July, the water temperature in the pond dropped and no successful spawning was documented. In 2001, the Willamette Basin experienced drought conditions and Lookout Point Reservoir did not fill. These conditions negatively impacted the recruitment of Oregon chub in Hospital Pond. Successful spawning was limited in 2001, resulting in a weak 2001 year-class.

Pond modifications were conducted in 2001-2003. In the spring of 2001, the USACE installed a gate on the culvert exiting Hospital Pond. However, leakages around the culvert and through the road fill prevented managers from being able to increase pond elevations enough to flood the pond terrace. In the spring of 2002, the USACE sealed the western end of the pond with bentonite clay and reconstructed the gate on the culvert. In 2002, pond elevation was maintained above the elevation of the vegetated terrace (921 feet) only when the reservoir elevation exceeded 917 feet. When the reservoir dropped below 917 feet, the pond elevation stabilized at 920 feet. In 2003, the USACE excavated a shallow alcove in the terrace to provide potential spawning habitat that was available for Oregon chub at the pond elevations less than 920 feet. In 2003-2005, the newly excavated alcove was flooded from May through October. However, water temperatures in the alcove exceeded 15°C (a threshold for supporting chub spawning) only when the water depth in the alcove was relatively shallow (< 1.5 feet).

The USACE working with ODFW will continue to monitor chub populations and productivity in Hospital Pond. Active management of pond water levels and habitat conditions will continue with the goal of maintaining a viable Oregon chub population in Hospital Pond.

#### 3.5.1.6. Coast Fork Basin – Dorena and Cottage Grove Lakes

Bald eagles are the only known listed or proposed threatened or endangered wildlife and plant species documented at Dorena Lake. However, northern spotted owls and Canada lynx may occur in the broader resource area surrounding the project. Species of concern and candidate species documented at Dorena Lake include northwestern pond turtle, red-legged frog, western rattlesnake, western grey squirrel, western bluebird, willow flycatcher, yellow-breasted chat, purple martin (*Progne subis*), and shaggy horkelia (*Horkelia congesta ssp. congesta*). A 493-acre unit at the lake's upper end is managed to provide riparian and wetland habitats for a variety of wildlife and supports a nesting colony of purple martins, an Oregon conservation strategy species.

#### 3.5.1.7. Long Tom Basin – Fern Ridge Lake

Since 1979, almost 900 acres of wetland impoundment have been constructed and operated to provide habitat for wildlife, with an emphasis on attracting and holding wintering waterfowl. In past years, this was accomplished by draining the impoundments in the spring and planting cereal grains; most acreage is now managed to maintain year round wetland habitat through moist soil management, which provides waterfowl with seed from native plants while also providing quality wetlands for the myriad species that use them. Moist soil management techniques employ a combination of water level control, periodic soil disturbance, and timed draw down and inundation to foster growth of native wetland species. These seasonally wet or semi permanent marshes provide a productive habitat base to support wildlife diversity.

Completed in 2000, the most recent additions (Fisher Butte field #5 and #6) added 320 acres of wetland habitat to the project. These last two impoundments were constructed within the lake in an extensive reed canary grass marsh; current efforts focus on disking, water level control, and other treatments to reduce canary grass and promote native vegetation in the wetland. Water level control is integral to moist soil management within the impoundments and is achieved primarily through pumping and a system of control structures used to drain or fill a cell as appropriate. Approximately 50-100 acres of grain crops (corn, soybeans, rice) are planted each year in the Fisher Butte and Coyote units; these crops require irrigation to produce seed for waterfowl.

Of the 13 Willamette projects, Fern Ridge has the greatest abundance and diversity of listed threatened and endangered plant and wildlife species, as well as those that are candidates or species of concern. The following are known to occur at Fern Ridge Lake: Camas pocket-gopher (*Thomomys bulbivorous*), western grey squirrel, black tern (*Chlidonias niger*), willow flycatcher, yellow-breasted chat, purple martin, western bluebird, Oregon vesper sparrow (*Poocetes gramineus*), western meadowlark (*Sturnella neglecta*), bald eagle, Bradshaw's desert parsley (*Lomatium bradshawii*), white-topped aster (*Aster curtus*), Willamette daisy (*Erigeron decumbens var. decumbens*), Kincaid's lupine (*Lupinus sulphureus ssp. kincaidii*), Fender's blue butterfly (*Icaricia icaroides fenderi*), wayside aster (*Aster vialis*), Willamette Valley larkspur (*Delphinium oreganum*), shaggy horkelia, thin-leaved pea vine, timwort (*Cicendia quadrangularis*), northern red-legged frog, northwestern pond turtle, long-eared myotis, fringed myotis, Howell's montia, little willow flycatcher (*Empidonax traillii brewsteri*), olive-sided flycatcher (*Contopus borealis*), and streaked horned lark (*Eremophila alpestris strigata*). Fern Ridge marsh provides breeding and brood habitat for several species that do not typically nest west of the Cascades or are otherwise unusual or rare,

including black tern, yellow-headed blackbird (*Xanthocephalus xanthocephalus*), Wilson's phalarope (*Phalaropus tricolor*), and black-necked stilt (*Himantopus mexicanus*). The box nesting population of purple martins is the second largest in Oregon.

On October 31, 2006, the USFWS designated critical habitat for Willamette daisy, Kincaid's lupine, and Fender's blue butterfly. At Fern Ridge, most high quality wet prairie sites and most upland prairie habitat occupied by the lupine/butterfly system was included in this designation. The USACE is pursuing a comprehensive management program to maintain habitat and increase population numbers of listed plant and insect species. Four listed species typical of prairie habitats are the primary targets. Willamette daisy and Bradshaw's lomatium are characteristic of a rare wet prairie plant community in the Willamette Valley. Kincaid's lupine and Fender's blue butterfly occur in upland prairie sites. Globally important occurrences of these species persist at Fern Ridge. For example, the Willamette daisy population is among the largest left. Recovery activities by the USACE include prescribed fire, habitat mowing, weed treatment, ecological restoration of degraded sites, and propagation of listed species for population augmentation and creation. Consultation on the effects of these activities to the species and their critical habitat was completed on March 21, 2007. The recovery program is described in the document, *Management Activities for Rare Plants and Insects, Fern Ridge* dated June 12, 2006 and the subsequent BiOp (TS number 06-1967); the program is summarized below.

The wet prairie habitat of Willamette daisy and Bradshaw's lomatium is a fire-dependent system. Research has demonstrated that fire directly benefits both prairie structure and population numbers of listed plants. The USACE schedules prescribed burning on a 2-3 year cycle on these sites. Mowing is used to control woody invasion in wet prairie and upland sites, and carefully timed early season mowing is intended to reduce the dominance of invasive grasses. Substantial manual and chemical treatment of invasive species is required annually in both habitat types. These treatments target a number of invasive plants that threaten listed species and their habitats, including exotic blackberries, Scotch broom, reed canarygrass, false-brome, meadow knapweed (*Centaurea x pratensis*), and tall oatgrass (*Arrhenatherum elatius*). A complete restoration program will initially target about 80 acres of upland prairie with the ultimate goal of introducing the lupine/butterfly system. Potential to restore up to 300 upland acres exists at Fern Ridge. The USACE propagates all listed plant species, as well as other species of conservation concern, from local seed collections in order to augment small populations and create new ones in high-quality sites. In addition, the USACE monitors each listed species to determine population trends and guide management.

The western pond turtle population at Fern Ridge is one of the largest remaining in the Willamette Valley; nesting areas are managed at Kirk Pond below the dam and can produce 120-150 hatchlings annually. The Kirk Pond population is hydrologically connected to a large tract of riparian and wetland habitat downstream along Coyote Creek, identified as a high quality remnant of a historically more common oak/ash forested wetland.

### 3.5.2. Offsite Habitat Restoration Actions

#### 3.5.2.1. Habitat Restoration Actions

**Proposed Action:** ***For offsite river reaches upstream and downstream of USACE project lands, the USACE will use its existing authorities under the General Investigations (GI), Continuing Authorities Program (CAP), and Planning Assistance to States to undertake habitat restoration projects in the Willamette Basin. Under these programs, the USACE has standing authorities to evaluate and implement aquatic ecosystem restoration projects throughout the basin. These***

***programs do require cost-sharing and other forms of support from qualified non-federal sponsors. They also are not currently a high budgetary priority of the administration and federal funds can be difficult to obtain. However, these programs are the only vehicle available to the USACE for undertaking habitat restoration off of USACE project lands.***

The Action Agencies are committed to continuing to working collaboratively with the Services and other key public and private entities with responsibilities and interests in habitat restoration to strategically identify potential ecosystem restoration projects focused on restoring priority habitat needed for life-cycle requirements of ESA-listed species. The process for coordination of the strategic use of the USACE GI and CAP authorities to address ESA needs in the Willamette Basin will need to be integrated with ongoing actions of that specific nature, including (but not limited to) the development and implementation of the NMFS Recovery Plan for Lower Columbia and Upper Willamette Salmon and Steelhead ESUs

Section 1.6.1 of the 2000 BA (USACE 2000) includes a description of the GI and CAP programs, and included the projects underway at that time. The GI and CAP programs are the normal USACE mechanism for planning, designing, and constructing new projects and updating existing ones. Both programs include procedures for obtaining Congressional authorization and funding for project construction. Although these programs are constrained by non-federal sponsorship requirements and by current federal budgetary priorities, they are the only mechanisms directly available to the USACE for addressing downstream habitat needs for improved survival and recovery of listed species. Therefore, the Action Agencies are proposing to work strategically with the Services to use those authorities wherever possible to address the habitat needs of ESA-listed species.

The habitat restoration projects in the Willamette Basin under development by the Action Agencies and their partners vary in size, design, scope, and location. In general, all habitat and bank protection-related restoration projects are intended to improve stream banks and adjacent river reaches by moving the trajectory of associated principle constituent elements of critical habitat within them toward a properly-functioning condition. Restoration projects are expected to improve hydrogeomorphic dynamics, large wood and sediment processes, floodplain forest recovery and connectivity, sediment transport processes, and channel complexity by replacing hardened (e.g., rip rap) bank structures that provide little geomorphic or biological benefit with more natural bank treatments containing large wood, riparian vegetation, and natural bank material. Additionally, some bank protection-related restoration projects may involve removal of a structure to reconnect off-channel habitat, providing additional rearing and holding habitat to improve abundance and productivity of UWR Chinook salmon and steelhead. Physical and biological monitoring is important in determining the effects of each project on geomorphic and biological processes within the project area. Results of the monitoring efforts will be important for designing and implementing future restoration projects, and for evaluating the response of listed species, their prey base, and habitat to the projects implemented.

#### 3.5.2.2. General Investigations Program

The GI program is used by the USACE and non-federal sponsors to generally address complex, large-scale, multiple purpose water resource projects that are specifically authorized by Congress. Projects under this authority can look at a broad and complex range of activities and have no set funding cap or limit. The GI study is conducted in two phases. The first phase, called the reconnaissance phase, is designed to identify water resource problems and opportunities in which there is a federal interest in conducting a more detailed feasibility phase study. The feasibility study is conducted with 50/50 cost-sharing by a non-federal sponsor. Feasibility studies are generally

intended to lead toward recommendations for federal water resource projects. The recommendations contained in feasibility studies are submitted forward for administration approval and Congressional authorization and approval. Implementation by the USACE requires both Congressional authorization and approval.

There are currently three ongoing feasibility studies in the Willamette Basin in which ecosystem restoration is a primary objective: (1) Willamette Floodplain Restoration Study; (2) Eugene/Springfield Metropolitan Area Watershed Study; and (3) Lower Willamette Ecosystem Restoration Study. Individually and collectively, these GI efforts have the potential to lead to future ecosystem restoration projects that could significantly benefit habitat requirements for ESA-listed aquatic and terrestrial species. However, none of these studies is expected to lead to project implementation prior to FY 2010.

Willamette River Floodplain Restoration Study. The 2000 BA (USACE 2000) described the Willamette River Floodplain Restoration Study, which was in the reconnaissance phase at the time. The feasibility study began in 2003 when the USACE executed a Feasibility Cost-sharing Agreement with the non-federal Sponsor, the Willamette Partnership. Other key partners include the Willamette Middle and Coast Fork Watershed councils, ODFW, and The Nature Conservancy (TNC). In addition, there is an inter-disciplinary expert and stakeholder group that includes approximately 20 federal, state, and local entities, as well as private landowners. Both the NMFS and USFWS have participated in the stakeholder group.

The purpose of the Willamette River Floodplain Restoration Study is to evaluate opportunities to modify existing floodplain features in the Willamette Valley to reduce flood damages while restoring natural wetlands and promoting ecosystem restoration. Floodplain restoration offers an excellent opportunity to provide additional flood protection for the Willamette Basin through non-structural floodplain restoration measures. Floodplain restoration would reduce flood hazards to homes, public structures, and farms while allowing for fish and wildlife habitat restoration. A restored floodplain would act to absorb excess flood waters, slow the velocity of flood waters, and create habitat for a wide variety of plants and animals, including proposed and federally-listed threatened and endangered fish species, such as bull trout, steelhead, and spring Chinook salmon.

After evaluating a number of alternative reaches of the Willamette mainstem and other subbasins, the Middle and Coast Forks were chosen as priority focus areas. These reaches were selected based on the potential for restoring floodplain and related habitat complexity and diversity, the availability of public lands on which to initiate restoration projects, and a high degree of interest by watershed councils and other local stakeholders. Efforts to date have focused on technical analysis of the study area reaches, including inventory and analysis of site conditions, development of baseline ecological and physical data, evaluation of historic and ongoing hydrogeomorphic conditions and processes, and preparation of hydraulic and ecological models. Preliminary analysis identified five reaches within the two rivers in the study area with high potential for ecosystem restoration. In 2007, depending on available funds, the USACE and non-federal sponsor intend to continue with more detailed evaluation of the one or two highest priority reaches.

A key element of the study is evaluation of potential modifications of flow releases on the Coast and Middle Fork dams. This element of the study is being conducted by the USACE in partnership with The Nature Conservancy under the nationwide Sustainable Rivers Project (SRP). The Willamette SRP will build on the floodplain restoration study by developing environmental flow recommendations for the reaches downstream of the USACE dams and linking those flows to opportunities for stream channel and floodplain restoration, and improvement in operation of the

dams consistent with authorized purposes. Given the existing floodplain restoration study, the initial SRP efforts is focusing on the Coast and Middle Forks and the mainstem Willamette River immediately downstream of these tributaries, as a pilot study that can be replicated in the rest of the Willamette system.

Possible outcomes and alternatives that might be recommended for implementation as a result of the Willamette Floodplain Restoration Feasibility Study include:

- Criteria and priorities for floodplain restoration activities.
- Conservation of floodplain lands.
- Removal and/or modification of bank revetments.
- Restoration of riparian corridors.
- Agricultural levee set-backs.
- Increased natural flood storage.
- Bio-sensitive channel bank and floodplain protection.
- Modification of reservoir operation.

The feasibility study is scheduled for completion in FY 2008. It is intended to be a pilot reach study; the tools, processes and projects developed as a result of the Middle and Coast Fork studies will be exported to other reaches and subbasins in the Willamette Basin, although additional federal and non-federal funding will be required to expand the study beyond its current scope.

Eugene-Springfield Metropolitan Area Watershed Feasibility Study. The purpose of this study is to develop comprehensive water-resource improvement projects in four western watersheds within the urban metropolitan area – with benefits for multiple water resource objectives. These objectives include flood damage reduction, aquatic ecosystem restoration, water quality improvement, public use, waterway improvements and integrated watershed management. The study is initially focusing on two priority-planning corridors: Amazon and Cedar creeks. The USACE and non-federal sponsors are currently developing cost estimates for conceptual alternatives along each creek. The study will eventually focus on practically all the waterways located in the metropolitan area of Eugene-Springfield, including the mainstem Willamette River and the McKenzie River.

Lower Willamette Ecosystem Restoration Feasibility Study. This study was initiated in FY 2004. The non-federal sponsor is the City of Portland. The study will assess the feasibility of ecosystem restoration, including remediation of contaminated sediments over a portion of a 25-mile reach of the Willamette River in Portland. The feasibility study area encompasses the lower Willamette River watershed from Willamette Falls to its confluence with the Columbia River. The study objectives are to assess opportunities to: (1) increase the number of interconnected, active channels and open slack water areas; (2) increase shallow-sloped and less reinforced shoreline areas, and bank vegetation; (3) improve access to tributary streams; (4) increase emergent wetlands and riparian forest; and (5) improve sediment and water quality.

Under the current federal funding environment, the feasibility study is scheduled for completion by FY 2011. In FY 2006, the USACE completed the without-project condition report, which identified numerous conceptual projects as shown in Table 3-22. This list is provided as en example of the types of restoration projects that may ultimately be implemented as a result of the feasibility study.

**Table 3-22. Initial Screening of Potential Lower Willamette Ecosystem Restoration Projects**

| Project | Water Body | Potential Ecosystem Restoration Projects |
|---|---|---|
| Alsop-Brownwood | Johnson Creek | Create off-channel habitat for salmonids and water quality improvements. Create flood storage to mitigate nuisance flooding. |
| Arnold Creek Culvert | Tryon Creek | Retrofit Tryon Creek culvert to provide passage to lower Arnold Creek Bell Station. Create off-channel habitat. Purchase frequently flooded properties and create flood storage to mitigate nuisance flooding. Address exposed sewer pipe crossing creek. |
| Bell Station | Johnson Creek | Create off-channel habitat. Purchase frequently flooded properties and create flood storage to mitigate nuisance flooding. Address exposed sewer pipe crossing creek. |
| St. John's Landfill Boat Launch | Columbia Slough | Pull back banks and create wetland benches, create off-channel wetland habitat, and plant vegetation to create wildlife habitat. |
| BES Treatment Plant Banks | Columbia Slough | Lay back banks, increase amount and quality of vegetation, add anchored wood. Create small off-channel wetlands (if site uses and existing habitat can be protected). |
| Blind Slough | Columbia Slough | Valuable off-channel habitat with good existing riparian canopy and shrub vegetation. Habitat values can be increased by improving channel structure by adding large woody debris (LWD), increasing area of off-channel habitat, and minor revegetation. |
| Boones Ferry Culvert Retrofit | Tryon Creek | Retrofit culvert to provide passage from Tryon Creek State Natural Area to Marshall Park and Upper Tryon Creek. |
| Cathedral Park | Willamette Mainstem | Revegetate banks; retrofit parking lot and existing swale; create off-channel wetland habitat (includes increase in shallow water habitat), LWD placement. |
| Centennial Mills | Willamette Mainstem | Demolition or redevelopment of this site provides the opportunity to improve banks and floodplain. Daylight Tanner Creek and create off-channel cool water confluence habitat. |
| City Banks opposite Kelley Point | Columbia Slough | Pull back banks and create small alcoves. Location at major confluence provides important connections to both Willamette and Columbia River fish populations. |
| Crystal Springs Culvert Replacements | Johnson Creek | Replace culverts at Tacoma and Tenino Streets and improve passage under private carport to improve access to restored habitat at Westmoreland Park. |
| Eastbank Crescent | Willamette Mainstem | Regrade and revegetate banks; increase shallow water habitat; incorporate stormwater treatment. |
| Elk Rock/Spring Park | Willamette Mainstem | Add wood, increase vegetation and enhance good existing habitat. Acquire property from willing sellers to increase complexity of off-channel habitat. |
| Freeway Land Company/East Lents | Johnson Creek | Create off-channel habitat for salmon and water quality improvement. Create flood storage to mitigate nuisance flooding. Purchase homes to move residents out of floodplain. |
| Kelley Point Park | Willamette Mainstem | Remove invasive plants and plant native species; create off-channel habitat |
| Kenton Cove | Columbia Slough | Add wood to enhance habitat complexity in this off-channel habitat. |
| Lower Powell Butte | Johnson Creek | Purchase frequently flooded properties from willing sellers. Restore floodplain and create off-channel habitat. |
| Marshall Park Channel Restoration | Tryon Creek | Improve channel conditions along Marshall Park by stabilizing banks with bio-engineering and adding instream complexity to improve habitat and water quality. |
| Middle TCSNA Habitat Enhancement | Tryon Creek | Enhance habitat by controlling erosion along the tributaries to protect mainstem habitat, replacing culverts, and increasing instream complexity along the mainstem. |
| Oaks Bottom Wildlife Refuge | Willamette Mainstem | Restore off-channel habitat; control invasive plant species; improve banks. |

| Project | Water Body | Potential Ecosystem Restoration Projects |
|---|---|---|
| Oaks Crossing/Sellwood Riverfront Park | Willamette Mainstem | Improve amount and quality of vegetation in floodplain. Create off-channel and additional shallow water habitat that are consistent with park uses. |
| Oxbow at Errol Heights | Johnson Creek | Purchase frequent flooded properties and create flood storage to mitigate flooding. Rehabilitate wetlands. Create off-channel habitat. |
| Powers Marine Park | Willamette Mainstem | Remove invasive plant species, revegetate, establish wood jams, create off-channel habitat at the confluences of the seasonal streams flowing off the hillside. |
| Ramsey Refugia | Columbia Slough | Restore 5 acres of floodplain forest and backwater slough habitat by restoring hydrologic connectivity between Ramsey Lake Wetland and the Columbia Slough. |
| Smith and Bybee Lakes | Willamette Mainstem | Revegetate areas along the lakes. Upgrade water control structure to allow more natural hydrology and salmon access (in progress). |
| Stephens Creek Mouth | Willamette Mainstem | Maintain off-channel habitat; expand on existing high quality functions. |
| Swan Island Beach South | Willamette Mainstem | Maintain habitat values at this site. Pull back banks, increase vegetation and wood, and restore floodplain. |
| Tryon Creek Confluence | Tryon Creek | Pull back steepened banks, improve composition of floodplain and frequency of inundation, vegetate banks, improve complexity of channel, add wood. |
| Tryon Highway 43 Culvert | Tryon Creek | Improve passage and channel conditions to improve access to one of the largest contiguous high quality habitats in the city, Tryon Creek State Natural Area. |
| Waterfront Park Bowl | Willamette Mainstem | Remove rip rap, plant native vegetation, create shallow water habitat, and increase bank complexity. Provide moorage to discourage anchoring on banks. |
| West Lents | Johnson Creek | Create off-channel habitat. Create flood storage to mitigate nuisance flooding. Purchase frequently flooded properties to move people out of the floodplain. |
| Westmoreland Park | Johnson Creek | Improve fish and wildlife habitat and fish passage in Crystal Springs and Westmoreland Park. |
| Willamette Cove | Willamette Mainstem | Restore consistent with site master plan. Create off-channel habitat. Remove riprap and regrade banks to expand shallow water habitat and floodplain. Increase vegetation on banks and floodplain. |
| Willamette Park | Willamette Mainstem | Improve over-steepened and hardened banks; revegetate, protect and enhance shallow water habitat; create off-channel habitat. |
| Wright and Moore Islands | Columbia Slough | Enhance good existing habitat by adding wood and looking for opportunities to excavate off-channel wetland habitat. Lay back banks at Heron Lakes to create wetland benches. |

#### 3.5.2.3. Continuing Authorities Program

The CAP generally includes smaller, single-purpose water resource projects for which Congress has delegated authority to the USACE to construct without specific authorization. Two of these authorities specifically allow ecosystem restoration projects, including restoration of habitat critical for recovery of ESA-listed species. Section 1135 authorizes the USACE to modify existing projects for ecosystem restoration, and the Section 206 authority is used to restore degraded aquatic ecosystems.

There have been no significant changes in these authorities from the descriptions contained in the 2000 BA (USACE 2000). They remain potentially valuable tools for the USACE and other Action Agencies to use to restore aquatic habitat conditions in the Willamette Basin. However since FY 2004, funding for the CAP has been highly constrained. Coupled with a high national demand for projects under the Sections 1135 and 206, federal funds under these authorities can be difficult to obtain. Nevertheless, the USACE has a number of Sections 1135 and 206 projects on-going (in different phases of development) in the Willamette Basin that individually and cumulatively could lead to significant habitat improvements for ESA-listed species. As noted in the proposed action

statement above, the USACE is committed to continuing to working collaboratively with NMFS, USFWS, ODFW, and other key public and private entities with responsibilities and interests in habitat restoration to strategically identify potential ecosystem restoration projects focused on restoring priority habitat needed for life-cycle requirements of ESA-listed species. Provided below is an updated list of Willamette Basin projects currently in the Section 1135 and 206 programs.

Lower Amazon Creek Wetlands Section 1135. This project was constructed in partnership with City of Eugene. Construction was initiated in 1999 and substantially completed in 2004. The project removed approximately 24,000 linear feet of levee along Amazon Creek (a tributary to the Long Tom River) and restored floodplain connectivity between Amazon Creek and approximately 400 acres of wet prairie wetlands.

Eugene Delta Ponds Section 206. Construction was initiated in 2005 in partnership with City of Eugene. The project is providing floodplain and hydrologic connectivity to the Willamette River mainstem through a series of old gravel pits. After initial hydrologic connections were installed in 2006, juvenile salmonids were found using the restored rearing habitat almost immediately.

Springfield Millrace Section 206. The feasibility study is completed and design has been initiated. The project will protect, enhance, an create habitat for native wildlife and fish, including ESA-listed species by constructing a permanent water intake structure for the millrace; ensuring adequate water delivery to the millrace, millpond, and associated wetlands; placing fish screens to prevent fish entrapment; creating a main channel through the millpond and lowering the dam to increase water velocity through the pond; constructing a 20-acre wetland and swales in the millpond to increase wildlife habitat diversity and filter run-off into the millrace; and restoring riparian vegetation along the banks of the millpond. The project is currently on-hold due to lack of funding but will be resumed when funding becomes available.

Springwater Wetlands Complex Section 206. The feasibility study will be completed in FY 2007. The project improves habitat for a wide variety of wildlife species, including neotropical migratory birds, waterfowl, shorebirds, amphibians, reptiles and mammals. The scope of this ecosystem restoration project would consist of up to 40 acres of wetland and riparian restoration. The project is scheduled for completion in the fall of 2008.

Westmoreland Park Section 206. The feasibility study was completed in partnership with the City of Portland. The project will provide juvenile fish passage from Johnson Creek up to the upper end of Westmoreland Park; significantly improve aquatic habitat for ESA-listed salmonid rearing and refuge; provide a significant riparian corridor and wetland habitat for wildlife species; and significantly improve water quality conditions by eliminating the duck pond (which currently causes significant heating of the water), reducing excessive waterfowl use of the park, and reducing runoff of other contaminants by providing a buffer for the creek and wetlands. The project is currently on-hold due to lack of funding. Project will be resumed when funding becomes available.

Oaks Bottom 206. The feasibility study was completed in partnership with the City of Portland. The project would relocate culverts; restore lands north of the existing reservoir through excavation of channels, and restore critical habitat for ESA-listed salmonids. The project is part of the City of Portland's "River Renaissance Project" that aims to restore the health of the Willamette River. Oaks Bottom is part of this larger initiative and is important to help restore native vegetation, improve water quality, and restore habitat for threatened and endangered fish species. The project is currently on-hold due to lack of funding, but will be resumed when funding becomes available.

### 3.5.3. North Santiam Gravel and Large Wood Restoration Study

**Proposed Action:** ***The Action Agencies, working in collaboration with the North Santiam Watershed Council and other project partners, will undertake a study to determine the potential for improvement of habitat conditions for ESA-listed species and other aquatic species through a well-planned gravel augmentation and large wood restoration project.***

A technical team with representatives from USACE, NMFS, USFWS, ODFW, and the North Santiam Watershed Council met on February 16, 2006 to discuss the potential for improving salmonid spawning through gravel augmentation and related habitat restoration activities, including large wood restoration. The team concluded that potential does exist but that there is currently no clearly defined project ready to be implemented. The group further concluded that a number of research questions exist that should be addressed before a restoration project or projects can be designed. Questions include:

1. Gravel Composition: (a) What is the gravel composition above Big Cliff Dam and is it appropriate to enhance spawning beds? (b) What size is the gravel and is it appropriate for spawning?

2. Gravel Placement: (a) How far downstream is gravel depreciated? (b) Should gravel be placed strategically downstream? If so, where and how do we maintain it? (c) If gravel is placed just downstream of the dam, how do we ensure sorting and distribution? (d) Is there enough structure (e.g. large wood) downstream to retain gravel so that it may provide benefits for spawning habitat?

3. Hydrology: (a) Do releases from dams need to be adjusted to ensure sorting and distribution? If so, how? Is flow timing and quantity adequate to move gravel as needed? (b) Do releases from the dams need to be adjusted to ensure access to spawning area provided by gravel augmentation?

4. Resulting Habitat: (a) What are the target species and life stages this project will benefit? (b) Can we quantify how much spawning habitat will result from moving this gravel downstream? (c) Is it enough gravel to provide benefits?

The proposed study will be designed to address those and other related questions. The objectives of the study are to: (1) define the problem; (2) identify potential solutions/alternatives; and (3) analyze costs, benefits, and environmental impacts of alternatives. The goal of the study is to identify gravel augmentation and/or large wood projects that can be implemented in the North Santiam basin to restore habitat. The Action Agencies assume that the North Santiam study results can also be applied to similar situations in other subbasins.

### 3.5.4. Willamette River Bank Protection Program

**Proposed Action:** ***The Action Agencies propose to undertake a comprehensive evaluation of the habitat and biological impacts of revetments placed or funded by the USACE Willamette River Bank Protection Program. The objectives of the study will be to: (1) inventory and analyze the status of existing bank protection sites in the basin; (2) identify bank protection sites where removal or modification may be feasible to restore natural river functions; (3) evaluate the cumulative effects of bank protection on the river and riparian zone; (4) provide an estimate of areas threatened by future erosion and bank protection work; (5) reexamine procedures and criteria for justifying new bank protection projects; (6) identify and evaluate current and***

***alternative bank protection measures; and (7) recommend and establish criteria for future bank protection works, including maintenance, repair and rehabilitation of existing sites. The study will be undertaken in close coordination with the Services.***

Section 2.12 of the 2000 BA (USACE 2000) described the Willamette River Bank Protection Program. The USACE constructed approximately 93 miles of bank protection projects on the Willamette River and its tributaries. The USACE has not undertaken any new bank protection works nor repaired or replaced any of the existing project sites since the 2000 BA was completed.

In reviewing the Willamette River Bank Protection Program, the USACE acknowledges that the program, as authorized by the 1938, 1950, and 1960 FCAs, has been long since completed and operation and maintenance turned over to others, as required by the 1936 FCA. The USACE also acknowledges that in the overall Congressional scheme for Willamette Valley flood control, about half of the flood control protection was to be achieved by the 13 dams and the other half by the bank protection and levee works. Consequently, without additional statutory authorizations including real estate and sizable additional appropriations, as well as without the State of Oregon or other qualified governmental parties stepping forward as local sponsors, the USACE legal authority and ability to make changes to the existing bank protection sites are extremely limited by current law.

The revetments in the Willamette Project area have degraded habitat processes in a number of ways and are continuing to simplify natural habitat for listed species and to maintain artificial habitat for their predators. The proposed study will identify the feasibility of removing or modifying existing revetments to restore natural habitat and biological processes. The Action Agencies will use the information developed through the comprehensive review to proceed with the planning and coordination required for removing or modifying identified revetments. A source of funding and a time frame for conducting the proposed study has not been identified. The USACE will place a priority on attempting to program funds and initiating the study as soon as possible.

#### 3.5.4.1. Brief Description of the Proposed Bank Protection Study

The proposed study will include all USACE revetments in the Willamette Basin. There are approximately 330 revetments to be included in this review. The scope of the study will be developed in coordination with the Services. However, as a preliminary proposal the Action Agencies recommend the study encompass the following tasks.

Task No. 1 – Establish Biological and Physical Goals and Objectives. The study will seek to establish defining goals and objectives for maintaining the existing revetments in the Willamette Basin that allows the bank protection program to work in concert with the described goals for protection of ESA-listed species. It will also define goals and objectives for future new bank protection projects in the basin. Although no new bank protection projects are currently envisioned it can be assumed that some bank protection works may be necessary in the future to protect critical infrastructure. The study will clarify tasks for both USACE-maintained bank protection projects and sponsor maintained bank protection projects.

Task No. 2 – Develop Biological and Physical Criteria. Based on the goals and objectives established in Task 1, the study will develop specific protocols and criteria for maintenance, repair, and rehabilitation of existing bank protection sites. It will also establish general design criteria for modification and/or removal of existing bank protection sites.

Task No. 3 – Perform Complete Inventory of Bank Protection Sites. This task will involve development and implementation of a process for inventorying existing revetments and using criteria and protocols developed under Task 2 to identify revetments which could be removed or otherwise modified to restore ecological function.

Task No. 4 -- Preliminary Site Evaluations. Based on Task 3, identify bank protection locations that could provide the significant improvement in physical and/or biological conditions subsequent to modification, repair, or removal.

Task No. 5 – Prepare Conceptual Designs and Preliminary River Hydraulics/Channel-stability Analysis. Generic conceptual designs will be prepared for the sites identified under Task 4 as having potential for modification to improve biological conditions. Preliminary hydraulics/channel stability evaluations will be undertaken.

Task No. 6 – Final Report. The product of the study will be a Preliminary Inventory and Evaluation Report. The report will identify and list pertinent information on each revetment; include additional information (current condition, function, and recommendations) on those revetments identified that could be removed or modified; conceptual designs; and the preliminary hydraulics/channel-stability analysis. The report will be forwarded to the Services with USACE recommendations.

#### 3.5.4.2. Future Actions to Remove or Modify Revetments

Out of the 138 bank protection sites constructed by the USACE in the Willamette Basin, the USACE retains maintenance responsibility for only those 88 sites constructed prior to 1951; the remaining sites are maintained by a non-federal sponsor. The USACE may be able to use operations and maintenance funding to modify sites for which the USACE does retain maintenance responsibility. However, those funds are likely to remain highly constrained.

It is more likely that the USACE will seek funds to implement the recommendations of the bank protection study through the GI and CAP Section 1135 and 206 authorities. In particular, the Willamette Floodplain Restoration Study is currently evaluating the potential for restoring floodplain restoration function on the reaches of the Coast and Middle Forks downstream of the USACE dams. The study will consider the potential for removing or modifying some of the approximately 30 bank revetments in the study area. As previously noted, non-federal sponsorship will be required to implement project modification under CAP and GI authorities. Detailed design and hydraulic analysis necessary to undertake any bank revetment modifications will need to be done for any sites chosen for revetment modification or removal.

In any case, the USACE has no unilateral authority to remove or modify existing bank protection sites. The sponsor must provide part of the funding for project construction and is responsible for maintaining the project when construction is complete. Before the USACE can remove or modify any of these projects, it must reach agreement with the project sponsor about the action. The USACE will negotiate such agreements. Once the evaluation is complete to specify the number, location, methods, and monitoring of these projects. Even for those projects constructed prior to 1950 for which there is no local sponsor, the bank improvements are located on private lands. The USACE manages only minimal real estate interest for placement and maintenance of the revetments. Landowner approval will be a prerequisite for any revetment removal or modification.

### 3.5.5. Habitat Related Research Monitoring and Evaluation

In conjunction with the previously described existing authorities for land and water resource protection and management on USACE-administered lands, the CAP and GI programs, and the Willamette Bank Protection project, the Action Agencies will undertake certain habitat-related research, monitoring and evaluation (RM&E) measures. Action Agency funding for RM&E activities is limited. The USACE has a national policy limiting expenditures for RM&E associated with ecosystem restoration projects to 1% of total project costs. This policy will be applied to all restoration projects developed under the CAP and GI programs unless a waiver is granted by USACE headquarters. Likewise, funding available for RM&E in the USACE operations and maintenance budget is also constrained.

Nevertheless, the Action Agencies recognize that effectiveness monitoring associated with habitat restoration projects is critical for continuing an effective adaptive management approach to restoring habitat utilized by ESA-listed and other aquatic and terrestrial species in the Willamette Basin. Habitat restoration needs in the basin are extensive but total funding available to the Action Agencies and others for implementing habitat restoration is limited. In that situation, an adequate RM&E program will be necessary to establish and maintain clear priorities.

It is the intent of the Action Agencies that the RM&E program be developed in more detail and implemented in coordination through the RM&E Committee of WATER (see Section 3.1). Section 3.8 provides a proposed RM&E program overview including further guidance on principles, guidelines, and procedures for a proposed RM&E program integrated across all the separable elements of the revised proposed action.

#### 3.5.5.1. Aquatic Habitat Assessments

**Proposed Action:** ***By the end of FY 2007, the Action Agencies will complete ongoing surveys of aquatic habitat availability and condition in the Willamette River mainstem and major tributaries. The Action Agencies recognize that this data will be valuable to NMFS, USFWS, USFS, ODFW, and other agencies and entities engaged in planning and implementing recovery actions for ESA-listed aquatic species in the Willamette Basin. The Action Agencies will distribute copies of the final report to the Services and will make the report available on the internet at https://www.nwp.usace.army.mil/home.asp. Habitat survey data will also be available to the public on this website in a GIS format.***

The Action Agencies believe that accurate and current survey and assessment of aquatic habitat conditions in the Willamette River and tributaries will be necessary in order to compare and evaluate the entire range of ESA-related conservation measures under consideration by the Action Agencies in this revised proposed action as well as by others in the Willamette Basin. For example, a critical step in the process of evaluating efforts to reintroduce UWR Chinook salmon and winter steelhead into habitat upstream of USACE dams, is determining if adequate habitat exists support the holding, spawning and rearing life stages of spring Chinook. Only based on that evaluation would it be prudent to consider substantial investments in structural modifications at USACE dams to improve fish passage conditions. Most habitat upstream of USACE dams is under federal management and it appears to be in relatively good condition. However, no summary of habitat quality in these areas existed prior to 2005.

In 2005, the USACE contracted with R2 Resource Consultants to prepare an inventory of all habitat surveys that had been completed to date. R2 Resource Consultants compiled a thorough list of all

existing habitat surveys in the Willamette Basin, organized by river reach. The results of this inventory are described in the *Willamette Valley Anadromous Fish and Bull Trout Habitat Assessment* (R2 Resource Consultants 2005). The report concluded that many river miles had been surveyed, but there were several limitations with the existing dataset. First, data were collected using different protocols – some were conducted using USFS protocol while others were conducted using ODFW protocol for their Aquatic Inventory project. Second, neither protocol was designed to specifically quantify the parameters need to inform the Action Agency decisions about the potential for Chinook and steelhead reintroduction (i.e., adult holding, spawning, and rearing habitat). Most of the surveys were conducted primarily in wadeable streams and did not focus on the large river habitat used by spring Chinook for holding and spawning. Many surveys were conducted prior to the 1996 flood, which significantly altered channel morphometry in many stream reaches. Therefore, the report recommended that additional data be collected to answer the specific questions of interest.

Based on recommendations in the report, in 2006 and 2007 the USACE again contracted with R2 Resources to develop an appropriate protocol and complete a thorough habitat survey upstream and downstream of USACE dams. Survey methods were modified from the Oregon Aquatic Inventory project to further characterize adult holding, spawning, and juvenile rearing habitat suitability by collecting more detailed data on holding pool depth, substrates, and velocities in spawning areas, and habitat complexity in juvenile rearing areas. Criteria used in the methodology were developed with input from the Services, ODFW, and the USFS via the SCAB group. During September and October 2006, R2 Resource surveyed approximately 89% of the habitat within the historic distribution of spring Chinook salmon above and below the Detroit, Foster, Green Peter, Cougar, Lookout Point, and Hills Creek dams. Approximately 157 miles of habitat were surveyed above the dams and 55 miles below dams in the North Santiam, South Santiam, Middle Fork, and McKenzie subbasins.

As of the writing of this Supplemental BA, R2 Resource Consulting is completing quality assurance/quality control on the data, but preliminary results indicate ample habitat exists in most areas upstream of USACE dams. The Action Agencies will distribute copies of the final report to the Services and make the report available at https://www.nwp.usace.army.mil/home.asp. Habitat survey data will also be available to the public on this website in a GIS format. The on-the-ground surveys are accompanied by detailed digital photographic documentation and aerial videography. The Action Agencies hope to fund completion of the remaining miles of survey and entry of the photo documentation into the GIS-based database in 2007.

## 3.6. Structural Modifications: Fish Passage, Temperature Control and Hatcheries

### 3.6.1. Summary of Proposed Actions

This section deals with Action Agency proposed measures to address structural modifications at USACE dams in the Willamette River Basin that may be needed for improving the survival and productivity of ESA-listed species. This includes providing an update of structural modifications undertaken subsequent to the 2000 BA (USACE 2000), as well as proposed strategies for evaluating potential future structural modifications and implementing those shown to be feasible and justified. A summary of related proposed actions includes:

- An update of the completion and initiation of operation of the WTC facility at Cougar Dam and description of the related post-authorization change (PAC) proposal to install fish passage facilities at Cougar under the Willamette River Temperature Control Project authority (see Section 3.6.2).
- A description of the initial evaluation undertaken by the USACE to evaluate fish trapping, handling, and transportation facility needs for listed fish species at the existing fish trapping facilities at Minto, Foster Dam, Dexter Pond, and Fall Creek, as well as proposals to implement high priority modifications at those facilities (see Section 3.6.3).
- A proposed strategy to undertake a series of studies initially looking comprehensively at the entire Willamette Basin and then systematically at key subbasins to evaluate the feasibility and relative benefits of structural and related operational modifications to the Willamette dams designed to improve survival and productivity of ESA-listed aquatic species (see Section 3.6.4).

### 3.6.2. Willamette River Temperature Control Project

**Proposed Action:** ***The Action Agencies propose to complete a Post-authorization Change report for the Willamette River Temperature Control Project that will seek approval for modifying the authorized project to (1) add fish passage facilities at Cougar Dam; (2) undertake a detailed post-construction monitoring and evaluation program; and (3) defer construction of Blue River selective withdrawal capability. If approved, construction of the proposed fish passage facilities will be initiated in FY 2008.***

This section deals with recent and proposed structural modifications at Cougar Dam on the South Fork McKenzie River. This is the only location in the Willamette Project where significant structural modifications associated with ESA-listed species have occurred since the 2000 BA (USACE 2000) was completed.

At the time the 2000 BA was written, construction of selective withdrawal towers at Cougar and Blue River dams was authorized under the Willamette River Temperature Control Project. As authorized, the purpose of the project was to improve fish habitat conditions and increase productivity in the mainstem McKenzie River, South Fork McKenzie River, and Blue River below the dams. The selective withdrawal towers were to be designed to allow for withdrawal of water from various levels in the reservoirs during periods of thermal stratification to more closely meet pre-project temperatures below the reservoirs. The temperature control project would modify the existing intake towers at both dams by adding new wet wells with throttled ports. The Services and ODFW supported construction of selective withdrawal first at Cougar Dam because it had much more of an influence on downstream water temperatures in the mainstem McKenzie than did Blue

River, and also because modifying water temperatures in the South Fork McKenzie would directly restore more habitat than that available in Blue River. Construction of the selective withdrawal tower at Cougar Dam was initiated in 2000 and completed in December 2004.

As described in the 2000 BA (USACE 2000), construction of the selective withdrawal tower at Blue River Dam was anticipated to begin in 2002. However, construction has not been initiated. This was partially the result of cost overruns in the construction of the Cougar selective withdrawal tower. Not enough funds remain under the authorized expenditure limit for the total McKenzie River Temperature Control project to allow construction of Blue River. However, the USACE, state, and federal resource agencies agreed that providing fish passage at Cougar Dam may be a more cost-effective means for increasing productivity for spring Chinook than the inclusion of temperature control at Blue River. In addition, fish passage at Cougar Dam would help to address bull trout protection needs in ways that temperature control at Blue River would not. On that basis, the USACE has undertaken a PAC report to evaluate and recommend alternatives including constructing fish passage facilities at Cougar Dam in lieu of selective withdrawal at Blue River.

Construction of the Cougar Dam WTC facility was covered under a separate BiOp. However, continued operation of the facility as an integral part of Cougar Dam and the Willamette System is addressed under the ongoing Section 7 consultation for continued operation of the Willamette system of dams covered under this Supplemental BA. A separate BiOp has been prepared addressing construction of the proposed fish passage facilities at Cougar Dam.

#### 3.6.2.1. Updated Status of Cougar Dam Water Temperature Control Project Construction and Operation

The 2000 BA (USACE 2000) described the planned construction of the selective WTC tower at Cougar Dam. Construction was initiated in 2000 and completed in December 2004, and the project was fully operational by May 2005. The alternative implemented was a multilevel intake structure that was found to be the most effective means of controlling water temperatures for discharges of up to 2,000 cfs. This required significant modification of the existing structure. Gates in front of the regulating outlet and penstock maintain the required maximum discharge capacity of the intake structure. Operation for temperature control requires selectively withdrawing water from different elevations in the pool to meet target outflow temperatures. Decisions on the flow distribution are based on the outflow and data from temperature instrumentation on the face of the structure. This instrumentation allows for effective remote operation of the selective WTC tower. In addition to controlling the volume of flows, temperature data is required to determine thermal stratification in the reservoir and finally outflow temperatures. The capability to mix water from different levels to achieve a target temperature and volume is required. Gates can be “throttled” at different levels to control the proportion of flow from different levels. In addition, the electrical generation system was upgraded to include replacement of turbine runners with “fish friendlier” runners that utilize minimum gap technology.

Since its initial operation in January 2005, the newly constructed WTC structure has substantially shifted the thermal hydrograph for Cougar’s water releases back to the natural temperature hydrograph on the South Fork of the McKenzie River immediately downstream of the dam. This structural improvement has increased salmon survival in the McKenzie River mainstem and the South Fork of the McKenzie River below the dam. Cougar Dam is the only federal project in the Willamette Basin with temperature control capability.

#### 3.6.2.2. Post-Authorization Change Report

In January 2006, the USACE prepared a PAC report to provide the historical basis and justification for constructing a permanent fish collection and transportation facility and creating a program for extended biological monitoring and evaluation at Cougar Dam under the authorized Willamette Temperature Control Project. Final BiOps from NMFS and USFWS are attached to the PAC report as appendices. The PAC report is being routed internally through the USACE review and approval process. If approved, construction of the fish passage facilities will be initiated in FY 2008. Funding for initiation of construction of the fish passage facilities is contained in the President's FY 2008 budget.

Although the Cougar WTC facility has successfully shifted the temperature profile for the water releases and the downstream ecosystem has realized a significant benefit, the returning anadromous salmonids and resident bull trout remain separated from over 20 miles of high-quality upstream habitat. The NMFS, USFWS, ODFW, and local citizen groups strongly recommended the inclusion of fish passage above Cougar Dam throughout the planning, design, and construction of the WTC structure, but a permanent collection and transportation facility was not included because the USACE determined it lacked the authority to include fish passage facilities under existing authorization for construction of the WTC (contained in the Water Resources Development Act of 1999). To remedy this disconnect, the USACE conducted a limited reevaluation of the project evaluating to the addition of fish passage at Cougar using Willamette Temperature Control Project funds. The result of the reevaluation is the PAC report that will be submitted forward through the agency review and approval process for possible action on a series of recommendations:

- Construct a permanent fish trap-and-haul facility, as described in the Cougar Fish Collection and Transportation Facility Alternatives report, to allow implementation of a trap-and-haul program that will restore connectivity between fish populations located above and below the Cougar project. This program will help in the protection and recovery of spring Chinook salmon by re-accessing historic spawning and rearing habitat located above the Cougar project. It will help in the protection and recovery of bull trout by providing a genetic link among local subpopulations in the McKenzie River Basin. It will also insure a mechanism by which sub-adult and adult bull trout passing to below Cougar Dam via the water temperature control tower can be restored to the relatively small subpopulation located above the Cougar project. If authorized, fish passage facilities at Cougar Dam would be constructed using appropriated WTC project funds beginning in FY 2008.

- Provide for an extended biological monitoring and evaluation program of the downstream ecosystem and of fish entrainment in the tower to determine and insure the most effective protocol for implementation of water temperature control and of the trap-and-haul program, and to document the biological benefits realized from these protective and restorative measures.

- Reduce the operating hatchery mitigation program when the monitoring and evaluation program and other studies demonstrate and document the successful natural production of juveniles and of adult return rates leading to a self-sustaining population of Chinook salmon over a range of natural environmental conditions above Cougar Dam. Since the mitigation program was put into place to offset the loss of habitat and production above the dam, this program's efforts would be decreased once the habitat supports a viable population. However, because 6 miles of habitat will remain inundated by Cougar Reservoir, the USACE will continue some level of hatchery mitigation for Cougar Dam.

- Defer construction of the Blue River WTC structure. The PAC report demonstrates that the upstream effect of construction of a fish trap-and-haul facility when added to the effect of the WTC structure at Cougar is comparable to the biological benefits that would be realized with the construction of a WTC at both Cougar and Blue River, at a lower cost per output. The PAC report does not, however, advocate for removing Blue River from the authorizing legislation, because it is possible there could be a future need for constructing the facility. Implementation of temperature control facilities at Blue River Dam will likely be one of the alternative measures evaluated in the context of the system review studies.

The PAC report estimates that, in terms of fish productivity, the benefits of fish transportation facilities at Cougar Dam will more than offset the benefits that would have been gained through temperature control at Blue River. By not constructing the Blue River facility but adding the permanent fish collection and transportation facility and implementation of the extended biological monitoring and evaluation program, the total project cost will be reduced by an estimated 22%.

### 3.6.3. Willamette Valley Fish Handling and Transport Facilities Improvements

**Proposed Action**: ***Evaluate Willamette Valley fish handling and transport facilities associated with the dams and implement modifications determined to be necessary to meet requirements for ESA-listed species as soon as programmed funds can be made available.***

#### 3.6.3.1. South Willamette Valley Fish Facilities Improvements Conceptual Design Report

Subsequent to completion of the 2000 BA, the USACE undertook initial efforts to evaluate facility needs for listed fish species at collection facilities at Willamette dams and selected hatchery facilities. The *South Willamette Valley Fish Facilities Improvements Conceptual Design Report*, completed in 2005, reviewed existing fish trapping facilities at Minto Pond on the North Santiam River, Foster Dam on the South Santiam River, Dexter Pond on the Middle Fork Willamette, and Fall Creek Dam on Fall Creek. These facilities were primarily designed as broodstock collection facilities without the benefit of current knowledge and design criteria developed to provide safe and effective handling. None of these facilities were designed to sort hatchery and wild fish. The Conceptual Design Report evaluated the existing condition of each fish facility and determined that the existing trapping facilities do not have adequate collection, sorting, holding, and transport capabilities to handle ESA-listed fish or meet the demands of current hatchery operations.

The Conceptual Design Report also presented conceptual design alternatives for improving the existing facilities to (1) meet updated criteria for reducing stress, injury, and mortality of ESA-listed species, including hatchery fish; and (2) to allow safe and efficient sorting of hatchery and wild fish, as necessary for current hatchery operations. With the exception of the Minto trapping facility, the report recommendations focused on improving the sorting, post-sort holding, and truck loading facilities. These features were found to be inadequate and the report suggested that replacement of all four trapping facilities may be required to meet current criteria for ESA-listed species. The report presented designs and cost estimates for the recommended alternative at each location. Table 3-23 summarizes the recommended improvements for each of the fish handling facilities, as well as preliminary cost estimates. Note that this is a preliminary report and more detailed analysis and design will be required before construction. Furthermore, designs developed (and approved by the Services) for the fish trap at Cougar Dam (see Section 3.6.2.2) may inform the design of future

facilities. The Action Agencies will seek input from the Services regarding the most appropriate design features for each facility and hope to incorporate common design elements into each facility to facilitate ease of operation, maintenance, and repair.

**Table 3-23. Recommended Improvements to Fish Handling Facilities as Described in the Conceptual Design Report**

| Facility | Existing System Modifications* | New Facility Components* | Estimated Project Cost |
|---|---|---|---|
| Minto Pond | Raise barrier dam crest with Obermeyer spillway gate.<br>Upgrade existing access road. | Intake with fish screen.<br>Fish ladder<br>Pre-sort holding ponds.<br>Elevated sorting facility including sorting area, post-sort raceways, crowding channel, & truck loading.<br>Complete electrical system. | $10,003,000 |
| Foster Dam Trap | Tie to existing fish ladder entrance and AWS. | Fish ladder.<br>Pre-sort holding pond.<br>Elevated sorting facility including sorting area, post-sort raceways, crowding channel, & truck loading.<br>Broodstock holding and spawning facility. | $7,546,000 |
| Dexter Pond | Install intake screen on existing intake.<br>Install new fish entrance barrier panel.<br>Install new floor diffusers for existing pre-sort holding pond.<br>Install new fish crowder on existing pre-sort holding pond.<br>Upgrade electrical system/controls. | Fish lock.<br>Elevated sorting facility including sorting area, post-sort raceways, crowding channel, & truck loading. | $5,748,000 |
| Fall Creek Dam Trap | Inspect and repair/replace existing gates and pumps.<br>Replace electrical system and control panels.<br>Install gravity water supply pipe from fish horns to elevated sorting facility. | Fish lock.<br>Elevated sorting facility including sorting area, post-sort raceways, crowding channel, &truck loading. | $3,751,000 |

* These proposed modifications and new design features are recommended by the Conceptual Design Report and describe the types of modifications (or reconstruction) necessary at each facility. However, the USACE will work with the Services as it develops more detailed designs, which may include changes to some of these features. Source: McMillen Engineering 2005.

Because the handling and sorting of ESA-listed salmon and steelhead currently occurs at these facilities, and because these operations are central to management of those listed species for the foreseeable future, the Action Agencies consider upgrading these facilities a high priority. The USACE is seeking funding through the operations and maintenance budget's Critical Infrastructure Program. The USACE believes that the highest priority among the four sites evaluated is the Minto Pond Fish Collection Facility below Big Cliff Dam on the North Santiam River. This is due not only to considerations for protecting ESA-listed fish species but also for protecting the health and safety of workers at the Minto Pond facility.

The President's FY 2008 budget includes $200,000 for developing a Detailed Design Report from the initial conceptual design. The Action Agencies will continue to seek program funds for completion of design and construction of the Minto Pond facility in the out years. The Action Agencies will work with the Services and other resource agencies to establish priorities amongst the other fish handling facilities. Evaluation of those alternatives will be integrated into the system review studies described in Section 3.6.4.

#### 3.6.3.2. Operational Protocols and Maintenance Plans for Fish Handling Facilities on the Santiam, McKenzie, and Middle Fork Willamette Rivers.

In order to monitor and evaluate biological effectiveness of the upgraded fish collection and handling facilities, the Action Agencies propose to develop post-construction maintenance, monitoring and evaluation plans for the each of the four fish collection and handling sites, starting with the Minto Fish Collection facility. The Action Agencies believe that the plans should include the following elements:

Post-construction Hydraulic Evaluation Plan and Report. Develop a plan to document that the collection and transport features of the facility were constructed and operate as designed and intended. Verify that hydraulic conditions (e.g., water velocities, barrier heights) are consistent with the design criteria developed collaboratively with the Services and with WATER. If deficiencies are identified, develop and implement solutions in collaboration with the Services and WATER. Prepare a post-construction hydraulic evaluation project report that summarizes the results.

Post-construction Biological Evaluation Plan and Report. Develop a plan to verify the effectiveness of fish collection, guidance, and/or exclusion devices (i.e., ensure the facility is collecting/guiding fish with minimal delay and injury and identify injury and mortality associated with each component of the facility and with associated release procedures, if applicable). If deficiencies are identified, we will develop and implement solutions in collaboration with the Services and WATER. A post-construction biological evaluation project report will be prepared that summarizes the results.

Maintenance Plan and Annual Maintenance Reports. Develop a protocol for regularly inspecting all fish passage facilities to ensure continual operation with minimal potential for injury and mortality throughout the duration of the fish passage season. The plan will include a procedure for reporting, addressing, and correcting any deficiencies including seeking input from WATER and the Services regarding possible solutions. The plan will allow for the Action Agencies to correct any deficiencies identified to a properly functioning condition within a reasonable period of time after deficiencies are identified, consistent with the scope and nature of the deficiency and the availability of funds needed for correcting the deficiency. Provide an annual maintenance report summarizing the results of monitoring and maintenance activities. It will include identification of any deficiencies noted or solutions implemented to correct them.

Development and Implementation of an Operational Protocol and a Monitoring and Evaluation Plan and Annual Monitoring Reports. The Action Agencies, in collaboration with WATER, will develop an operational protocol for the fish trapping and handling facilities and a plan for monitoring all operations associated with the facilities, including the number of each species passing through the facility, species-specific injury and mortality rates, any modifications or special operations of the fish passage facilities, any unusual problems or events related to the facilities and local fish populations handled, and plans to correct any problems that are identified. Prepare an annual monitoring report that summarizes the above information.

### 3.6.4. Willamette System Review Study

**Proposed Action**: ***The Action Agencies propose to undertake a series of studies looking first comprehensively at the entire basin and then systematically at the key subbasins to evaluate the feasibility and relative benefits of structural and related operational modifications to the Willamette dams designed to improve survival and productivity of ESA-listed aquatic species. Collectively called the Willamette System Review Study, these studies will include evaluation of (1) the technical feasibility; (2) biological justification; and (3) cost-effectiveness of these and other potential proposed measures so that the relative effectiveness and efficiency of potential federal actions can be compared. In addition to addressing the ESA issue, the System Review Study would also address structural and operational needs associated with CWA compliance. The studies will be conducted in close coordination with the Services and other appropriate state and federal resource agencies and tribes. The studies will result in decision documents stating agency positions on individual measures. For those measures determined to be feasible and recommended, the Action Agencies will seek authorization and appropriation for implementation through normal budget and program procedures.***

#### 3.6.4.1. Overview

The Action Agencies, assisted by state and other federal resource agencies including the Services, have identified a number of potential structural modifications that should be evaluated to determine their individual and collective potential for improving the survival and productivity of ESA-listed aquatic species, including (but not limited to):

- Improving existing fish collection and handling facilities to meet current accepted standards for ESA-listed species at Dexter Dam, Fall Creek Dam, Foster Dam, and Minto Fish Collection Facility below Big Cliff Dam (see Section 3.6.3).
- Upgrading and updating adult and juvenile fish passage facilities at those projects where passage was authorized and constructed as part of the original project, including Foster, Green Peter, Cougar and Fall Creek dams.
- Evaluating the potential for providing adult and juvenile fish passage at those dams in the basin where passage facilities were not constructed as part of the original project, including Big Cliff, Detroit, Blue River, Lookout Point, Hills Creek, Dorena, Cottage Grove and Fern Ridge dams (including adult volitional passage as a potential long-term alternative solution).
- Modifying and/or replacing existing fish hatchery facilities constructed to mitigate for the impacts of the projects (see Section 3.4).
- Providing selective withdrawal capacity or other alternative methods to achieve downstream water temperature regimes to provide improved fish passage efficiency and habitat conditions, and survival and recovery opportunities below those dams where such capability does not exist.

In the 2000 BA (USACE 2000), the Action Agencies identified adverse impacts of the Willamette dams on certain ESA-listed species. The Action Agencies recognize that there is an expectation that they will implement structural modifications that the Services believe have been demonstrated to provide substantial habitat improvements needed to avoid jeopardy for these species. However, the Action Agencies believe that decisions to implement the proposed structural modifications should be based on an agreed upon set of criteria that include a full lifecycle analysis of the listed species that will take into account the comprehensive beneficial effect of proposed federal mitigation actions, in the context of all the environmental factors affecting the survival and fitness of the species. From that perspective, it is not clear that all of these potential structural measures are necessary to avoid

jeopardizing the continued existence of listed species or that they would effectively improve habitat conditions and survival for listed species.

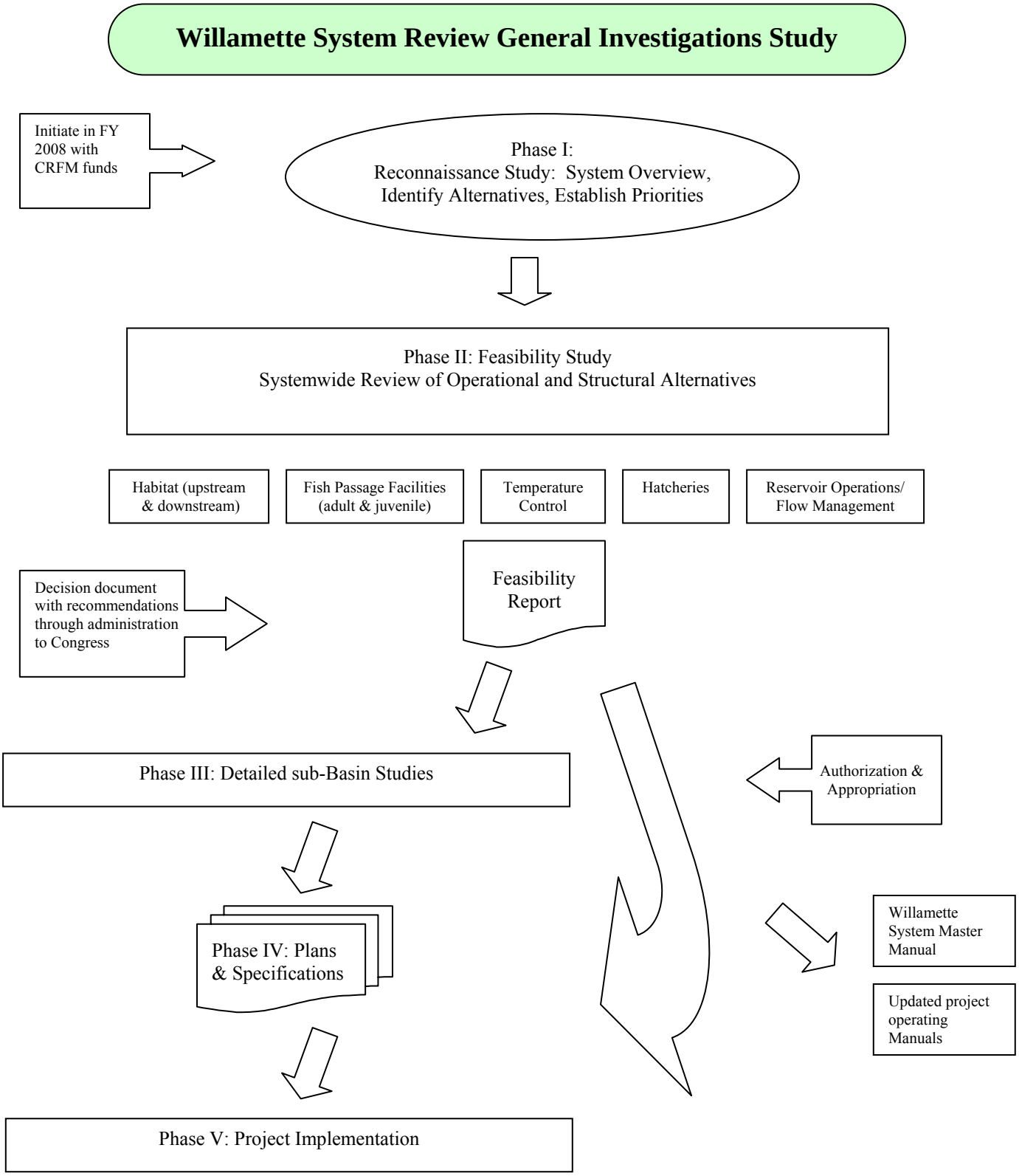
Individually and collectively, these potential measures will be expensive and will take years to study and implement. Therefore, it will be necessary to clearly identify which structural modifications are the highest priority measures that will provide measurable biological benefits. In most cases, the USACE and Reclamation do not have existing authority and/or the funding necessary to implement them. However, if specific measures are determined to be necessary to avoid jeopardy consistent with authorized project purposes, or are determined otherwise appropriate to propose as federal actions, the Action Agencies would be willing to seek the necessary authority and funding. This element of the revised proposed action is presented from the perspective of the Action Agencies recognizing the existence of the dams and the Congressional mandates to operate them for multiple project purposes. The Action Agencies are required to work through the necessary Federal planning, program and budget process to evaluate project modifications and seek necessary authorization and funding processes.

This section describes a proposal by the Action Agencies to undertake a comprehensive set of studies, collectively called the Willamette System Review. Within that framework, the Action Agencies propose to evaluate a suite of actions focusing on evaluating potential structural and related operational modifications that may be needed at USACE Willamette dams to address the adverse impacts of those projects (both known and at this time unknown) upon the survival and recovery of ESA-listed species. The intent of the Willamette System Review Study is for the Action Agencies, working collaboratively with the Services and other stakeholders to evaluate the technical, biological, and economic merits of those measures. For those measures determined to be biologically and economically justified in terms of avoiding jeopardizing the continued existence of the ESA-listed species and potentially assisting in their recovery, the Action Agencies will seek to implement such actions (including seeking authorization and funding as needed.

Figure 3-11 presents a conceptual diagram of the proposed steps or phases in the Willamette System Review Study process. The Action Agencies envision the study being conducted in phases: Phase I—Reconnaissance Study; Phase II— Systemwide Feasibility Phase Study; Phase III—Subbasin System Configuration Studies; Phase IV—Detailed Preconstruction Engineering and Design; and, Phase V—Implementation.

Plate 1 (located at the end of the Supplemental BA) presents a conceptual schedule for the system configuration studies. The intent is to show a possible logical progression of efforts based on the assumption that resources to undertake the studies will be limited. Completion of the studies and ultimate implementation of recommended projects is dependent on the Action Agency's receipt of adequate funds and necessary authorization. If funds are available, it would be possible to expedite the schedule by conducting more overlapping phases. For example detailed Phase III System Configuration Studies for two or more subbasins could be conducted simultaneously if funds are available to support that level of effort. The timeframes shown for completing each of the major phases or steps are estimates based on Action Agency experience for similar activities. It may be possible to expedite the schedule for completion of each of those phases depending on the detailed scope of activities undertaken in each.

**Figure 3-11. Willamette System Review Conceptual ESA/CWA Implementation Strategy**



#### 3.6.4.2. Guidance for Conducting Studies

The Willamette System Review Study will generally follow USACE guidance for conducting large-scale water resource studies. This guidance is stipulated in detail in Engineer Regulation (ER) 1105-2-100, also known as the "Planning Guidance Notebook." The ER provides the overall direction by which the proposed Action Agency ESA recovery measures will be formulated, evaluated, and selected for implementation. While many elements will not be applicable to the Willamette System Review Study, the studies will otherwise follow the USACE planning processes, especially analytical requirements, as specified in ER 1105-2-100. For example, feasibility studies conducted under ER 1105-2-100 are normally required to be cost-shared by a non-federal entity willing to act as the project sponsor—in the case of the Willamette System Review Study, the Action Agencies will seek funding to conduct the studies at 100% federal cost since they address federal ESA requirements at existing federal projects. This section is included to emphasize the need for the Action Agencies and the Services to cooperatively follow a rigorous analytical planning and evaluation and discrete decision-making process within process within the Willamette System Review framework. The Action Agencies are open to consideration of other approaches and guidance, including processes and criteria used for the Columbia River Fish Mitigation Program. The major steps and phases of the proposed Willamette System Review Study are described below.

#### 3.6.4.3. Phase I: Reconnaissance Phase Study

The initial phase of the Willamette System Review will be a reconnaissance phase study. The reconnaissance study will be used primarily to establish a basis for moving forward into more detailed feasibility studies in Phase II. The reconnaissance study will:

- Include a regional (basin-wide) overview of structural problems and opportunities related to ESA and CWA compliance that will set the stage for the more detailed subbasin studies that will follow;
- Identify and describe the full range of potential structural and related operational measures and alternatives that will be evaluated in the more detailed feasibility studies to follow;
- Address integration of potential Action Agency measures with ongoing NMFS and ODFW Recovery Planning efforts for ESA-listed salmonids in the Upper Willamette ESU;
- Provide initial definition of detailed evaluation criteria to be used for determining technical feasibility, biological merit, and cost-effectiveness of the measures to be evaluated. Criteria developed in Phase I will be applied to the detailed studies conducted in Phase II;
- Establish initial priorities for evaluating structural and operational alternatives and for the order in which subbasins will be evaluated; and,
- Provide the basis to scope the more detailed feasibility phase studies to follow.

The reconnaissance report completed at the end of this phase will be used to communicate the scope and purpose of the feasibility studies and to seek support and consensus from stakeholders (including the State of Oregon, other federal and state agencies, tribes, and others) regarding the proposed approach. Coordination with stakeholder to establish basin-wide priorities for follow-on action will be critical. The Action Agencies will seek funding to initiate the reconnaissance study during FY 2008. It is expected to take approximately 1 year to complete.

#### 3.6.4.4. Phase II: Comprehensive Systemwide Feasibility Study

Phase II of the Willamette System Review Study will be a systemwide feasibility study. The final feasibility report will be a decision document that will make recommendations through review and approval chains within the Action Agencies, and where necessary the administration and Congress, in regard to measures thought to be justified. Where shown to be justified, the Action Agencies will seek the necessary authorization and appropriation for implementation. The feasibility report will include appropriate National Environmental Policy Act (NEPA) documentation for implementation of proposed actions. Public involvement and outreach will need to be part of the feasibility study process. The systemwide feasibility report may also provide the foundation for the USACE to move forward on updating individual project operating manuals and possibly developing an operations master manual.

The systemwide feasibility study will include a preliminary evaluation of structural alternatives, including:

- Fish handling and passage facilities (such as ladders, screens, juvenile bypass systems, spillway modifications, stilling basin improvements, etc).
- Temperature control facilities (selective withdrawal towers and other alternatives).
- Hatcheries
- Modification of revetments bank protection sites.

The feasibility study is not intended to be an evaluation of a full range of operational alternatives. However, it will include a preliminary study of operational alternatives to the extent that they are related to structural alternatives, such as:

- Operational changes that should be considered as alternatives to structural modifications; or,
- Operational changes that may be needed to fully realize the benefits associated with structural modifications.

The systemwide feasibility study would use the feasibility criteria established in Phase I and specify final evaluation criteria. To support this process, the Action Agencies recommend the development and use of a broadly accepted version of an agreed modeling methodology (e.g., a "COMPASS" model for the Willamette System) and criteria for evaluating the lower Willamette's habitat conditions' impact on the utility of upriver physical modifications. The process would need to assure that a full lifecycle biological analysis is applied to any structural modification proposal. In order to support this decision process, it will be necessary to undertake substantial biological research, evaluation, and monitoring as soon as possible in Phases I and II.

The systemwide feasibility study would set the context for decisions within the region and for operation of the 13 Willamette dams as a system. It will also help to establish a priority or ranking of various alternative measures in terms of their technological potential, biological merit, and cost-effectiveness that will provide a basis to inform federal agency decision-makers about which actions would be most beneficial to listed species. It will specifically address such issues as whether structural solutions should be used and if so, in which subbasins; the order in which the projects need to be constructed; and strategies for organizing and implementing this long-term, phased ESA recovery effort.

Detailed evaluations of the potential structural and related operational alternatives would be conducted in Phase III, the Subbasin Detailed System Configuration Studies described in the next section. However, as shown on Figure 3-11, the Action Agencies intend to integrate and concurrently conduct the first of the Phase III studies (North Santiam) with the Phase II study. The intent is for the Phase II feasibility study to contain evaluation of the highest priority measures and to ensure as expeditious movement as possible toward a decision on identification and implementation of the highest priority structural modifications for addressing ESA needs. The Phase II study is expected to be initiated no earlier than FY 2009 and would take approximately 30 months to complete.

#### 3.6.4.5. Phase III: Subbasin Detailed System Configuration Studies

Phase III will consist of a series of detailed feasibility level system configuration studies conducted for each of the major subbasins in the Willamette Basin on which USACE projects are located. As shown on Figure 3-11, the conceptual schedule for completion of the System Configuration Studies would call for these studies to be conducted in rolling and overlapping order (and the same for subsequent pre-construction engineering and design and then construction). For example:

- Phase IIIa: North Santiam
- Phase IIIb: McKenzie River
- Phase IIIc: Middle Fork
- Phase IIId: South Santiam
- Phase IIIe: Coast Fork
- Phase IIIf: Long Tom

The actual order in which the subbasin studies would be conducted would be based on priorities determined in Phases I and II and may be reordered as more knowledge of problems and solutions is obtained. As previously noted, it is the intent of the Action Agencies to initiate the first Phase III study (North Santiam) concurrently with Phase II and complete them simultaneously so that the Phase II decision document can be submitted forward for necessary authorization or approval of specific measures for implementation in the highest priority subbasin as expeditiously as possible. The Action Agencies envision completion of Phase II and the Initial Phase III evaluation within 30 months of Phase I completion (during federal FY 2011). This will be a major decision point in the process of determining the feasibility for passing listed fish safely through the Willamette dams and reservoirs, as well as the potential for reintroducing naturally self-sustaining populations of listed fish species upstream of the dams.

The Phase III studies would include detailed evaluation of potential structural and operational alternatives at individual USACE dams in the Willamette Basin within their respective subbasins. As previously noted, the evaluations would generally follow the planning and analytical processes promulgated in the ER 1105-2-100. The scope of the Phase III studies will be based on results of the Phase I reconnaissance study and initial work in Phase II and will be developed in collaboration between the Action Agencies, NMFS, USFWS, and other stakeholders. The primary objective of the Phase III studies would be to recommend for implementation those measures shown to be technically feasible, biologically justified, and cost-effective. In order to achieve those objectives, there are some important study elements and tasks that will have to be included in the scope of work. Adequate NEPA compliance and documentation would be included in the scope of each of the subbasin studies to ensure that recommended measures may be implemented.

Technical Feasibility. The measure can be shown to be feasible to implement given the physical and operational constraints of the Willamette Basin project including consistency with authorized project purposes. In this phase the Action Agencies will need to plan, design and engineer the alternatives to a sufficient level of detail (10% to 30% design, depending upon the complexity and uniqueness of the facility) to make a determination of technical feasibility. That level of design also allows a reasonably accurate estimation of costs of alternative measures necessary to determine cost-efficiency.

Biological Justification. If implemented, the measure is expected to produce the desired physical and ecological results leading to avoidance of jeopardy. In order to determine the relative biological benefits of proposed alternatives are biologically justified, an important element of the study will be a detailed evaluation of the environmental baseline of habitat conditions and potential future condition of habitat upstream and downstream of Willamette dams (the USACE collected of this baseline data in 2006 although it has yet to be analyzed). In order to understand, compare and evaluate the potential impacts and benefits associated with alternative mitigation measures such as fish passage and temperature control, and to establish implementation priorities, it will be essential to first clearly understand the potential for that habitat to support and produce ESA-listed species under a variety of alternative mitigation strategies. This will also allow a comparison of current and expected future environmental conditions both with and without the proposed alternative measures.

As previously noted, as part of the feasibility study the Action Agencies expect to develop, test, calibrate, and use widely accepted biological life-cycle models (e.g., the COMPASS model used for supporting decisions on the Columbia River) or other tools to estimate and forecast survival and productivity of listed species under baseline conditions and under various alternative measures and strategies. Decisions regarding which model or models to use and the metrics they measure will be developed in coordination with NMFS, USFWS, and other stakeholders, and agreed upon within the region through the conduct of the feasibility study. Input parameters for any population models developed and used for this purpose will need to be based on collected site- or reach-specific field data.

In order to achieve these objectives, substantial biological RM&E will need to be conducted in conjunction with the Phase III (and Phase II) studies. Section 3.6.4.8 describes a framework of RM&E recommended in conjunction with the system review studies.

Cost-effectiveness. The proposed measures recommended for implementation must be shown to be cost-effective consistent with authorized project purposes to achieve the desired biological results for avoiding jeopardizing the continued existence of ESA-listed species and supporting their recovery. Under ER 1130-2-400, the USACE undertakes a cost effectiveness/incremental cost analysis (CE/ICA) process to evaluate projects where the primary outputs are ecological rather than monetary. The CE/ICA is an alternative to traditional cost/benefit analysis and is intended to provide decision makers with information needed to determine if a proposed project or measure is economically justified. As previously noted, in order to perform CE/ICE it will be necessary to produce quantifiable estimates of ecological outputs. In addition, it will be necessary to produce accurate estimates of implementations costs, including costs to construct and operate and maintain the proposed measures, as well as other related costs such as benefits foregone to other authorized project purposes (flood control, hydropower, irrigation, recreation, etc) as a result of implementation.

#### 3.6.4.6. Phase IV: Pre-construction Engineering and Design

Phase IV consists of the developments of detailed pre-construction engineering and design (PED) necessary to award contracts and construct structural measures recommended for implementation. Pre-construction engineering and design typically can be initiated while the USACE is waiting for authorization and appropriation to construct as long as Congress appropriates funds for the PED phase. The scope and schedule of PED will depend on the type and extent of measures proposed for implementation following Phase III.

#### 3.6.4.7. Phase V: Implementation

Implementation, including project construction and operation, will occur following project approval by Action Agency higher authority and Congressional authorization and appropriation where necessary.

#### 3.6.4.8. Research, Monitoring and Evaluation Program for the Willamette System Review Study

Substantial biological RM&E will need to be conducted in conjunction with the proposed Phase I, II, and III studies. The RM&E will provide the basis for comparing and evaluating alternatives and for demonstrating effectiveness (performance measures). Some strategic questions are listed below that the Action Agencies believe should be addressed by the RM&E program in order to determine the feasibility of implementing fish passage, temperature control, and other related measures. The recommendations for a RM&E Program must be integrated into the comprehensive program overseen by the RM&E Committee (see Section 3.8) and following the principles and strategic questions developed by the committee.

**Fish Passage Strategic RM&E Questions**

1. What currently are the critical assumptions about habitat availability and function (i.e., quantity and quality) in areas located below or above federal dams in the Willamette Basin?
2. Is there any analysis, research, monitoring, or evaluation that should be completed in order to validate or invalidate any of the critical assumptions regarding habitat quantity or quality in the tributaries below or upstream of the USACE projects?
3. Are habitat conditions (e.g., quantity, quality, connectivity) below dams for each species and life history stage suitable to assure persistence and allow for recovery?
4. What is the level or range of self-sustainable natural production for ESA-listed fish species that can reasonably be achieved below each dam, considering the effects of interaction with hatchery fish?
5. Are habitat conditions (e.g., quantity, quality, connectivity) above dams for each species and life history stage likely to aid in reducing risks associated with persistence and in allowing for recovery?
    - To what extent does suitable habitat for the various life history stages of ESA-listed fish species exist upstream of federal dams?
    - Can this habitat contribute to an increase in the self-sustained natural productivity of these species?
    - What is the level or range of self-sustainable natural production for ESA-listed fish species that can reasonably be achieved above each dam?
    - What is the optimum way to seed productive habitat located above dams?
    - How do downstream habitat conditions influence potential upstream productivity?

- Is the reservoir environment above each dam where fish may be released conducive to increasing the productivity of the species in question (e.g., through availability of suitable rearing habitat and an acceptable rate of loss to predation)?
- If suitable habitat is available above dams, what are the factors that must be assessed to determine if developing the potential productivity increase is technically feasible and cost effective?

6. Is the potential increase in population productivity sufficient to result in a reduction in the overall hatchery mitigation program obligation?
7. Should adult salmon and steelhead returning to below a dam be transported and released above the dam or left below the dam? Proposed actions should consider:
    - Production goals, objectives, and strategy.
    - Local population dynamics and hatchery broodstock needs.
    - Place of fish's origin.
    - Effect of straying on natural production.
    - Likelihood of adult survival to spawning and of offspring survival.
8. What is the survival rate of juvenile fish produced above a dam in passing through each alternative route from above to below the dam?
9. What facilities are needed above and below federal dams to provide for adequate connectivity (i.e., to allow development of a self-sustaining, naturally producing, local population) and how should they function and be operated to maximize productivity?

**Water Temperature Modification Questions**

1. What is the biological effectiveness of water temperature control implementation within the McKenzie River subbasin?
2. How has alteration of the natural (i.e., pre-dam) water temperature regime affected survival and productivity of the species of concern below each federal dam in tributary basins outside of the McKenzie River subbasin?
3. To what extent might corrective water temperature control actions contribute to the protection and recovery of local populations of the species of concern?

### 3.6.5. Construction Projects Environmental Coordination and Management

**Proposed Action:** ***Working through the Technical Coordinating Committee of WATER described in Section 3.1, the Action Agencies propose to collaborate with the Services on the design, construction and operation of all potential structural modifications to the dams and associated facilities, including fish collection and handling facilities, fish passage improvements, and water temperature control facilities implemented to improve conditions for ESA-listed species.***

In the previous sections of this chapter, the Action Agencies described a series of steps that they are committed to undertaking to assess the feasibility of structural modifications at the Willamette dams needed to improve conditions for ESA-listed species. Where determined feasible, the Action agencies will seek authorization and appropriations necessary to implement those modifications. The Action Agencies recognize that there is a high degree of uncertainty regarding the types, locations, and extent of structural modifications that may ultimately be implemented through the measures previously described in this chapter. Correspondingly, the potential environmental benefits and effects of each of the individual measures are currently uncertain. In order to reduce the uncertainties surrounding these potential modifications, the Action Agencies agree to collaborate closely with the Services on planning, designing, and constructing the potential facilities.

Section 3.1 presents a proposed organizational structure for coordinating ESA and related CWA compliance activities undertaken by the Action Agencies in the Willamette Basin. As shown, key elements of that organization include a series of technical committees established to oversee implementation of key elements of the revised proposed action and related activities. One of the proposed committees is the CPEC Committee. Modeled after the environmental coordinating committee established by the USACE to assist in implementing the Cougar Dam WTC, the CPEC Committee would be a standing committee established to assist in implementing all future construction projects in the Willamette Basin related to ESA recovery actions including improvements for fish passage, collection and handling, hatcheries, and WTC facilities. Responsibilities of the CPEC Committee are described below.

Facility Planning and Design. The CPEC Committee will advise the Action Agencies with respect to facility design, construction planning, and operation. Through the CPEC Committee, the Services will have the opportunity to provide input into development of planning and design criteria, and review and approve facility planning, design and construction documents.

Standard Operating Plans and Procedures. The CPEC Committee will assist the Action Agencies in the development of initial draft standard operating plans for facilities in planning and design phases and final draft operating plans for completed facilities including associated monitoring/evaluation.

Effects Assessment. The CPEC Committee would assist the Action Agencies in describing and evaluating the potential biological effects associated with construction of proposed facility improvements, including but not necessarily limited to:

- Water quality: temperature, turbidity, contaminants, TDG.
- Habitat access: cofferdam placement and removal, dewatering.
- Habitat alteration: temporary changes, permanent changes, potential mitigation.
- Fish salvage operations.

Biological Monitoring and Evaluation Plan. The CPEC Committee will assist the Action Agencies in developing a biological monitoring and evaluation plan for pre-, during, and post-construction periods. The plans developed by CPEC Committee will be used by the Action Agencies to determine the most effective protocol for achieving facility improvement goals. They will be used to evaluate changes in indicators of biological productivity associated with facility operation.

**Proposed Action:** ***The Action Agencies agree to adopt and follow best management practices (BMPs) for construction of all potential structural modifications to the dams and associated facilities including fish collection and handling facilities, fish passage improvements, and water temperature control facilities implemented to improve conditions for ESA-listed species.***

The CPEC Committee will assist the Action Agencies in development of construction BMPs. At a minimum, the Action Agencies agree to adopt the basic BMPs outlined in the BiOp for the Cougar Dam Fish Trap (NMFS 2007) to avoid or minimize unavoidable effects on ESA-listed species or critical habitat. These may consider but are not limited to:

- Timing of in-water work periods.
- Confinement of construction work areas.
- Preconstruction activities: marking and flagging to minimize impacts to prevent ground disturbance to critical riparian vegetation, wetlands, and other sensitive habitat.

- Cessation of work causes and protocols.
- Use of fish screen and other protective devices.
- Pollution and Erosion Control Plans: erosion controls such as temporary in-place controls, emergency controls and materials, and inspection; construction discharge water control such as water quality collection and treatment, discharge velocity, pollutants, and drilling discharge; and stormwater management plan.
- Restrictions on heavy equipment use.
- Vehicle and materials staging and inspection.
- Conservation of native materials and site restoration.
- Minimization of earthwork impacts: drilling, sampling and site stabilization
- Treated wood; piling installation and removal.

### 3.6.6. Conceptual Implementation Schedule

Plate 1 shows a conceptual schedule for implementation of structural modifications proposed in this section. The schedule is dependent on (1) completion of decision documents justifying moving forward on subsequent phases; and (2) receipt of appropriate Congressional authorization and appropriation to implement those phases. A proposed major milestone would occur within 5 years of completion of final BiOps for continued operation of the Willamette system (approximately FY 2011). Within that time frame, the Action Agencies propose to have:

- Completed a PAC Report on the Willamette Temperature Control Project and, assuming that the draft recommendations are approved, constructed and initiated operation of fish passage facilities at Cougar Dam and undertaken a detailed monitoring and evaluation program of the operational selective withdrawal tower and fish passage facilities.

- Constructed upgraded fish collection, handling, and transport facilities at the Minto location on the North Santiam River and completed detailed design analysis on other high priority sites.

- Completed Phase II of the Willamette System Review Study, including processing the initial Phase III decision document through the Action Agency review and approval process, establishing Action Agency position and recommendations regarding implementation of other potential structural modifications such as fish passage and temperature control at the highest priority locations in the basin.

## 3.7. Water Quality Improvements

This section describes Action Agency existing and proposed measures for improving water quality conditions associated with operating the USACE Willamette projects including:

- An update on operation, monitoring and evaluation of the Cougar Dam WTC tower (proposed actions for evaluating the potential for implementing additional WTC facilities at other dams in the basin are described in Section 3.6).
- Measures to address the TMDL for temperature and other water quality parameters in the basin.
- Existing and proposed water quality research, monitoring and evaluation.

### 3.7.1. Cougar Dam Temperature Control Project

**Proposed Action:** ***In coordination with the WATER Flow Management and Water Quality/Temperature committees, the USACE will continue to operate the Cougar WTC project to meet downstream water temperature targets required for protection of Chinook salmon and other aquatic species.***

**Proposed Action:** ***If authorized under the PAC for the Willamette Temperature Control Project, the Action Agencies will provide for an extended biological RM&E program associated with the Cougar Dam WTC. The RM&E program will include effects of the WTC operation on the downstream ecosystem, and fish entrainment in the tower. The objectives of the program will be to determine and insure the most effective protocols for implementation of water temperature control and of the trap-and-haul program, and to document the biological benefits realized from these protective and restorative measures. A Cougar Dam WTC Monitoring and Evaluation Plan will be developed and implemented in close coordination with the Services and other members of the existing Cougar Dam Environmental Coordinating Committee.***

#### 3.7.1.1. Continued Operation of the Cougar WTC Facility

The 2000 BA (USACE 2000) described the planned construction of the selective WTC tower at Cougar Dam. Construction was initiated in 2000. The facility was completed in December 2004 and was fully operational by May 2005. The multilevel intake structure alternative was implemented, which was found to be the most effective means of controlling water temperatures for discharges of up to 2,000 cfs. This required significant modification of the existing structure. Gates in front of the regulating outlet and penstock maintain the required maximum discharge capacity of the intake structure. Operation for temperature control requires selectively withdrawing water from different elevations in the pool to meet target outflow temperatures. Operational decisions on the flow distribution are based on the outflow and data from temperature instrumentation on the face of the structure. This instrumentation allows for effective remote operation of the selective withdrawal structure. In addition to controlling the volume of flows, temperature data is required to determine thermal stratification in the reservoir, and finally outflow temperatures. The capability to mix water from different levels to achieve a target temperature and volume is required. Gates can be "throttled" at different levels to control the proportion of flow from different levels. At the same time that the WTC was being constructed, the electrical generation system at Cougar Dam was upgraded to include replacement of turbine runners with "fish friendlier" runners that utilize minimum gap technology.

Since its initial operation in January 2005, the newly constructed WTC structure has substantially shifted the thermal hydrograph for Cougar's water releases back toward the natural temperature regime on the South Fork of the McKenzie River immediately downstream of the dam. This structural improvement has increased ESA-listed UWR spring Chinook salmon survival in the McKenzie River mainstem and South Fork below the dam. Figure 3-12 shows the actual water year 2006 performance of Cougar Dam in terms of daily mean, maximum, and minimum water temperatures as compared to pre-selective withdrawal tower temperatures, TMDL load allocation temperatures, and operational targets developed in conjunction with the Services and ODFW.

The Cougar WTC tower will continue to be operated as an integral element of the Willamette system of reservoirs. As described in Section 3.1, operation of Cougar Dam and the other elements of the system will be undertaken in close coordination with the FM Committee of WATER. Because of Cougar Dam's status as the only dam in the Willamette system with WTC capability, USACE operations will be coordinated with the WQTC Committee of WATER.

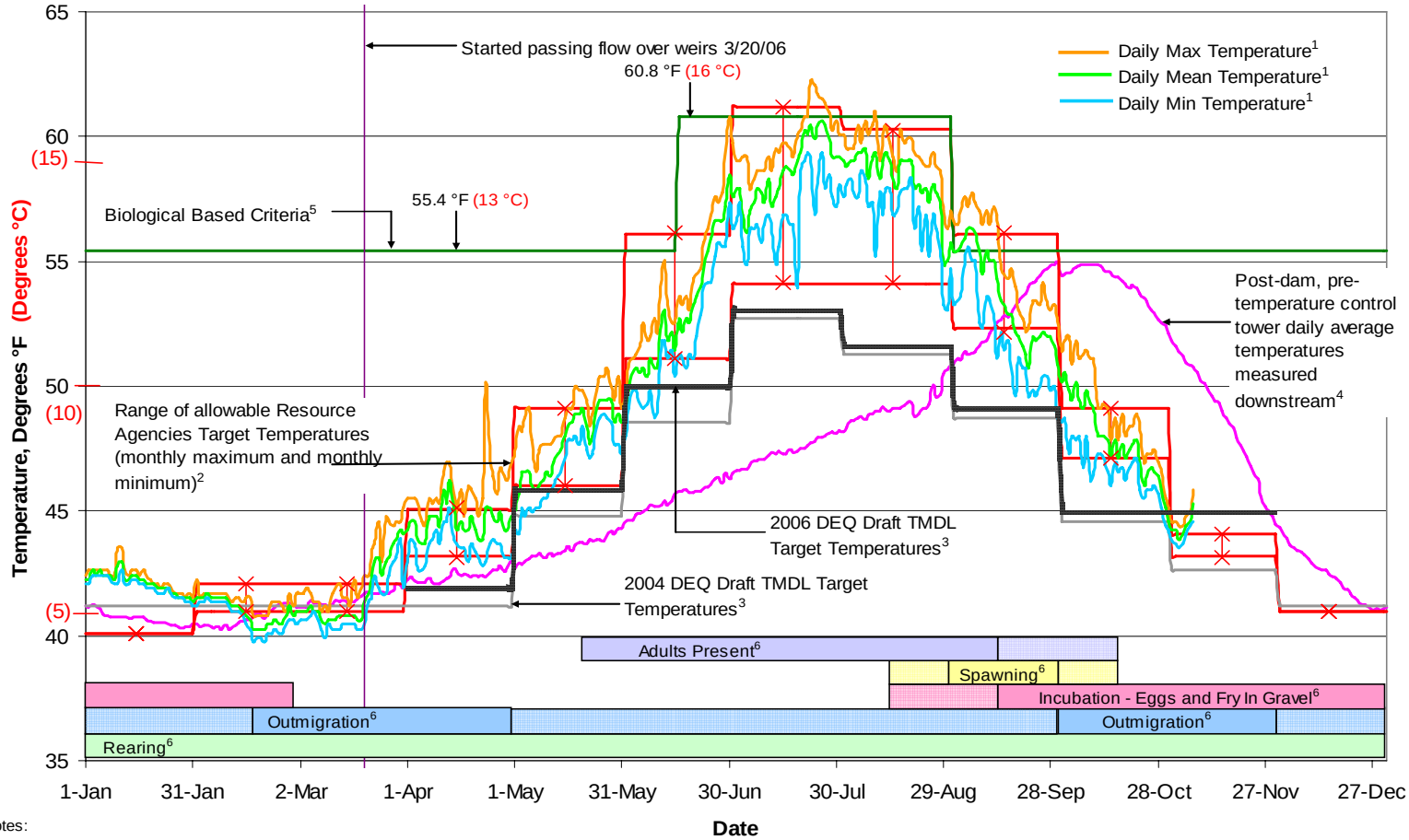
#### 3.7.1.2. Cougar Dam WTC Research, Monitoring and Evaluation

Section 3.6.2 describes the Action Agency proposal to complete a PAC report for the Willamette River Temperature Control Project that will seek approval for modifying the authorized project to: (1) add fish passage facilities at Cougar Dam; (2) defer construction of the Blue River selective withdrawal capability; and, (3) undertake a detailed post-construction monitoring and evaluation program. The current post-construction biological monitoring and evaluation program for the Cougar WTC is very limited and is expected to end with conclusion of construction. As described below, a comprehensive monitoring and evaluation program associated with Cougar Dam may require the construction of additional monitoring facilities, including a trap below Cougar Dam and juvenile monitoring facilities in the South Fork and mainstem McKenzie rivers. It is unlikely that the Action Agencies will have adequate authorization and funding to implement those measures in the near term outside of the Willamette River Temperature Control Project.

As previously noted, Cougar is the only dam in the Willamette Basin with selective withdrawal capability and the new fish passage facilities will be the first designed and built by the USACE in decades. Water quality and related biological data collected and evaluated at Cougar Dam will be essential for several reasons: (1) There is still some need to fine-tune the operation of Cougar WTC to maximize benefits for ESA-listed and other aquatic species and also balance outputs from other operating purposes such as hydropower; (2) RM&E associated with the Cougar facilities will be critical for making decisions regarding implementation of similar temperature control (and fish passage) facilities at the other USACE projects in the system facing similar ESA and CWA issues (in conjunction with the system configuration feasibility studies proposed in Section 3.6); and, (3) any future adjustments to the operating mitigation program will need to be based on monitoring observations.

If the recommendations in the PAC report are approved, the extensive monitoring and evaluation program will be initiated in FY 2008. The Action Agencies envision the initial step being development and implementation of Cougar WTC Monitoring and Evaluation Plan to evaluate the ability of the WTC structure to achieve normalized stream temperatures below the dam, and to evaluate the effects of the new facility on macroinvertebrate and fish communities below the dam. A key element of the plan will be periodic reporting summarizing the results of the monitoring efforts.

**Figure 3-12. Cougar Temperature Control Performance in 2006**




Notes:

[1]Downstream temperatures measured at USGS gage 14159500 located 0.6 miles downstream of dam.

[2]Resource Agencies Target Temperatures from letter dated September 14, 1984 signed by representatives from NOAA, FWS, and ODFW. These are the targets that we have operated to meet this year.

[3]Oregon Department of Environmental Quality (DEQ) proposed total maximum daily load (TMDL) target temperatures. The most recent draft of the TMDL was sent out for comment in March 2006. The Willamette TMDL has not been published and we are not operating to meet these targets. **This data is for information only.**

[4]Daily average historical temperatures below Cougar Dam from 01OCT1963 to 30SEP2003 measured at USGS gage 14159500 located 0.6 miles downstream of dam.

[5]Biological criteria developed by DEQ as outlined in Oregon Administrative Rules (OAR), Chapter 340, Division 041, *Water Quality Standards: Beneficial Uses, Policies, and Criteria for Oregon*.

[6]Life history of Spring Chinook above Willamette Falls, below Willamette Reservoirs taken from Willamette Project Biological Assessment, April 2000. Dark color represents normal peak period.

The Cougar WTC Monitoring and Evaluation Plan will be developed in close coordination with the Services and other members of the existing Cougar Environmental Coordinating Committee (ECC). The ECC was established early in the process of developing detailed plans for the Cougar WTC project. Its members include local, state, and federal agencies with responsibilities for managing water and related land resources in the McKenzie subbasin (including NMFS, USFWS, and ODFW). The ECC provided input into management and development through completion of construction of the selective withdrawal tower in 2005 and has been engaged in the planning and design of the proposed fish passage facilities. The role of the ECC may be supplanted by WATER (see Section 3.1) when that regional forum is established. When WATER is formed, the proposed RM&E, WQTC, FM, and FPHM committees will all need to have coordinated and integrated input into the Cougar Water Temperature Control Monitoring and Evaluation Plan and results.

Implementation of this action will require the construction of additional monitoring facilities, including a trap below Cougar Dam and juvenile monitoring facilities in the South Fork and mainstem McKenzie rivers. At a minimum, the Action Agencies believe that the plan should address the following issues and may consist of several sub-studies:

- Determine how operation of the water temperature control structure affects UWR Chinook salmon adult migration and spawn timing in the mainstem McKenzie River and the South Fork McKenzie River. Monitor movement of migrating adults as they enter the McKenzie River system up to the base of Cougar Dam and/or to spawning grounds and to the adult trap at Cougar Dam using radio tags or a similar tracking system.
- Determine how operation of the Cougar WTC structure affects UWR Chinook salmon incubation and emergence timing in the mainstem McKenzie River and the South Fork McKenzie River below Cougar Dam.
- Determine how operation of the Cougar WTC structure affects the timing of UWR Chinook salmon juvenile fry and smolt migration in the mainstem McKenzie River and the South Fork McKenzie River below Cougar Dam. Monitor movement of UWR Chinook salmon fry and smolts from rearing areas in upper reaches of the McKenzie downstream to the lower McKenzie and upper Willamette rivers.

### 3.7.2. TMDL Water Quality Management Plan

**Proposed Action:** ***The Action Agencies will coordinate with ODEQ, USEPA, USFWS, and NMFS to prepare a Water Quality Management Plan (WQMP) for the Willamette Project that will address the Willamette total maximum daily load for temperature and other water quality parameters consistent with the needs of aquatic species listed under the Endangered Species Act. The Willamette WQMP should be completed no later than March 2008.***

#### 3.7.2.1. Background

In September 2006, ODEQ released and USEPA approved a final TMDL for the Willamette Basin that was developed by ODEQ under the requirements of the CWA. A TMDL is a pollution analysis conducted with the primary purpose of determining how much a pollutant must be reduced in order to meet state water quality criteria. The focus of the Willamette TMDL was on the most commonly listed pollutants in the basin, which include bacteria, mercury, and temperature, although other pollutants also were considered. Temperature and TDG are the two pollutants or particular relevance to the USACE dams and the life cycle requirements of ESA-listed aquatic species.

The Willamette TMDL established temperature load allocations (target temperatures) target temperatures for each USACE dam in the Willamette Basin. The load allocations were based on estimates of "natural thermal potential" (NTP) of the individual streams under a without dam condition. In the development of the draft and final TMDL documents, the USACE expressed strong concerns to ODEQ about the technical and policy approaches used to develop the estimates of NTP and subsequent load allocations, including:

- Inconsistent policy approaches: pre-dam baseline conditions for below dam temperature load allocations;
- Technical methods used to estimate NTP based on very limited data;
- Discrepancies between numeric biological requirements and NTP load allocations; and
- NTP load allocations for the dams that are not fully attainable.

The USACE concerns included a clear statement that even with the completion of selective withdrawal capacity at each of the reservoirs in the Willamette system; the USACE dams will not be able to meet the temperature load allocations as stipulated in the TMDL. The discrepancies between the TMDL target temperatures and actual releases from Cougar Dam with the temperature control tower in place are shown on Figure 3-12. While the dam cannot meet the TMDL targets at all times of the year, it is operated very close to the biologically-driven temperature targets established in conjunction with NMFS, USFWS, and ODFW.

While ODEQ did not adjust the final estimates of NTP or temperature load allocations in response to USACE concerns, the TMDL document does recognize that limited data was used in their development and expresses a willingness to work with the USACE and others to further refine load allocations and NTP and possibly undertake a Use Attainability Analysis as additional information and data on the effects of the dams on water temperatures becomes available. In recognition of the uncertainties surrounding the effects of the dams on temperatures and potential for meeting the established load allocations, ODEQ makes only one-half of the "temperature reserve capacity" available under the initial TMDL. The remaining half of the reserve capacity will be made available following more detailed analysis of USACE dams and reservoirs when it is demonstrated that significant steps to TMDL implementation have been taken.

The final TMDL identified the USACE dams as "non-point sources" for temperature. The USACE is identified as a Designated Management Agency for temperature, and as such the ODEQ expects the USACE to prepare a TMDL WQMP.

There remain a number of critical uncertainties regarding the appropriate response of federal dam managing agencies, such as the USACE and Reclamation, to the CWA. These issues are being addressed at a national policy level between the USACE, Reclamation, and USEPA. From November 14-16, 2006, an interagency workshop on a comprehensive regional approach to CWA and ESA compliance at federal dams was held Portland, Oregon. The workshop was attended by representatives of the USACE, Reclamation, USEPA, USFWS, NMFS, and BPA from the headquarters and regional levels, the states of Oregon, Washington, and Idaho, and by several tribes. The workshop concluded that while there is a need and a desire for a regional forum to discuss and coordinate the integration of CWA and ESA compliance issues surrounding federal dams in the Pacific Northwest, there is no clear uniform approach possible across the different states. Each of the three states has different policies and procedures in place for federal dam compliance with state water quality standards. As an outcome of the meeting, the USACE agreed to coordinate with ODEQ on development of a WQMP to address the Willamette TMDL.

#### 3.7.2.2. Water Quality Management Plan

The Action Agencies will coordinate with ODEQ, USEPA, and the Services to prepare a WQMP for the Willamette Project that will address the Willamette TMDL for temperature and other water quality parameters consistent with the needs of aquatic species listed under ESA.

The Willamette TMDL designates the USACE as a Designated Management Agency for the purpose of implementing water quality improvement measures to achieve the temperature-related water quality standards. The TMDL requests that the USACE prepare a WQMP that addresses the following five major topics.

1. *Participate in an Interagency Management Process for temperature-related improvements in the Willamette Basin.*

The Action Agencies propose that the WATER regional forum described in Section 3.1, specifically the WQTC Committee, will be the interagency forum for integration temperature and other water quality-related improvements associated with the federal dams in the Willamette Basin. In addition to the Action Agencies, USFWS, NMFS, ODEQ, USEPA, and other agencies, entities and tribes with an interest in water quality conditions in the Willamette River may be represented. The Committee may make recommendations to the USACE with regard to the following activities:

- Development of scopes of work for water-quality related RM&E and projects;
- Establishing priorities and schedules for actions;
- Development of criteria by which temperature reduction proposals will be prioritized;
- Monitor and evaluate completion of improvement actions and studies;
- Evaluate study results;
- Make recommendations on proceeding with actions based on study results;
- Make recommendations on whether actions are feasible based on study results;
- Participate in a water quality standards revision process, if appropriate, in the future; and
- Develop a process to prioritize and recommend allocation of resources.

2. *Assist with collection and analysis of data necessary to support ODEQ revisions of load allocations for each of the 13 dams and reservoirs.*

Section 3.7.3 describes ongoing and potential water quality related RM&E activities associated with operation and maintenance of the Willamette Project. These RM&E activities will be developed in further coordination with the WQTC Committee.

There is no clear established source of funding available for a comprehensive water quality monitoring and evaluation program in the Willamette Basin at a level that may be required to support ODEQ revision of temperature load allocations. The Action Agencies are committed to seeking adequate funding to support a comprehensive program through normal budgeting and programming. Significant funding probably cannot be worked into the program until FY 2009.

The USACE has an ongoing water quality RM&E program (see Section 3.7.3). The potential RM&E program associated with Cougar Dam was previously described in Section 3.7.1. The Cougar RM&E program will be implemented if authorized through the PAC report process that the USACE is currently undertaking. As previously discussed, RM&E associated with effectiveness of the Cougar WTC will be critical to the decision process for a wide range of potential actions in the

Willamette Basin for addressing temperatures and related ESA needs. Funding for additional temperature-related RM&E may need to be integrated into the system configuration studies evaluating the feasibility of temperature control and other potential structural and operational alternatives described in Section 3.6.

3. *Demonstrate compliance and consistency with the BiOp for the Willamette Project*.

The Action Agencies will work with the members of the WQTC Committee, including representatives of the Services, to ensure that the WQMP is consistent with and complies with the requirements of this ongoing ESA Section 7 consultation.

4. *Development of a temperature management plan that will show temperature improvements needed to achieve load allocations*.

The results of the completed WTC facility at Cougar Dam clearly demonstrate that even with the addition of selective withdrawal capacity, the dams will not be able to meet temperature load allocations based on estimates of NTP as developed in the current TMDL. Cougar Dam just as clearly demonstrates that selective withdrawal facilities can be very effective in moving downstream temperatures much closer back to a natural thermal hydrograph that benefits ESA-listed and other aquatic species. Section 3.6 proposes a process for evaluating the feasibility of WTC facilities at the other dams in the Willamette system along with other structural and operational modifications. Such improvements are very expensive and may take many years to implement if shown to be feasible. In the interim, the Action Agencies will work with ODEQ, NMFS, and USFWS to demonstrate that they are doing everything possible to manage for temperatures within the existing structural limitations of the projects. This may include performing additional modeling of operational alternatives.

5. *Development of a data and information strategy that may be used for future use attainability analyses for the dams*.

The Use Attainability Analysis is a process authorized under the CWA for changing a state-approved water quality standard if it can be shown that the standard cannot be attained. The Action Agencies believe that the Use Attainability Analysis may be the appropriate action in the case of many of the Willamette Basin dams and will coordinate with ODEQ to determine when and where a Use Attainability Analysis process should be applied.

### 3.7.3. Water Quality Research Monitoring & Evaluation

#### 3.7.3.1. Ongoing Willamette Water Quality Monitoring Programs

It is official USACE policy to monitor water quality at projects and to meet the intent of national environmental law, which requires water quality monitoring at federal projects. Historically, water temperature data was collected at USGS gage stations upstream and downstream of nearly all of the USACE Willamette dams. Over the years budget cuts resulted in some sites being dropped. However, because of TMDL and ESA issues, temperature data collection at inflow and outflow sites is being restored. Also, in-lake profiles of water temperature from surface to bottom are being collected at Willamette projects that need water quality temperature models.

Current water quality monitoring at the Willamette projects consists of water temperature and TDG data collection and analysis, and site-specific studies. For example, occasionally project operations lead to conditions where water is spilled from a project, which has the potential of increasing TDG in outflow waters to levels above the TDG standard (110% TDG). In a situation where spill conditions arise for which the USACE does not have sufficient data to predict TDG in waters below a dam, TDG data is collected and evaluated to improve predictions. Sometimes site-specific water quality problems arise at a project.

Recent examples include harmful algae blooms at Hills Creek Reservoir and mercury loading from an abandoned mine at Cottage Grove reservoir. When this happens the USACE conducts studies (funding permitting) to evaluate the problem. For instance, phytoplankton and water samples were collected at Hills Creek reservoir to identify potentially toxic blue-green algae and to determine the concentrations of toxic chemicals produced by the algae. Mercury studies were conducted at Cottage Grove and Dorena reservoirs to characterize mercury dynamics in these reservoirs. Other examples include studies at Cougar Reservoir related to the construction of the new WTC facility. Prior to construction of the WTC facility, water quality studies were conducted at the Cougar and Blue River projects for the purpose of predicting the effects of WTC on in-lake and downstream water quality. During construction of the Cougar WTC facility, studies were conducted by the USGS under contract to the USACE to address the impacts of the lowered pool on turbidity and the export of sediment and dichloro-diphenyl-trichloroethane (DDT).

More recent data collection revolves around improving knowledge of inflow, in-lake, and outflow temperatures at the projects, particularly those that do not have temperature models in place. The Portland District's goal is to develop CE-QUAL-W2 temperature models for all of the Willamette projects so that project operations and improvements can be evaluated in relation to TMDL and ESA requirements. These models may also be useful in determining whether to modify TMDLs, in developing the Willamette WQMP and Use Attainability Analysis. Temperature models have been developed for the large storage projects – Hills Creek, Lookout Point/Dexter, Cougar, Blue River, Green Peter/Foster, and Detroit. The smaller, lower elevation projects – Cottage Grove, Dorena, Fall Creek, and Fern Ridge – need temperature models developed.

Portland District's Reservoir Regulation and Water Quality Section is working on a Water Quality Program Management Plan to guide future water quality staffing, monitoring and evaluation activities and to provide managers with estimates of funding requirements. The need to meet USACE water quality monitoring policy and the impact of TMDL and ESA issues will play an important role in shaping the Water Quality Program Management Plan.

Over the years water quality data of various kinds has been collected at the Willamette projects by federal and state agencies, and universities. In the late 1990s the USACE decided that all the historical water quality data for the Willamette projects should be summarized. Dr. Doug Larson, a former USACE employee that worked on water quality issues, prepared two reports for the USACE that covered historical water quality data collection at the Willamette projects from 1950 to 2000. These reports are:

- Willamette Reservoirs Oregon, Detroit, Big Cliff, Green Peter, Foster, Blue River, Cougar; Limnological and Water Quality Studies, 1950-2000.
- Willamette Reservoirs Oregon, Hills Creek, Lookout Point, Dexter, Fall Creek, Dorena, Cottage Grove, Fern Ridge; Limnological and Water Quality Studies, 1950-2000.

These reports are invaluable in that they cover the history of project construction, data collection in the basin and at the projects, describe water quality conditions within each reservoir, and contain massive, invaluable bibliographies of almost any study remotely related to the Willamette projects (water quality, fisheries, economic, geologic, hydrologic, etc). The reports made the following recommendations regarding water quality data collection.

> "First, develop and maintain a reliable, long-term database to provide future investigators with a historical perspective of reservoir limnology. Second, identify actual or potential reservoir-related water quality problems and address these with specific research projects… And third, in the interest of scientific inquiry, pursue research that will provide a better understanding of reservoir limnology and the effects of reservoir operations on water quality in the Willamette River Basin."

The Water Quality Program Management Plan will address these recommendations.

#### 3.7.3.2. Potential Framework for Water Quality RM&E

The Action Agencies will work with the WQTC Committee to develop and implement a comprehensive water quality/temperature RM&E program. The RM&E program will need to address the respective needs for CWA compliance under the temperature TMDL and life cycle requirements for ESA-listed aquatic species. It will need to integrate the existing and ongoing RM&E activities conducted by ODEQ and other in development of the temperature TMDL with ongoing water quality monitoring and evaluation by the USACE and others. The Action Agencies believe that effectiveness monitoring associated with the Cougar WTC will be a critical component in the decision-process for a wide range of potential actions in the Willamette Basin for addressing temperatures and related ESA needs. A water quality/temperature RM&E program will need to be a central element of the proposed system configuration studies evaluating the feasibility of temperature control and other potential structural and operational alternatives described in Section 3.6. The recommendations for a Water Quality RM&E Program must be integrated into the comprehensive program overseen by the RM&E Committee (see Section 3.8) and following the principles and strategic questions developed by the committee.

The Action Agencies do not currently have a clearly established source of funding available for a comprehensive water quality monitoring and evaluation program in the Willamette Basin. Funding for the water quality/temperature RM&E program will need to be derived from a variety of sources, including ongoing operations and maintenance funding, Cougar Dam/Willamette Temperature Control Project and from funding for the system configuration studies. The earliest that significant funding may be available for this program is FY 2009.

## 3.8. Research, Monitoring and Evaluation Program

**Proposed Action:** ***The Action Agencies propose to collaborate closely with the Services, ODFW, and others in developing and managing the comprehensive Willamette Basin RM&E program. The coordinating mechanism will be the WATER RM&E Committee described in Section 3.2.***

Throughout the preceding sections of Chapter 3, the Action Agencies have proposed to conduct significant RM&E efforts consistent with the respective elements of the revised proposed action. Some general RM&E recommendations are made in Section 3.3, Flow Management; Section 3.4, Hatchery Operations and Reform Actions; Section 3.5, Habitat Restoration and Management

Actions; and Section 3.7, Water Quality Improvements. In each of these cases, the proposed RM&E activities can be characterized primarily as effectiveness monitoring tied to individual elements the proposed actions. The overall intent of the RM&E program in those cases will be to determine whether or not measures and activities implemented to protect and restore listed ESA species and their habitats are having the desired results and to make adaptive management adjustments to the measures as needed.

The Action Agencies do not generally consider it to be their responsibility to undertake RM&E efforts designed principally to establish the population status and dynamics of ESA-listed species. However, the Action Agencies do recognize that a significantly more comprehensive RM&E program will be necessary to complete the system configuration feasibility studies described in Section 3.6, Structural Modifications. In that case adequate RM&E needs to be conducted to support development of life-cycle biological model that can be used to quantitatively evaluate the effects of a variety of different operational and structural alternatives against the baseline condition.

The Action Agencies do not have a single unified source of funding for implementation of a comprehensive RM&E program in the Willamette Basin. Funding for RM&E activities will necessarily be drawn from a variety of sources consistent with allocation of funding for the individual action areas. In all cases, the funding available for RM&E activities will be constrained.

Although they are described in some detail across the different elements of the proposed action, the Action Agencies recognize that it will be critical to closely integrate and coordinate RM&E measures and activities with the Services, ODFW, and others in the basin.

The details of the program will be established in coordination with the Services in development of the WATER Charter. However, the Action Agencies currently envision that the RM&E program will be implemented within an annual planning process similar to the FCRPS regional forum that develops and manages the USACE Anadromous Fish Evaluation Program. The RM&E Committee, with representatives from each resource management agency, will function as a study review group. This committee's role will be to identify RM&E needs and priorities, develop research summaries, provide peer review for research proposals and reports, and provide recommendations on ongoing and future actions based on research results. The RM&E Committee will, of necessity, have to closely coordinate with the WATER FM, FPHM, CPEC, and WQTC committees.

The RM&E Committee will be chaired by an Action Agency representative who will convene meetings, record minutes, and assure that action items are completed. The Action Agencies will solicit study proposals, oversee study completion, and facilitate peer review of study proposals and research reports to ensure results are based on sound science.

Through a series of meetings, the RM&E Committee will draft and review single-page research summaries that address specific RM&E strategic questions and needs. These summaries will identify the research question, the management application, and the goals and objectives of the research. Once research goals and objectives have been developed and ranked by the WATER RM&E Committee, research proposals will be solicited by the USACE. The description in the research summaries will form the basis for a proposal's contents. All draft research proposals will be peer-reviewed by the RM&E Subcommittee to ensure the proposal methods are sound and will meet the study objectives. Based on input from this first review, the Action Agencies will work with study proposal writers (contractors, other government agencies, internal) to incorporate comments and develop final study proposals.

Research results will be disseminated through reports and presentations at an annual review meeting. All studies and reports will be made available to all RM&E Committee members as soon as reasonably possible. Draft reports will be circulated through the RM&E Committee representatives for comment, which shall be due within 30 days, unless the work group decides otherwise, and comments received will either be addressed in, or included as an appendix to, the final reports. All final reports will be kept on file at the USACE Portland District and will be available to the public. All RM&E efforts will be based on sound biological and statistical design and analysis.

Annually, the RM&E Committee will collaboratively write a report of findings from the previous year's research. The findings summarized in this report will be comprised of key study results necessary to make fishery and water management decisions. The RM&E Committee will have the ability to select an independent, third party for the purpose of providing an independent scientific review of any disputed study results and/or report.

### 3.8.1. Coordination with the FCRPS RME Plan

The Action Agencies have developed an RM&E plan as part of their Proposed Action for continued operation of the Federal Columbia River Power System (FCRPS). The Willamette Project and FCRPS RM&E plans are interrelated in that proposed FCRPS Estuary and Ocean RM&E will provide information on the effects of FCRPS habitat and predator management actions on Willamette Chinook and steelhead ESUs. In addition, the FCRPS RM&E plan proposes other activities that may be directly applicable to Willamette Project RM&E, including standardization of tagging and monitoring methods, and development of a regionally coordinated information system. Lessons learned from other FCRPS RM&E actions, such as tributary and hatchery RM&E, may also be obtained. Coordination across the two RM&E efforts is needed to ensure that duplication of research does not occur, relevant results are shared, and lessons are learned. The Action Agencies will coordinate FCRPS RM&E actions and results with Willamette activities through participation in the Corps Anadromous Fish Evaluation Program, Northwest Power and Conservation Council's Fish and Wildlife Program, Pacific Northwest Aquatic Monitoring Program, and Northwest Environmental Data network.

### 3.8.2. Guiding Principles and Strategic Questions for RM&E Needs

The Action Agencies believe it will be necessary to work with the Services, ODFW and others to articulate a clear and mutually supportable set of guiding principles and strategic questions to be used in developing, evaluating, and integrating RM&E needs associated with components of the Supplemental BA's revised proposed action and associated BiOps related to the continuing operation of the Willamette Project.

The Action Agencies propose to use the following guiding principles in the development and implementation of the Willamette RM&E Program. The purpose of, and intended use for the guiding principles is to stimulate and guide cooperative thinking in identifying critical RM&E needs. They are an initial effort by the Action Agencies to lay the ground rules or framework for the future Willamette RM&E Program.

- The RM&E elements of the proposed action will be described at a sufficient level of detail for the Action Agencies and the Services to understand the overall plan and general approach for addressing strategic questions associated with each of the key elements of the proposed action

(relating to hatcheries, flow, fish passage, temperature control and other water quality, and physical habitat).

- Detailed Scopes of work for RM&E will be developed later in coordination with the Services and with others under the WATER framework and process following these guiding principles:
  - RM&E efforts must focus on addressing strategic questions oriented toward achieving a better understanding of the functional relationships between the structural components or operational options of the Willamette Project system and their environmental or biological effects, including documentation of beneficial changes in effects resulting from corrective actions.
  - Relevant studies should focus on understanding effects of Willamette Project dams or related structures (e.g., bank protection) on ESA-listed fish species in the Willamette Basin. The discernment or monitoring of overall population status is the responsibility of others.
  - A relevant study design and scope should consider and address the following questions.
    a. What critical assumptions and hypotheses need to be tested?
    b. What are the relevant conclusions or decisions of interest associated with each hypothesis or a set of hypotheses?
    c. How will hypotheses be tested?
    d. How much data and precision is needed to permit drawing a conclusion or making a decision?
    e. Will the study scope and design meet these needs?
- To a reasonable and applicable extent, study designs should use standardized criteria, methodologies, and means of measurement. Study designs should consider standardization with respect to former research conducted within the Willamette Basin and with respect to related approaches developed under the FCRPS research planning and implementation process.
- Seek consistency with the Pacific Northwest Aquatic Monitoring Program coordination process, as appropriate (e.g., assistance in coordinating with states, other project efforts, etc).
- Data and findings will be consolidated in a uniform location for ease of sharing.

## 3.9. Contract Water Marketing Program

**Proposed Action**: ***Reclamation and the USACE propose to continue the existing irrigation contract water marketing program for the Willamette Project. No formal discussions have taken place between Reclamation and the USACE to identify a future cap on irrigation water marketing from the Project. For the purposes of the proposed action, the Action Agencies agree that a water marketing program of up to 95,000 acre feet can be supported by current reservoir operations. Taking both existing contracts and pending contract applications into account, 14,569.33 acre-feet would remain available to meet future irrigation demands under the duration of the consultation. In the event that future irrigation demand exceeded 95,000 acre-feet, it will be necessary for Reclamation and the USACE to reevaluate the availability of water from conservation storage for the water marketing program and consult with the Services.***

### 3.9.1. Program Background

Irrigated agriculture in the Willamette Basin is somewhat unique, relative to other areas in the western United States, due to the Willamette Valley's proximity to the coast and it being located on the wetter, windward side of the Cascade Mountains. Rainfall is normally sufficient to permit the production of all early maturing crops without the benefit of irrigation. Irrigation during the months

of July to October benefits late maturing crops. Up until the 1990s, irrigators used both natural stream flows and groundwater for late season irrigation.

Although the primary function of the Willamette Project is flood control, it is also authorized for the purposes of fish and wildlife, hydropower, irrigation, municipal and industrial, navigation, recreation, and water quality. Conservation storage space totaling 1,592,800 acre-feet is included in 11 of the 13 reservoirs. The State of Oregon issued certificates of water right to Reclamation to store water for irrigation use in this space.

Since 1953, Reclamation has administered a program to market stored water available from the project. Section 8 of the Flood Control Act of 1944 gives the Secretary of the Interior authority to market water from USACE reservoirs when the Secretary of War determines that available water may be used for irrigation. A copy of correspondence between the USACE and Reclamation on implementation of the water marketing program is included in the Appendix D, *Water Marketing Program*. A 1956 letter states that, "The series of correspondence during 1952 and 1953 ... constitute the agreement between Bureau of Reclamation and Corps of Engineers for the sale of water from Willamette Basin reservoirs of the Corps for irrigation purposes."

Reclamation began contracting activities in 1953 to market irrigation water from the three reservoirs existing at that time. Contracts are made pursuant to Federal Reclamation law; in particular §9(e) of the Act of August 4, 1939 (53 Stat. 1187), §8 of the Act of December 22, 1944 (58 Stat. 887, 891), the Flood Control Act of 1938 (52 Stat. 1222), and the Flood Control Act of 1950 (64 Stat. 170). Joint efforts by Reclamation, USACE, and the state were initially directed toward identifying or establishing a single entity which would contract with the United States on behalf of irrigation interests throughout the Willamette Basin area. These agencies realized that due to a general lack of interest in obtaining stored water for irrigation purposes, any progress at establishing a water marketing program would have to be aimed at individual irrigators and irrigation districts, water districts, or other existing water user organizations which represented only a few farmers in the area. Reclamation prepared a form of contract within this framework suitable to those few individuals expressing an immediate interest and need for stored water. The State reviewed and concurred with this form of contract and it was approved by the Secretary of the Interior on June 1, 1953.

From the beginning in 1953, the number of executed water service contracts increased slowly and consistently until 1977 when the number doubled during a single year due to low stream-flow conditions for the Willamette River and its tributaries. When water supply conditions returned to normal, a number of water users canceled their contracts.

### 3.9.2. Active Long-term Contracts under the Proposed Action

At present a total of 205 long-term water service contracts are in effect. The largest contract can provide up to 9,625 acre-feet of water for the irrigation of 3,500 acres of land served by the Junction City Water Control District. Another five contracts are also with water user entities that each serve more than 400 acres and can provide more than 1,000 acre-feet annually. The remaining 199 contracts serve smaller acreages and are almost all with individual water users. Cumulatively, the 205 contracts can provide up to a maximum of 50,230.802 acre-feet of stored water for irrigation of 25,026.64 acres of land.

Sixty-two percent (127) of existing contracts have been entered into since 1990. The increase in contracting activity during the 1990s is attributable to several factors: (1) below average precipitation in some years, (2) the state's determination that Willamette natural stream-flows are

fully appropriated in the summer with referral of applicants to Reclamation for stored water contracts, (3) initiation by the state of a contested case process on the Coast Fork (initially) to define USACE discretionary flow releases as in-stream flows with a 1964 priority date, and (4) the federal listing of the Oregon chub as endangered in 1993. Upper Willamette River Chinook salmon and winter steelhead were both listed as threatened in March 1999.

Table 3-24 and the water service contracts reach map for the Willamette Basin (Figure 3-13) identify the number of contracts and quantity of stored water provided under each of the 15 reaches downstream of USACE reservoirs. A list of the 205 existing contracts is provided in Appendix D (sorted by date of execution, contract number, reach, acre-feet, and acres). In 1999, Reclamation sampled 41 contracts (and their application materials) for review and then estimated that 40% of the contracts provided stored water to be used as supplemental water on lands with primary natural flow and/or groundwater rights. The other 60% of the contracts provide a primary source of water supply to the water users.

**Figure 3-13. Water Service Contracts Reach Map, Willamette Basin**

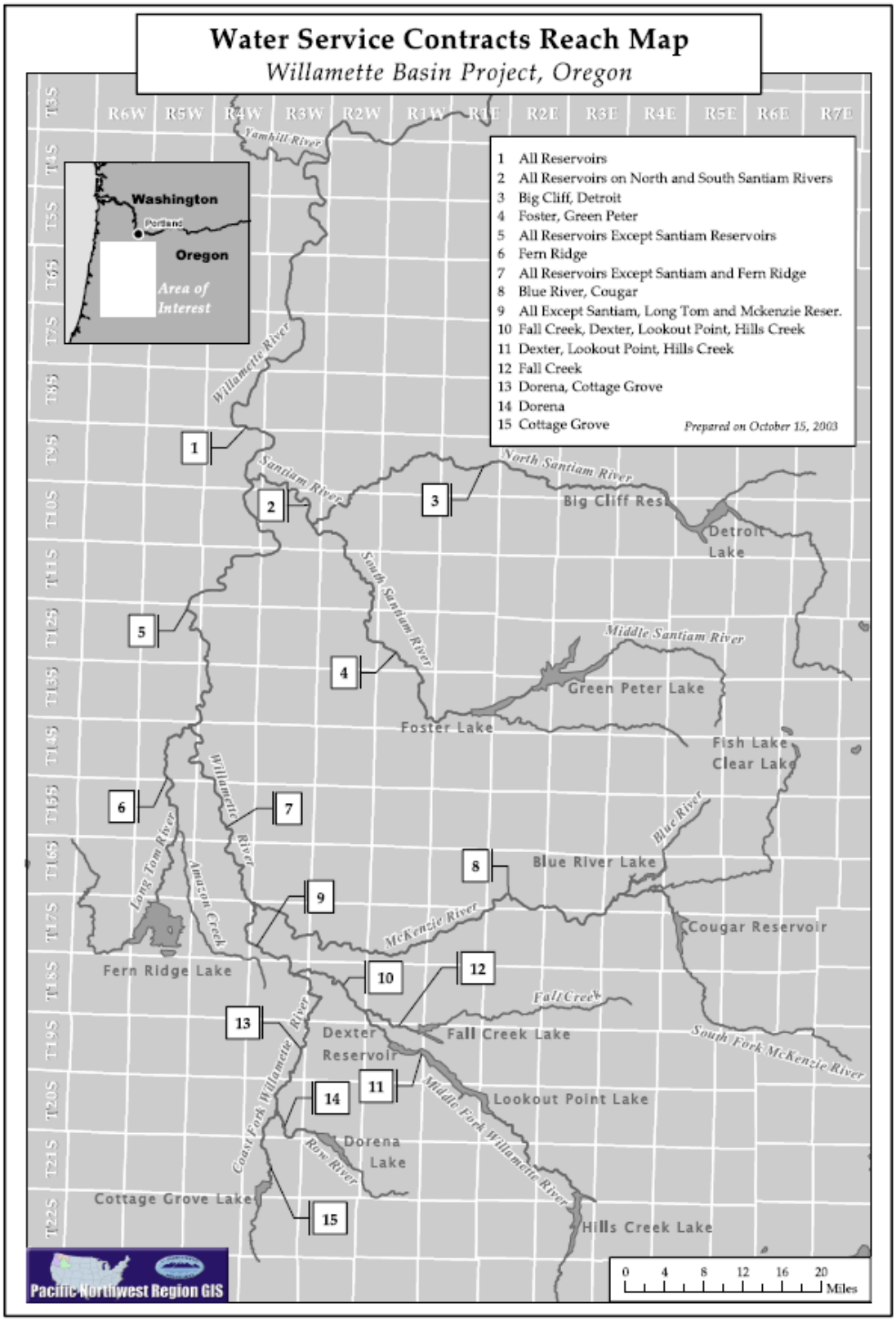

Water Service Contracts Reach Map
Willamette Basin Project, Oregon
1 All Reservoirs
2 All Reservoirs on North and South Santiam Rivers
3 Big Cliff, Detroit
4 Foster, Green Peter
5 All Reservoirs Except Santiam Reservoirs
6 Fern Ridge
7 All Reservoirs Except Santiam and Fern Ridge
8 Blue River, Cougar
9 All Except Santiam, Long Tom and Mckenzie Reser.
10 Fall Creek, Dexter, Lookout Point, Hills Creek
11 Dexter, Lookout Point, Hills Creek
12 Fall Creek
13 Dorena, Cottage Grove
14 Dorena
15 Cottage Grove
Prepared on October 15, 2003
Washington
Portland
Oregon
Area of Interest
Yamhill River
Willamette River
Santiam River
North Santiam River
Big Cliff Res
Detroit Lake
South Santiam River
Middle Santiam River
Green Peter Lake
Foster Lake
Fish Lake
Clear Lake
Blue River
Blue River Lake
Long Tom River
Amazon Creek
McKenzie River
Cougar Reservoir
Fern Ridge Lake
Fall Creek
Fall Creek Lake
South Fork McKenzie River
Dexter Reservoir
Coast Fork Willamette River
Lookout Point Lake
Middle Fork Willamette River
Dorena Lake
Row River
Cottage Grove Lake
Hills Creek Lake
Pacific Northwest Region GIS
0 4 8 12 16 20 Miles

**Table 3-24. Storage Volumes Currently under Contract for Irrigation Use**

| Reach | Reservoir Providing Water | Number of Contractors | Total Acre-feet Contracted | Total Acres Served |
|---|---|---|---|---|
| **Willamette River** | | | | |
| Downstream of Santiam River | All | 28 | 6,760.05 | 3,544.44 |
| Santiam River - Long Tom River | All except Santiam Basin reservoirs | 15 | 3,631.39 | 1,842.62 |
| Long Tom River - McKenzie River | All except Santiam Basin reservoirs & Fern Ridge | 5 | 570.00 | 255.00 |
| McKenzie River - Coast Fork | Fall Creek, Dexter/Lookout Point, Hills Creek, Cottage Grove, Dorena | 1 | 9.50 | 3.80 |
| **Long Tom River** | Fern Ridge | 58 | 24,052.875 | 9,876.55 |
| **Middle Fork Willamette River** | | | | |
| Downstream of Fall Creek | Fall Creek, Dexter/Lookout Point, Hills Creek | 1 | 135.73 | 54.29 |
| Fall Creek - Dexter | Dexter/Lookout Point, Hills Creek | 2 | 92.00 | 36.80 |
| **Fall Creek** | Fall Creek | 2 | 12.50 | 5.00 |
| **Coast Fork Willamette River** | | | | |
| Middle Fork - Row River | Dorena, Cottage Grove | 9 | 1,164.55 | 469.61 |
| Row River - Cottage Grove | Cottage Grove | 1 | 56.387 | 45.11 |
| **Row River** | Dorena | 1 | 51.00 | 20.40 |
| **McKenzie River** | Blue River, Cougar | 31 | 1,640.115 | 854.48 |
| Santiam River to Forks | Detroit/Big Cliff, Green Peter, Foster | 7 | 1,485.05 | 1,646.60 |
| North Santiam River | Detroit/Big Cliff | 30 | 9,473.545 | 5,807.26 |
| South Santiam River | Green Peter, Foster | 14 | 1,096.11 | 564.68 |
| **TOTALS** | | **205** | **50,230.802** | **25,026.64** |

No new long-term contracts have been executed since 1999. Per an agreement reached between Reclamation and USACE subsequent to the listing of UWR Chinook salmon and winter steelhead, Reclamation observed a moratorium on the processing and approval of contract applications for water service from the project. At the time of the initiation of the moratorium, Reclamation had 11 contract requests (each less than 1,000 acre-feet) pending approval. The decision was made to offer temporary contracts for the 1999 irrigation season to these applicants. Given the favorable hydrologic conditions, as well as the temporary nature of the contracts and their language, Reclamation concluded that execution of the contracts would not result in any irreversible or irretrievable commitments of resources and therefore, were in accord with §7(d) of the ESA. For the same reasons, temporary contracts were offered to these contractors in 2000 and 2002 (due to extremely dry conditions in 2001, the USACE determined that no water was available for temporary contracts).

The moratorium was lifted in January 2003 upon agreement with the USACE and Services that it was no longer necessary to discontinue water marketing activities in order to protect listed species. The rationale was that listed species would be protected through the USACE's ongoing flow management and through the appropriate language in Reclamation contracts.

Although the moratorium was lifted, Reclamation has yet to enter into any water service contracts with terms longer than 1 year. In preparation for execution of new contracts with terms up to the statutory maximum of 40 years, Reclamation revised its form of contract and continues to plan, coordinate, and accomplish the environmental compliance necessary to approve requests for contracts. Consequently, in 2003 and subsequent years when water was determined to be available from the project, temporary contracts were offered to all pending applicants that could meet the same criteria as those that received 1 year temporary contracts in 1999, 2000, and 2002.

### 3.9.3. Pending Contracts under the Proposed Action

As of March 2007, there are a total of 62 applications pending for water service from the project in the various stages of processing (a summary of applications per reach is included in Appendix D). These requests, if approved, would provide up to 30,199.87 acre-feet of stored water to irrigate 17,648.690 acres of land. Upon execution of these contracts, the water marketing program will include 267 active long-term contracts for the annual irrigation of 42,675.330 acres with up to 80,430.672 acre-feet of stored water; approximately 5% of the active conservation storage space available in project reservoirs[2]. Table 3-25 identifies the number of contracts and quantity of stored water provided under each of the 15 reaches downstream of USACE dams and includes the storage volumes associated with the pending contracts.

Water users continue to be interested in securing a supply of stored water from the project for irrigation purposes. Each year, Reclamation continues to receive applications for new water service contracts. Estimates of future irrigation demand vary greatly[3]. The state's policies for applications for new surface water rights in the Willamette Basin will continue to be the main factor influencing the water marketing program. As a result, Reclamation anticipates that the water marketing program will continue to grow.

No formal discussions have taken place with the USACE to identify a future cap on irrigation water marketing from the project. For the purposes of the proposed action, the USACE and Reclamation agree that a water marketing program of up to 95,000 acre-feet can be supported by current reservoir operations. Taking both existing contracts and pending contract applications into account, 14,569.33 acre-feet would remain available to meet future irrigation demands under the duration of the consultation. In the event that future irrigation demand exceeded the 95,000 acre-feet, it will be necessary for Reclamation and USACE to reevaluate the availability of water from conservation storage for the water marketing program and consult with the Services.

At the current low level of use for water service contracts, it is not necessary for the USACE to make special operational adjustments, such as increasing flow releases, to meet contract requirements.[4] The USACE believes that the release of stored water for pending and future contracts within the 95,000 acre-feet would result in insignificant incremental effects on listed species. The relatively small amount of additional water proposed for contracting still would not raise the amount of water under contract above the threshold where the USACE would need to make special additional flow

[2] The 205 contracts presently in force cover approximately 3% of the available conservation storage space.
[3] The USACE 1980 EIS estimated irrigation demand for the year 2020 as a range from 372,600 to 675,000 acre-feet. The 1999 preliminary draft Willamette Basin Reservoir Study estimated irrigation demand for the year 2020 to include an increase use of 95,388 acre-feet from storage.
[4] The USACE takes the existing level of contracts into account when making operational releases for project purposes.

adjustments to fulfill contract obligations. The amount of water obligated under existing, pending, and proposed contracts remains below a level at which the USACE believes individual reservoir or system effects can be modeled. Furthermore, Reclamation and the USACE believe that any potential impacts of water service contracts on listed species can be avoided through the USACE's ongoing reservoir management activities and through continued inclusion of protective language developed for contracts. Reclamation has developed a revised form of water service contract that will be used for all new long-term contracts from the project. Evaluation and accomplishment of NEPA and ESA compliance requirements will be done by Reclamation prior to execution of new long-term contracts.

**Table 3-25. Storage Volumes under Existing and Pending Irrigation Contracts**

| Reach | Reservoir Providing Water | Number of Contractors | Total Acre-feet Contracted | Total Acres Served |
|---|---|---|---|---|
| **Willamette River** | | | | |
| Downstream of Santiam River | All | 53 | 23,275.32 | 11,593.40 |
| Santiam River - Long Tom River | All except Santiam Basin reservoirs | 24 | 12,424.54 | 8,890.52 |
| Long Tom River - McKenzie River | All except Santiam Basin reservoirs & Fern Ridge | 6 | 768.75 | 334.50 |
| McKenzie River - Coast Fork | Fall Creek, Dexter/Lookout Point, Hills Creek, Cottage Grove, Dorena | 1 | 9.50 | 3.80 |
| **Long Tom River** | Fern Ridge | 63 | 24,594.275 | 10,310.20 |
| **Middle Fork Willamette River** | | | | |
| Downstream of Fall Creek | Fall Creek, Dexter/Lookout Point, Hills Creek | 4 | 958.73 | 498.29 |
| Fall Creek - Dexter | Dexter/Lookout Point, Hills Creek | 4 | 94.75 | 37.90 |
| **Fall Creek** | Fall Creek | 2 | 12.50 | 5.00 |
| **Coast Fork Willamette River** | | | | |
| Middle Fork - Row River | Dorena, Cottage Grove | 10 | 1,166.05 | 470.21 |
| Row River - Cottage Grove | Cottage Grove | 1 | 56.387 | 45.11 |
| **Row River** | Dorena | 1 | 51.00 | 20.40 |
| **McKenzie River** | Blue River, Cougar | 38 | 1,740.165 | 915.96 |
| Santiam River to Forks | Detroit/Big Cliff, Green Peter, Foster | 8 | 1,835.05 | 1,882.60 |
| North Santiam River | Detroit/Big Cliff | 34 | 12,269.045 | 7,071.36 |
| South Santiam River | Green Peter, Foster | 18 | 1,174.61 | 596.08 |
| **TOTALS** | | **267** | **80,430.672** | **42,675.33** |

### 3.9.4. Stored Water Provided and Other Contract Provisions

Reclamation first developed a standard form of contract when water marketing from the project began in 1953. Since inception of the program, changes have occurred in the form of contract from time to time. Some of the changes are discussed below. However, this narrative does not address many of the differences in the contracts. Instead, copies of pertinent standard forms of contracts are available upon request (contracts executed in 1962, 1977, 1980, 1981, 1985, 1988, 1995, 1996, 1998, and the form of temporary contract).

The contracts vary in their term of contract from 1 year to 40 years. The majority of the contracts contain 40-year terms. With the exception of 1-year temporary contracts, all contracts entered into since 1996 contained a 10-year term which is automatically renewable three times but may be terminated unilaterally by either party following the first 10-year term, or any year thereafter, provided advance written notice is given. Automatic renewal means that no contract action is required in order to extend the contract for the next 10-year increment of the term. Pursuant to current Reclamation policy with respect to length of contract term, all new water service contracts will provide for up to the maximum 40-year term allowed by Reclamation law.

Although these contracts can be in force for up to 40 years, they are subject to termination under certain conditions. All contracts entered into since 1979 include language that they may be terminated if the contractor is delinquent in payment of the water service charge or upon failure of the contractor to abide by any notice, order, rule, or regulation of the United States or the state now or hereafter established affecting water service.

Reclamation's annual water service rate increased during the past 16 years from $1.50 per acre-foot in 1990 to the current rate of $8 per acre-foot that has applied to all contractors since 1996. Reclamation periodically reviews and revises its water service rate as necessary to appropriately recover project costs allocated to the irrigation purpose.

While the existing contracts provide for a total annual use of up to 50,230.802 acre-feet of stored water, actual water use is typically significantly less. For example in 1999, Reclamation billed contractors for 30,025 acre-feet (which took into account actual 1998 water use information received from 28 contractors as discussed below). However, the billed amount of 30,025 acre-feet is still greater than the amount of actual use due to the fact that under contracts executed prior to 1995, Reclamation bills for minimum amounts (up until 1979 this was set at 1 acre-foot per acre), without providing a credit for less use. Contracts executed prior to 1995 contain a provision that allows for the additional use of stored water (up to a total amount of 2.15, 2.5, or 2.75 acre-feet per acre);[5] however, the contractor must request and pay for any additional water beyond the minimum amount.

Contracts written since 1995 provide for a maximum diversion of stored water requested by each contractor (up to the amount allowed under the State's per acre unit duty) and contain a provision that allows for downward adjustment in the annual payment based upon the actual amount delivered if documented as set forth in the contract. Contractors who request such adjustment must provide written documentation supporting their claimed use. This most commonly takes the form of a summary of meter readings or pump records. As discussed above, Reclamation adjusted the payments for 28 of these contracts in 1999. These contractors submitted documentation that they used 1,624 acre-feet in 1998 instead of the maximum of 7,966 acre-feet allowed under the contracts. Similar adjustments have occurred in succeeding years with 29 contractors submitting evidence for payment adjustment following the recently completed 2006 irrigation season (documented use was 2,464 acre-feet out of a maximum of 7,983 acre-feet available). Most of the contracts provide for the use of more than twice as much water than has been needed, or would be needed, except (perhaps) in very dry years. This contract duty is consistent with the State's water right rules, and it is the amount the state would likely recognize in an adjudication process. Reclamation's policy to allow contractors to reduce annual payments by using less than their allowed duty is meant to foster

[5] The current state unit-duty of water for this area of Oregon is 2.5 acre-feet per acre (5.0 acre-feet per acre for container nursery use).

conservation while allowing flexibility to meet annual changes in demand required by climate and cropping patterns.

It should be noted that the water use information provided by contractors in support of their requests for payment adjustment is the only water use data which Reclamation receives. Neither Reclamation nor the USACE monitors the diversion, use, or return flow associated with the water service contracts. The diversion works are privately owned structures maintained and operated by the contractors. Diversion of the water made available under these contracts occurs pursuant to State water rights. Prior to taking water under Reclamation contract, the OWRD requires all contractors to obtain a water right permit to divert stored water under their contracts. All contractors are required to conform their diversions and releases to the control of the stream as established by the watermaster. Monitoring of these diversions falls under the jurisdiction of the local watermaster.

All contracts acknowledge in some form or another that there are constraints on the availability of water from the project. All contracts entered into since 1979 include the sentence, "Because of possible fluctuations in reservoir surface elevations and downstream flows associated with the Willamette Basin Project, the United States does not guarantee the availability of water at the point of the Contractor's diversion facilities as they may now be constructed or constructed hereafter."

In addition, all existing contracts contain the sentence: "The obligation of the United States to deliver water under this contract is subject to an operating plan for the Willamette Basin Project determined in accordance with the law governing the project." New contracts will contain language identical or similar to the following:

> "The obligation of the United States to furnish water under this contract is subject to an operating plan for the Willamette Basin Project determined in accordance with the law governing the project and other applicable State and Federal laws, including but not limited to the Endangered Species Act (16 U.S.C. § 1531 *et seq.*)(ESA). Furthermore, the obligation of the United States to furnish water under this contract shall be subject and subordinate to a determination of water availability to be made annually by the United States, on or before mm/dd of each year, taking into account the operating plan for the project, water forecasts, and other factors, including but not limited to those that may affect the ability of the United States under the ESA to provide flows for candidate, listed, or proposed species or to protect or preserve designated or proposed critical habitat."

All existing contracts contain language that the United States is not liable for shortages in the water supply provided. All new contracts will contain language identical or similar to the following:

> "No liability shall accrue against the United States or any of its officers, agents, or employees for damages, direct or indirect, arising by reason of shortages in the quantity of water available through the project or interruptions in water deliveries to lands furnished water under this contract resulting from drought, inaccuracy in distribution, hostile diversion, prior or superior claims, accident to or failure of facilities of the project, whether or not attributable to negligence of officers, agents, or employees of the United States, or other causes of whatsoever kind."

All existing contracts entered into since 1995 contain a subarticle that allows for review and modification of the terms and conditions of the contract by Reclamation, at any time, to avoid or minimize impacts to endangered species or other valuable natural resources. New contracts will contain language identical or similar to the following:

> "In the interests of conservation and protection of environmental resources, from time to time, but not less often than once every 5 years, this contract shall be reviewed by the Contracting Officer. The terms and conditions of this contract, including the amount of stored water provided hereunder, may be modified, as determined by the Contracting Officer, to avoid or minimize impacts to species and/or critical habitat that are proposed, listed, or designated under the ESA, or to other valuable natural resources. Any modification to the contract by the Contracting Officer shall be announced by written notice to the Contractor."

Since 1994 the ODFW and OWRD have required applicants for new water right permits to design, construct, install, operate, and maintain fish screening devices to prevent game fish and ESA- and state-listed fish from getting lost in the proposed diversions, as well as installing a fishway at any obstruction to provide adequate upstream and downstream passage for fish. Applicants for permits may submit evidence that the ODFW has determined screens and/or fishways are not necessary. The required screens and fishways must be functional, and approved by ODFW before diversion of any water. Existing water right users of more than 30 cfs are required to design, construct, install, operate, and maintain fish screening devices to federal and state standards. For diversions with existing water rights of less than 30 cfs, ODFW has a voluntary cost-sharing program in which the water user pays 40% of the costs and is responsible for minor maintenance, while the state provides for the remaining costs and maintenance. If the water right permit is conditioned so that fish screening is needed at the ditch or pump for fish, then no cost-sharing is provided.

All new water service contracts will require compliance with state and federal fish screening and passage standards as a condition precedent for receipt of water service, and existing contractors will be notified of their responsibility to comply with these standards. New contracts will contain language identical or similar to the following:

> "Prior to delivery of water under this contract, the Contractor shall submit to the Contracting Officer written verification that, where required, fish passage structure(s) and fish screens compliant with State and Federal standards, as set by the State and Federal officers responsible for establishment of said standards, are operational at the point(s) of diversion described in (b) above, or that the Contractor and the Oregon Department of Fish and Wildlife, U.S. Fish and Wildlife Service, and/or National Marine Fisheries Service have reached a mutually satisfactory agreement concerning compliance with State and Federal fish screening/passage standards at said point(s) of diversion. Such fish screen(s) and/or fish passage structure(s) shall be furnished, installed, operated, and maintained by and at the expense of the Contractor, but shall remain at all times available for inspection by the Contracting Officer, the State of Oregon, the U.S. Fish and Wildlife Service, and/or National Marine Fisheries Service whose representatives may at all times have access to them over any lands of the Contractor."

### 3.9.5. Compliance with Environmental Laws

Compliance with NEPA for irrigation water marketing activities was covered in the 1980 final EIS for operation and maintenance of the Willamette system (USACE 1980). Reclamation performs specific NEPA compliance for each contract into which it enters. This compliance is documented with a Categorical Exclusion Checklist, Environmental Assessment, or EIS with a corresponding Finding of No Significant Impact or Record of Decision, as appropriate. Reclamation does not execute contracts without successful NEPA compliance.

Reclamation is providing this description of the contracts and water marketing program to the USACE for their ongoing ESA Section 7 consultation process, which will address potential impacts of project operations to ESA-listed bull trout, Oregon chub, Chinook salmon, and steelhead. The ongoing consultation process addresses USACE operations to store and release water to meet the water service contracts administered by Reclamation. Reclamation's proposed action is the continued marketing, execution, and administration of water service contracts for the irrigation use of water made available by the USACE from the conservation storage in project reservoirs.

### 3.9.6. Estimate of Impact on Streamflow from Diversions Associated with Contracts

The following information is provided in an effort to estimate the impact on streamflow from the diversion of the stored water made available pursuant to Reclamation water service contracts. The points of diversion in the Willamette Basin are shown on Plate 2. As previously stated, Reclamation does not monitor the contractor's diversion, use, or return flow associated with these contracts. Therefore, in order to identify what the impact of full utilization of water supplies provided under the contracts would be, it was assumed that the contractors irrigated all their lands annually and diverted water at the maximum rate allowable by state water law.

With respect to the timing of water demand, Reclamation cannot be certain when the peak months of water use occurs, which can vary depending on the crops involved and size of irrigation operations. Language in older forms of existing contracts provides that water users may use up to 35% of their water supply entitlement in any one month (there are a small amount of these contracts that allow up to 50%). However, these contracts also provide that the contractor must conform its diversion to the control of the stream as established by the state (through the watermasters). Water rights within the Willamette Basin are subject to a maximum flow rate restriction of 1/80 cfs per acre per day (or 0.74375 acre-feet/month). That is, in exercising their right to take water provided under Reclamation contract, the contractor cannot exceed this diversion rate. Irrespective of the timing of peak demand for irrigation water, the contractors can not divert more water than this flow rate restriction would allow. Table 3-26 shows the subbasin effects of the baseline under both assumptions.

It should be noted that the assumptions made for this analysis are weighted towards overstating the rate of utilization of stored water. By doing so, the impact on streamflow estimated here represents a maximum impact. Realistically, it is an exaggeration of the effects of the irrigation program to assume that storage utilization rates equal what is under contract. A large portion of the contracts are intended by the water user to be supplemental in nature. Some historical operational evidence supports this view. A case in point is the Long Tom subbasin. Maximum utilization of water supply entitlements would require releases from Fern Ridge well in excess of the usual 50 cfs release to meet the flow target at the Monroe gauge (this is considerably less than the 123 to 151 cfs estimated to be required to meet maximum irrigation demands).

## Table 3-26. Diversion Impacts by Subbasin

| River Reach | River Reach No. from Figure 3-13 | Diversion Impact Existing (cfs) | Diversion Impact Existing + Pending + Proposed (cfs) |
|---|---|---|---|
| **Santiam Subbasin** | | | |
| North Santiam | 3 | 72.585 | 99.496 |
| South Santiam | 4 | 7.058 | 8.514 |
| Downstream of confluence of North & South Santiam | 2 | 20.581 | 25.192 |
| Totals | --- | 100.223 | 133.202 |
| **McKenzie Subbasin** | | | |
| McKenzie River | 8 | 10.680 | 13.024 |
| **Middle Fork Willamette Subbasin** | | | |
| Fall Creek | 12 | 0.062 | 0.074 |
| Downstream of Dexter, Lookout Point & Hills Creek | 11 | 0.460 | 0.560 |
| Downstream of Fall Creek/Dexter | 10 | 0.679 | 7.096 |
| Totals | --- | 1.201 | 7.730 |
| **Coast Fork Willamette Subbasin** | | | |
| Middle Fork to Row River | 13 | 5.870 | 6.933 |
| Row River to Cottage Grove | 15 | 0.564 | 0.615 |
| Row River | 14 | 0.255 | 0.301 |
| Totals | --- | 6.688 | 7.849 |
| **Long Tom Subbasin** | | | |
| Long Tom River | 6 | 123.447 | 151.140 |
| **Willamette River** | | | |
| Downstream of All Reservoirs | 1 | 44.302 | 165.984 |
| Santiam River to Long Tom R. | 5 | 23.031 | 122.374 |
| Long Tom R. to McKenzie R. | 7 | 3.187 | 4.877 |
| McKenzie River to Coast Fork | 9 | 0.047 | 0.056 |
| **Grand Totals** | --- | **312.807** | **606.237** |

# 4. BIOLOGICAL INFORMATION FOR LISTED SPECIES

This chapter presents updated information for ESA-listed species occurring in the action area since the 2000 BA (USACE 2000) was prepared. A total of 29 species occurring in the Willamette Basin, or downstream of the confluence of the Willamette River and the Columbia River, are currently listed under the ESA (Table 4-1). The NMFS has listed 12 evolutionarily significant units (ESUs) of anadromous salmonids. The USFWS has listed 16 species of vertebrate animals, fish, plants, and insects. Since the 2000 BA, a final rule adding the Lower Columbia River coho salmon ESU as a threatened species was published on June 28, 2005 (70 FR 37160) and became effective on August 29, 2005. Critical habitat for this ESU has not been proposed or designated at this time.

### 4.1.1. NMFS Hatchery Listing Policy and Status Reviews

In a September 12, 2001 order in *Alsea Valley Alliance v. Evans* (99-6265-HO, D. OR), Judge Michael R. Hogan of the U.S. District Court in Eugene found NMFS' definition of an ESU to be a permissible interpretation of "distinct population segment" (DPS) for salmon. However, the Court determined that when NMFS finds that an ESA listing includes both hatchery and naturally spawned fish, the agency may not permissibly list on the naturally spawned fish as threatened or endangered under the ESA. On these grounds, the Court set aside the NMFS 1998 listing of Oregon Coast coho salmon. Although this ruling affected only one ESU, the interpretive issue raised by the ruling potentially affected nearly all West Coast salmon and steelhead listing determinations made to date.

In response to the Alsea decision, the NMFS conducted a review to examine how the logic of the Alsea decision should be applied to those ESUs that include fish reared in hatcheries. The NMFS published its proposed hatchery listing policy in the *Federal Register* on June 3, 2004 (69 FR 31354), as well as its proposed rule to revise the listing status of 25 Pacific salmonid ESUs and to list two additional ESUs on June 14, 2004 (69 FR 33102).

After consideration of public comments received, the NMFS issued a final policy on June 28, 2005, addressing the role of hatchery produced Pacific salmon and steelhead in listing determinations under the ESA (70 FR 123). Under the new policy, hatchery stock determined to be part of a DPS would be considered in determining whether a DPS is threatened or endangered under the ESA, and would be included in any listing of that DPS. To incorporate this policy change, the NMFS revised the listing status of 25 ESUs, which was published in the *Federal Register* on June 28, 2005 (70 FR 37160) and January 5, 2006 (71 FR 834).

## 4.2. Critical Habitat Designations

This section provides a summary of changes in critical habitat designations since completion of the 2000 BA (USACE 2000).

### 4.2.1. Recovery Activities at Fern Ridge Lake

On October 31, 2006, the USFWS designated critical habitat for Willamette daisy, Kincaid's lupine, and Fender's blue butterfly. At Fern Ridge Lake, most high quality wet prairie sites and upland prairie habitats occupied by the lupine/butterfly system were included in this designation.

## Table 4-1. ESA-listed Species in the Willamette Basin

| Species | ESA Jurisdiction | Listing Status & Federal Register Citation | Critical Habitat Status & Federal Register Citation |
|---|---|---|---|
| Upper Willamette River Chinook Salmon *Oncorhynchus tshawytscha* | NMFS | Threatened: Mar 24, 1999; 64 FR 14308 Jun 28, 2005; 70 FR 37160 | Designated Feb 16, 2000; 65 FR 7764; Withdrawn by consent decree Apr 30, 2002; Re-designated Sep 2, 2005; 70 FR 52630 |
| Upper Willamette River Steelhead Trout *Oncorhynchus mykiss* | NMFS | Threatened: Mar 25, 1999; 64 FR 14517 Jun 28, 2005; 70 FR 37160 Jan 5, 2006; 71 FR 834 | Designated Feb 16, 2000; 65 FR 7764; Withdrawn by consent decree Apr 30, 2002; Redesignated Sep 2, 2005; 70 FR 52630 |
| Lower Columbia River Chinook Salmon | NMFS | Threatened: Mar 24, 1999; 64 FR 14308 Jun 28, 2005; 70 FR 37160 | Designated Feb 16, 2000; 65 FR 7764; Withdrawn by consent decree Apr 30, 2002; Redesignated Sep 2, 2005; 70 FR 52630 |
| Lower Columbia River Steelhead Trout | NMFS | Threatened: Mar 19, 1998; 63 FR 13347 Jun 28, 2005; 70 FR 37160 Jan 5, 2006; 71 FR 834 | Designated Feb 16, 2000; 65 FR 7764; Withdrawn by consent decree Apr 30, 2002; Redesignated Sep 2, 2005; 70 FR 52630 |
| Lower Columbia River Coho Salmon *Oncorhynchus kisutch* | NMFS | Threatened: Jun 28, 2005; 70 FR 37160 | Not Applicable |
| Columbia River Chum Salmon *Oncorhynchus keta* | NMFS | Threatened: Mar 25, 1999; 64 FR 14508 Jun 28, 2005; 70 FR 37160 | Designated Feb 16, 2000; 65 FR 7764; Withdrawn by consent decree Apr 30, 2002; Redesignated Sep 2, 2005; 70 FR 52630 |
| Snake River Spring/ Summer Chinook Salmon | NMFS | Threatened: Apr 22, 1992; 57 FR 14653 Jun 28, 2005; 70 FR 37160 | Designated Dec 28, 1993; 58 FR 68543 Revised Oct 25, 1999; 64 FR 57399 |
| Snake River Fall Chinook Salmon | NMFS | Threatened: Apr 22, 1992; 57 FR 14653 Jun 28, 2005; 70 FR 37160 | Designated Dec 28, 1993; 58 FR 68543 |
| Upper Columbia River Spring Chinook Salmon | NMFS | Endangered: Mar 24, 1999; 64 FR 14308; Jun 28, 2005; 70 FR 37160 | Designated Feb 16, 2000; 65 FR 7764; Withdrawn by consent decree Apr 30, 2002; Redesignated Sep 2, 2005; 70 FR 52630 |
| Snake River Steelhead Trout | NMFS | Threatened: Aug 18, 1997; 62 FR 43937 Jun 28, 2005; 70 FR 37160 Jan 5, 2006; 71 FR 834 | Designated Feb 16, 2000; 65 FR 7764; Withdrawn by consent decree Apr 30, 2002; Redesignated Sep 2, 2005; 70 FR 52630 |
| Upper Columbia River Steelhead Trout | NMFS | Endangered: Aug 18, 1997; 62 FR 43937 Threatened: Jun 28, 2005; 70 FR 37160 Jan 5, 2006; 71 FR 834 | Designated Feb 16, 2000; 65 FR 7764; Withdrawn by consent decree April 30, 2002; Redesignated Sep 2, 2005; 70 FR 52630 |
| Middle Columbia River Steelhead Trout | NMFS | Threatened: Mar 25, 1999; 64 FR 14517 Jun 28, 2005; 70 FR 37160 Jan 5, 2006; 71 FR 834 | Designated Feb 16, 2000; 65 FR 7764; Withdrawn by consent decree Apr 30, 2002; Redesignated Sep 2, 2005; 70 FR 52630 |
| Snake River Sockeye Salmon *Oncorhynchus nerka* | NMFS | Endangered: Nov. 20, 1991; 56 FR 58619 Jun 28, 2005; 70 FR 37160 | Designated Dec 28, 1993; 58 FR 68543 |

**Table 4-1 (continued). ESA-listed Species in the Willamette Basin**

| Species | ESA Jurisdiction | Listing Status & Federal Register Citation | Critical Habitat Status & Federal Register Citation |
|---|---|---|---|
| Columbia River Bull Trout *Salvelinus confluentus* | USFWS | Threatened: Columbia River DPS Jun 10, 1998; 63 FR 31674. Coterminous U.S. Nov 1, 1999; 64 FR 58910. | Designated Sep 26, 2005; 70 FR 56212 |
| Oregon Chub *Oregonichthys crameri* | USFWS | Endangered: Oct 18, 1993; 58 FR 53804 | None |
| Gray Wolf *Canis lupus* | USFWS | Endangered: Mar 11, 1967; 32 FR 4001 | Designated Mar 9, 1978; 43 FR 9607 |
| Columbian White-tailed Deer *Odocoileus virginianus leucurus* | USFWS | Endangered: Mar 11, 1967; 32 FR 4001 | None |
| Canada Lynx *Lynx canadensis* | USFWS | Threatened: Mar 24, 2000; 65 FR 16051 | None in Oregon |
| Marbled Murrelet Brachyramphus marmoratus | USFWS | Threatened: Oct 1, 1992; 57 FR 45337 | Designated May 24, 1996; 61 FR 26255 |
| Aleutian Canada Goose *Branta canadensis leucoparia* | USFWS | Threatened: Mar 11, 1967; 32 FR 4001 | None |
| Bald Eagle *Haliaeetus leucocephalus* | USFWS | Threatened: Mar 11, 1967; 32 FR 4001 | None |
| Northern Spotted Owl *Strix occidentalis caurina* | USFWS | Threatened: Jun 26, 1990; 55 FR 26194 | Designated Jun 26, 1990; 57 FR 1796 |
| Fender's Blue Butterfly *Icaricia icarioides fenderi* | USFWS | Endangered: Jan 25, 2000; 65 FR 3875 | Designated Oct 31, 2006; 71 FR 63862 |
| Willamette Daisy *Erigeron decumbens* var. *decumbens* | USFWS | Endangered: Jan 25, 2000; 65 FR 3875 | Designated Oct 31, 2006; 71 FR 63862 |
| Kincaid's Lupine *Lupinus oreganus* var. *kincaidii* | USFWS | Threatened: Jan 25, 2000; 65 FR 3875 | Designated Oct 31, 2006; 71 FR 63862 |
| Golden Paintbrush *Castilleja levisecta* | USFWS | Threatened: Jun 11, 1997; 62 FR 31748 | None |
| Water Howellia *Howellia aquatilis* | USFWS | Threatened: Jul 14, 1994; 59 FR 35864 | None |
| Bradshaw's Desert Parsley *Lomatium bradshawii* | USFWS | Endangered: Sep 30, 1988; 53 FR 38451 | None |
| Nelson's Checkermallow *Sidalcea nelsoniana* | USFWS | Threatened: Feb 12, 1993; 58 FR 8242 | None |

The USACE is pursuing a comprehensive management program to maintain habitat and increase population numbers of these listed plant and insect species. Four listed species typical of prairie habitats are the primary targets. Willamette daisy and Bradshaw's lomatium are characteristic of a rare wet prairie plant community in the Willamette Valley. Kincaid's lupine and Fender's blue butterfly occur in upland prairie sites. Globally important occurrences of these species persist at Fern Ridge. For example, the Willamette daisy population is among the largest remaining. Recovery activities include prescribed fire, habitat mowing, weed treatment, ecological restoration of degraded sites, and propagation of listed species for population augmentation and creation.

Consultation on the effects of these activities to the species and their critical habitat was completed on March 21, 2007. The program is described in *Management Activities for Rare Plants and Insects, Fern Ridge* (USACE June 2006) and in the subsequent BiOp (TS number 06-1967). The program is summarized below.

The wet prairie habitat of Willamette daisy and Bradshaw's lomatium is a fire-dependent system; research has demonstrated that fire directly benefits both prairie structure and population numbers of listed plants. The USACE schedules prescribed burning on a 2-3 year cycle on these sites. Mowing is used to control woody invasion in wet prairie and upland sites, and carefully timed early season mowing is intended to reduce the dominance of invasive grasses. Substantial manual and chemical treatment of invasive species is required annually in both habitat types. These treatments target a number of invasive plants that threaten listed species and their habitats, including exotic blackberries (*Rubus armeniacus*); Scotch broom (*Cytisus scoparius*); reed canarygrass (*Phalaris arundinacea*); false-brome (*Brachypodium sylvaticum*); meadow knapweed (*Centaurea* X *pratensis*); and tall oatgrass (*Arrhenatherum elatius*). A complete restoration program will initially target about 80 acres of upland prairie with the ultimate goal of introducing the lupine/butterfly system. Potential to restore up to 300 upland acres exists at Fern Ridge. The USACE propagates all listed plant species (as well as other species of conservation concern) from local seed collections in order to augment small populations and create new ones in high-quality sites. In addition, the USACE monitors each listed species to determine population trends and guide management.

### 4.2.2. NMFS Species

On February 16, 2000, the NMFS designated critical habitat for 19 ESUs of Chinook, chum, and sockeye salmon, as well as steelhead in Washington, Oregon, Idaho, and California. On September 27, 2000, the NMFS approved Amendment 14 to the Pacific Coast Salmon Fishery Management Plan, designating marine and freshwater Essential Fish Habitat (EFH) for Pacific salmon pursuant to the Magnuson-Stevens Fishery Conservation and Management Act (MSA), as amended (Public Law 94-265). Shortly after these designations, the National Association of Homebuilders filed a lawsuit challenging the designations on a number of grounds. On April 30 2002, the U.S. District Court for the District of Columbia adopted a consent decree resolving the claims in the lawsuit. Pursuant to that consent decree, the Court issued an order vacating the critical habitat designations, but retaining the MSA EFH designations [*National Association of Homebuilders, et al. v. Evans*, Civil Action No. 00-2799, 2002 WL 1205743 (D.D.C. April 30, 2002)]. As a result of this lawsuit, the NMFS completed new critical habitat designations that were published in the *Federal Register* on September 2, 2005 (70 FR 52630). These new designations affect critical habitat for nine of the species of salmon and steelhead considered in this Supplemental BA.

### 4.2.3. USFWS Species

The USFWS does not use on the regulatory definition of "destruction or adverse modification" of critical habitat found at 50 CFR 402.02. The USFWS relies on the statute and the August 6, 2004, 9$^{th}$ Circuit Court of Appeals decision in *Gifford Pinchot Task Force v. U.S. Fish and Wildlife Service* 378 F.3d 1059 (9$^{th}$ Cir. 2004) with respect to analysis and designation of critical habitat. The USFWS published a final critical habitat designation for the coterminous United States population of the bull trout on September 26, 2005 (70 FR 56212); the rule became effective on October 26, 2005. The scope of the designation involved the Klamath River, Columbia River, Coastal-Puget Sound, and Saint Mary-Belly River population segments (also considered as interim recovery units). See Section 4.4 for an updated status on bull trout in the Columbia River interim recovery unit.

## 4.3. Status of NMFS Species

The biological requirements, life histories, migration timing, historical abundance, and factors contributing to the decline of the salmon and steelhead species listed in Table 4-1 have been well documented. The following sections summarize information contained in recent documents. More information is provided for the species that spawn and rear in the Willamette Basin than for the other species, which are less likely to be directly affected by actions in the Willamette Basin.

### 4.3.1. Upper Willamette River Chinook Salmon

ESU Description. The UWR Chinook salmon ESU includes all naturally spawned populations of spring-run Chinook salmon in the Clackamas River and in the Willamette River, and its tributaries, above Willamette Falls, Oregon (NMFS 2005a). The Willamette/Lower Columbia Technical Recovery Team (W/LC TRT) identified seven independent populations within this ESU: Clackamas River, Molalla River, North Fork Santiam River, South Fork Santiam River, Calapooia River, McKenzie River, and Middle Fork Willamette River (Myers et al., 2006). Of these, the W/LC TRT designated the Clackamas River, North Santiam River, McKenzie River, and Middle Fork Willamette River populations as core populations. Core populations are defined as those populations which are believed to have been the most productive historically. The W/LC TRT also designated the McKenzie River population as a genetic legacy population, which is a population having minimal hatchery influence or exhibiting important life-history characteristics no longer found throughout the ESU (McElhany et al., 2003). McElhany and others (2003) recommended that core and legacy populations be given priority in recovery planning because these populations may have the intrinsic capacity to sustain large populations into the future and they retain the most intact representation of the genetic character of the ESU.

Seven artificial propagation programs are considered to be part of the ESU: McKenzie River Hatchery (stock # 24), Marion Forks/North Fork Santiam River (stock # 21), South Santiam Hatchery (stock # 23) in the South Fork Santiam River, South Santiam Hatchery (stock # 23) in the Calapooia River, South Santiam Hatchery (stock # 23) in the Molalla River, Willamette Hatchery (stock # 22), and Clackamas Hatchery (stock # 19) spring-run Chinook programs (NMFS 2005a).

Life History Types. The UWR Chinook salmon ESU exhibits one life history type. As cited in Myers and others (2006), Chinook salmon native to the upper Willamette River are considered to be ocean-type. Ocean-type salmon out-migrate to the ocean during their first year and tend to migrate north along the coast. Marine recoveries of CWT-marked UWR Chinook occur off the British Columbia and Alaska coasts (Myers et al., 2006). Ocean-type Chinook in the upper Willamette historically returned in February and March, but did not ascend Willamette Falls until April and May. Upper Willamette River Chinook mature during their fourth and fifth years. Life history timing for UWR spring Chinook is shown in Table 4-2.

Current Viability. The W/LC TRT identified seven independent populations within the UWR Chinook salmon ESU. According to the W/LC TRT, none of these independent populations were considered viable (McElhany et al., 2004). For the evaluation, populations were ranked for extinction risk on a scale of 0 to 4, with 0 meaning extinct or at a very high risk of extinction and 4 meaning a very low extinction risk in 100 years.

**Table 4-2. UWR Spring Chinook Salmon Life History Timing**

| Life History Stage | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Upstream migration | | | | | | | | | | | | |
| Spawning in tributaries | | | | | | | | | | | | |
| Intragravel development | | | | | | | | | | | | |
| Juvenile rearing | | | | | | | | | | | | |
| Juvenile out-migration | | | | | | | | | | | | |

Note: Light vertical-line shading represents low-level abundance; darker horizontal-line shading represents high abundance, and white represents rare or absent. After USACE 2000.

To estimate population extinction risk, the W/LC TRT evaluated four key attributes: abundance and productivity, diversity, spatial structure, and habitat. A fifth population attribute, juvenile out-migrant growth rate, was part of the W/LC TRT viability criteria, but did not have much impact on the population evaluations due to lack of data. The four main population attributes were evaluated on the same 0–4 risk scale. To obtain the overall population score, individual population attribute scores were integrated using a simple weighted mean; the abundance and productivity scores were weighted at twice the other scores (McElhany, et al. 2004). Abundance and productivity are given greater weight than other attributes because they are considered to be clearer predictors of extinction risk than the other population attributes. The scores for the populations are in Table 4-3.

**Table 4-3. W/LC TRT Viability Assessment for UWR Chinook Salmon**

| Population | Viability Score |
|---|---|
| Clackamas River | 1.66 |
| Molalla River | 0.62 |
| North Santiam River | 0.71 |
| South Santiam River | 0.84 |
| Calapooia River | 0.65 |
| McKenzie River | 1.85 |
| Middle Fork Willamette River | 0.64 |

Limiting Factors. The major limiting factors for UWR spring Chinook salmon include:

- Reduced access to spawning/rearing habitat in tributaries.
- Altered water quality and temperature in tributaries.
- Lost/degraded floodplain connectivity and lowland stream habitat.
- Altered streamflow in tributaries.
- Hatchery impacts (NMFS 2005b).

### 4.3.2. Upper Willamette River Steelhead

ESU Description. The UWR steelhead DPS includes all naturally spawned populations of winter-run steelhead in the Willamette River and its tributaries upstream from Willamette Falls to the Calapooia River, inclusive (NMFS 2006). The W/LC TRT identified four independent populations within this DPS: Molalla River, North Fork Santiam River, South Fork Santiam River, and Calapooia River (Myers et al., 2006). Although spawning winter steelhead have been reported in the west-side tributaries to the Willamette River, these tributaries are not considered to have historically constituted a distinct independent population (Myers et al., 2006). However, these tributaries may serve as a population sink for this DPS, where fish spawning in these areas do not produce appreciable numbers of offspring due to habitat conditions. Of these populations, the W/LC TRT designated the North Fork Santiam River and South Fork Santiam River as core populations (McElhany et al., 2003). Core populations historically represented substantial portions of the DPS's abundance or contained life-histories specific to the DPS. In addition, due to their genetic integrity, the W/LC TRT also designated the North Fork Santiam River and South Fork Santiam River as genetic legacy populations (McElhany et al., 2003).

This DPS does not include any artificially propagated steelhead stocks that reside within the historical geographic range of the DPS. Hatchery summer-run steelhead occur in the Willamette Basin but are an out-of-basin stock that is not included as part of the DPS (NMFS 2006).

Life History. While both summer and winter-run life history types of steelhead currently exist in the Upper Willamette River, only winter steelhead were present historically (Myers et al., 2006). Winter-run steelhead enter the Willamette River beginning in January and February, but they do not ascend to their spawning areas until late March or April (Table 4-4). Spawning takes place from April to June 1 (Myers et al., 2006).

**Table 4-4. UWR Steelhead Life History Timing**

| Life History Stage | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Upstream migration | | | | | | | | | | | | |
| Spawning in tributaries | | | | | | | | | | | | |
| Intragravel development | | | | | | | | | | | | |
| Juvenile rearing | | | | | | | | | | | | |
| Juvenile out-migration | | | | | | | | | | | | |

Note: Light vertical-line shading represents low-level abundance; darker horizontal-line shading represents high abundance, and white represents rare or absent. After USACE 2000.

Current Viability. According to the W/LC TRT, none of the four UWR River steelhead independent populations were considered viable (McElhany et al., 2004). The W/LC TRT viability scores for the populations are shown in Table 4-5.

**Table 4-5. W/LC TRT Viability Assessment for UWR Steelhead**

| Population | Viability Score |
|---|---|
| Molalla River | 1.18 |
| North Fork Santiam River | 1.45 |
| South Fork Santiam River | 1.48 |
| Calapooia River | 1.48 |

Limiting Factors. The major limiting factors for UWR steelhead include:

- Reduced access to spawning/rearing habitat in tributaries
- Altered water quality and temperature in tributaries
- Lost/degraded floodplain connectivity and lowland stream habitat
- Altered streamflow in tributaries (NMFS 2005b).

### 4.3.3. Lower Columbia River Chinook Salmon

ESU Description. The Lower Columbia River Chinook salmon ESU includes all naturally spawned populations of Chinook salmon from the Columbia River and its tributaries from its mouth at the Pacific Ocean upstream to a transitional point between Washington and Oregon east of the Hood River and the White Salmon River, and includes the Willamette River to Willamette Falls, excluding spring Chinook salmon in the Clackamas River (NMFS 2005a). Not included in this ESU are stream-type spring Chinook salmon found in the Klickitat River (which are considered part of the Middle Columbia River spring ESU) or the introduced Carson spring Chinook salmon strain. Tule fall Chinook salmon in the Wind and Little White Salmon rivers are included in this ESU, but not introduced upriver bright fall Chinook salmon populations in the Wind, White Salmon, and Klickitat rivers. The Cowlitz, Kalama, Lewis, Washougal, and White Salmon rivers constitute the major systems on the Washington side; the lower Willamette and Sandy rivers are foremost on the Oregon side. Most of this ESU is currently represented by fall fish. The spring-run life history type is at very high risk overall. Many spring-run populations have been extirpated or nearly so as a result of dams blocking access to their high elevation habitat. Almost all current spring-run spawners in the Washington part of the ESU are of hatchery origin (Good et al., 2005).

Seventeen artificial propagation programs releasing hatchery Chinook salmon are considered part of the Lower Columbia River Chinook salmon ESU. All of these programs are designed to produce fish for harvest, and three of these programs are also intended to augment naturally spawning populations in the basins where the fish are released. These three programs integrate naturally produced spring Chinook salmon into the broodstock in an attempt to minimize the genetic effects of returning hatchery adults that spawn in the wild (NMFS 2005a).

Life History Types. The Lower Columbia River Chinook salmon ESU exhibits three major life history types: fall-run ("tules"), late fall-run ("brights"), and spring-run (Good et al., 2005). Spring Chinook salmon on the lower Columbia River, like those from coastal stocks, enter fresh water in March and April, well in advance of spawning in August and September. Historically, the spring migration was synchronized with periods of high rainfall or snowmelt to provide access to upper reaches of most tributaries, where spring stocks would hold until spawning.

Fall Chinook salmon predominate in the lower Columbia River salmon runs. Tule-type fall Chinook salmon, differentiated from bright fall Chinook salmon by their dark skin coloration and advanced state of maturation at the time of freshwater entry, begin returning to the Columbia River in mid-

August and spawn within a few weeks. Bright fall Chinook salmon populations typically return to the fresh water later than tule fall Chinook salmon and spawn between late September and early November. Most fall Chinook salmon emigrate to the marine environment as subyearlings. Adult fall tule Chinook salmon return to tributaries in the lower Columbia River at 3 and 4 years of age, compared to 4 to 5 years for bright Chinook salmon and spring-run fish. Marine coded-wire-tag recoveries for Lower Columbia River stocks tend to occur off the British Columbia and Washington coasts, although a small proportion of the tags are recovered in Alaskan waters.

Current Viability. Many populations within the Lower Columbia River Chinook salmon ESU exhibited pronounced increases in abundance and productivity in recent years, possibly due to improved ocean conditions (Good et al., 2005). Abundance estimates of naturally spawned populations have been uncertain until recently due to a high (about 70%) fraction of naturally spawning hatchery fish. Abundance estimates of naturally produced spring Chinook salmon have improved since 2001 due to the marking of all hatchery spring Chinook salmon releases (compared to a previous marking rate of only 1% to 2%), which allows for the separation in counts at weirs and traps and on spawning grounds. Despite recent improvements, long-term trends in productivity are below replacement for the majority of populations in the ESU. Of the 31 historical populations, 8 to 10 have been extirpated or nearly extirpated. Although about 35% of historical habitat has been lost behind impassable barriers, the ESU exhibits a broad spatial distribution in a variety of watersheds and habitat types. Natural production currently occurs in about 20 populations, although only one population has a mean spawner abundance exceeding 1,000 fish. The West Coast Salmon Biological Review Team, a group of scientists with diverse backgrounds convened by NMFS to conduct a status review for listing or listed species, expressed concern that most of the extirpated populations are spring-run, and the disproportionate loss of this life history type represents a risk to ESU diversity (Good et al., 2005). Additionally, of the four hatchery spring-run Chinook salmon populations considered part of the ESU, two are propagated in rivers that, although they are within the historical geographic range of the ESU, probably did not support spring-run populations. These populations may not be expected to contribute significantly to the ESU because they are in habitat not historically used; however, substantial human-influenced changes have occurred and no current information on the productivity of these area is available. High hatchery production poses genetic and ecological risks to the natural populations and complicates assessments of their performance. The Biological Review Team also expressed concern over the introgression of out-of-ESU hatchery stocks. In its conclusion, the Biological Review Team found moderately high risk for all viable salmonid population (VSP) categories for this ESU.

Limiting Factors. The major limiting factors for Lower Columbia River Chinook salmon include:

- Reduced access to spawning/rearing habitat in tributaries.
- Hatchery impacts.
- Loss of habitat diversity and channel stability in tributaries.
- Excessive sediment in spawning gravel.
- Elevated water temperatures in tributaries.
- Harvest impacts to fall Chinook (NMFS 2005b).

### 4.3.4. Lower Columbia River Coho Salmon

ESU Description. The Lower Columbia River coho ESU includes all naturally spawned populations of coho salmon in the Columbia River and its tributaries from the mouth of the Columbia up to and including the Big White Salmon and Hood Rivers, and includes the Willamette River to Willamette Falls (NMFS 2005a). Twenty-five artificial propagation programs are considered to be part of the

ESU: Grays River, Sea Resources Hatchery, Peterson Coho Project, Big Creek Hatchery, Astoria High School (STEP) Coho Program, Warrenton High School (STEP) Coho Program, Elochoman Type-S Coho Program, Elochoman Type-N Coho Program, Cathlamet High School FFA Type-N Coho Program, Cowlitz Type-N Coho Program in the Upper and Lower Cowlitz Rivers, Cowlitz Game and Anglers Coho Program, Friends of the Cowlitz Coho Program, North Fork Toutle River Hatchery, Kalama River Type-N Coho Program, Kalama River Type-S Coho Program, Lewis River Type-N Coho Program, Lewis River Type-S Coho Program, Fish First Wild Coho Program, Fish First Type-N Coho Program, Syverson Project Type-N Coho Program, Washougal River Type-N Coho Program, Eagle Creek NFH, Sandy Hatchery, and the Bonneville/Cascade/Oxbow complex coho hatchery programs. The NMFS determined that these artificially propagated stocks are no more divergent relative to the local natural population(s) than would be expected for closely related natural populations within the ESU (NMFS 2005a). These determinations were based on comparisons of available life history characteristics and genetic variation of the hatchery broodstocks relative to the existing natural populations, and information related to the original founding population used in the hatcheries. No substantial genetic deviations by hatchery broodstocks were detected from existing natural populations.

Life Histories. Populations in the Lower Columbia River coho salmon ESU display one of two major life history types: early or late adult return time to freshwater (Myers et al., 2006). Early returning coho salmon (Type S) return to freshwater from August to October, and spawn from October to November. Late returning coho salmon (Type N) return to freshwater from October through November or December and spawn primarily from November through January. It is generally thought that early returning coho salmon migrate to headwater areas to spawn and late returning fish migrate to the lower reaches of larger rivers or smaller streams along the Columbia River. In both cases, adults typically return as age three (Myers et al., 2006). Juveniles typically migrate to the ocean as yearlings from mid-February through the end of May with the peak migrations in the lower Columbia River occurring during May (Weitkamp et al., 1995).

Current Viability. McElhany and others (2004) identified a total of 21 extant, demographically independent populations in three major population groups in the Lower Columbia River coho salmon ESU: Coastal, Cascade, and Gorge. Only two of these extant populations in this ESU are believed to have appreciable natural productivity outside of hatchery production: those in the Clackamas and Sandy rivers (Good et al., 2005). The scarcity of naturally produced spawners throughout the ESU is the most serious overall concern threatening coho. Even in the Clackamas and Sandy rivers, short- and long-term population trends are negative, and productivity is decreased from 1980s levels.

The lack of naturally produced spawners is contrasted by the very large number of hatchery-produced adults. The abundance of hatchery coho salmon returning to the lower Columbia River in 2001 and 2002 exceeded 1 million and 600,000 fish, respectively. The West Coast Salmon Biological Review Team (Good et al., 2005) expressed concern that the magnitude of hatchery production continues to pose significant genetic and ecological threats to the extant natural populations in the ESU. However, these hatchery stocks collectively represent a significant portion of the ESU's remaining genetic resources. The 21 hatchery stocks considered to be part of the ESU, if appropriately managed, may prove essential to the restoration of more widespread naturally spawning populations. Several of these risks (potential for domestication, intentional or inadvertent selection, incorporation of non-native fish into the broodstocks, release strategies that result in high straying rates, and competition with or predation on naturally produced fish) have recently begun to be addressed by improvements in hatchery practices. Out-of-ESU broodstock is no longer used, and almost 100% of hatchery fish are marked to improve monitoring and evaluation of broodstock and hatchery- and natural-origin returns.

The NMFS' assessment of the effects of artificial propagation on ESU extinction risk concluded that hatchery programs collectively mitigate the immediacy of extinction risk for the Lower Columbia River coho salmon ESU in the short term, but these programs do not substantially reduce the extinction risk of the ESU in the foreseeable future (NMFS 2005a). At present, within-ESU hatchery programs significantly increase the abundance of the ESU. Without adequate long-term monitoring, the contribution of ESU hatchery programs to the productivity of the ESU is uncertain. The hatchery programs are widely distributed throughout the lower Columbia River, reducing the spatial distribution of risk to catastrophic events.

Limiting Factors. The major limiting factors for Lower Columbia River coho salmon include:

- No access to approximately 40% of historical habitat.
- Loss of naturally spawning populations.
- Low abundance of extant populations.
- Diminished diversity.
- Fragmentation and isolation of the remaining naturally produced fish (NMFS 2005a).

### 4.3.5. Lower Columbia River Steelhead

ESU Description. The Lower Columbia River steelhead DPS includes all naturally produced steelhead in tributaries to the Columbia River between the Cowlitz and Wind Rivers in Washington and the Willamette and Hood Rivers in Oregon, excluding steelhead in the upper Willamette River above Willamette Falls (NMFS 2006). This DPS includes both winter steelhead (Cowlitz, Toutle, Coweeman, Kalama, Washougal, Sandy, Hood, Clackamas and Wind rivers) and summer steelhead (Kalama, Lewis, Hood, Wind, and Washougal rivers). The Willamette/Lower Columbia River Technical Recovery Team identified 23 historical populations within the DPS (Myers et al., 2006). Hatchery programs using endemic natural stocks of winter steelhead have been developed in the Cowlitz, Sandy, Kalama, and Hood River basins since the listing and are considered to be part of the DPS (NMFS 2006).

Life Histories. Two distinct life history types of steelhead, summer and winter runs, historically were and currently are found in the lower Columbia River (Myers et al., 2006). These two life history types are reproductively isolated from one another temporally, as described below, and are considered separate populations. Summer steelhead return to fresh water from May to October, and enter the Columbia in a sexually immature condition, requiring several months in freshwater to reach sexual maturity and spawn. Spawning of summer steelhead occurs from January through July in the following year, with peak spawning occurring from late February through early April. Winter steelhead enter freshwater from December to May and return as sexually mature individuals that spawn shortly thereafter. Spawning occurs from February through June, with peak spawning activity occurring between late April and May (Myers et al., 2006). Adult steelhead, unlike salmon, do not necessarily die after spawning and may return to the ocean shortly after spawning (kelts). Summer and winter steelhead juvenile life histories overlap considerably. Both rear in freshwater for 1 to 4 years, select similar freshwater rearing habitats and spend 1 to 4 years in the ocean prior to spawning (Myers et al., 2006). Steelhead exhibit a great deal of variability in smolt age (Busby et al., 1996). Outmigrating steelhead smolts in the lower Columbia River are predominately age two. In the lower Columbia River, outmigration of steelhead smolts generally occurs from March to June, with peak migration usually in April or May.

Current Viability. Myers and others (2006) identified 23 demographically independent historical populations in this DPS. Four of these populations were at a very high risk of extinction, 13 were at a high risk of extinction, and 5 were at a moderate risk of extinction (McElhany et al., 2004).

While some anadromous populations in the Lower Columbia DPS, particularly summer-run populations, have shown increases in abundance in the past few years, abundance levels remain low (NMFS 2006). Only half of the historical populations currently exhibit appreciable natural production. Spatial distribution of the DPS remains relatively good, despite loss of about 35% of historical habitat. Genetic diversity is a concern due to high proportions of hatchery-origin spawners, releases of non-native hatchery stocks in some areas, and disproportionate declines in the summer steelhead life history (NMFS 2006).

Limiting Factors. The major limiting factors for Lower Columbia River steelhead include:

- Degraded floodplain and stream channel structure and function.
- Reduced access to spawning/rearing habitat.
- Altered streamflow in tributaries.
- Excessive sediment and elevated water temperatures in tributaries.
- Hatchery impacts (NMFS 2005b).

### 4.3.6. Columbia River Chum Salmon

ESU Description. The Columbia River chum ESU includes all naturally spawned populations of chum salmon in the Columbia River and its tributaries in Washington and Oregon (NMFS 1999b). Three artificial propagation programs are considered to be part of the ESU: Chinook River (Sea Resources Hatchery), Grays River, and Washougal River/Duncan Creek chum hatchery programs. The NMFS determined that these artificially propagated stocks are no more divergent relative to the local natural population(s) than what would be expected between closely related natural populations within the ESU (NMFS 2005a).

Life Histories. Adult Columbia River chum salmon typically enter the Columbia River in October and spawn from early November through December (Myers et al., 2006). Age at maturity occurs from 3 to 6 years and most adults spawn at 4 years in age (WDFW 2006). Emergence is likely to occur between February and April. Juvenile chum salmon migrate to the estuary as fry between March and May.

Current Viability. About 90% of the historical populations in the Columbia River chum ESU are extirpated or nearly so (NMFS 2005a). During the 1980s and 1990s, the combined abundance of natural spawners for the lower and upper Columbia River Gorge, Washougal, and Grays River populations was below 4,000 adults. In 2002, however, the abundance of natural spawners exhibited a substantial increase evident at several locations in the ESU. The preliminary estimate of natural spawners was approximately 20,000 adults. This dramatic increase in abundance coincided with the first returns from the Grays River hatchery program, but improved ocean conditions, improved flow management at Bonneville Dam, favorable freshwater conditions, and increased survey sampling effort may all have contributed to the elevated 2002 abundance. Despite the high returns in 2002, long- and short-term productivity trends for the ESU are at or below replacement. The loss of off-channel habitats and the extirpation of about 17 historical populations increase the ESU's vulnerability to environmental variability and catastrophic events. The populations that remain are still low in abundance compared to historical numbers and have limited distributions and poor connectivity (NMFS 2005a).

There are now three artificial propagation programs producing chum salmon considered to be part of the Columbia River chum ESU (NMFS 2005a). These are conservation programs designed to support natural production. The Sea Resources program has begun to provide benefits to ESU spatial structure through reintroduction of chum salmon into restored habitats in the Chinook River. The Washougal Hatchery artificial propagation program provides juvenile chum salmon for re-introduction into recently restored habitat in Duncan Creek, Washington. This program also serves as a genetic reserve for the naturally spawning population in the mainstem Columbia River below Bonneville Dam, which can access only a portion of spawning habitat during low hydrologic years. The other two programs are designed to augment natural production in the Grays River and the Chinook River in Washington. All these programs use naturally produced adults for broodstock. These programs were only recently established (1998-2002).

The NMFS' assessment of the effects of artificial propagation on ESU extinction risk concluded that these hatchery programs collectively do not substantially reduce the extinction risk of the ESU in-total (NMFS 2005a). The Columbia River chum hatchery programs have only recently been initiated, and, as described above, are beginning to provide benefits to ESU abundance. The contribution of ESU hatchery programs to the productivity of the ESU in-total is uncertain. These three programs have a neutral effect on ESU diversity. Collectively, artificial propagation programs in the ESU provide a slight beneficial effect to ESU abundance and spatial structure.

Limiting Factors. The major limiting factors for Columbia River chum include:

- Altered channel form and stability in tributaries.
- Excessive sediment in tributary spawning gravels.
- Altered stream flow in tributaries and mainstem Columbia.
- Loss of some tributary habitat types.
- Harassment of spawners in tributary and mainstem (NMFS 2005b).

### 4.3.7. Other Salmon and Steelhead ESUs/DPSs

Middle Columbia River steelhead, Snake River spring/summer Chinook salmon, Snake River fall Chinook salmon, Snake River sockeye salmon, Snake River steelhead, Upper Columbia River spring Chinook salmon, and Upper Columbia River steelhead spawn in tributaries to the Columbia River above the mouth of the Willamette River (NMFS 2005a, 2006). Adults and juveniles of these ESUs migrate through the lower Columbia River, and some juvenile rearing occurs there as well. All of these species are listed as threatened under the ESA except for Snake River sockeye salmon, which was determined to be endangered.

## 4.4. Status for Bull Trout

This section presents updated information for bull trout in the action area since the 2000 BA (USACE 2000) was prepared.

### 4.4.1. Distinct Population Segments and Population Units

The USFWS published a draft *Bull Trout Recovery Plan* in October 2002 (USFWS 2002). At the time of publication of the draft recovery plan, there were 27 recovery units described. After publication, the USFWS recognized that these units may not meet the standard for "recovery units" and decided to call them "management units." Consequently, "recovery units" as described in the

draft recovery plan are interchangeable with "management units" and "interim recovery units" are interchangeable with "DPSs." Until the draft recovery plan is finalized, the USFWS has adopted the use of local population, core area, management unit, and interim recovery unit for purposes of consultation and recovery. Table 4-6 shows the hierarchal relationships between these geographical units of analysis for the Willamette Project.

**Table 4-6. Hierarchy of Geographical Units of Analysis for Bull Trout**

| Name | Hierarchal Relationship |
|---|---|
| Columbia River Interim Recovery Unit (formerly a DPS) | One of 5 interim recovery units in the range of the species within the coterminous U.S. |
| Willamette River Management Unit (formerly a Recovery Unit) | One of 23 management units in the Columbia River interim recovery unit |
| Upper Willamette Core Area (no change in terminology) | The only core area in the Willamette River Management Unit |
| South Fork McKenzie Local Population (no change in terminology) | One of 4 local populations in the Upper Willamette Core Area |

Central to the survival and recovery of bull trout is the maintenance of viable core areas (USFWS 2002). A core area is defined as a geographic area occupied by one or more local bull trout populations that overlap in their use of rearing, foraging, migratory, and overwintering habitat.

### 4.4.2. Columbia River Interim Recovery Unit

The Columbia River interim recovery unit is one of five segments of the coterminous United States population of the bull trout that is considered essential to the survival and recovery of the species. Each of the five interim recovery units is necessary to maintain the bull trout's distribution, as well as its genetic and phenotypic diversity, all of which are important to ensure the species' resilience to changing environmental conditions. The overall status of the Columbia River interim recovery unit has not changed appreciably since its listing on June 10, 1998 (63 FR 31647).

The conservation needs of bull trout are often generally expressed as the four "Cs" – cold, clean, complex, and connected habitat. Cold stream temperatures, clean water quality that is relatively free of sediment and contaminants, complex channel characteristics (including abundant large wood and undercut banks), and large patches of such habitat that are well connected by unobstructed migratory pathways are all needed to promote conservation of bull trout at multiple scales ranging from the coterminous to local populations (a local population is a group of bull trout that spawn within a particular stream or portion of a stream system). The recovery planning process for bull trout (USFWS 2002) has also identified the following conservation needs: (1) maintenance and restoration of multiple, interconnected populations in diverse habitats across the range of each interim recovery unit, (2) preservation of the diversity of life-history strategies, (3) maintenance of genetic and phenotypic diversity across the range of each interim recovery unit, and (4) establishment of a positive population trend.

The Columbia River interim recovery unit includes bull trout residing in portions of Oregon, Washington, Idaho, and Montana. Bull trout are estimated to have occupied about 60% of the Columbia River Basin and presently occur in 45% of the estimated historical range (Quigley and Arbelbide 1997). The Columbia River interim recovery unit has declined in overall range and numbers of fish (63 FR 31647). Although some strongholds still exist with migratory fish present, bull trout generally occur as isolated local populations in headwater lakes or tributaries where the

migratory life history form has been lost. Though still widespread, there have been numerous local extirpations reported throughout the Columbia River Basin. The draft *Bull Trout Recovery Plan* (USFWS 2002) identifies the following conservation needs for the Columbia River interim recovery unit: (1) maintain or expand the current distribution of the bull trout within core areas; (2) maintain stable or increasing trends in bull trout abundance; (3) restore and maintain suitable habitat conditions for all bull trout life history stages and strategies; and (4) conserve genetic diversity and provide opportunities for genetic exchange.

#### 4.4.2.1. Willamette River Management Unit

Bull trout were historically widespread in multiple tributaries of the Willamette River but are now limited to less than 250 adults in the McKenzie River. A translocation program to move bull trout fry from the McKenzie to the Middle Fork Willamette River began in 1997 and has occurred annually to augment the small, or perhaps extirpated, population of bull trout last documented in the 1980s above Hills Creek Dam. Spawning and reproductive success, likely a result of the translocation program, was documented for the first time in 2005. The current number of spawning adults in the Middle Fork Willamette is less than 15 fish.

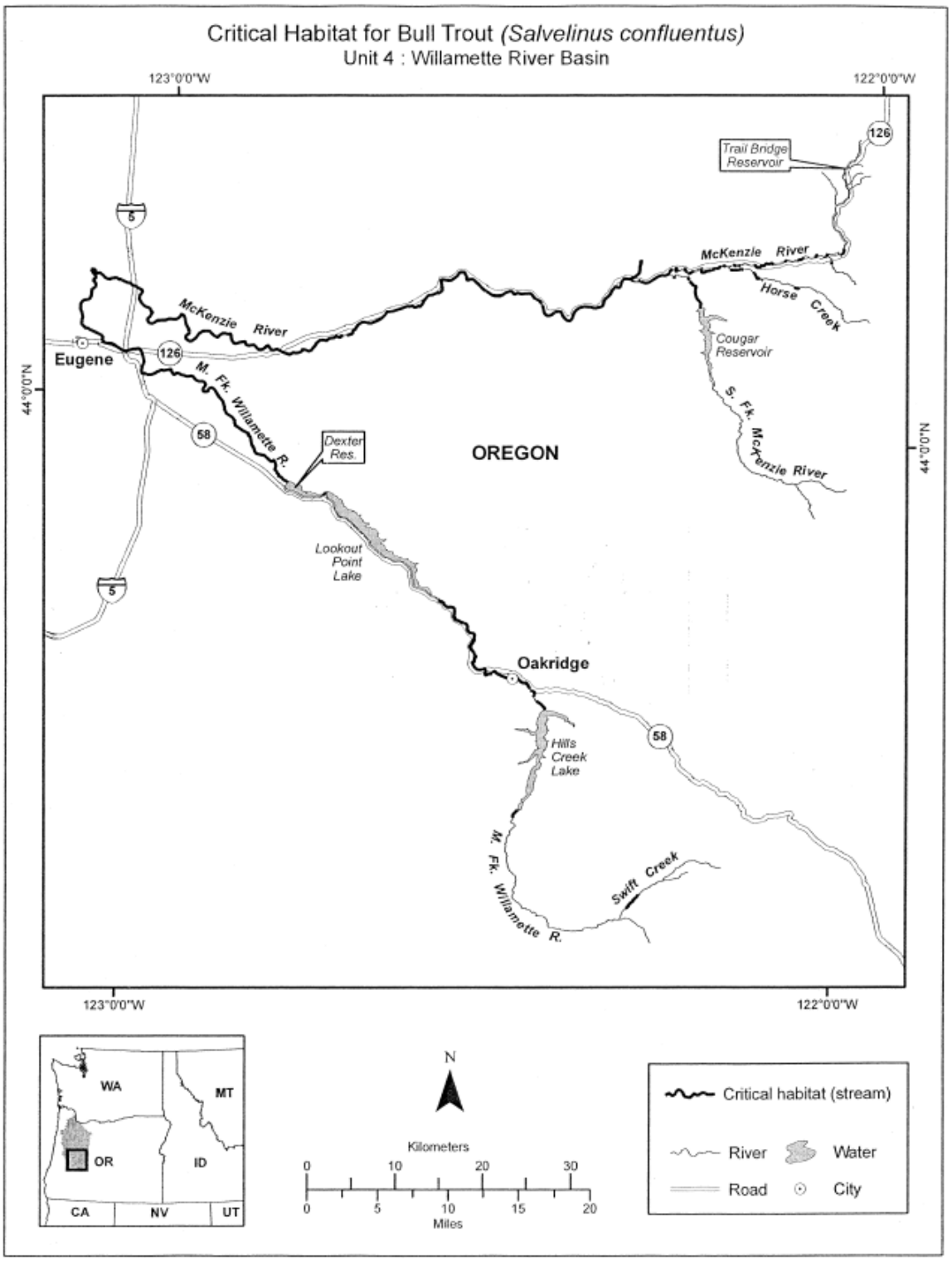
The bull trout population in the McKenzie River was likely a single fluvial population prior to the construction of flood control and hydropower dams in the 1960s. Cougar Dam on the South Fork McKenzie River and Trail Bridge Dam on the upper mainstem McKenzie River effectively isolated bull trout above these projects, resulting in two adfluvial populations that continue to exist today despite each numbering less than 75 spawning adults. The remaining fluvial population in the McKenzie River below these dams is the most viable of the three populations, although abundance is likely depressed. Bull trout in the McKenzie subbasin have been monitored since the mid-1990s.

USFWS (2002) reported that the conservation needs of the bull trout in the Willamette Basin are: (1) restoring connectivity between isolated populations; (2) restoring viable bull trout populations in currently and historically occupied areas; (3) restoring anadromous fish in areas currently occupied by the bull trout in order to restore a portion of their historical prey base; (4) restoring, to the degree possible, normal flow and stream temperature patterns by constructing water temperature control towers and adopting alternative flow management strategies; and (5) reducing bull trout injury and mortality from entrainment into turbine intakes, regulating outlets, and spillways.

### 4.4.3. Bull Trout Critical Habitat

The USFWS published a final critical habitat designation for the coterminous United States population of the bull trout on September 26, 2005 (70 FR 56212); the rule became effective on October 26, 2005. In the Willamette River Basin, the USFWS designated 111 stream or shoreline miles as bull trout critical habitat in the following water bodies (Figure 4-1): Blue River, Horse Creek, Lost Creek, McKenzie River, Middle Fork Willamette River, South Fork McKenzie River, Swift Creek, West Fork Horse Creek, and the Willamette River (70 FR 56212). Currently, there are three known bull trout local populations in the McKenzie River subbasin, and one potential bull trout local population in the Middle Fork Willamette River subbasin. All four of these populations are identified as essential for bull trout recovery in the draft *Bull Trout Recovery Plan* (USFWS 2002). With the exception of the mainstem Willamette River, the lower Middle Fork Willamette River, and Lost Creek, all segments proposed as critical habitat are currently occupied by bull trout, and all segments are essential to recovery as indicated in the recovery criteria in the draft *Bull Trout Recovery Plan* (USFWS 2002).

**Figure 4-1. Critical Habitat for Bull Trout in the Willamette River Basin**




Source: 70 FR 56212

Within the designated critical habitat areas, the primary constituent elements (PCEs) for bull trout are those habitat components that are essential for the primary biological needs of foraging, reproducing, rearing of young, dispersal, genetic exchange, or sheltering. The PCEs are as follows:

1. Water temperatures that support bull trout use. Bull trout have been documented in streams with temperatures from 32º to 72ºF (0 to 22ºC) but are found more frequently in temperatures ranging from 36º to 59ºF (2º to 15ºC). These temperature ranges may vary depending on life-history stage and form, geography, elevation, diurnal and seasonal variation, shade such as that provided by riparian habitat, and local groundwater influence. Stream reaches with temperatures that preclude bull trout use are excluded from designation.

2. Complex stream channels with features such as woody debris, side channels, pools, and undercut banks to provide a variety of depths, velocities, and instream structures.

3. Substrates of sufficient amount, size, and composition to ensure success of egg and embryo overwinter survival, fry emergence, and young-of-the-year and juvenile survival. This should include a minimal amount of fine substrate less than 0.25 inch (0.63 centimeter) in diameter.

4. A natural hydrograph, including peak, high, low, and base flows within historic ranges or, if regulated, currently operate under a biological opinion that addresses bull trout, or a hydrograph that demonstrates the ability to support bull trout populations by minimizing daily and day-to-day fluctuations and minimizing departures from the natural cycle of flow levels corresponding with seasonal variation.

5. Springs, seeps, groundwater sources, and subsurface water to contribute to water quality and quantity as a cold water source.

6. Migratory corridors with minimal physical, biological, or water quality impediments between spawning, rearing, overwintering, and foraging habitats, including intermittent or seasonal barriers induced by high water temperatures or low flows.

7. An abundant food base including terrestrial organisms of riparian origin, aquatic macroinvertebrates, and forage fish.

8. Permanent water of sufficient quantity and quality such that normal reproduction, growth, and survival are not inhibited.

There is widespread agreement in the scientific literature that many factors related to human activities have impacted bull trout and their habitat, and continue to do so. Among the many factors that contribute to degraded PCEs, those which appear to be particularly significant and have resulted in a legacy of degraded habitat conditions include: (1) fragmentation and isolation of local populations due to the proliferation of dams and water diversions that have eliminated habitat, altered water flow and temperature regimes, and impeded migratory movements; (2) degradation of spawning and rearing habitat and upper watershed areas, particularly alterations in sedimentation rates and water temperature, resulting from forest and rangeland practices and intensive development of roads; (3) the introduction and spread of nonnative fish species as a result of fish stocking and degraded habitat conditions, which compete with bull trout for limited resources; and (4) degradation of foraging, migratory, and overwintering habitat resulting from reduced prey base, roads, agriculture, development, and dams.

# 5. ENVIRONMENTAL BASELINE

This section provides revised information for the environmental baseline presented in the 2000 BA (USACE 2000).

## 5.1. Primary Constituent Elements of Designated Critical Habitat in the Action Area

### 5.1.1. North Santiam River Subbasin

Table 5-1 provides a matrix of pathways and indicators for the condition of primary constituent elements (PCEs) of critical habitat in the North Santiam River subbasin under the environmental baseline condition.

**Table 5-1. Matrix of Pathways and Indicators for PCEs of Critical Habitat in the North Santiam River Subbasin**

| PCEs | Pathway | Indicator | North Santiam Baseline Condition | Limiting Factors |
|---|---|---|---|---|
| Freshwater spawning sites<br>Freshwater rearing<br>Freshwater migration corridors | Water quality | Temperature | Indirect evidence that warmer fall temperatures have shortened the incubation and emergence timing of Chinook salmon fry. | USACE operations (Detroit). |
| | | | ODEQ's 2002 CWA 303(d) database indicates that maximum temperatures for spawning, incubation, and fry emergence have been exceeded in the lower North Santiam River (up to RM 26.5), and in the Santiam River below the mouth of the South Santiam. | USACE operations (Detroit).<br>Agriculture |
| | | | Maxima for core and non-core rearing and adult and juvenile migration have been exceeded in the mainstem Santiam River and in the North Santiam River up to RM 10. | USACE operations.<br>Agriculture |
| | | | Maxima for core and non-core rearing and adult and juvenile migration also have been exceeded in streams above Detroit Reservoir (Blowout, Boulder, and Marion creeks), and in tributaries to lower reaches of the North Santiam (Chehulpum Creek, Bear Branch, and the Little North Santiam River, including Stout and Elkhorn creeks). | Timber harvest |
| | | | Average daily temperatures less than 52°F during May through late June, cool enough to have delayed the upstream migration of adult spring Chinook salmon. | USACE operations (Detroit). |

| PCEs | Pathway | Indicator | North Santiam Baseline Condition | Limiting Factors |
|---|---|---|---|---|
| Freshwater spawning sites<br>Freshwater rearing<br>Freshwater migration corridors | Water quality | Total suspended solids/turbidity | Although high turbidity events have been reported in the North Santiam subbasin in recent years, there is no indication that turbidity has adversely affected the habitat requirements of anadromous salmonids.<br><br>ODEQ's 2002 CWA 303(d) database does not include any exceedences of water quality criteria for excess turbidity. | N/A |
| Freshwater spawning sites<br>Freshwater rearing<br>Freshwater migration corridors | Water quality | Chemical contamination/nutrients | ODEQ's 2002 CWA 303(d) database does not include any exceedences of water quality criteria for toxics.<br><br>ODEQ's 2002 CWA 303(d) database does not indicate that any streams are impaired due to excess nutrients.<br><br>Operations at Detroit and Big Cliff dams may have reduced nutrient loads in the mainstem North Santiam and Santiam rivers by increasing summer flows. | N/A<br><br>N/A<br><br>Apparent benefit of USACE operations |
| Freshwater spawning sites<br>Freshwater rearing<br>Freshwater migration corridors | Water quality | Dissolved oxygen (DO) | ODEQ's 2002 CWA 303(d) database indicates dissolved oxygen concentrations lower than the criterion for salmonid spawning and rearing [11 milligrams per liter (mg/L) or 95% saturation] at RM 9.3 and RM 11.2 in the mainstem Santiam River (below the mouth of the South Santiam). | May be linked to causes of high temperatures in this reach. |
| Freshwater spawning sites<br>Freshwater rearing<br>Freshwater migration corridors | Water quality | Total dissolved gas (TDG) | TDG level of 129% saturation measured 950 feet below Big Cliff Dam and TDG level of 120.2% measured 2 miles downstream. | Regulating outlet spill at Detroit and Big Cliff dams. |

| PCEs | Pathway | Indicator | North Santiam Baseline Condition | Limiting Factors |
|---|---|---|---|---|
| Freshwater migration corridors | Habitat access | Physical barriers | *Barriers below Big Cliff Dam:* Reduced flows for upstream passage and juvenile entrainment into power and water supply canals in the lower subbasin. During construction of Detroit and Big Cliff dams (early 1950s), a concrete weir (Minto Dam) was built about three miles downstream of the dams to replace the old hatchery rack. Minto Dam has blocked passage of all adult spring Chinook salmon and most winter steelhead since 1952. | SWCD.<br>City of Salem.<br><br>State hatchery operations. |
| | | | *Barriers above Detroit Reservoir:* A hatchery rack near the mouth of the Breitenbush River (now under Detroit Reservoir) intercepted a large proportion of the adult spring Chinook salmon and winter steelhead runs from 1911 through 1941. | State hatchery operations (not a factor since 1941). |
| | | | *Big Cliff and Detroit Projects as Barriers:* Both projects were built without fish passage facilities; populations are restricted to below Big Cliff Dam. Preliminary screw trap studies indicate survival rates for juvenile spring Chinook of 51%-60.5% at Detroit Dam and 69% at Big Cliff Dam; the combined survival rate for fish that pass both dams was 35%-42%. No estimate of reservoir survival available. | USACE projects (Big Cliff/Detroit) |
| | | | *Predation as a Barrier to Reservoir Migration:* Cool water temperatures above Detroit Dam limit production of northern pikeminnow. | N/A |
| Freshwater spawning sites | Habitat elements | Substrate | Substrate has coarsened downstream of Big Cliff Dam.<br><br>River channel downstream of Big Cliff Reservoir may be downcutting.<br><br>Channel downstream of Big Cliff Dam could lack spawning gravel.<br><br>Many areas scoured to bedrock.<br><br>Current sediment budget not creating and maintaining side channel and gravel bar habitat needed by anadromous salmonids. | USACE reservoirs trap sediment from headwaters.<br><br>Operation of Detroit/ Big Cliff reduces magnitude/frequency of peak flows.<br><br>USACE and private revetments.<br><br>Gravel mining.<br>Historical log drives. |

| PCEs | Pathway | Indicator | North Santiam Baseline Condition | Limiting Factors |
|---|---|---|---|---|
| Freshwater rearing sites<br>Freshwater migration corridors | Habitat elements | Large woody debris (LWD) | *In the Tributaries and Upper Mainstem North Santiam Rivers:* Large wood is lacking in most small tributaries; few meet the ODFW benchmarks.<br><br>Recruitment potential for large wood is low along most surveyed streams. | Timber harvesting<br><br>Stream clean-out<br><br>Fire suppression |
| Freshwater rearing sites<br>Freshwater migration corridors | Habitat elements | Large woody debris (LWD) | *In the Mainstem North Santiam and Santiam Rivers:* Reaches of the North Santiam River below Detroit and Big Cliff Dams are deprived of large wood.<br><br>Inadequate recruitment of large wood from riparian areas along mainstem North Santiam and tributaries downstream from Big Cliff Dam.<br><br>Lack of large wood-associated habitat for anadromous salmonids and invertebrates upon which they feed. | USACE removes large wood from reservoirs.<br><br>Inadequate recruitment from riparian forests.<br><br>USACE and private revetments prevent recruitment of large wood from banks.<br><br>Operation of Detroit/ Big Cliff reduces frequency of channel-forming flows needed to recruit large wood from banks. |
| Freshwater rearing sites<br>Freshwater migration corridors | Habitat elements | Pool frequency and quality | Pool frequency and quality in the North Santiam below Detroit/Big Cliff is fair to good due to the presence of pool forming elements such as riparian forests and LWD. | N/A |

| PCEs | Pathway | Indicator | North Santiam Baseline Condition | Limiting Factors |
|---|---|---|---|---|
| Freshwater spawning sites<br>Freshwater rearing<br>Freshwater migration corridors | Habitat elements | Off-channel habitat | While no quantitative data are available, the North Santiam likely contains fewer off-channel habitats, simplified mainstem habitat, and few new gravel bars or channel surfaces. | Operation of Detroit/Big Cliff reduces magnitude/ frequency of peak flows.<br><br>USACE and private revetments.<br><br>USACE removes large wood from reservoirs.<br><br>Gravel mining in lower river.<br><br>USACE traps sediment from 60% of upper subbasin in Detroit and Big Cliff reservoirs. |
| Freshwater spawning sites<br>Freshwater rearing | Channel conditions and dynamics | Width/depth ratio | Channel forming processes in the North Santiam River downstream of the Detroit/Big Cliff dam complex have been restricted by changes to the natural hydrograph and by reductions in sediment load and LWD derived from above Detroit Dam. Flow regulation, fractionation of the sediment load passed to below the dams, and accumulation of fine sediment fractions below Big Cliff Dam have resulted in bank and substrate armoring (i.e., compaction and stabilization) and in habitat simplification. | Operation of Detroit/Big Cliff reduces magnitude/ frequency of peak flows.<br><br>USACE removes large wood from reservoirs.<br><br>USACE traps sediment from 60% of upper subbasin in Detroit and Big Cliff reservoirs. |
| Freshwater spawning sites<br>Freshwater rearing<br>Freshwater migration corridors | Channel conditions and dynamics | Streambank condition | Streambanks do not support natural floodplain function in the lower North Santiam River downstream of the canyon area below the Detroit/Big Cliff dam complex. | Operation of Detroit and Big Cliff reduces magnitude/frequency of peak flows.<br><br>USACE and private revetments. |

| PCEs | Pathway | Indicator | North Santiam Baseline Condition | Limiting Factors |
|---|---|---|---|---|
| Freshwater rearing<br>Freshwater migration corridors | Channel conditions and dynamics | Floodplain connectivity | Floodplain is not frequently inundated, with less over-bank flow and side channel connectivity.<br><br>Reduced nutrient exchange, reduced sediment exchange, reduced flood refugia for fish, and reduced establishment of new riparian forests. | Operation of Detroit and Big Cliff reduces magnitude/frequency of peak flows.<br><br>USACE and private revetments. |
| Freshwater spawning sites<br>Freshwater rearing<br>Freshwater migration corridors | Water quantity (flow/hydrology) | Change in peak/base flow | Frequency of channel-forming flows not of sufficient magnitude to create and maintain channel complexity and provide nutrient, organic matter, and sediment inputs from floodplain areas.<br><br>Increased fall flows may allow spring Chinook to spawn in areas that will be dewatered during active flood control operations.<br><br>Winter and spring flow reductions may reduce rearing area and the survival of steelhead fry.<br><br>Increased summer flows may increase rearing area and the heat capacity of the stream.<br><br>Low summer flows in specific reaches (due to diversions) may reduce the juvenile rearing habitat area, block adult passage to upstream spawning areas, and decrease the heat capacity of the stream.<br><br>Flow fluctuations now occur at rates rapid enough to entrap and strand juvenile anadromous fish. | Flood control operations at Detroit/ Big Cliff reduce the magnitude/frequency of peak flows.<br><br>Fall releases from Detroit and Big Cliff to create storage space.<br><br>Winter flood control and late winter and spring refill operations at Detroit/Big Cliff reservoirs.<br><br>Flow augmentation from Detroit/Big Cliff dams to meet mainstem targets.<br><br>Summer diversions at SWCD's Stayton complex and other diversions, including those served by Reclamation contracts.<br><br>Active flood control operations at Detroit/ Big Cliff dams cause rapid flow reductions.<br><br>Rapid changes in diversion rates at the SWCD's Stayton complex. |

| PCEs | Pathway | Indicator | North Santiam Baseline Condition | Limiting Factors |
|---|---|---|---|---|
| Freshwater spawning sites<br>Freshwater rearing<br>Freshwater migration corridors | Watershed conditions | Road density and location | Moderate to high road densities exist in North Santiam watershed above and below Detroit/Big Cliff. These roads are managed by Oregon Dept. Transportation and by USFS; corrective measures are not included as a part of the revised proposed action. | N/A |
| Freshwater spawning sites<br>Freshwater rearing<br>Freshwater migration corridors | Watershed conditions | Disturbance history | Forests are dominated by early- to mid-successional stages with few late-successional forests. Disturbance regime is dominated by timber harvesting, which has increased sediment delivery to streams while decreasing large wood input.<br><br>Upper watershed is forested, but some managed for timber production rather than ecosystem health. Lower watershed contains extensive agricultural, urban, rural, and residential development. Only 8% of lower watershed contains native Willamette Valley vegetation. | Fire suppression<br>Timber harvest<br><br>Conversion to agricultural, urban, rural, and residential uses.<br><br>Flood control operations at Detroit/ Big Cliff probably increased agricultural, urban, rural, and residential development in the floodplain. |
| Freshwater spawning sites<br>Freshwater rearing<br>Freshwater migration corridors | Watershed conditions | Riparian reserves | *Headwater Forests Riparian Conditions:* Most riparian areas in small tributaries are vegetated, but consist of alder or young coniferous riparian areas. Some drainages contain up to 33% mature riparian vegetation (e.g., Little North Fork), but others have less (e.g., Breitenbush). Many tributaries do not provide adequate shading or large wood recruitment.<br><br>*Floodplain Forest Riparian Conditions:* Low large wood recruitment potential and poor shading because the lower watershed contains only 25% of original extent of floodplain forest and many remaining patches of floodplain forest are interspersed with pasture land. | Timber harvest<br><br>Stream clean-out practices<br><br>Clearing for agriculture or development<br><br>USACE and private revetments<br><br>Operation of Detroit/ Big Cliff alters the hydrologic regime.<br><br>Private dikes<br>Timber harvest |

### 5.1.2. South Santiam River Subbasin

Table 5-2 provides a matrix of pathways and indicators for the condition of PCEs of critical habitat in the South Santiam River subbasin under the environmental baseline condition.

**Table 5-2. Matrix of Pathways and Indicators for PCEs of Critical Habitat in the South Santiam River Subbasin**

| PCEs | Pathway | Indicator | South Santiam Baseline Condition | Limiting Factors |
|---|---|---|---|---|
| Freshwater spawning sites<br>Freshwater rearing<br>Freshwater migration corridors | Water quality | Temperature | Operation of USACE reservoirs reduced spring/summer temperatures in the South Santiam River and increased temperatures during most of the rest of the year. | USACE operations (Green Peter) |
| | | | ODEQ 2002 CWA 303(d) database indicates that temperatures between the mouth of the South Santiam and Waterloo have exceeded maxima for salmonid spawning (55°F) during mid-September through June, and summer maxima for core rearing (61°F) and non-core rearing and adult and juvenile migration (64°F) during most of the rest of the year. | USACE operations (Foster/Green Peter).<br><br>Agriculture<br>Water withdrawals<br>Revetments |
| | | | Summer water temperatures in the South Santiam River often neared or exceeded 68°F before Green Peter; cooler spring/summer discharges from Green Peter may prevent the lower South Santiam from reaching warmer temperatures in the fall. | Natural conditions<br><br>Benefit of USACE operations. |
| | | | ODEQ 2002 CWA 303(d) database indicates exceedences of the maximum for spawning (55°F), core rearing (61°F), and non-core rearing and adult and juvenile migration (64°F) in the South Santiam above Foster Reservoir; exceedences of the maximum for non-core rearing and migration maximum have been recorded in the Middle Santiam River above Green Peter Reservoir; and for core and non-core rearing, and adult and juvenile migration in Quartzville Creek. | Timber harvest |
| | | | Temperatures below Foster Dam (1968-1972) were less than 52°F during May through early July, cold enough to delay upstream migration of spring Chinook. | USACE operations (especially Green Peter). |

| PCEs | Pathway | Indicator | South Santiam Baseline Condition | Limiting Factors |
|---|---|---|---|---|
| Freshwater spawning sites<br>Freshwater rearing<br>Freshwater migration corridors | Water quality | Total suspended solids/turbidity | No reports of turbidity levels adversely affecting the habitat requirements of spring Chinook salmon or winter steelhead.<br><br>ODEQ 2002 CWA 303(d) database does not list any streams in this subbasin as water quality limited for turbidity. | N/A |
| Freshwater spawning sites<br>Freshwater rearing<br>Freshwater migration corridors | Water quality | Chemical contamination/nutrients | ODEQ's 2002 CWA 303(d) database does not indicate that any streams are water quality limited due to the presence of toxics.<br><br>ODEQ 2002 CWA 303(d) database does not indicate that streams in the South Santiam subbasin are impaired due to excessive nutrient loadings.<br><br>Operations at Green Peter/Foster dams that increased summer flows may have reduced nutrient loads in mainstem South Santiam River. | N/A<br><br>N/A<br><br>Benefit of USACE operations |
| Freshwater spawning sites<br>Freshwater rearing<br>Freshwater migration corridors | Water quality | Dissolved oxygen (DO) | Historical pollution due to pulp mill effluent and sewage in the lower 19 miles; oxygen block during summer months.<br><br>Improved paper pulping processes, secondary wastewater treatment, and summer flow augmentation from Foster and Green Peter dams helped correct the problem.<br><br>ODEQ 2002 CWA 303(d) database does not indicate that any streams in the South Santiam subbasin are water quality limited due to low levels of dissolved oxygen. | Pulp mill<br>Municipal sewage<br><br>Benefit of USACE operations (especially Green Peter). |
| Freshwater spawning sites<br>Freshwater rearing<br>Freshwater migration corridors | Water quality | Total dissolved gas (TDG) | A TDG level of 129.2% saturation, measured in the tailrace in January 1971, was high enough to cause gas bubble trauma in juvenile salmonids rearing in the area and could kill Chinook yolk sac larvae incubating in this reach.<br><br>TDG levels of 115.8% at 1.2 miles below Foster Dam and 113.3% another 2.3 miles downstream (March 1972) could have killed yolk sac larvae.<br><br>Symptoms of gas bubble trauma have not been reported in juvenile or adult anadromous salmonids in the South Santiam subbasin. | Regulating outlet spill - USACE operations at Foster Dam. |

| PCEs | Pathway | Indicator | South Santiam Baseline Condition | Limiting Factors |
|---|---|---|---|---|
| Freshwater migration corridors | Habitat access | Physical barriers | *Barriers below Foster Dam:* Juveniles are entrained into the unscreened Lebanon Dam (RM 21), which diverts water into the Lebanon-Albany power canal for irrigation, hydropower, and municipal use. Several older fish ladders allow passage of adult spring Chinook salmon but probably cause some migration delay. Irrigation diversions on the lower tributaries of Crabtree and Thomas creeks pose migration barriers to adult spring Chinook. | Privately-owned diversions, dams, and hydroelectric facilities. |
| | | | *Barriers above Foster & Green Peter Reservoirs:* Hatchery broodstock collection began near the site of Foster Dam in 1923 and was discontinued in the 1930s. A weir was on the Middle Santiam River, a few miles upstream from the confluence with the South Santiam River; fell into disuse in the 1930s. | State hatchery operations. |
| | | | *Foster Dam as a Barrier to Upstream Migrants:* No estimates of upstream passage mortality at Foster Dam. Dated design does not allow facilities for holding, handling, examining, and sorting hatchery- from natural-origin fish (flexibility in disposition). The operator is unable to see how many fish have accumulated in the trap, leading to potential crowding and injury during handling. The device can be operated improperly by inexperienced personnel, leading to fish injury. | USACE operations (Foster). |
| | | | *Foster Dam and Reservoir as a Barrier to Downstream Migrants:* Kaplan turbines expected to safely pass juveniles but fish hesitate to dive to intakes. Surface spill used to flush juvenile steelhead from the reservoir since 1983. About 89.9% survival for juvenile Chinook through Kaplan turbines (similar rates for juvenile steelhead). About 41% mortality of steelhead kelts recovered in the downstream nets. | USACE operations (Foster). |
| | | | *Fallback at Foster Dam:* Estimated fallback rates for wild winter steelhead of 2.5% to 4%. | USACE operations (Foster). |

| PCEs | Pathway | Indicator | South Santiam Baseline Condition | Limiting Factors |
|---|---|---|---|---|
| Freshwater migration corridors | Habitat access | Physical barriers | *Green Peter Dam as a Barrier to Upstream Migrants:* Adult passage facility at Green Peter mothballed in 1988; water in the ladder was too cold to attract adults. | USACE operations (Green Peter). |
| | | | *Green Peter Dam and Reservoir as a Barrier to Downstream Migrants:* Slow water velocity and long, convoluted reservoir shoreline. Populations of native northern pikeminnow and introduced largemouth bass. High rates of injury and mortality for steelhead captured in bypass evaluator. | USACE operations (Green Peter). |
| | | | *Fallback at Green Peter Dam:* Adult spring Chinook and winter steelhead released in the forebay of Green Peter Dam sometimes fall back down to the tailrace via turbines (and possibly through the spillway). Surviving fallback had to move upstream through the fish passage facility a second time, increasing the likelihood of injury. | USACE operations (Green Peter). |
| | | | *Predation as a Barrier to Reservoir Migration:* Foster and Green Peter reservoirs support native northern pikeminnow. Green Peter supports a population of non-native largemouth bass. | USACE operations (Foster/Green Peter). |
| Freshwater spawning sites | Habitat elements | Substrate | Substrate has coarsened downstream of Foster Dam.<br><br>River channel downstream of Foster Dam may be downcutting.<br><br>Channel downstream of Foster Dam could lack spawning gravel.<br><br>Many areas scoured to bedrock.<br><br>Current sediment budget not creating and maintaining side channel and gravel bar habitat needed by anadromous salmonids. | USACE reservoirs trap sediment from headwaters.<br><br>USACE operates Foster/Green Peter Dams to reduce magnitude/frequency of peak flows.<br><br>USACE and private revetments.<br>Gravel mining<br>Historic log drives |
| Freshwater rearing sites<br>Freshwater migration corridors | Habitat elements | Large woody debris (LWD) | *In Tributaries and Upper South Santiam Mainstem:* Large wood is lacking in most small tributaries and the upper South Santiam; very few reaches meet the ODFW benchmarks. Future recruitment potential for large wood is low along the lower portions of surveyed streams, but relatively high in upper reaches. | Timber harvesting<br>Stream clean-out<br><br>Unique sequence of fire and flood disturbance in upper South Santiam<br><br>Fire suppression |

| PCEs | Pathway | Indicator | South Santiam Baseline Condition | Limiting Factors |
|---|---|---|---|---|
| Freshwater rearing sites<br>Freshwater migration corridors | Habitat elements | Large woody debris (LWD) | *In the Mainstem South Santiam River*: Reaches of the South Santiam River below Green Peter and Foster dams are deprived of large wood.<br><br>Inadequate recruitment of large wood from riparian areas along mainstem South Santiam and tributaries downstream from Foster Dam.<br><br>Lack of large wood-associated habitat for anadromous salmonids and invertebrates upon which they feed. | USACE removes large wood from reservoirs.<br><br>Inadequate recruitment from riparian forests.<br><br>USACE and private revetments prevent recruitment from banks.<br><br>USACE operation of Green Peter/Foster reduces frequency of channel-forming flows needed to recruit large wood from banks. |
| Freshwater rearing sites<br>Freshwater migration corridors | Habitat elements | Pool frequency and quality | Pool frequency and quality in the South Santiam River downstream of Green Peter/Foster dam complex is fair. | N/A |
| Freshwater spawning sites<br>Freshwater rearing<br>Freshwater migration corridors | Habitat elements | Off-channel habitat | Floodplain is not frequently inundated, with less overbank flow and side channel connectivity. | USACE operates Foster/Green Peter dams to reduce the magnitude and frequency of peak flows.<br><br>USACE and private revetments. |

| PCEs | Pathway | Indicator | South Santiam Baseline Condition | Limiting Factors |
|---|---|---|---|---|
| Freshwater spawning sites<br>Freshwater rearing | Channel conditions and dynamics | Width/depth ratio | Channel forming processes in the South Santiam River downstream of the Green Peter/Foster dam complex have been restricted by changes to the natural hydrograph and by reductions in sediment load and LWD derived from areas located above the dams. Flow regulation, fractionation of the sediment load passed to below the dams, and accumulation of fine sediment fractions below Foster Dam have resulted in bank and substrate armoring (i.e., compaction and stabilization) and in habitat simplification. | USACE reservoirs trap sediment from headwaters.<br><br>USACE operates Foster/Green Peter Dams to reduce magnitude/frequency of peak flows.<br><br>USACE and private revetments. |
| Freshwater spawning sites<br>Freshwater rearing<br>Freshwater migration corridors | Channel conditions and dynamics | Streambank condition | Streambanks do not support natural floodplain function in the lower South Santiam River downstream of the Green Peter/Foster dam complex. | USACE operates Foster/Green Peter dams to reduce the magnitude/frequency of peak flows<br><br>USACE and private revetments. |
| Freshwater rearing<br>Freshwater migration corridors | Channel conditions and dynamics | Floodplain connectivity | Floodplain is not frequently inundated, with less over-bank flow and side channel connectivity.<br><br>Reduced nutrient exchange, reduced sediment exchange, reduced flood refugia for fish, and reduced establishment of new riparian forests.<br><br>Lower South Santiam is confined primarily to a single main channel.<br><br>While no quantitative data are available, the South Santiam likely contains fewer off-channel habitats, simplified mainstem habitat, and few new gravel bars or side channels. | USACE operates Foster/Green Peter dams to reduce the magnitude/frequency of peak flows<br><br>USACE and private revetments.<br><br>USACE removes large wood from reservoirs.<br><br>Gravel mining in lower river.<br><br>USACE traps sediment in Green Peter/Foster reservoirs. |

| PCEs | Pathway | Indicator | South Santiam Baseline Condition | Limiting Factors |
|---|---|---|---|---|
| Freshwater spawning sites<br>Freshwater rearing<br>Freshwater migration corridors | Water quantity (flow/hydrology) | Change in peak/base flow | Increased fall flows may allow spring Chinook to spawn in areas that will be dewatered during active flood control operations.<br><br>Winter and spring flow reductions may reduce rearing area and the survival of steelhead fry.<br><br>Increased summer flows may increase rearing area and the heat capacity of the stream.<br><br>Low summer flows in specific reaches (due to diversions) may reduce the juvenile rearing habitat area, block adult passage to upstream spawning areas, and decrease the heat capacity of the stream.<br><br>Flow fluctuations now occur at rates rapid enough to entrap and strand juvenile anadromous fish.<br><br>Frequency of channel-forming flows not of sufficient magnitude to create and maintain channel complexity and provide nutrient, organic matter, and sediment inputs from floodplain areas. | Fall releases from Foster/Green Peter dams to create storage space.<br><br>Winter flood control and late winter/spring refill operations at Foster/Green Peter reservoirs<br><br>Flow augmentation from Foster/Green Peter dams to meet mainstem targets.<br><br>Summer diversions at Lebanon-Albany Canal and others, including those served by Reclamation contracts.<br><br>Flood control operations at Green Peter/Foster dams cause rapid flow reductions.<br><br>Rapid changes in diversion rates at the Lebanon-Albany Canal.<br><br>Flood control operations at Green Peter/Foster dams. |
| Freshwater spawning sites<br>Freshwater rearing<br>Freshwater migration corridors | Watershed conditions | Road density and location | Moderate to high road densities exist in South Santiam watershed above and below the Green Peter/Foster dam complex. These roads are managed by Oregon Dept. Transportation and by USFS; corrective measures are not included as a part of the revised proposed action. | N/A |

| PCEs | Pathway | Indicator | South Santiam Baseline Condition | Limiting Factors |
|---|---|---|---|---|
| Freshwater spawning sites<br>Freshwater rearing<br>Freshwater migration corridors | Watershed conditions | Disturbance history | Some forests in the upper watershed are dominated by early- to mid-successional stages, but up to 39% of the Middle Santiam and 43% of the Quartzville drainages contain late-successional forests.<br><br>Disturbance regime is dominated by timber harvesting, which can increase sediment delivery to streams, while decreasing large wood input.<br><br>Upper watershed is predominantly forested.<br><br>Lower watershed contains extensive agricultural, urban, rural, and residential development. | Fire suppression<br>Timber harvesting<br><br>Conversion to agricultural, urban, residential, and rural uses.<br><br>Flood control provided by operations at Green Peter/Foster dams has probably increased agricultural, urban, rural, and residential development in the South Santiam floodplain. |
| Freshwater spawning sites<br>Freshwater rearing<br>Freshwater migration corridors | Watershed conditions | Riparian reserves | *Headwater Forests Riparian Conditions:*<br>Riparian areas in upper watershed tributaries dominated by late-successional vegetation on federal land and early-successional vegetation on private lands.<br><br>Width and continuity of riparian areas are good along Thomas and Crabtree creeks in the lower South Santiam subbasin, but almost all vegetation is less than 80 years old.<br><br>Riparian areas in many tributaries do not provide adequate shading or large wood recruitment.<br><br>*Floodplain Forest Riparian Conditions:*<br>Low large wood recruitment potential because less than 30% of the riparian forest along the mainstem South Santiam river is greater than 30 meters wide and many remaining patches of floodplain forest are interspersed with pasture land. | Timber harvesting<br><br>Stream clean-out practices.<br><br>Conversion to agriculture.<br><br>Clearing for agriculture or development.<br><br>USACE and private revetments.<br><br>USACE operation of Foster/Green Peter dams alters the hydrologic regime.<br><br>Private dikes<br>Timber harvest |

### 5.1.3. McKenzie River Subbasin

Table 5-3 provides a matrix of pathways and indicators for the condition of PCEs of critical habitat in the McKenzie River subbasin under the environmental baseline condition.

**Table 5-3. Matrix of Pathways and Indicators for PCEs of Critical Habitat in the McKenzie River Subbasin**

| PCEs | Pathway | Indicator | McKenzie River Baseline Condition | Limiting Factors |
|---|---|---|---|---|
| Freshwater spawning sites<br>Freshwater rearing<br>Freshwater migration corridors | Water quality | Temperature | Without WTC, cooler water temperatures in the late spring and summer impede upstream migration of spring Chinook salmon; warmer fall/winter temperatures accelerate egg incubation and fry emergence. | USACE operations (Cougar has a WTC tower, Blue River does not). |
| | | | EWEB's Leaburg-Walterville project diverts flow into two power canals downstream of RM 38; water at lower ends of the two mainstem bypass reaches could increase by 2.7° and 3.6°F, respectively, due to diversions. | EWEB's Leaburg and Waterville projects. |
| | | | ODEQ 2002 CWA 303(d) database indicates that temperatures in South Fork below Cougar Dam exceeded maxima for salmonid spawning, incubation, and emergence in summer and fall. | USACE operations (Cougar). |
| | | | ODEQ database indicates that temperatures in the lower 1.8 miles of Blue River have exceeded maxima for salmonid spawning, incubation, and emergence; core migration; and non-core rearing and adult and juvenile migration. | USACE operations (Blue River). |
| | | | ODEQ database indicates that temperatures in mainstem McKenzie from RM 0-54.5 exceeded the maximum for spawning, incubation, and emergence. | USACE operations (Cougar/Blue River), EWEB's Leaburg-Walterville diversions. |
| | | | ODEQ database indicates that temperatures in streams not affected by Willamette Project flow management (Deer Creek, Mohawk River and its tributaries) have exceeded maxima for core and non-core rearing, and adult/juvenile migration. | Degraded riparian areas due to clearing for floodplain development, and timber harvest. |

| PCEs | Pathway | Indicator | McKenzie River Baseline Condition | Limiting Factors |
|---|---|---|---|---|
| Freshwater spawning sites<br>Freshwater rearing<br>Freshwater migration corridors | Water quality | Total suspended solids/turbidity | Release of turbid water during the spring 2002 drawdown of Cougar Reservoir for construction of the water temperature control tower resulted in elevated turbidity levels, including a maximum of 379 nephelometric turbidity units (NTU) as compared to background of 5 NTU.<br><br>After the turbidity event, higher proportions of fine sediments in gravel bars below Cougar Dam compared to reaches above the reservoir; clay enrichment decreased rapidly downstream; clouds of sediment stirred up while wading in the South Fork below Cougar Dam, and to some extent in the mainstem McKenzie. | USACE operations (Cougar WTC) |
| Freshwater spawning sites<br>Freshwater rearing<br>Freshwater migration corridors | Water quality | Chemical contamination/nutrients | ODEQ 2002 CWA 303(d) database does not indicate that any streams in the McKenzie subbasin are water quality limited due to toxics.<br><br>ODEQ 2002 CWA 303(d) database does not indicate that any streams in the McKenzie subbasin are water quality limited due to excess nutrients. | N/A |
| Freshwater spawning sites<br>Freshwater rearing<br>Freshwater migration corridors | Water quality | Dissolved oxygen (DO) | ODEQ 2002 CWA 303(d) database indicates that the Mohawk River (RM 1.5) was water quality limited for dissolved oxygen from October 1 through May 31. | May be related to causes of elevated temperatures. |
| Freshwater spawning sites<br>Freshwater rearing<br>Freshwater migration corridors | Water quality | Total dissolved gas (TDG) | TDG levels of 97.8% to 124.1% saturation near the base of Cougar Dam; 99.5% to 115.7% approximately 3,000 feet downstream; and 103.4% to 108.6% at a site 2.7 miles downstream during November (1970), when yolk sac fry may have been present.<br><br>TDG levels of 107.9% to 120.4% saturation in March (1971 and 1972) below Blue River Dam. | USACE operations (Cougar Dam).<br><br>USACE operations (Blue River Dam). |

| PCEs | Pathway | Indicator | McKenzie River Baseline Condition | Limiting Factors |
|---|---|---|---|---|
| Freshwater migration corridors | Habitat access | Physical barriers | Adult passage and delay, up to 14.5% mortality of outmigrating smolts, and low flows in Leaburg and Walterville bypass reaches of lower mainstem; corrected during 2002-2004 under terms of the new FERC license.<br><br>Trail Bridge and Smith dams exclude spring Chinook salmon (~10 miles) from a portion of their historical range.<br><br>*Cougar Dam as Barrier to Upstream Migrants.* Currently there is no upstream passage at Cougar Dam, which blocks over 37 miles of upstream historical habitat. The USACE has proposed to construct a permanent trap-and-haul facility to provide upstream passage.<br><br>*Cougar Dam and Reservoir as Barrier to Downstream Migrants.* Cougar Dam was built with juvenile fish passage facilities; juveniles entered through one of five fish horns on the upstream face of intake tower. Fish horns collected only a low percent of juvenile Chinook in the reservoir; many of those were injured or killed. For hatchery-reared fingerling Chinook released into Cougar Reservoir in 1963-2002, survival was 67.4% through the regulating outlet and 93% through the turbines; survival decreased with increasing fish size.<br><br>*Blue River Dam as Barrier to Migration.* Blue River Dam blocks access to 2.7 miles of historical habitat below a falls that was probably a natural historical barrier at low flows. | EWEB's Leaburg and Walterville hydroprojects.<br><br>EWEB's and Carmen-Smith-Trailbridge hydroprojects.<br><br>Cougar Dam is currently an upstream migration barrier, but USACE intends to construct upstream fish passage facilities by April 2009.<br><br>Cougar Dam is a downstream migration barrier and currently does not provide safe downstream fish passage conditions.<br><br>Blue River Dam is a migration barrier and does not have up or downstream fish passage facilities. |
| Freshwater spawning sites | Habitat elements | Substrate | Substrate has coarsened in the mainstem McKenzie downstream of Cougar and Blue River dams.<br><br>South Fork McKenzie River downstream of Cougar Reservoir has stabilized.<br><br>Channel downstream of USACE dams could lack spawning gravel.<br><br>Current sediment budget not creating and maintaining habitat needed by anadromous salmonids. | USACE and EWEB reservoirs trap sediment and large wood from headwaters.<br><br>USACE operates Cougar and Blue River dams to reduce magnitude/frequency of peak flows.<br><br>USACE and private revetments, gravel mining. |

| PCEs | Pathway | Indicator | McKenzie River Baseline Condition | Limiting Factors |
|---|---|---|---|---|
| Freshwater rearing sites<br>Freshwater migration corridors | Habitat elements | Large woody debris (LWD) | *In Headwater Tributaries:* Large wood does not meet USFS targets in some tributaries (Lower Deer Creek, Quartz Creek, Mohawk River, the South Fork and some of its tributaries). Large wood meets USFS targets in some tributaries (North Fork Quartz Creek, Lookout Creek, some South Fork tributaries). Some tributaries, such as Horse Creek, have high recruitment potential. Some restoration efforts are underway in the McKenzie subbasin.<br><br>*In the Mainstem McKenzie River:* The upper McKenzie River below EWEB's Trailbridge Dam is deprived of large wood, although some restoration efforts have begun. The South Fork McKenzie below Cougar Dam and Blue River below Blue River Dam are deprived of large wood from the headwaters. The McKenzie River below Cougar and Blue River dams is deprived of large wood from the South Fork and Blue River.<br><br>Inadequate recruitment of large wood from riparian areas along mainstem McKenzie and tributaries downstream from Cougar and Blue River dams. Lack of large wood-associated habitat for anadromous salmonids and invertebrates upon which they feed. | Timber harvesting<br><br>Stream clean-out<br><br>Fire suppression<br><br>USACE and EWEB remove large wood from reservoirs.<br><br>USACE removed snags in lower river for navigation.<br><br>Inadequate recruitment from riparian forests.<br><br>Removal of large wood by landowners and boaters for navigation and/or firewood. |
| Freshwater rearing sites<br>Freshwater migration corridors | Habitat elements | Pool frequency and quality | Pool frequency and quality in the South Fork McKenzie below Cougar Dam is fair to good due to the presence of pool forming elements such as riparian forests and LWD. The 1.7 miles of Blue River located below Blue River Dam will continue to have minimal production capacity. | N/A |

| PCEs | Pathway | Indicator | McKenzie River Baseline Condition | Limiting Factors |
|---|---|---|---|---|
| Freshwater spawning sites<br>Freshwater rearing<br>Freshwater migration corridors | Habitat elements | Off-channel habitat | The South Fork McKenzie below Cougar Dam has stabilized and lost side channels.<br><br>The mainstem McKenzie below the Deerhorn Park lost 53% of its islands, and many side channels have filled in and become alcoves.<br><br>The McKenzie prior to dam construction migrated frequently, and has since stabilized.<br><br>The lower McKenzie is simplified and channelized. | USACE operates Cougar & Blue River dams to reduce the magnitude and frequency of peak flows, important to creating & maintaining salmonid habitats.<br><br>USACE and EWEB remove large wood from reservoirs.<br><br>USACE and private revetments. Gravel mining in lower river. |
| Freshwater spawning sites<br>Freshwater rearing | Channel conditions and dynamics | Width/depth ratio | Channel forming processes in the lower South Fork McKenzie and Blue rivers have been restricted by changes to the natural hydrograph and by reductions in sediment load and LWD derived from above the dams. Flow regulation, fractionation of the sediment load passing through the reservoirs, and accumulation of fine sediment fractions below the dams have resulted in bank and substrate armoring (i.e., stabilization) and in habitat simplification. | USACE operates Cougar & Blue River dams to reduce the magnitude/frequency of peak flows.<br><br>USACE and private revetments.<br><br>USACE and EWEB remove large wood from reservoirs. |
| Freshwater spawning sites<br>Freshwater rearing<br>Freshwater migration corridors | Channel conditions and dynamics | Streambank condition | Streambanks do not support natural floodplain function in the lower South Fork McKenzie downstream of Cougar Dam. Experimentation with various flow rates (e.g., pulsed flows) will be pursued under RM&E efforts and may help to restore more normative ecosystem function with regard to the interplay between channel, streambank, and floodplain conditions in the lower South Fork McKenzie. | USACE operates Cougar & Blue River dams to reduce the magnitude/frequency of peak flows.<br><br>USACE and private revetments. |
| Freshwater rearing<br>Freshwater migration corridors | Channel conditions and dynamics | Floodplain connectivity | Floodplain is not frequently inundated, with less overbank flow and side-channel connectivity.<br><br>Reduced nutrient exchange, reduced sediment exchange, reduced flood refugia for fish, and reduced establishment of new riparian forests. | USACE operates Cougar & Blue River dams to reduce the magnitude/frequency of peak flows.<br><br>USACE and private revetments.<br><br>Residential development. |

| PCEs | Pathway | Indicator | McKenzie River Baseline Condition | Limiting Factors |
|---|---|---|---|---|
| Freshwater spawning sites<br>Freshwater rearing<br>Freshwater migration corridors | Water quantity (flow/hydrology) | Change in peak/base flow | Frequency of flows in the South Fork McKenzie, Blue River, and lower McKenzie River not of sufficient magnitude to create and maintain channel complexity, and provide nutrient, organic matter, and sediment inputs from floodplain areas.<br><br>Flow fluctuations now occur at rates rapid enough to entrap and strand juvenile anadromous fish.<br><br>Increased fall flows may allow spring Chinook to spawn in areas that will be dewatered during active flood control operations.<br><br>Winter and spring flow reductions may reduce rearing area and the survival of steelhead fry.<br><br>Increased summer flows may increase rearing area and the heat capacity of the stream.<br><br>Low summer flows in specific reaches (due to diversions) may reduce juvenile rearing habitat area, block adult passage to upstream spawning areas, and decrease heat capacity of the stream. | Flood control operations at Cougar & Blue River dams reduce the magnitude & frequency of peak flows.<br><br>Flood control operations at Cougar Dam cause rapid flow reductions.<br><br>Fall releases from Cougar and Blue River reservoirs.<br><br>Winter flood control and late winter/spring refill operations at Cougar/Blue River dams.<br><br>Flow augmentation from Cougar/Blue River dams to meet mainstem flow targets.<br><br>Summer diversions at EWEB's Leaburg and Walterville project. |
| Freshwater spawning sites<br>Freshwater rearing<br>Freshwater migration corridors | Watershed conditions | Road density and location | Moderate to low road densities exist in Blue River watershed and in South Fork McKenzie watershed above and below Cougar Dam. These roads are managed by the USFS; and corrective measures are not included as a part of the revised proposed action. | N/A |

| PCEs | Pathway | Indicator | McKenzie River Baseline Condition | Limiting Factors |
|---|---|---|---|---|
| Freshwater spawning sites<br>Freshwater rearing<br>Freshwater migration corridors | Watershed conditions | Disturbance history | Disturbance regime is dominated by timber harvesting. Forests are dominated by early- to mid-successional stages, with some late-successional forests in wilderness areas in the Horse Creek and South Fork drainages.<br><br>Timber harvesting has increased sediment delivery to streams, but decreased large wood input, resulting in degraded aquatic habitat.<br><br>Upper watershed is forested, but some is managed for timber production rather than ecosystem health. Lower watershed contains extensive agricultural, urban, and residential development. | Fire suppression<br><br>Timber harvesting<br><br>Conversion to agricultural, urban, residential, and rural uses |
| Freshwater spawning sites<br>Freshwater rearing<br>Freshwater migration corridors | Watershed conditions | Riparian reserves | *Headwater Forests Riparian Conditions:*<br>Riparian areas in some tributaries contain mature riparian vegetation (e.g., Horse Creek and the South Fork McKenzie) but others (e.g., Quartz Creek, Mohawk River) are dominated by young alder or conifers. Many tributaries do not provide adequate shading or large wood recruitment. Riparian vegetation along confined reaches of the upper McKenzie River contains only 39% mature conifers.<br><br>*Floodplain Forest Riparian Conditions:*<br>Many remaining patches of floodplain forest are interspersed with pastureland, highways, and residential development.<br><br>Extent of floodplain vegetation restricted to a narrow band along river.<br><br>Low large wood recruitment potential. | Timber harvesting<br><br>Stream clean-out practices.<br><br>Clearing for agriculture or development.<br><br>USACE and private revetments.<br><br>USACE operation of Cougar/Blue River dams alters the hydrologic regime.<br><br>Timber harvest |

### 5.1.4. Middle Fork Willamette River Subbasin

Table 5-4 provides a matrix of pathways and indicators for the condition of PCEs of critical habitat in the Middle Fork Willamette River subbasin under the environmental baseline condition.

**Table 5-4. Matrix of Pathways and Indicators for PCEs of Critical Habitat in the Middle Fork Willamette River Subbasin**

| PCEs | Pathway | Indicator | Middle Fork Willamette Baseline Condition | Limiting Factors |
|---|---|---|---|---|
| Freshwater spawning sites<br>Freshwater rearing<br>Freshwater migration corridors | Water quality | Temperature | Spring and summer releases from Hills Creek Dam are cooler than inflow; winter releases are warmer than inflow.<br><br>ODEQ 2002 CWA 303(d) database indicates exceedences of summer maxima for core rearing (61°F) and non-core rearing and adult and juvenile migration (64°F) in the Middle Fork Willamette below Dexter Dam and in Fall Creek below Fall Creek Dam.<br><br>ODEQ 2002 CWA 303(d) database indicates exceedences of summer maxima for core rearing (61°F) and non-core rearing and adult and juvenile migration (64°F) in the upper Middle Fork Willamette above Hills Creek Reservoir; Salt Creek; the North Fork of the Middle Fork Willamette; Lost Creek; Fall Creek above Fall Creek Dam; and other streams that are not affected by Willamette Project flow management.<br><br>Because the water is too cold, releases from Hills Creek Dam do not meet the minimum threshold for upstream migration (52°F) until early September. | USACE operations (Hills Creek).<br><br>USACE operations (Lookout Point/Dexter, and Fall Creek).<br><br>Timber harvest<br><br>Clearing for floodplain development.<br><br>USACE operations (Hills Creek). |
| Freshwater spawning sites<br>Freshwater rearing<br>Freshwater migration corridors | Water quality | Total suspended solids/turbidity | ODEQ 2002 CWA 303(d) database does not report any streams as water quality limited due to turbidity. | N/A |

| PCEs | Pathway | Indicator | Middle Fork Willamette Baseline Condition | Limiting Factors |
|---|---|---|---|---|
| Freshwater spawning sites<br>Freshwater rearing<br>Freshwater migration corridors | Water quality | Chemical contamination/nutrients | ODEQ 2002 CWA 303(d) database does not indicate that any streams were water quality limited due to excess nutrients.<br><br>Rotenone applied above Fall Creek Dam just before impoundment.<br><br>ODEQ 2002 CWA 303(d) database does not report any streams as water quality limited due to toxics. | N/A<br><br>USACE operation (Fall Creek).<br><br>N/A |
| Freshwater spawning sites<br>Freshwater rearing<br>Freshwater migration corridors | Water quality | Dissolved oxygen (DO) | ODEQ 2002 CWA 303(d) database indicates that Lost Creek was water quality limited for dissolved oxygen year-round. | May be related to causes of elevated temperatures. |
| Freshwater spawning sites<br>Freshwater rearing<br>Freshwater migration corridors | Water quality | Total dissolved gas (TDG) | TDG measurements up to 125.5% of saturation within 0.3 miles below Dexter Dam and up to 112.5% at sites 2.3 and 4.6 miles downstream. | USACE operations (Dexter Dam). |
| Freshwater migration corridors | Habitat access | Physical barriers | *Barriers Below Dexter and Fall Creek Dams:* Eugene Canal Dam, an 8-foot high, a laddered cement barrier that stretched 400 to 500 feet across the entire stream and diverted 200 to 300 cfs that reentered the Willamette below Eugene. Canal to Springfield or mill pond, located 2.5 miles above confluence with Coast Fork. | Privately owned dams |

| PCEs | Pathway | Indicator | Middle Fork Willamette Baseline Condition | Limiting Factors |
|---|---|---|---|---|
| Freshwater migration corridors | Habitat access | Physical barriers | *Barriers between Lookout Point Reservoir and Hills Creek Dam:* Hatchery rack above Oakridge in the early part of the 20th century blocked nearly all adult spring Chinook; later moved to mouth of Salmon Creek where it diverted all returning adults to Salmon Creek Hatchery. Inefficient fish ladder at the Westfir Lumber Mill Dam completely blocked migration 1.3 miles above mouth of North Fork of the Middle Fork; breached in 1995. | State hatchery program.<br><br>Private lumber operation. |
| | | | *Fall Creek Dam as Barrier to Upstream Migration:* Most adult spring Chinook salmon and some introduced winter steelhead trapped at Fall Creek Dam were trucked to McKenzie and other hatcheries; some released at a site two miles above head of reservoir. Since 1998, all spring Chinook salmon returning to the collection facility have been released above the dam. Upstream migrants could experience abrasion, mechanical injury, stress, migration delay, disease, and low dissolved oxygen concentrations in the trapping and transport facilities.<br><br>About 77 (incl. 27 unmarked) spring Chinook found dead at release site in August 2002 when large run overwhelmed the collection facility, leading to delay; USACE has since taken corrective action. | USACE project (Fall Creek). |
| | | | *Fall Creek Dam as Barrier to Downstream Migration:* Fish horn apertures on the upstream face of the dam were ineffective. Chinook smolt recoveries never exceeded 15.6% and winter steelhead emigrated at even lower rates. USACE passed smolts by draining the reservoir in the fall; 19 to 29% juvenile Chinook survival under this condition compared with 32% through the (mothballed) fish horn system (where most of the survivors had severe head and eye abrasions). | USACE project (Fall Creek). |

| PCEs | Pathway | Indicator | Middle Fork Willamette Baseline Condition | Limiting Factors |
|---|---|---|---|---|
| Freshwater migration corridors | Habitat access | Physical barriers | *Dexter and Lookout Point Dams as Barriers to Migration:* Neither project built with fish passage facilities. Upstream migrants trapped at Dexter are trucked to the Willamette Hatchery near Oakridge for spawning. ODFW began releasing adult spring Chinook into the North Fork of the Middle Fork Willamette in 1999 and 2002 and into Salt Creek in 2001. The ODFW released Chinook fingerlings into the reservoir to augment the recreational trout fishery; 88% survival through turbines at Lookout Point. Survival through the Kaplan turbines at Dexter unknown (may be similar to Foster Dam, 92%).<br><br>*Hills Creek Dam as Barrier to Migration:* Hills Creek built without fish passage facilities. ODFW began releasing adult spring Chinook salmon above Hills Creek Reservoir in 1993 and has occasionally released hatchery-reared Chinook fingerlings into the reservoir. 41% survival of juvenile Chinook through the turbines; 68% through the regulating outlet. | USACE project (Dexter/Lookout Point).<br><br>USACE project (Hills Creek). |
| Freshwater spawning sites | Habitat elements | Substrate | Substrate has coarsened in the Middle Fork downstream of Dexter Dam.<br><br>Channel downstream of USACE dams could lack spawning gravel.<br><br>USACE reservoirs block sediment into the lower Middle Fork from 90% of the Middle Fork subbasin.<br><br>Current sediment budget not creating and maintaining habitat needed by anadromous salmonids downstream of Dexter Dam. | USACE reservoirs trap sediment and large wood from headwaters.<br><br>USACE operates Fall Creek, Hills Creek, Lookout Point, and Dexter dams to reduce magnitude/ frequency of peak flows.<br><br>USACE and private revetments.<br>Gravel mining. |

| PCEs | Pathway | Indicator | Middle Fork Willamette Baseline Condition | Limiting Factors |
|---|---|---|---|---|
| Freshwater rearing sites<br>Freshwater migration corridors | Habitat elements | Large woody debris (LWD) | *In Tributaries and Upper Middle Fork Mainstem:* Large wood does not meet USFS targets in most low-gradient upper Middle Fork tributaries, most of the North Fork Middle Fork drainage, Salmon Creek, Hills Creek, and the mainstem Fall Creek). Some large wood restoration efforts are underway in the upper subbasin (Salt Creek, Fall Creek).<br><br>*In the Mainstem Middle Fork:* Large wood into the lower Middle Fork Willamette River is blocked from 90% of the subbasin. The lower Middle Fork probably lacks large wood downstream of Dexter Dam. | Timber harvesting.<br>Stream clean-out.<br>Fire suppression.<br>Constraint by roads.<br><br>USACE removes large wood from reservoirs.<br><br>USACE removed snags in lower river for navigation.<br><br>Inadequate recruitment from riparian forests.<br><br>Removal of large wood by landowners and boaters for navigation and/or firewood. |
| Freshwater rearing sites<br>Freshwater migration corridors | Habitat elements | Pool frequency and quality | Pool frequency and quality in the Middle Fork Willamette below Dexter Dam is poor. There is less than one large holding pool per mile in the Middle Fork Willamette from Dexter Dam to Jasper Bridge. | N/A |
| Freshwater spawning sites<br>Freshwater rearing<br>Freshwater migration corridors | Habitat elements | Off-channel habitat | Middle Fork Willamette River between Lookout Point and Hills Creek Dam is confined primarily to a single channel.<br><br>Gravel bar surface area has decreased by 65% below Lookout Point Dam.<br><br>50% of lower 8 miles of the Middle Fork are protected by revetments. | USACE operates Fall Creek, Hills Creek, Lookout Point, and Dexter to reduce magnitude/frequency of peak flows.<br><br>USACE and private revetments.<br><br>USACE and EWEB remove large wood from reservoirs.<br><br>Gravel mining in lower river. |

| PCEs | Pathway | Indicator | Middle Fork Willamette Baseline Condition | Limiting Factors |
|---|---|---|---|---|
| Freshwater spawning sites<br>Freshwater rearing | Channel conditions and dynamics | Width/depth ratio | Channel forming processes in the Middle Fork Willamette below Dexter Dam have been restricted by changes to the natural hydrograph and reductions in sediment load and LWD. Dykaar (2005) noted the almost complete loss of first order avulsions in the post-dam era. | USACE operates Fall Creek, Hills Creek, Lookout Point, and Dexter to reduce magnitude/frequency of peak flows.<br><br>USACE and private revetments. |
| Freshwater spawning sites<br>Freshwater rearing<br>Freshwater migration corridors | Channel conditions and dynamics | Streambank condition | Streambanks do not support natural floodplain function in the Middle Fork Willamette below Dexter Dam. | USACE operates Fall Creek, Hills Creek, Lookout Point, and Dexter to reduce magnitude/frequency of peak flows.<br><br>USACE and private revetments. |
| Freshwater rearing<br>Freshwater migration corridors | Channel conditions and dynamics | Floodplain connectivity | Floodplain is not frequently inundated, with less over-bank flow and side channel connectivity.<br><br>Reduced nutrient exchange, reduced sediment exchange, reduced flood refugia for fish, and reduced establishment of new riparian forests. | USACE operates Fall Creek, Hills Creek, Lookout Point, and Dexter to reduce magnitude/frequency of peak flows.<br><br>USACE and private revetments; residential development. |

| PCEs | Pathway | Indicator | Middle Fork Willamette Baseline Condition | Limiting Factors |
|---|---|---|---|---|
| Freshwater spawning sites<br>Freshwater rearing<br>Freshwater migration corridors | Water quantity (flow/hydrology) | Change in peak/base flow | Frequency of channel-forming flows not of sufficient magnitude to create and maintain channel complexity and provide nutrients, organic matter, and sediment inputs from floodplain areas.<br><br>Increased fall flows may allow spring Chinook to spawn in areas that will be dewatered during active flood control operations.<br><br>Winter and spring flow reductions may have reduced rearing area and the survival of steelhead fry.<br><br>Increased summer flows may increase rearing area and the heat capacity of the stream.<br><br>Low summer flows in specific reaches (due to diversions) may reduce the juvenile rearing habitat area, block adult passage to upstream spawning areas, and decrease the heat capacity of the stream.<br><br>Flow fluctuations now occur at rates rapid enough to entrap and strand juvenile anadromous fish. | Flood control operations at Fall Creek, Dexter/Lookout Point, and Hills Creek reduce the magnitude and frequency of peak flows.<br><br>Fall releases from Fall Creek, Dexter/Lookout Point, and Hills Creek reservoirs.<br><br>Winter flood control and late winter and spring refill operations at USACE reservoirs.<br><br>Flow augmentation operations at USACE dams to meet mainstem flow targets.<br><br>Summer diversions for out-of-stream uses.<br><br>Power peaking at Hills Creek Dam.<br><br>Flood control operations at Fall Creek, Dexter/Lookout Point, and Hills Creek cause rapid flow reductions. |
| Freshwater spawning sites<br>Freshwater rearing<br>Freshwater migration corridors | Watershed conditions | Road density and location | High road densities exist in the Middle Fork Willamette watershed below Dexter Dam. | N/A |

| PCEs | Pathway | Indicator | Middle Fork Willamette Baseline Condition | Limiting Factors |
|---|---|---|---|---|
| Freshwater spawning sites<br>Freshwater rearing<br>Freshwater migration corridors | Watershed conditions | Disturbance history | Disturbance regime is dominated by timber harvesting.<br><br>Forests are dominated by early- to mid-successional stages, with few late-successional forests.<br><br>Timber harvesting has increased sediment delivery to streams, but decreased large wood input, resulting in degraded aquatic habitat.<br><br>Upper watershed is forested, but some is managed for timber production rather than ecosystem health.<br><br>Lower watershed is mostly privately-owned, and while 65% of the lower watershed is managed for timber production, the remainder consists of agricultural, urban, and residential development. | Fire suppression<br><br>Timber harvesting<br><br>Conversion to agricultural, urban, and rural uses. |
| Freshwater spawning sites<br>Freshwater rearing<br>Freshwater migration corridors | Watershed conditions | Riparian reserves | *Headwater Forests Riparian Conditions:* Riparian areas in some tributaries contain mature riparian vegetation (e.g., small tributaries of Lookout Point, Fall Creek) but others (e.g., the North Fork Middle Fork, Salt Creek, Little Fall Creek, and small tributaries of lower Middle Fork) are dominated by deciduous trees or conifers. Many tributaries do not provide adequate shading or large wood recruitment. Decreased extent of streamside riparian vegetation.<br><br>*Floodplain Forest Riparian Conditions:* Many remaining patches of floodplain forest are interspersed with pastureland, highways, and residential development. Floodplain forests along lower river invaded by non-native species that hinder development of natural community. About 74% of riparian forests along lower Middle Fork have low or medium large wood recruitment potential. Decreased surface area of gravel bars for potential young riparian stand recruitment. | Timber harvesting.<br><br>Stream clean-out practices.<br><br>Extensive inundation of streamside riparian vegetation by USACE reservoir construction.<br><br>Clearing for agriculture or development.<br><br>USACE and private revetments.<br><br>Operation of Fall Creek, Hills Creek, Lookout Point, and Dexter dams alters the hydrologic regime.<br><br>Timber harvest. |

### 5.1.5. Coast Fork Willamette River Subbasin

Table 5-5 provides a matrix of pathways and indicators for the PCEs of functional habitat for fish in the Coast Fork Willamette River subbasin under the environmental baseline condition.

**Table 5-5. Matrix of Pathways and Indicators for the PCEs of Functional Habitat in the Coast Fork Willamette River Subbasin**

| PCEs | Pathway | Indicator | Coast Fork Willamette Baseline Condition | Limiting Factors |
|---|---|---|---|---|
| Freshwater spawning sites<br>Freshwater rearing<br>Freshwater migration corridors | Water quality | Temperature | The ODEQ 2002 CWA 303(d) database indicates exceedences of summer maximum temperatures for non-core rearing below Cottage Grove and Dorena dams.<br><br>Exceedences have also been reported in some unregulated reaches (i.e., not affected by Willamette Project flow management). | USACE operations<br><br>Clearing for floodplain development. |
| Freshwater spawning sites<br>Freshwater rearing<br>Freshwater migration corridors | Water quality | Total suspended solids/turbidity | ODEQ's 2002 CWA 303(d) database does not report any streams as water quality limited due to excess turbidity. | N/A |
| Freshwater spawning sites<br>Freshwater rearing<br>Freshwater migration corridors | Water quality | Chemical contamination/nutrients | The ODEQ's 2002 CWA 303(d) database lists the mainstem Coast Fork Willamette River from the mouth to RM 31.3 as impaired for anadromous fish passage due to mercury, which has been mined intensively in the Black Butte area in the upper drainage.<br><br>The ODEQ 2002 CWA 303(d) database does not indicate that any streams are water quality limited due to excess nutrients. | Mining<br><br>N/A |

| PCEs | Pathway | Indicator | Coast Fork Willamette Baseline Condition | Limiting Factors |
|---|---|---|---|---|
| Freshwater spawning sites<br>Freshwater rearing<br>Freshwater migration corridors | Water quality | Dissolved oxygen (DO) | The ODEQ 2002 CWA 303(d) database indicates dissolved oxygen concentrations below the dynamic axial dispersion model's 7 standard for salmonid spawning from October 1 through May 31 in Camas Swale Creek, a tributary to the Coast Fork Willamette River near Cresswell (below Cottage Grove Dam). | City of Cresswell sewage treatment plant<br><br>Other local sources |
| Freshwater spawning sites<br>Freshwater rearing<br>Freshwater migration corridors | Water quality | Total dissolved gas (TDG) | There is no data indicating that TDG concentrations exceed 110% saturation occur in areas used by ESA-listed fish species in the Coast Fork Willamette River subbasin. | N/A |
| Freshwater migration corridors | Habitat access | Physical barriers | No man-made barriers limit the viability of a demographically independent population. | N/A |
| Freshwater spawning sites | Habitat elements | Substrate | Substrate has probably coarsened downstream of Cottage Grove and Dorena dams.<br><br>River channel downstream of Cottage Grove and Dorena dams may be downcutting.<br><br>Current sediment budget is not creating and maintaining the quantity or quality of habitat needed by anadromous salmonids downstream of the dams. | USACE reservoirs trap sediment from headwaters.<br><br>USACE operation of Cottage Grove and Dorena dams reduces magnitude/frequency of peak flows.<br><br>USACE and private revetments.<br><br>Gravel mining.<br>Log drives. |

| PCEs | Pathway | Indicator | Coast Fork Willamette Baseline Condition | Limiting Factors |
|---|---|---|---|---|
| Freshwater rearing sites<br>Freshwater migration corridors | Habitat elements | Large woody debris (LWD) | *In Headwater Tributaries:* Large wood is lacking in most small tributaries. Recruitment potential for large wood is low along most surveyed streams.<br><br>*Below Dams*: Reaches of the Row River and Coast Fork Willamette below Cottage Grove and Dorena dams, respectively, are probably deprived of large wood.<br><br>Riparian areas along mainstem Coast Fork and its tributaries downstream from Cottage Grove Dam, and along Row River downstream of Dorena Dam cannot produce and contribute adequate quantities of large wood to support effective ecosystem processes related to habitat complexity and rejuvenation, resulting in a lack of large wood-associated habitat needed for anadromous salmonid rearing and for invertebrate communities upon which they feed. | Conversion to agricultural, urban and rural uses.<br><br>Clearing for agriculture and development. Timber harvesting. Stream clean-out practices.<br><br>USACE and private revetments and levees.<br><br>USACE channel straightening.<br><br>USACE operation of Dorena and Cottage Grove dams alters the hydrologic regime. |
| Freshwater rearing sites<br>Freshwater migration corridors | Habitat elements | Pool frequency and quality | Pool frequency and quality has been substantially reduced in the upper Willamette Basin in tributaries that have been heavily forested like the Coast Fork Willamette. Sedell and Everest (1991) compared the change in large pool areas that occurred from 1940 to 1990 in Willamette Basin watersheds "managed" for timber harvest as compared to those left "unmanaged" (i.e., wilderness areas). Managed forests experienced large losses in the proportion of pool habitat (e.g., Fall Creek -61%, South Fork McKenzie -82%). Only some streams remaining in unmanaged forests showed increases in the number of large pools. | |
| Freshwater spawning sites<br>Freshwater rearing<br>Freshwater migration corridors | Habitat elements | Off-channel habitat | No quantitative data are currently available for the Row and Coast Fork Willamette rivers regarding off-channel habitat. Based on the findings of Sedell and Everest (1991), these streams likely have substantially less off-channel habitat, simplified mainstem habitat, and few new gravel bars or channel surfaces in comparison to pre-dam conditions. | USACE operation of Dorena and Cottage Grove reduces the magnitude/frequency of peak flows.<br><br>USACE and private revetments.<br><br>USACE removes large wood from reservoirs.<br><br>Gravel mining in lower river. |

| PCEs | Pathway | Indicator | Coast Fork Willamette Baseline Condition | Limiting Factors |
|---|---|---|---|---|
| Freshwater spawning sites<br>Freshwater rearing | Channel conditions and dynamics | Width/depth ratio | Channel forming processes in the Row River and in the Coast Fork Willamette downstream of Dorena and Cottage Grove dams, respectively, have been restricted by changes to their natural hydrographs and by reductions in their transportation of sediment load and LWD. Flow regulation, fractionation of the sediment load passed to below the dams, and accumulation of fine sediment fractions below Foster Dam have resulted in bank and substrate armoring (i.e., compaction and stabilization) and in habitat simplification. | |
| Freshwater spawning sites<br>Freshwater rearing<br>Freshwater migration corridors | Channel conditions and dynamics | Streambank condition | Streambanks do not support natural floodplain function in the Row River downstream of Dorena Dam or in the Coast Fork Willamette River downstream of Cottage Grove Dam. | |
| Freshwater rearing<br>Freshwater migration corridors | Channel conditions and dynamics | Floodplain connectivity | Dorena and Cottage Grove dams have substantially decreased the magnitude and frequency of high flow events in the Row River and in the Coast Fork Willamette downstream of the dams. As a result, the floodplain is not frequently inundated by overbank flow and there is less side channel connectivity than occurred under pre-dam conditions. These factors result in reduced nutrient exchange, reduced sediment exchange, reduced areas of refuge for fish under high-flow conditions, and reduced opportunities for reestablishment of riparian forests. | USACE operation of Dorena/Cottage Grove dams reduces the magnitude/frequency of peak flows.<br><br>USACE and private revetments. |
| Freshwater spawning sites<br>Freshwater rearing<br>Freshwater migration corridors | Water quantity (flow/hydrology) | Change in peak/base flow | The frequency of flows with a channel-forming magnitude is insufficient to create and maintain channel complexity and to provide nutrients, organic matter, and sediment inputs from floodplain areas.<br><br>Increased summer flows may provide more rearing area for ESA-listed fish and may improve the heat capacity of the stream.<br><br>Low stream flow conditions are affected by water development and reservoir operations to a lesser extent in the Coast Fork Willamette River than in other Willamette subbasins.<br><br>Flow fluctuations below Dorena and Cottage Grove dams now occur at rates rapid enough to entrap and strand juvenile anadromous fish. | USACE flood control operations at Dorena and Cottage Grove reduce the magnitude and frequency of peak flows.<br><br>Flow augmentation from Cottage Grove and Dorena to meet mainstem flow targets.<br><br>Summer diversions for out-of-stream use. Flood control operations at Coast Fork Willamette dams cause rapid flow reductions. |

| PCEs | Pathway | Indicator | Coast Fork Willamette Baseline Condition | Limiting Factors |
|---|---|---|---|---|
| Freshwater spawning sites<br>Freshwater rearing<br>Freshwater migration corridors | Watershed conditions | Road density and location | The lower parts of the watershed contain extensive agricultural, urban, and residential development. Relatively high road densities exist in these parts of the watershed. | |
| Freshwater spawning sites<br>Freshwater rearing<br>Freshwater migration corridors | Watershed conditions | Disturbance history | Disturbance regime is dominated by timber harvesting. About 97% of timber in the Row River drainage has been harvested, and 76% of the upper Coast Fork drainage has been harvested. Forests are dominated by early- to mid-successional stages with few late-successional forests. Timber harvesting has increased sediment delivery to streams, but decreased large wood input, resulting in degraded aquatic habitat. The upper parts of the watershed are forested, but most are managed for timber production rather than for healthy ecosystem function. | Fire suppression.<br><br>Timber harvesting.<br><br>Conversion to agricultural, urban, and rural uses. |
| Freshwater spawning sites<br>Freshwater rearing<br>Freshwater migration corridors | Watershed conditions | Riparian reserves | *Headwater Forests Riparian Conditions:* Most riparian vegetation in the subbasin is less than 60 years old. The riparian conditions in many tributary areas do not provide adequate shading or large wood recruitment.<br><br>*Floodplain Forest Riparian Conditions:* Riparian areas in the lower watershed are constrained by Interstate 5. | Timber harvesting. Stream clean-out practices.<br><br>Clearing for agriculture or development.<br><br>USACE and private revetments.<br><br>Operation of Dorena/Cottage Grove alters the hydrologic regime.<br><br>Private dikes |

### 5.1.6. Long Tom River Subbasin

Table 5-6 provides a matrix of pathways and indicators for the PCEs of functional habitat for fish in the Long Tom River subbasin under the environmental baseline condition.

**Table 5-6. Matrix of Pathways and Indicators for the PCEs of Functional Habitat in the Long Tom River Subbasin**

| PCEs | Pathway | Indicator | Long Tom River Baseline Condition | Limiting Factors |
|---|---|---|---|---|
| Freshwater spawning sites<br>Freshwater rearing<br>Freshwater migration corridors | Water quality | Temperature | ODEQ 2002 CWA 303(d) database indicates that 98% of summer temperature measurements at RM 4.7 exceeded maxima for core rearing (61°F) and non-core rearing and adult and juvenile migration (64°F) during the period 1986 through 1995.,<br><br>The maximum measured value, 84.2°F, exceeded the lethal temperature (assuming a 1-week exposure) for juvenile salmonid rearing.<br><br>Juvenile Chinook occupy the lower Long Tom during winter, when temperatures are below maxima. | Timber harvest (upper watershed).<br><br>Livestock operations.<br><br>USACE operations at Fern Ridge dam. |
| Freshwater spawning sites<br>Freshwater rearing<br>Freshwater migration corridors | Water quality | Total suspended solids/turbidity | Only 5% of 41 turbidity measurements below Fern Ridge Dam during the 1990s had levels that exceeded 50 NTU, which ODEQ described as "unimpaired." However, 16% of total dissolved solids measurements exceeded 100 mg/L, which ODEQ described as "moderately impaired." | Streambank erosion due to grazing.<br><br>Agriculture<br><br>Timber harvest (upper watershed).<br><br>Road construction and maintenance. |
| Freshwater spawning sites<br>Freshwater rearing<br>Freshwater migration corridors | Water quality | Chemical contamination/nutrients | Most (98%) of 43 water samples collected below Fern Ridge Dam during the 1990s had total phosphorus concentrations that exceeded 0.05 mg/L, a condition described as "impaired" based on Governor's Watershed Enhancement Board recommendations. Fourteen pesticides were detected at a site near Bundy Bridge (Long Tom RM 1) during four sampling periods in 1994. | Agriculture<br><br>Rural development (fertilizers).<br><br>Transportation |

| PCEs | Pathway | Indicator | Long Tom River Baseline Condition | Limiting Factors |
|---|---|---|---|---|
| Freshwater spawning sites<br>Freshwater rearing<br>Freshwater migration corridors | Water quality | Dissolved oxygen (DO) | ODEQ 2002 CWA 303(d) list does not indicate that any streams in the Long Tom subbasin are water quality limited due to low DO concentrations. | N/A |
| Freshwater spawning sites<br>Freshwater rearing<br>Freshwater migration corridors | Water quality | Total dissolved gas (TDG) | ODEQ 2002 CWA 303(d) list does not indicate that any streams in the Long Tom subbasin are water quality limited due to TDG. | N/A |
| Freshwater migration corridors | Habitat access | Physical barriers | No man-made barriers at or below Fern Ridge Dam limit the viability of demographically independent salmonid populations of anadromous fish. | N/A |
| Freshwater spawning sites | Habitat elements | Substrate | Amazon Creek and the mainstem Long Tom River have been channelized. Flow velocity and sediment transport capacity increased and the channels have incised. | USACE reservoirs trap sediment and large wood from headwaters.<br><br>USACE operates Fern Ridge to reduce the magnitude/frequency of peak flows.<br><br>USACE and private revetments.<br><br>USACE channel straightening. |

| PCEs | Pathway | Indicator | Long Tom River Baseline Condition | Limiting Factors |
|---|---|---|---|---|
| Freshwater rearing sites<br>Freshwater migration corridors | Habitat elements | Large woody debris (LWD) | *In Headwater Tributaries*: Large wood does not meet ODFW benchmarks in Ferguson and Bear Creeks, which are the only two surveyed streams. Large wood levels are probably low in other tributaries due to timber harvesting.<br><br>*In the Mainstem Long Tom River*: Although no current estimates are available, the Long Tom River probably lacks large wood downstream of Fern Ridge Dam. | Timber harvesting.<br>Stream clean-out.<br>Fire suppression.<br>Extensive splash damming.<br><br>USACE removes large wood from reservoirs.<br><br>USACE removed snags in lower river for navigation.<br><br>Inadequate recruitment from riparian forests. |
| Freshwater rearing sites<br>Freshwater migration corridors | Habitat elements | Pool frequency and quality | Pool frequency and quality has been substantially reduced in the upper Willamette Basin in tributaries like the Long Tom River that have been heavily forested. Sedell and Everest (1991) compared the change in large pool areas that occurred from 1940 to 1990 in Willamette Basin watersheds "managed" for timber harvest as compared to those left "unmanaged" (i.e., wilderness areas). Managed forests experienced large losses in the proportion of pool habitat (e.g., Fall Creek -61%, South Fork McKenzie -82%). Only some streams remaining in unmanaged forests showed increases in the number of large pools. | |
| Freshwater spawning sites<br>Freshwater rearing<br>Freshwater migration corridors | Habitat elements | Off-channel habitat | About 61 miles of the mainstem Long Tom River are extensively channelized and it is predominantly a single channel. About 60 miles of Amazon Creek are channelized and simplified. | USACE operates Fern Ridge to reduce the magnitude/frequency of peak flows.<br><br>USACE channel straightening and levees.<br><br>USACE and private revetments.<br><br>USACE removes large wood from reservoir. |

| PCEs | Pathway | Indicator | Long Tom River Baseline Condition | Limiting Factors |
|---|---|---|---|---|
| Freshwater spawning sites<br>Freshwater rearing | Channel conditions and dynamics | Width/depth ratio | Channel forming processes in the Long Tom River downstream of Fern Ridge Dams have been restricted by changes to the natural hydrograph and by reductions in the transportation of sediment load and LWD. Flow regulation, fractionation of the sediment load passed to below the dam, and accumulation of fine sediment fractions below Fern Ridge Dam have resulted in bank and substrate armoring (i.e., compaction and stabilization) and in habitat simplification. | |
| Freshwater spawning sites<br>Freshwater rearing<br>Freshwater migration corridors | Channel conditions and dynamics | Streambank condition | Streambanks do not support natural floodplain function in the Long Tom River downstream of Fern Ridge Dam. | |
| Freshwater rearing<br>Freshwater migration corridors | Channel conditions and dynamics | Floodplain connectivity | Fern Ridge Dam has substantially decreased the magnitude and frequency of high flow events in the Long Tom River downstream of the dam. As a result, the floodplain is not frequently inundated by over-bank flow and there is less side channel connectivity than occurred under pre-dam conditions. These factors result in reduced nutrient exchange, reduced sediment exchange, reduced areas of refuge for fish under high-flow conditions, and reduced opportunities for re-establishment of riparian forests. | USACE operation of Fern Ridge Dam reduces the magnitude/frequency of peak flows.<br><br>USACE and private revetments.<br><br>Levees<br><br>USACE channel straightening. |

| PCEs | Pathway | Indicator | Long Tom River Baseline Condition | Limiting Factors |
|---|---|---|---|---|
| Freshwater spawning sites<br>Freshwater rearing<br>Freshwater migration corridors | Water quantity (flow/hydrology) | Change in peak/base flow | The frequency of flows with a channel-forming magnitude is insufficient to create and maintain channel complexity and to provide nutrients, organic matter, and sediment inputs from floodplain areas.<br><br>Increased summer flows may provide more rearing area for ESA-listed fish and may improve the heat capacity of the stream.<br><br>Low stream flow conditions are affected by water development and reservoir operations to a large extent in the Long Tom River subbasin than in other Willamette subbasins.<br><br>Flow fluctuations below Fern Ridge Dam are generally minor in magnitude except during flood management operations. | USACE flood control operations at Fern Ridge reduce the magnitude/frequency of peak flows.<br><br>Flood control operations at Fern Ridge cause rapid flow reductions.<br><br>Flow augmentation operations at Fern Ridge (typically July - August) |
| Freshwater spawning sites<br>Freshwater rearing<br>Freshwater migration corridors | Watershed conditions | Road density and location | The lower parts of the Long Tom watershed contain extensive agricultural, urban, and residential development. Relatively high road densities exist in these parts of the watershed. | |
| Freshwater spawning sites<br>Freshwater rearing<br>Freshwater migration corridors | Watershed conditions | Disturbance history | The disturbance regime is dominated by timber harvesting. Forests are dominated by early- to mid-successional stages, with few late-successional forests. Timber harvesting has increased sediment delivery to streams, but decreased large wood input, resulting in degraded aquatic habitat. | Fire suppression<br><br>Timber harvesting |

| PCEs | Pathway | Indicator | Long Tom River Baseline Condition | Limiting Factors |
|---|---|---|---|---|
| Freshwater spawning sites<br>Freshwater rearing<br>Freshwater migration corridors | Watershed conditions | Riparian reserves | Portions of the upper watershed are forested, but most is managed for timber production rather than ecosystem health. Lower watershed contains extensive agricultural, urban, and residential development. Portions of the upper watershed are heavily urbanized.<br><br>*In the Headwaters*: About 45% of riparian areas in the upper watershed have a moderate loss of function, and about 45% have a low loss of function. Many riparian areas consist of smaller-diameter trees with low large wood recruitment potential (Coyote Creek, mainstem Long Tom River). Some drainages have relatively intact riparian forests (Amazon, Elk, Spencer, and Ferguson creeks).<br><br>*In the Lower Floodplain*: About 46% of closed bottomland forest has a "high loss of function" rating. Many remaining patches of floodplain forest are interspersed with pastureland. Low large wood recruitment potential. | Conversion to agricultural, urban, and rural uses.<br><br>Timber harvesting<br><br>Stream clean-out practices.<br><br>Clearing for agriculture or development.<br><br>USACE and private revetments and levees.<br><br>USACE channel straightening.<br><br>USACE operation of Fern Ridge alters the hydrologic regime.<br><br>Timber harvest |

### 5.1.7. Mainstem Willamette River

Table 5-7 provides a matrix of pathways and indicators for the condition of PCEs of critical habitat in the mainstem Willamette River under the environmental baseline condition.

**Table 5-7. Matrix of Pathways and Indicators for PCEs of Critical Habitat in the Mainstem Willamette River**

| PCEs | Pathway | Indicator | Mainstem Willamette Baseline Condition | Limiting Factors |
|---|---|---|---|---|
| Freshwater spawning sites<br>Freshwater rearing<br>Freshwater migration corridors | Water quality | Temperature | ODEQ 2002 CWA 303(d) database indicates that summer temperatures in the mainstem Willamette (RM 0 to 186) exceeded maxima for core and non-core rearing and adult and juvenile migration during 1986 through 1995.<br><br>Water stored in Willamette Project reservoirs is released during late July and August to protect mainstem water quality (including temperature). | Land use practices throughout the basin: timber harvest, agriculture, and urbanization.<br><br>USACE operations at the 13 Willamette Project reservoirs. |
| Freshwater spawning sites<br>Freshwater rearing<br>Freshwater migration corridors | Water quality | Total suspended solids/turbidity | ODEQ 2002 CWA 303(d) database does not indicate exceedences of water quality criteria for turbidity. | N/A |
| Freshwater spawning sites<br>Freshwater rearing<br>Freshwater migration corridors | Water quality | Chemical contamination/nutrients | ODEQ 2002 CWA section 303(d) database indicates the following exceedences of criteria for the protection of anadromous fish passage:<br>(1) Two out of 7 water column samples at RM 12.7 exceeded the criterion of 0.000024 ug/L for DDT. (2) For polynuclear aromatic hydrocarbons at RM 6, the 35-day average of 52,900 pg/L exceeded the criterion of 2,800 pg/L.<br><br>Potential adverse affects on anadromous fish passage due to pentachlorophenol in sediment near McCormick and Baxter creosoting site (RM 7).<br><br>ODEQ 2002 CWA 303(d) database does not indicate exceedences of water quality criteria for excess nutrients. | Pesticide applications: agriculture, transportation, and rural development.<br><br>N/A |

| PCEs | Pathway | Indicator | Mainstem Willamette Baseline Condition | Limiting Factors |
|---|---|---|---|---|
| Freshwater spawning sites<br>Freshwater rearing<br>Freshwater migration corridors | Water quality | Dissolved oxygen (DO) | DO concentrations in the mainstem Willamette (RM 151 to 141.6) have fluctuated below ODEQ numerical criteria.<br><br>DO levels in the mainstem Willamette have increased since 1945, as evidenced by increased numbers of fish species that are relatively sensitive to low DO levels. | Periphyton (attached algae) respiration.<br><br>Flow augmentation from USACE reservoirs.<br><br>Basin-wide secondary sewage treatment. |
| Freshwater spawning sites<br>Freshwater rearing<br>Freshwater migration corridors | Water quality | Total dissolved gas (TDG) | There is no information indicating that total dissolved gas concentrations in the mainstem Willamette River have exceeded 110% of saturation. | N/A |
| Freshwater migration corridors | Habitat access | Physical barriers | *Willamette Falls as Barrier to Migration:* Willamette Falls (RM 26.6) is a natural barrier that has always restricted fish passage during low flows.<br><br>Navigation locks built in 1873 allowed some upstream fish passage; first crude rock fishway built at Willamette Falls in mid-1880s to early 1890s.<br><br>Falls developed for hydroelectric production in 1891 with as many as 52 turbines in operation at one time; juvenile Chinook turbine mortality rates are 7.7%-100%.<br><br>Sullivan Plant was closed during the downstream migration in the mid-1970s and 1980s; with structural improvements to the bypass in 1991, Sullivan Plant operates year-round. | Natural condition.<br><br>Privately owned navigation lock.<br><br>Private hydroelectric development. |

| PCEs | Pathway | Indicator | Mainstem Willamette Baseline Condition | Limiting Factors |
|---|---|---|---|---|
| Freshwater spawning sites | Habitat elements | Substrate | Mainstem Willamette is downcutting at several gage locations.<br><br>Sediment budget is not balanced due to extraction from gravel mining, retention in reservoirs, and lack of recruitment from eroding banks.<br><br>Substrate is probably armored. | USACE reservoirs trap sediment and large wood from headwaters.<br><br>USACE operates flood control dams to reduce the magnitude and frequency of peak flows.<br><br>USACE and private revetments.<br><br>USACE channel straightening.<br><br>Extensive in-stream and floodplain gravel mining. |
| Freshwater rearing sites<br>Freshwater migration corridors | Habitat elements | Large woody debris (LWD) | Lack of large wood in main channel and side channels. | USACE removes large wood from reservoirs.<br><br>USACE removed snags in the upper and mid sections of the river for navigation.<br><br>Inadequate recruitment from Willamette riparian forests.<br><br>Inadequate recruitment from tributaries. |
| Freshwater rearing sites<br>Freshwater migration corridors | Habitat elements | Pool frequency and quality | Pool frequency and quality in the mainstem Willamette River has been greatly reduced by dredging and channel simplification to develop and maintain waterborne transportation and to mine gravel. | USACE operates flood control dams to reduce magnitude/frequency of peak flows.<br><br>USACE reservoirs trap sediment and large wood from headwaters.<br><br>USACE channel straightening.<br><br>USACE and private revetments. |

| PCEs | Pathway | Indicator | Mainstem Willamette Baseline Condition | Limiting Factors |
|---|---|---|---|---|
| Freshwater spawning sites<br>Freshwater rearing<br>Freshwater migration corridors | Habitat elements | Off-channel habitat | Substantial loss of off-channel habitat in the mainstem Willamette River. | USACE operates flood control dams to reduce magnitude/frequency of peak flows.<br><br>USACE reservoirs trap sediment and large wood from headwaters.<br><br>USACE channel straightening.<br><br>USACE and private revetments. |
| Freshwater spawning sites<br>Freshwater rearing | Channel conditions and dynamics | Width/depth ratio | Channel forming processes in the upper mainstem Willamette River have been restricted by changes in the natural hydrograph, by streambank armoring, and by reductions in LWD derived from riparian forests that have been removed. Channel length and complexity between Albany and Eugene was reduced by 45% to 50% since 1800 (Benner and Sedell 1997). The Newberg Pool located upstream of Willamette Falls has always been relatively deep and has not changed significantly from historic conditions. Land use practices (e.g., agriculture) that have resulted in elevated fine sediment loads have contributed to compaction and stabilization of substrates and overall habitat simplification. | USACE operates flood control dams to reduce magnitude/frequency of peak flows.<br><br>USACE reservoirs trap sediment and large wood from headwaters.<br><br>USACE channel straightening.<br><br>USACE and private revetments.<br><br>Agricultural practices |
| Freshwater spawning sites<br>Freshwater rearing<br>Freshwater migration corridors | Channel conditions and dynamics | Streambank condition | 46 miles of USACE revetments and 50 miles of private revetments along the mainstem Willamette prevent lateral channel migration.<br><br>65% of outer bends of meanders revetted.<br><br>Channel length in 1990 reduced to only 20%-30% of channel length in 1850.<br><br>Alcove and island area reduced to 20%-30% of that present in 1850.<br><br>River channel form does not change frequently, and new islands and gravel bars seldom form. | USACE operates flood control dams to reduce magnitude/frequency of peak flows.<br><br>USACE reservoirs trap sediment and large wood from headwaters.<br><br>USACE channel straightening.<br><br>USACE and private revetments.<br><br>Development of floodplain land. |

| PCEs | Pathway | Indicator | Mainstem Willamette Baseline Condition | Limiting Factors |
|---|---|---|---|---|
| Freshwater rearing<br>Freshwater migration corridors | Channel conditions and dynamics | Floodplain connectivity | Floodplain is not frequently inundated, with less over-bank flow and side channel connectivity.<br><br>Reduced nutrient exchange, reduced sediment exchange, reduced flood refugia for fish, and reduced establishment of new riparian forests. | USACE blockage of side channels and channelization for navigation.<br><br>USACE operation of flood control dams reduces magnitude/frequency of peak flows.<br><br>USACE and private revetments.<br><br>Levees |
| Freshwater spawning sites<br>Freshwater rearing<br>Freshwater migration corridors | Water quantity (flow/hydrology) | Change in peak/base flow | Late winter and spring flow reductions may reduce the survival of outmigrating winter steelhead and spring Chinook smolts.<br><br>Spring flow reductions may reduce delays adult Chinook experience at the Willamette Falls hydro project during high flows.<br><br>Increased flows in summer may benefit juvenile Chinook by increasing rearing habitat area for rearing juveniles and by increasing the heat capacity of the system.<br><br>Frequency of channel-forming and over-bank flows has been greatly reduced.<br><br>Human-caused increases in the rate of flow fluctuations are not a significant concern. | Late winter and spring refill operations at Willamette reservoirs.<br><br>Flow augmentation operations at Willamette reservoirs (typically Jul-Aug).<br><br>Flood control operations at the 13 Willamette Project dams reduce magnitude and frequency of peak flows in the mainstem Willamette. |
| Freshwater spawning sites<br>Freshwater rearing<br>Freshwater migration corridors | Watershed conditions | Road density and location | High road densities exist throughout the Willamette Valley near the mainstem as a result of agricultural, urban, industrial, and rural development. These are managed by Oregon Dept. Transportation; corrective measures are not included as a part of the revised proposed action. | N/A |

| PCEs | Pathway | Indicator | Mainstem Willamette Baseline Condition | Limiting Factors |
|---|---|---|---|---|
| Freshwater spawning sites<br>Freshwater rearing<br>Freshwater migration corridors | Watershed conditions | Disturbance history | Prairie and oak savanna habitat is rare within the Willamette Valley foothills.<br><br>Lower watershed contains extensive agricultural, urban, and residential development.<br><br>Agriculture and development constitute almost 60% of the Willamette Valley lowland vegetation. | Conversion to agricultural, urban, residential, industrial, and rural uses. |
| Freshwater spawning sites<br>Freshwater rearing<br>Freshwater migration corridors | Watershed conditions | Riparian reserves | Area of riparian forest along the mainstem Willamette in 1990 is 75-90% less than in 1850.<br><br>Many remaining patches of floodplain forest are interspersed with agriculture.<br><br>Low large wood recruitment potential.<br><br>Few continuous large patches of riparian forest.<br><br>Many forests contain non-native Himalayan blackberry and reed canarygrass that hinder development of young cottonwood forests.<br><br>Prairie and oak savanna habitat is rare within the Willamette Valley foothills. | Clearing for navigation, agriculture, or development.<br><br>USACE and private revetments.<br><br>USACE operation of flood control dams alters the hydrologic regime.<br><br>Timber harvest.<br><br>Conversion to agricultural, urban, residential, industrial, and rural uses. |

# 6. ANALYSIS OF EFFECTS

This chapter is divided into two major sections. The component of the Willamette Project revised proposed action evaluated in Section 6.1 is the continuing operation of the USACE dams and reservoirs and associated streamside revetments in each of the Willamette subbasins and the mainstem Willamette River. The component of the Willamette Project revised proposed action evaluated in Section 6.2 is the continuing operation of the Willamette Basin Hatchery Mitigation Program.

## 6.1. Continuing Operation of USACE Willamette Dams and Reservoirs

### 6.1.1. Effects of the Willamette Project Revised Proposed Action on UWR Spring Chinook and Winter Steelhead Populations and Critical Habitat in the North Santiam Subbasin

The component of the Willamette Project revised proposed action evaluated in this section is the continuing operation of the USACE Detroit/Big Cliff dams and reservoirs and associated streamside revetments on the North Santiam River upstream and downstream of the Detroit/Big Cliff complex. The North Santiam River above and below the Detroit/Big Cliff complex has been designated as critical habitat for UWR spring Chinook salmon and winter steelhead, or currently has spring Chinook and winter steelhead present. The primary constituent elements (PCEs) identified in critical habitat include sites for spawning, rearing, and migration. Table 6-1 assesses the anticipated effects of the revised proposed action on PCEs and viable salmonid population (VSP) parameters for spring Chinook and winter steelhead in the North Santiam subbasin.

**Table 6-1. Effects of the Revised Proposed Action on Critical Habitat and Viability of Spring Chinook and Winter Steelhead in the North Santiam Subbasin**

| PCEs | Pathway | Indicator | North Santiam Baseline Condition | Effects of the Revised Proposed Action | Effects on VSP Parameters |
|---|---|---|---|---|---|
| Freshwater spawning sites<br>Freshwater rearing<br>Freshwater migration corridors | Water quality | Temperature | Indirect evidence that warmer fall temperatures have shortened the incubation and emergence timing of Chinook salmon fry.<br><br>ODEQ's 2002 CWA 303(d) database indicates that maximum temperatures for spawning, incubation, and fry emergence have been exceeded in the lower North Santiam River (up to RM 26.5), and in the Santiam River below the mouth of the South Santiam.<br><br>Maxima for core and non-core rearing and adult and juvenile migration have been exceeded in the mainstem Santiam River and in the North Santiam River up to RM 10.<br><br>Maxima for core and non-core rearing and adult and juvenile migration also have been exceeded in streams above Detroit Reservoir (Blowout, Boulder, and Marion creeks), and in tributaries to lower reaches of the North Santiam (Chehulpum Creek, Bear Branch, and the Little North Santiam River, including Stout and Elkhorn creeks).<br><br>Average daily temperatures less than 52°F during May through late June, cool enough to have delayed the upstream migration of adult spring Chinook salmon. | The proposed action will assess the feasibility of constructing WTC at Detroit Dam. If feasible and authorization/funding is obtained, WTC capability at Detroit would substantially improve hatch and emergence timing and probably survival of naturally produced spring Chinook and winter steelhead in the North and mainstem Santiam rivers downstream of the Detroit/Big Cliff complex. Ecosystem function related to macroinvertebrate production and the growth of other fish species also would improve.<br><br>The Action Agencies assume no benefit from this action at present because feasibility and funding are uncertain. | Initially, no change in effect. If and when WTC capability is developed and implemented, population abundance and productivity would increase. Habitat quality in the natural production area below Minto Dam would improve. Spawning activity and egg-to-fingerling survival is expected to increase resulting in the potential for improved abundance and productivity. Biological monitoring would document realized changes. |
| Freshwater spawning sites<br>Freshwater rearing<br>Freshwater migration corridors | Water quality | Total suspended solids/turbidity | Although high turbidity events have been reported in the North Santiam subbasin in recent years, there is no indication that turbidity has adversely affected the habitat requirements of anadromous salmonids.<br><br>ODEQ's 2002 CWA 303(d) database does not include any exceedences of water quality criteria for excess turbidity. | The Detroit project will continue to trap high sediment loads resulting from storm events in the upper watershed (a positive effect), but will continue to pass fine sediment below the dam while blocking the movement of large particulate substrate (including spawning gravel) downstream. A study leading to a plan for gravel monitoring/augmentation, as needed, in the North Santiam below Big Cliff Dam is expected to maintain current gravel levels. | No change in effect. |

| PCEs | Pathway | Indicator | North Santiam Baseline Condition | Effects of the Revised Proposed Action | Effects on VSP Parameters |
|---|---|---|---|---|---|
| Freshwater spawning sites<br>Freshwater rearing<br>Freshwater migration corridors | Water quality | Chemical contamination/nutrients | ODEQ's 2002 CWA 303(d) database does not include any exceedences of water quality criteria for toxics.<br><br>ODEQ's 2002 CWA 303(d) database does not indicate that any streams are impaired due to excess nutrients.<br><br>Operations at Detroit and Big Cliff dams may have reduced nutrient loads in the mainstem North Santiam and Santiam rivers by increasing summer flows. | BMPs and spill prevention plans at USACE projects will be in place during any future construction activity associated with the Detroit/Big Cliff to avoid or minimize any potential contamination of waterways or adjacent lands.<br><br>Continued outplanting of spring Chinook salmon or winter steelhead above Detroit Reservoir will aid in adding marine derived nutrients to that area. | Productivity above the Detroit/Big Cliff project may increase to an unknown extent as a result of increased levels of marine derived nutrients.<br><br>At this time, the Action Agencies make a conservative assumption of no effect from our activities. |
| Freshwater spawning sites<br>Freshwater rearing<br>Freshwater migration corridors | Water quality | Dissolved oxygen (DO) | ODEQ's 2002 CWA 303(d) database indicates dissolved oxygen concentrations lower than the criterion for salmonid spawning and rearing (11 mg/L or 95% saturation) at RM 9.3 and RM 11.2 in the mainstem Santiam River (below the mouth of the South Santiam). | The revised proposed action will not alter DO conditions. | No effect. |
| Freshwater spawning sites<br>Freshwater rearing<br>Freshwater migration corridors | Water quality | Total dissolved gas (TDG) | TDG level of 129% saturation measured 950 feet below Big Cliff Dam and TDG level of 120.2% measured 2 miles downstream. | No effect. | No effect. |

| PCEs | Pathway | Indicator | North Santiam Baseline Condition | Effects of the Revised Proposed Action | Effects on VSP Parameters |
|---|---|---|---|---|---|
| Freshwater migration corridors | Habitat access | Physical barriers | *Barriers below Big Cliff Dam:* Reduced flows for upstream passage and juvenile entrainment into power and water supply canals in lower subbasin. During construction of Detroit and Big Cliff dams (early 1950s), a concrete weir (Minto Dam) was built about three miles downstream of the dams to replace the old hatchery rack. Minto Dam has blocked passage of all adult spring Chinook salmon and most winter steelhead since 1952.<br><br>*Barriers above Detroit Reservoir:* A hatchery rack near the mouth of the Breitenbush River (now under Detroit Reservoir) intercepted a large proportion of the adult spring Chinook salmon and winter steelhead runs from 1911 through 1941.<br><br>*Big Cliff/Detroit Projects as Barriers:* Both projects were built without fish passage facilities; populations are restricted to below Big Cliff Dam. Preliminary screw trap studies indicate survival rates for juvenile spring Chinook of 51%-60.5% at Detroit Dam and 69% at Big Cliff Dam; the combined survival rate for fish that pass both dams was 35%-42%. No estimate of reservoir survival available.<br><br>*Predation as a Barrier to Reservoir Migration:* Cool water temperatures above Detroit Dam limit production of northern pikeminnow. | A feasibility study funded by Action Agencies will determine how to restore connectivity (fish access) to productive habitat above Detroit and if feasible, will pursue development of this capability. This will include both adult upstream (capture and transport) and juvenile downstream (via turbine or bypass system) fish passage components.<br><br>Continuing outplanting of spring Chinook and winter steelhead above Detroit will contribute an unknown additional number of naturally produced adults to the North Santiam population. These fish will reproduce in an area where presence (and potential influence) of hatchery strays can be controlled, providing a natural production sanctuary. RM&E efforts will determine the survival of juveniles passing below Big Cliff. RM&E also will be used to document the success of restoring natural production above Detroit.<br><br>The Action Agencies will update the Minto fish facility to be in compliance with NMFS standards; this will greatly enhance safe handling of ESA-listed fish. | Local population survival and productivity should increase to an unknown, but relatively small, extent as a direct result of improved adult fish handling capability at the Minto fish capture and handling facility. Local population abundance and productivity, special distribution, and genetic diversity have the potential to substantially increase as a result of successfully reestablishing self-sustaining, naturally produced populations of winter steelhead in habitat located upstream of Detroit Dam. If efforts to restore fish passage are feasible and pursued, related biological research will focus on maximizing pre-spawner survival rates and on establishing effective juvenile fish passage to below Big Cliff Dam. Biological monitoring will document progress toward improving overall productivity of the local populations. |

| PCEs | Pathway | Indicator | North Santiam Baseline Condition | Effects of the Revised Proposed Action | Effects on VSP Parameters |
|---|---|---|---|---|---|
| Freshwater spawning sites | Habitat elements | Substrate | Substrate has coarsened downstream of Big Cliff Dam.<br><br>River channel downstream of Big Cliff Reservoir may be downcutting.<br><br>Channel downstream of Big Cliff Dam could lack spawning gravel.<br><br>Many areas scoured to bedrock.<br><br>Current sediment budget not creating and maintaining side channel and gravel bar habitat needed by anadromous salmonids. | Under the revised proposed action, a study will be performed to develop an effective plan for gravel monitoring and augmentation to maintain current gravel levels in the area below the Detroit/Big Cliff complex. | No effect. |
| Freshwater rearing sites<br>Freshwater migration corridors | Habitat elements | Large woody debris (LWD) | *In the Tributaries and Upper Mainstem North Santiam Rivers:* Large wood is lacking in most small tributaries; few meet the ODFW benchmarks. Recruitment potential for large wood is low along most surveyed streams.<br><br>*In the Mainstem North Santiam and Santiam Rivers:* Reaches of the North Santiam River below Detroit and Big Cliff Dams are deprived of large wood. Inadequate recruitment of large wood from riparian areas along mainstem North Santiam and tributaries downstream from Big Cliff Dam. Lack of large wood-associated habitat for anadromous salmonids and invertebrates upon which they feed. | Under the revised proposed action, a study will be performed to develop an effective plan for stockpiling LWD, which will then be made available to the USFS or others for use where appropriate in maintaining habitat complexity in the stream channel above or below the Detroit/Big Cliff complex. | No change in effect. |
| Freshwater rearing sites<br>Freshwater migration corridors | Habitat elements | Pool frequency and quality | Pool frequency and quality in the North Santiam below Detroit/Big Cliff is fair to good due to the presence of pool forming elements such as riparian forests and LWD. | No effect. | No effect. |

| PCEs | Pathway | Indicator | North Santiam Baseline Condition | Effects of the Revised Proposed Action | Effects on VSP Parameters |
|---|---|---|---|---|---|
| Freshwater spawning sites<br>Freshwater rearing<br>Freshwater migration corridors | Habitat elements | Off-channel habitat | While no quantitative data are available, the North Santiam likely contains fewer off-channel habitats, simplified mainstem habitat, and few new gravel bars or channel surfaces. | Flow management measures under the revised proposed action may improve the condition of habitat. Experimentation with pulsed flows and a hydro-geomorphic study will increase understanding and options for providing flows that protect and rejuvenate fish spawning and rearing habitat. Because specific improvements cannot be described at this time, the Action Agencies make a conservative assumption that the revised proposed action will not appreciably change habitat conditions. | No effect. |
| Freshwater spawning sites<br>Freshwater rearing | Channel conditions and dynamics | Width/depth ratio | Channel forming processes in the North Santiam River downstream of the Detroit/Big Cliff dam complex have been restricted by changes to the natural hydrograph and by reductions in sediment load and LWD derived from above Detroit Dam. Flow regulation, fractionation of the sediment load passed to below the dams, and accumulation of fine sediment fractions below Big Cliff Dam have resulted in bank and substrate armoring (i.e., compaction and stabilization) and in habitat simplification. | Reduction in peak flows below Detroit/Big Cliff will continue to limit pool formation and habitat rejuvenation downstream of the dams. However, the Action Agencies will undertake a study to develop an effective plan for providing stockpiled LWD for projects approved by the Services involving placement of LWD. Such projects can create pools and improve habitat diversity. Conservatively, the Action Agencies assume the revised proposed action will not degrade pool quality or habitat complexity, and will not appreciably enhance pool quality or habitat complexity by placement of LWD. | No effect. |
| Freshwater spawning sites<br>Freshwater rearing<br>Freshwater migration corridors | Channel conditions and dynamics | Streambank condition | Streambanks do not support natural floodplain function in the lower North Santiam River downstream of the canyon area below the Detroit/Big Cliff dam complex. | Experimentation with various flow rates (e.g., pulsed flows) will be pursued under RM&E efforts and may help restore more normative ecosystem function with regard to the interplay between channel, streambank, and floodplain conditions. Implementing flow management measures may help restore more normative ecosystem function. Habitat enhancement funds may be used to improve streambank condition. Because specific improvements cannot be described at this time, the Action Agencies make a conservative assumption that the revised proposed action will not appreciably change streambank conditions. | No effect. |

| PCEs | Pathway | Indicator | North Santiam Baseline Condition | Effects of the Revised Proposed Action | Effects on VSP Parameters |
|---|---|---|---|---|---|
| Freshwater rearing<br>Freshwater migration corridors | Channel conditions and dynamics | Floodplain connectivity | Floodplain is not frequently inundated, with less over-bank flow and side channel connectivity.<br><br>Reduced nutrient exchange, reduced sediment exchange, reduced flood refugia for fish, and reduced establishment of new riparian forests. | Implementation of flow management measures may help restore more normative ecosystem function. Habitat enhancement funds may be used to improve off-channel habitat by removing impediments to flow and by softening bank stabilization applications. Because specific improvements cannot be described at this time, the Action Agencies make a conservative assumption that the revised proposed action will not appreciably change floodplain connectivity. | No effect. |

| PCEs | Pathway | Indicator | North Santiam Baseline Condition | Effects of the Revised Proposed Action | Effects on VSP Parameters |
|---|---|---|---|---|---|
| Freshwater spawning sites<br>Freshwater rearing<br>Freshwater migration corridors | Water quantity (flow/hydrology) | Change in peak/base flow | Frequency of channel-forming flows not of sufficient magnitude to create and maintain channel complexity and provide nutrient, organic matter, and sediment inputs from floodplain areas.<br><br>Increased fall flows may allow spring Chinook to spawn in areas that will be dewatered during active flood control operations.<br><br>Winter and spring flow reductions may reduce rearing area and the survival of steelhead fry.<br><br>Increased summer flows may increase rearing area and the heat capacity of the stream.<br><br>Low summer flows in specific reaches (due to diversions) may reduce the juvenile rearing habitat area, block adult passage to upstream spawning areas, and decrease the heat capacity of the stream.<br><br>Flow fluctuations now occur at rates rapid enough to entrap and strand juvenile anadromous fish. | Under the revised proposed action, the hydrology in the North Santiam River will continue to be affected. However, the Action Agencies will evaluate the site-specific biological effects of current flow rates and experiment with managed variation in flow rates (e.g., pulsed flows) under flow studies included as part of the revised proposed action. Flow pulses may help to restore more normative ecosystem function with regard to the interplay between channel, streambank, and floodplain conditions. However, high flow rates equal to the pre-dam 2-year recurrence interval of 34,200 cfs (as measured at Mehama, 20 miles downstream of Big Cliff Dam) will remain rare, providing occasional channel forming flows during very wet years. Since construction of the Detroit/Big Cliff complex in 1954, the 2-year frequency event has been only 19,700 cfs (base flow of about 1,000 cfs).<br><br>Down ramping will be limited to 200 cfs per hour below Big Cliff and ramping will be performed (whenever possible) only during hours of darkness (1 hour after sunset/1 hour before sunrise) from January 1 through March 31 in order to minimize the potential for juvenile stranding. The Action Agencies will implement fish stranding and macroinvertebrate displacement studies and identify additional protective ramping measures, if needed and feasible. | Improved ramping rates and flow conditions below Big Cliff Dam will reduce risks to ESA-listed fish species. If water temperature conditions are also improved, the improved ramping and flow conditions could result in improved ecosystem health and function, expanded rearing habitat, higher egg-to-smolt survival, improved migration conditions, and improved overall productivity. As a result, local population abundance also may increase. Biological monitoring will document changes in local habitat conditions and in local population productivity resulting from a combination of Action Agency actions. |

| PCEs | Pathway | Indicator | North Santiam Baseline Condition | Effects of the Revised Proposed Action | Effects on VSP Parameters |
|---|---|---|---|---|---|
| Freshwater spawning sites<br>Freshwater rearing<br>Freshwater migration corridors | Watershed conditions | Road density and location | Moderate to high road densities exist in North Santiam watershed above and below Detroit/Big Cliff. These roads are managed by Oregon Dept. Transportation and by USFS; corrective measures are not included as a part of the revised proposed action. | No change. | No effect. |
| Freshwater spawning sites<br>Freshwater rearing<br>Freshwater migration corridors | Watershed conditions | Disturbance history | Forests are dominated by early- to mid-successional stages with few late-successional forests. Disturbance regime is dominated by timber harvesting, which has increased sediment delivery to streams while decreasing large wood input. Upper watershed is forested, but some managed for timber production rather than ecosystem health. Lower watershed contains extensive agricultural, urban, rural, and residential development. Only 8% of lower watershed contains native Willamette Valley vegetation. | The revised proposed action will not change the disturbance regime conditions. | No effect. |
| Freshwater spawning sites<br>Freshwater rearing<br>Freshwater migration corridors | Watershed conditions | Riparian reserves | *Headwater Forests Riparian Conditions:* Most riparian areas in small tributaries are vegetated, but consist of alder or young coniferous riparian areas. Some drainages contain up to 33% mature riparian vegetation (e.g., Little North Fork), but others have less (e.g., Breitenbush). Many tributaries do not provide adequate shading or large wood recruitment.<br><br>*Floodplain Forest Riparian Conditions:* Low large wood recruitment potential and poor shading because the lower watershed contains only 25% of original extent of floodplain forest and many remaining patches of floodplain forest are interspersed with pasture land. | No effect. | No effect. |

In summary, corrective actions proposed by the Action Agencies in the North Santiam subbasin have the potential to increase UWR spring Chinook salmon and winter steelhead abundance, productivity, spatial distribution, and genetic diversity. These VSP parameters may improve in response to more normalized water temperature conditions downstream of the Detroit/Big Cliff dam complex, increased habitat complexity above or below the Detroit/Big Cliff dam complex resulting from placement of LWD, improved ecosystem function and fish survival resulting from enhanced flow conditions downstream of Big Cliff Dam, reestablishing natural production in historic habitat located above Detroit Dam, and increased levels of marine derived nutrients in habitat located upstream of Detroit Reservoir. The implementation of major structural components of the revised proposed action depends upon the outcome of associated feasibility studies and subsequent project authorization and funding.

### 6.1.2. Effects of the Willamette Project Revised Proposed Action on UWR Spring Chinook and Winter Steelhead Populations and Critical Habitat in the South Santiam Subbasin

The component of the Willamette Project revised proposed action evaluated in this section is the continuing operation of the USACE Green Peter and Foster dams and reservoirs and associated streamside revetments on the South Santiam River upstream and downstream of the Green Peter/Foster complex. The South Santiam River above and below the Green Peter/Foster complex has been designated as critical habitat for UWR spring Chinook salmon and winter steelhead, or currently has spring Chinook and winter steelhead present. The PCEs identified in critical habitat include sites for spawning, rearing, and migration. Table 6-2 assesses the anticipated effects of the proposed action on PCEs and VSP parameters for spring Chinook and winter steelhead in the South Santiam subbasin.

**Table 6-2. Effects of the Revised Proposed Action on Critical Habitat and Viability of Spring Chinook and Winter Steelhead in the South Santiam Subbasin**

| PCEs | Pathway | Indicator | South Santiam Baseline Condition | Effects of the Revised Proposed Action | Effects on VSP Parameters |
|---|---|---|---|---|---|
| Freshwater spawning sites<br>Freshwater rearing<br>Freshwater migration corridors | Water quality | Temperature | Operation of USACE reservoirs reduced spring/summer temperatures in the South Santiam River and increased temperatures during most of the rest of the year.<br><br>ODEQ 2002 CWA 303(d) database indicates that temperatures between the mouth of the South Santiam and Waterloo have exceeded maxima for salmonid spawning (55°F) during mid-September through June, and summer maxima for core rearing (61°F) and non-core rearing and adult and juvenile migration (64°F) during most of the rest of the year. Summer water temperatures in the South Santiam River often neared or exceeded 68°F before Green Peter; cooler spring/summer discharges from Green Peter may prevent the lower South Santiam from reaching warmer temperatures in fall.<br><br>ODEQ 2002 CWA 303(d) database indicates exceedences of the maximum for spawning (55°F), core rearing (61°F), and non-core rearing and adult and juvenile migration (64°F) in the South Santiam above Foster Reservoir; exceedences of the maximum for non-core rearing and migration maximum have been recorded in the Middle Santiam River above Green Peter Reservoir; and for core and non-core rearing, and adult and juvenile migration in Quartzville Creek.<br><br>Temperatures below Foster Dam (1968-1972) were less than 52°F during May through early July, cold enough to delay upstream migration of spring Chinook. | The feasibility of constructing WTC at Green Peter Dam will be assessed. If feasible and authorization & funding is obtained, WTC capability at Green Peter would substantially improve hatch and emergence timing and probably survival of naturally produced spring Chinook and winter steelhead in the South Santiam and mainstem Santiam rivers downstream of Green Peter/Foster. Ecosystem function related to macro-invertebrate production and the growth of other fish species also would improve.<br><br>The Action Agencies assume no benefit from this action at present because feasibility and funding are uncertain. | Initially, no change in effect. If and when WTC capability is developed and implemented, population abundance and productivity would increase. Habitat quality in the natural production area below Foster would improve. Spawning activity and egg-to-fingerling survival is expected to increase resulting in the potential for improved abundance and productivity. Biological monitoring would document realized changes. |

| PCEs | Pathway | Indicator | South Santiam Baseline Condition | Effects of the Revised Proposed Action | Effects on VSP Parameters |
|---|---|---|---|---|---|
| Freshwater spawning sites<br>Freshwater rearing<br>Freshwater migration corridors | Water quality | Total suspended solids/turbidity | No reports of turbidity levels adversely affecting the habitat requirements of spring Chinook salmon or winter steelhead.<br><br>ODEQ 2002 CWA 303(d) database does not list any streams in this subbasin as water quality limited for turbidity. | The Green Peter/Foster project will continue to trap high sediment loads resulting from storm events in the upper watershed (a positive effect), but will continue to pass fine sediment below the dam while blocking the movement of large particulate substrate (including spawning gravel) downstream. A study leading to a plan for gravel monitoring and augmentation, as needed, in the South Santiam below Foster Dam is expected to maintain current gravel levels. | No change in effect. |
| Freshwater spawning sites<br>Freshwater rearing<br>Freshwater migration corridors | Water quality | Chemical contamination/nutrients | ODEQ's 2002 CWA 303(d) database does not indicate that any streams are water quality limited due to the presence of toxics.<br><br>ODEQ 2002 CWA 303(d) database does not indicate that streams in the South Santiam subbasin are impaired due to excessive nutrient loadings.<br><br>Operations at Green Peter/Foster dams that increased summer flows may have reduced nutrient loads in mainstem South Santiam River. | However, BMPs and spill prevention plans at USACE projects will be in place during any future construction activity associated with the Green Peter/Foster to avoid or minimize any potential contamination of waterways or adjacent lands. Continued outplanting of spring Chinook salmon or winter steelhead above Foster Dam will aid in adding marine derived nutrients to that area. | Productivity above the Green Peter/Foster project may increase to an unknown extent as a result of increased levels of marine derived nutrients. At this time, the Action Agencies make a conservative assumption of no effect from our activities. |
| Freshwater spawning sites<br>Freshwater rearing<br>Freshwater migration corridors | Water quality | Dissolved oxygen (DO) | Historical pollution due to pulp mill effluent and sewage in the lower 19 miles; oxygen block during summer months.<br><br>Improved paper pulping processes, secondary wastewater treatment, and summer flow augmentation from Foster and Green Peter dams helped correct the problem.<br><br>ODEQ 2002 CWA 303(d) database does not indicate that any streams in the South Santiam subbasin are water quality limited due to low levels of dissolved oxygen. | The revised proposed action will not alter DO conditions. | No effect. |
| Freshwater spawning sites<br>Freshwater rearing<br>Freshwater migration corridors | Water quality | Total dissolved gas (TDG) | A TDG level of 129.2% saturation, measured in the tailrace in January 1971, was high enough to cause gas bubble trauma in juvenile salmonids rearing in the area and could kill Chinook yolk sac larvae incubating in this reach. TDG levels of 115.8% at 1.2 miles below Foster Dam and 113.3% another 2.3 miles downstream (March 1972) could have killed yolk sac larvae.<br><br>Symptoms of gas bubble trauma have not been reported in juvenile or adult anadromous salmonids in the South Santiam subbasin. | No effect. | No effect. |

| PCEs | Pathway | Indicator | South Santiam Baseline Condition | Effects of the Revised Proposed Action | Effects on VSP Parameters |
|---|---|---|---|---|---|
| Freshwater migration corridors | Habitat access | Physical barriers | *Barriers below Foster Dam:* Juveniles are entrained into the unscreened Lebanon Dam (RM 21), which diverts water into the Lebanon-Albany power canal for irrigation, hydropower, and municipal use. Several older fish ladders allow passage of adult spring Chinook but probably cause some migration delay. Irrigation diversions on the lower tributaries of Crabtree and Thomas creeks pose migration barriers to adult Chinook.<br><br>*Barriers above Foster/Green Peter:* Hatchery broodstock collection began near the site of Foster Dam in 1923 and was discontinued in the 1930s. A weir was on the Middle Santiam a few miles upstream from the confluence with the South Santiam River; fell into disuse in the 1930s.<br><br>*Foster as Barrier to Upstream Migrants:* No estimates of upstream passage mortality at Foster Dam. Dated design does not allow facilities for holding, handling, examining, and sorting hatchery- from natural-origin fish (flexibility in disposition). The operator is unable to see how many fish have accumulated in the trap, leading to potential crowding/injury during handling. The device can be operated improperly by inexperienced personnel, leading to fish injury.<br><br>*Foster as Barrier to Downstream Migrants:* Kaplan turbines expected to safely pass juveniles but fish hesitate to dive to intakes. Surface spill used to flush juvenile steelhead from reservoir since 1983. 89.9% survival for juvenile Chinook through Kaplan turbines (similar rates for juvenile steelhead). 41% mortality of steelhead kelts recovered in downstream nets.<br><br>*Fallback at Foster Dam:* Estimated fallback rates for wild winter steelhead of 2.5% to 4%.<br><br>*Green Peter as Barrier to Upstream Migrants:* Adult passage facility at Green Peter mothballed in 1988; water in the ladder was too cold to attract adults.<br><br>*Green Peter as Barrier to Downstream Migrants:* Slow water velocity and long, convoluted reservoir shoreline. Populations of native northern pikeminnow and introduced largemouth bass. High rates of injury and mortality for steelhead captured in bypass evaluator.<br><br>*Fallback at Green Peter Dam:* Adult spring Chinook and winter steelhead released in the forebay of Green Peter sometimes fall back down to the tailrace via turbines (and possibly through the spillway). Surviving fallback had to move upstream through the fish passage facility a second time, increasing the likelihood of injury.<br><br>*Predation as a Barrier to Reservoir Migration:* Foster/Green Peter reservoirs support native northern pikeminnow. Green Peter supports a population of nonnative largemouth bass. | A feasibility study funded by the Action Agencies will determine how best to restore connectivity (fish access) to productive habitat located above Green Peter and if feasible, will pursue development of this capability. This will include consideration of adult upstream (e.g., capture and transport) and juvenile downstream (e.g., via turbine or bypass system) fish passage components.<br><br>Maintaining access through transport of spring Chinook and winter steelhead above Foster will continue to contribute an unknown number of naturally produced adults to the local South Santiam River population. Outplanting of spring Chinook and winter steelhead into habitat above Green Peter, if feasible, would provide an additional unknown number of naturally produced fish to the local population. These fish will be reproduced in areas where the presence (and potential influence) of hatchery strays can be controlled, providing a natural production sanctuary. RM&E will determine the survival of juveniles passing below Foster. RM&E also will be used to document the success of restoring natural production above Green Peter, if feasible.<br><br>The Action Agencies will update the fish capture and handling facility at Foster Dam to be in compliance with NMFS standards. This will greatly enhance the safe handling of ESA-listed fish. | Local population survival and productivity should increase to an unknown, but relatively small, extent as a direct result of improved adult fish handling capability at the Foster fish capture and handling facility. Aid in maintaining local population abundance and productivity, spatial distribution, and genetic diversity will be achieved as a result of continuing to provide access to habitat located above Foster Dam. These viability characteristics have the potential to substantially increase as a result of successfully re-establishing a self-sustaining, naturally produced population of spring Chinook and winter steelhead in habitat located upstream of Green Peter Dam. Biological research will focus on maximizing pre-spawner survival rates and on establishing effective juvenile fish passage to below Foster Dam. Biological monitoring will document progress toward improving overall productivity of the local population. |

| PCEs | Pathway | Indicator | South Santiam Baseline Condition | Effects of the Revised Proposed Action | Effects on VSP Parameters |
|---|---|---|---|---|---|
| Freshwater spawning sites | Habitat elements | Substrate | Substrate has coarsened downstream of Foster Dam.<br><br>River channel downstream of Foster Dam may be downcutting.<br><br>Channel downstream of Foster Dam could lack spawning gravel.<br><br>Many areas scoured to bedrock.<br><br>Current sediment budget not creating and maintaining side channel and gravel bar habitat needed by anadromous salmonids. | Under the revised proposed action, a study will be performed to develop an effective plan for gravel monitoring and augmentation to maintain current gravel levels in the area below the Green Peter/Foster dam complex. | No effect. |
| Freshwater rearing sites<br>Freshwater migration corridors | Habitat elements | Large woody debris (LWD) | *In Tributaries and Upper South Santiam Mainstem:* Large wood is lacking in most small tributaries and the upper South Santiam; very few reaches meet the ODFW benchmarks. Future recruitment potential for large wood is low along the lower portions of surveyed streams, but relatively high in upper reaches.<br><br>*In the Mainstem South Santiam River:* Reaches of the South Santiam River below Green Peter and Foster dams are deprived of large wood. Inadequate recruitment of large wood from riparian areas along mainstem South Santiam and tributaries downstream from Foster Dam. Lack of large wood-associated habitat for anadromous salmonids and invertebrates upon which they feed. | Under the revised proposed action, a study will be performed to develop an effective plan for stockpiling LWD, which will then be made available to the USFS or others for use where appropriate in maintaining habitat complexity in the stream channel above or below the Green Peter/Foster dam complex. | No change in effect. |
| Freshwater rearing sites<br>Freshwater migration corridors | Habitat elements | Pool frequency and quality | Pool frequency and quality in the South Santiam below Green Peter/Foster is fair. | No effect. | No effect. |

| PCEs | Pathway | Indicator | South Santiam Baseline Condition | Effects of the Revised Proposed Action | Effects on VSP Parameters |
|---|---|---|---|---|---|
| Freshwater spawning sites<br>Freshwater rearing<br>Freshwater migration corridors | Habitat elements | Off-channel habitat | Floodplain is not frequently inundated, with less overbank flow and side channel connectivity. | Flow management measures under the revised proposed action may improve the condition of habitat. Experimentation with pulsed flows and a hydrogeomorphic study will increase understanding and options for providing flows that protect and rejuvenate fish spawning and rearing habitat. Because specific improvements cannot be described at this time, the Action Agencies make a conservative assumption that the revised proposed action will not appreciably change habitat conditions. | No effect. |
| Freshwater spawning sites<br>Freshwater rearing | Channel conditions and dynamics | Width/depth ratio | Channel forming processes in the South Santiam River downstream of the Green Peter/Foster dam complex have been restricted by changes to the natural hydrograph and by reductions in sediment load and LWD derived from areas located above the dams. Flow regulation, fractionation of the sediment load passed to below the dams, and accumulation of fine sediment fractions below Foster Dam have resulted in bank and substrate armoring (i.e., compaction and stabilization) and in habitat simplification. | Reduction in peak flows below Green Peter/Foster will continue to limit pool formation and habitat rejuvenation downstream of the dams. However, the Action Agencies will undertake a study to develop an effective plan for providing stockpiled LWD for projects approved by the Services involving placement of LWD. Such projects can create pools and improve habitat diversity. Conservatively, the Action Agencies assume the revised proposed action will not degrade pool quality or habitat complexity, and will not appreciably enhance pool quality or habitat complexity by placement of LWD. | No effect. |

| PCEs | Pathway | Indicator | South Santiam Baseline Condition | Effects of the Revised Proposed Action | Effects on VSP Parameters |
|---|---|---|---|---|---|
| Freshwater spawning sites<br>Freshwater rearing<br>Freshwater migration corridors | Channel conditions and dynamics | Streambank condition | Streambanks do not support natural floodplain function in the lower South Santiam River downstream of the Green Peter/Foster dam complex. | Experimentation with various flow rates (e.g., pulsed flows) will be pursued under RM&E efforts and may help restore more normative ecosystem function with regard to the interplay between channel, streambank, and floodplain conditions. Implementing flow management measures may help restore more normative ecosystem function. Habitat enhancement funds may be used to improve streambank condition. Because specific improvements cannot be described at this time, the Action Agencies make a conservative assumption that the revised proposed action will not appreciably change streambank conditions. | No effect. |
| Freshwater rearing<br>Freshwater migration corridors | Channel conditions and dynamics | Floodplain connectivity | Floodplain is not frequently inundated, with less over-bank flow and side channel connectivity.<br><br>Reduced nutrient exchange, reduced sediment exchange, reduced flood refugia for fish, and reduced establishment of new riparian forests.<br><br>Lower South Santiam is confined primarily to a single main channel.<br><br>While no quantitative data are available, the South Santiam likely contains fewer off-channel habitats, simplified mainstem habitat, and few new gravel bars or side channels. | Implementation of flow management measures may help restore more normative ecosystem function. Habitat enhancement funds may be used to improve off-channel habitat by removing impediments to flow and by softening bank stabilization applications. Because specific improvements cannot be described at this time, the Action Agencies make a conservative assumption that the revised proposed action will not appreciably change floodplain connectivity. | No effect. |

| PCEs | Pathway | Indicator | South Santiam Baseline Condition | Effects of the Revised Proposed Action | Effects on VSP Parameters |
|---|---|---|---|---|---|
| Freshwater spawning sites<br>Freshwater rearing<br>Freshwater migration corridors | Water quantity (flow/hydrology) | Change in peak/base flow | Increased fall flows may allow spring Chinook to spawn in areas that will be dewatered during active flood control operations.<br><br>Winter and spring flow reductions may reduce rearing area and the survival of steelhead fry.<br><br>Increased summer flows may increase rearing area and the heat capacity of the stream.<br><br>Low summer flows in specific reaches (due to diversions) may reduce the juvenile rearing habitat area, block adult passage to upstream spawning areas, and decrease the heat capacity of the stream.<br><br>Flow fluctuations now occur at rates rapid enough to entrap and strand juvenile anadromous fish.<br><br>Frequency of channel-forming flows not of sufficient magnitude to create and maintain channel complexity and provide nutrient, organic matter, and sediment inputs from floodplain areas. | Under the revised proposed action, the hydrology in the South Santiam River will continue to be affected. However, the Action Agencies will evaluate the site-specific biological effects of current flow rates and experiment with managed variation in flow rates (e.g., pulsed flows) under flow studies included as part of the revised proposed action. Flow pulses may help to restore more normative ecosystem function with regard to the interplay between channel, streambank, and floodplain conditions. However, high flow rates equal to the pre-dam 2-year recurrence interval of 37,900 cfs (as measured at Waterloo, 14 miles downstream of Foster Dam) will remain highly unlikely even in very wet years. The maximum recorded flow since construction of Green Peter/Foster in 1968 has been 29,300 cfs with a 2-year frequency event of only 15,800 cfs (base flow of about 800 cfs).<br><br>Down ramping will be limited to 200 cfs per hour below Foster and ramping will be performed (whenever possible) only during hours of darkness (1 hour after sunset/1 hour before sunrise) from January 1 through March 31 in order to minimize the potential for juvenile stranding. The Action Agencies will implement fish stranding and macroinvertebrate displacement studies and identify additional protective ramping measures, if needed and feasible. | Improved ramping rates and flow conditions below Foster Dam will reduce risks to ESA-listed fish species. The improved ramping and flow conditions could result in improved ecosystem health and function, expanded rearing habitat, higher egg-to-smolt survival, improved migration conditions, and improved overall productivity. As a result, local population abundance also may increase. Biological monitoring will document changes in local habitat conditions and in local population productivity resulting from a combination of Action Agency actions. |

| PCEs | Pathway | Indicator | South Santiam Baseline Condition | Effects of the Revised Proposed Action | Effects on VSP Parameters |
|---|---|---|---|---|---|
| Freshwater spawning sites<br>Freshwater rearing<br>Freshwater migration corridors | Watershed conditions | Road density and location | Moderate to high road densities exist in the South Santiam watershed above and below Green Peter/Foster. These roads are managed by Oregon Dept. Transportation and the USFS; corrective measures are not included as a part of the revised proposed action. | No change. | No effect. |
| Freshwater spawning sites<br>Freshwater rearing<br>Freshwater migration corridors | Watershed conditions | Disturbance history | Some forests in the upper watershed are dominated by early- to mid-successional stages, but up to 39% of the Middle Santiam and 43% of the Quartzville drainages contain late-successional forests. Disturbance regime is dominated by timber harvesting, which can increase sediment delivery to streams, while decreasing large wood input. Upper watershed is predominantly forested. Lower watershed contains extensive agricultural, urban, rural, and residential development. | The revised proposed action will not change the disturbance regime conditions. | No effect. |
| Freshwater spawning sites<br>Freshwater rearing<br>Freshwater migration corridors | Watershed conditions | Riparian reserves | *Headwater Forests Riparian Conditions:*<br>Riparian areas in upper watershed tributaries dominated by late-successional vegetation on federal land and early-successional vegetation on private lands. Width and continuity of riparian areas are good along Thomas and Crabtree creeks in the lower South Santiam subbasin, but almost all vegetation is less than 80 years old. Riparian areas in many tributaries do not provide adequate shading or large wood recruitment.<br><br>*Floodplain Forest Riparian Conditions:*<br>Low large wood recruitment potential because less than 30% of the riparian forest along the mainstem South Santiam river is greater than 30 meters wide and many remaining patches of floodplain forest are interspersed with pasture land. | No effect. | No effect. |

In summary, corrective actions proposed by the Action Agencies in the South Santiam subbasin have the potential to increase UWR spring Chinook and winter steelhead abundance, productivity, spatial distribution, and genetic diversity. These VSP parameters may improve in response to more normalized water temperature conditions downstream of the Green Peter/Foster dam complex, increased habitat complexity above or below the Green Peter/Foster dam complex resulting from placement of LWD, improved ecosystem function and fish survival resulting from enhanced flow conditions downstream of Foster Dam, reestablishing natural production in historic habitat located above Green Peter Dam, and increased levels of marine derived nutrients in habitat located upstream of Green Peter Reservoir. The implementation of major structural components of the revised proposed action depends upon the outcome of associated feasibility studies and subsequent project authorization and funding.

### 6.1.3. Effects of the Willamette Project Revised Proposed Action on UWR Spring Chinook Populations and Critical Habitat in the McKenzie River Subbasin

The component of the Willamette Project revised proposed action evaluated in this section is the continuing operation of the USACE Cougar and Blue River dams and reservoirs on the South Fork McKenzie and Blue rivers, respectively, and on the mainstem McKenzie River downstream of its confluence with the South Fork. The South Fork McKenzie River above and below Cougar Dam, the Blue River below Blue River Dam, and the mainstem McKenzie River have been designated as critical habitat for UWR Chinook salmon. The PCEs identified in this portion of critical habitat include sites for spawning, rearing, and migration. Table 6-3 assesses the anticipated effects of the revised proposed action on PCEs and VSP parameters for spring Chinook salmon in the McKenzie River subbasin.

**Table 6-3. Effects of the Revised Proposed Action on Critical Habitat and Viability of Spring Chinook Salmon in the McKenzie River Subbasin**

| PCEs | Pathway | Indicator | McKenzie River Baseline Condition | Effects of the Revised Proposed Action | Effects on VSP Parameters |
|---|---|---|---|---|---|
| Freshwater spawning sites<br>Freshwater rearing<br>Freshwater migration corridors | Water quality | Temperature | Without WTC, cooler water temperatures in the late spring and summer impede upstream migration of spring Chinook salmon; warmer fall/winter temperatures accelerate egg incubation and fry emergence.<br><br>EWEB's Leaburg-Walterville project diverts flow into two power canals downstream of RM 38; water at lower ends of the two mainstem bypass reaches could increase by 2.7° and 3.6°F, respectively, due to diversions.<br><br>ODEQ 2002 CWA 303(d) database indicates that temperatures in South Fork below Cougar exceeded maxima for salmonid spawning, incubation, and emergence in summer and fall. ODEQ database indicates that temperatures in the lower 1.8 miles of Blue River have exceeded maxima for salmonid spawning, incubation, and emergence; core migration; and non-core rearing and adult and juvenile migration.<br><br>ODEQ database indicates that temperatures in mainstem McKenzie from RM 0-54.5 exceeded the maximum for spawning, incubation, and emergence.<br><br>ODEQ database indicates that temperatures in streams not affected by Willamette Project flow management (Deer Creek, Mohawk River and its tributaries) have exceeded maxima for core and non-core rearing, and adult/juvenile migration. | The new WTC tower at Cougar Dam is anticipated to substantially improve hatch and emergence timing and survival of naturally produced spring Chinook in the South Fork McKenzie River and in the mainstem McKenzie downstream of its confluence with the South Fork to Leaburg Dam. Ecosystem function related to macroinvertebrate production and the growth of other fish species are also likely to be improved. Physical (e.g., water quality) and biological monitoring will document habitat and production changes resulting from implementation of WTC in the McKenzie subbasin. | Population abundance and productivity will increase. Habitat quality of the natural production areas in the South Fork and mainstem McKenzie rivers from below Cougar Dam to above Leaburg Dam will improve. Both spawning activity and egg-to-fingerling survival are expected to increase, especially in the South Fork, resulting in improved spatial distribution. Biological monitoring will document realized changes. |

| PCEs | Pathway | Indicator | McKenzie River Baseline Condition | Effects of the Revised Proposed Action | Effects on VSP Parameters |
|---|---|---|---|---|---|
| Freshwater spawning sites<br>Freshwater rearing<br>Freshwater migration corridors | Water quality | Total suspended solids/turbidity | Release of turbid water during the spring 2002 drawdown of Cougar Reservoir for construction of the water temperature control tower resulted in elevated turbidity levels, including a maximum of 379 NTU (compared to background of 5 NTU).<br><br>After the turbidity event, higher proportions of fine sediments in gravel bars below Cougar Dam compared to reaches above the reservoir; clay enrichment decreased rapidly downstream; clouds of sediment stirred up while wading in the South Fork below Cougar Dam, and to some extent in the mainstem McKenzie. | The Cougar/Blue River projects will continue to trap high sediment loads resulting from storms in the upper watershed (a positive effect), but will continue to pass fine sediment below the dam while blocking movement of large particulate substrate (including spawning gravel) downstream. A study leading to a plan for gravel monitoring/augmentation, as needed, in the South Fork below Cougar Dam is expected to maintain current gravel levels. | No change in effect. |
| Freshwater spawning sites<br>Freshwater rearing<br>Freshwater migration corridors | Water quality | Chemical contamination/nutrients | ODEQ 2002 CWA 303(d) database does not indicate that any streams in the McKenzie subbasin are water quality limited due to toxics.<br><br>ODEQ 2002 CWA 303(d) database does not indicate that any streams in the McKenzie subbasin are water quality limited due to excess nutrients. | BMPs and spill prevention plans will be in place during any future construction activity associated with the Cougar and Blue River projects to avoid or minimize any potential contamination.<br><br>Continued outplanting of spring Chinook above Cougar Reservoir will aid in adding marine derived nutrients to that area. | Productivity above the Cougar Dam may increase to an unknown extent as a result of increased levels of marine derived nutrients. At this time, the Action Agencies make a conservative assumption of no effect from our activities. |
| Freshwater spawning sites<br>Freshwater rearing<br>Freshwater migration corridors | Water quality | Dissolved oxygen (DO) | ODEQ 2002 CWA 303(d) database indicates that the Mohawk River (RM 1.5) was water quality limited for dissolved oxygen from October 1 through May 31. | The revised proposed action will not alter DO conditions. | No effect. |
| Freshwater spawning sites<br>Freshwater rearing<br>Freshwater migration corridors | Water quality | Total dissolved gas (TDG) | TDG levels of 97.8% to 124.1% saturation near the base of Cougar Dam; 99.5% to 115.7% approximately 3,000 feet downstream; and 103.4% to 108.6% at a site 2.7 miles downstream during November (1970), when yolk sac fry may have been present.<br><br>TDG levels of 107.9% to 120.4% saturation in March (1971 and 1972) below Blue River Dam. | No effect. | No effect. |

| PCEs | Pathway | Indicator | McKenzie River Baseline Condition | Effects of the Revised Proposed Action | Effects on VSP Parameters |
|---|---|---|---|---|---|
| Freshwater migration corridors | Habitat access | Physical barriers | Adult passage and delay, up to 14.5% mortality of outmigrating smolts, and low flows in Leaburg and Walterville bypass reaches of lower mainstem; corrected during 2002-2004 under terms of the new FERC license. Trail Bridge and Smith dams exclude spring Chinook salmon (~10 miles) from a portion of their historical range.<br><br>*Cougar as Barrier to Upstream Migrants.* Currently there is no upstream passage at Cougar Dam, which blocks over 37 miles of upstream historical habitat. The USACE has proposed to construct a permanent trap-and-haul facility to provide upstream passage.<br><br>*Cougar as Barrier to Downstream Migrants.* Cougar Dam was built with juvenile fish passage facilities; juveniles entered through one of five fish horns on the upstream face of intake tower. Fish horns collected only a low percent of juvenile Chinook in the reservoir; many of those were injured or killed. For hatchery-reared fingerling Chinook released into Cougar Reservoir in 1963-2002, survival was 67.4% through the regulating outlet and 93% through the turbines; survival decreased with increasing fish size.<br><br>*Blue as Barrier to Migration.* Blue River Dam blocks access to 2.7 miles of historical habitat below a falls that was probably a natural historical barrier at low flows. | Outplanting of spring Chinook salmon above Cougar Dam will contribute an unknown additional number of naturally produced adults to the local McKenzie River population. These fish will reproduce in an area where presence (and potential influence) of hatchery strays can be controlled. | Population abundance and productivity, and spatial distribution, have the potential to substantially increase as a result of successfully reestablishing a self-sustaining, naturally produced population of spring Chinook salmon in habitat located upstream of Cougar Dam. Biological research will focus on maximizing pre-spawner survival rates and on establishing effective juvenile fish passage to below Cougar Dam. Biological monitoring will document progress toward improving overall productivity. |
| Freshwater spawning sites | Habitat elements | Substrate | Substrate has coarsened in the mainstem McKenzie downstream of Cougar and Blue River dams.<br><br>South Fork McKenzie River downstream of Cougar Reservoir has stabilized.<br><br>Channel downstream of USACE dams could lack spawning gravel.<br><br>Current sediment budget not creating and maintaining habitat needed by anadromous salmonids. | Under the revised proposed action, a study will be performed to develop an effective plan for gravel monitoring/augmentation to maintain current gravel levels in the area below Cougar Dam. | No effect. |

| PCEs | Pathway | Indicator | McKenzie River Baseline Condition | Effects of the Revised Proposed Action | Effects on VSP Parameters |
|---|---|---|---|---|---|
| Freshwater rearing sites<br>Freshwater migration corridors | Habitat elements | Large woody debris (LWD) | *In Headwater Tributaries:* Large wood does not meet USFS targets in some tributaries (Lower Deer Creek, Quartz Creek, Mohawk River, the South Fork and some of its tributaries). Large wood meets USFS targets in some tributaries (North Fork Quartz Creek, Lookout Creek, some South Fork tributaries). Some tributaries, such as Horse Creek, have high recruitment potential. Some restoration efforts are underway in the McKenzie subbasin.<br><br>*In the mainstem McKenzie River:* The upper McKenzie River below EWEB's Trailbridge Dam is deprived of large wood, although some restoration efforts have begun. The South Fork McKenzie below Cougar and Blue River below Blue River Dam are deprived of large wood from the headwaters. The McKenzie River below Cougar and Blue River dams is deprived of large wood from the South Fork and Blue River. Inadequate recruitment of large wood from riparian areas along mainstem McKenzie and tributaries downstream from Cougar and Blue River dams. Lack of large wood-associated habitat for anadromous salmonids and invertebrates upon which they feed. | Under the revised proposed action, a study will be performed to develop an effective plan for stockpiling LWD, which will then be made available to the USFS or others for use where appropriate in maintaining habitat complexity in the stream channel below Cougar Dam. | Improved channel complexity could result in expanded rearing habitat, higher egg-to-smolt survival, and improved overall productivity. Biological monitoring will document changes in local habitat conditions and in local population productivity resulting from a combination of Action Agency actions. |
| Freshwater rearing sites<br>Freshwater migration corridors | Habitat elements | Pool frequency and quality | Pool frequency and quality in the South Fork McKenzie below Cougar Dam is fair to good due to the presence of pool forming elements such as riparian forests and LWD. The 1.7 miles of Blue River located below Blue River Dam will continue to have minimal production capacity. | No effect. | No effect. |

| PCEs | Pathway | Indicator | McKenzie River Baseline Condition | Effects of the Revised Proposed Action | Effects on VSP Parameters |
|---|---|---|---|---|---|
| Freshwater spawning sites<br>Freshwater rearing<br>Freshwater migration corridors | Habitat elements | Off-channel habitat | The South Fork McKenzie below Cougar Dam has stabilized and lost side channels. The mainstem McKenzie below the Deerhorn Park lost 53% of its islands, and many side channels have filled in and become alcoves. The McKenzie prior to dam construction migrated frequently, and has since stabilized. The lower McKenzie is simplified and channelized. | Flow management measures under the revised proposed action may improve the condition of habitat. Because specific improvements cannot be described at this time, the Action Agencies make a conservative assumption that the revised proposed action will not appreciably change habitat conditions. | No effect. |
| Freshwater spawning sites<br>Freshwater rearing | Channel conditions and dynamics | Width/depth ratio | Channel forming processes in the lower South Fork McKenzie and Blue rivers have been restricted by changes to the natural hydrograph and by reductions in sediment load and LWD derived from above the dams. Flow regulation, fractionation of the sediment load passing through the reservoirs, and accumulation of fine sediment fractions below the dams have resulted in bank and substrate armoring (i.e., stabilization) and in habitat simplification. | Reduction in peak flows below Cougar and Blue River dams will continue to limit pool formation and habitat rejuvenation downstream of the dams in the South Fork McKenzie and Blue River, respectively. However, the Action Agencies will undertake a study to develop an effective plan for providing stockpiled LWD for projects approved by the Services involving placement of LWD. Such projects can create pools and improve habitat diversity. Conservatively, the Action Agencies assume the revised proposed action will not degrade pool quality or habitat complexity, and will not appreciably enhance pool quality or habitat complexity by placement of LWD. | No effect. |
| Freshwater spawning sites<br>Freshwater rearing<br>Freshwater migration corridors | Channel conditions and dynamics | Streambank condition | Streambanks do not support natural floodplain function in the lower South Fork McKenzie downstream of Cougar Dam. Experimentation with various flow rates (e.g., pulsed flows) will be pursued under RM&E efforts and may help to restore more normative ecosystem function with regard to the interplay between channel, streambank, and floodplain conditions in the lower South Fork McKenzie. | Implementing flow management measures may help restore more normative ecosystem function. Habitat enhancement funds may be used to improve streambank condition. Because specific improvements cannot be described at this time, the Action Agencies make a conservative assumption that the revised proposed action will not appreciably change streambank conditions. | No effect. |

| PCEs | Pathway | Indicator | McKenzie River Baseline Condition | Effects of the Revised Proposed Action | Effects on VSP Parameters |
|---|---|---|---|---|---|
| Freshwater rearing<br>Freshwater migration corridors | Channel conditions and dynamics | Floodplain connectivity | Floodplain is not frequently inundated, with less overbank flow and side-channel connectivity.<br><br>Reduced nutrient exchange, reduced sediment exchange, reduced flood refugia for fish, and reduced establishment of new riparian forests. | Implementation of flow management measures may help restore more normative ecosystem function. Habitat enhancement funds may be used to improve off-channel habitat by removing impediments to flow. Because specific improvements cannot be described at this time, the Action Agencies make a conservative assumption that the revised proposed action will not appreciably change floodplain connectivity. | No effect. |
| Freshwater spawning sites<br>Freshwater rearing<br>Freshwater migration corridors | Water quantity (flow/hydrology) | Change in peak/base flow | Frequency of flows in the South Fork McKenzie, Blue River, and lower McKenzie River not of sufficient magnitude to create and maintain channel complexity, and provide nutrient, organic matter, and sediment inputs from floodplain areas.<br><br>Flow fluctuations now occur at rates rapid enough to entrap and strand juvenile anadromous fish.<br><br>Increased fall flows may allow spring Chinook to spawn in areas that will be dewatered during active flood control operations.<br><br>Winter and spring flow reductions may reduce rearing area and the survival of steelhead fry.<br><br>Increased summer flows may increase rearing area and the heat capacity of the stream.<br><br>Low summer flows in specific reaches (due to diversions) may reduce juvenile rearing habitat area, block adult passage to upstream spawning areas, and decrease heat capacity of the stream. | Under the revised proposed action, the hydrology in Blue River, the South Fork McKenzie and the mainstem McKenzie will continue to be affected by seasonal reservoir drafting and refilling, flood management operations, peak flows that remain lower than natural flows, and augmented summer flow conditions. However, the Action Agencies will evaluate site-specific biological effects of current flow rates and experiment with managed variation in flow rates (e.g., pulsed flows) under flow studies included as part of the revised proposed action. Flow pulses may help to restore more normative ecosystem function with regard to the interplay between channel, streambank, and floodplain conditions. High flows in the South Fork greater than 3,000 cfs (base flow of approx. 400 cfs) will continue to occur infrequently, providing occasional channel forming flows during wet years.<br><br>Down ramping will be limited to 200 cfs per hour below Cougar and Blue River dams, and ramping will be performed (whenever possible) only during hours of darkness (1 hour after sunset and 1 hour before sunrise) from January 1 through March 31 in order to minimize the potential for juvenile spring Chinook stranding. The Action Agencies will implement fish stranding and macroinvertebrate displacement studies under the revised proposed action and identify additional ramping measures, if needed and feasible. | Improved ramping rates and flow conditions below Cougar Dam could result in improved ecosystem health and function, expanded rearing habitat, higher egg-to-smolt survival, improved migration conditions, and improved overall productivity. As a result, local population abundance may also increase. Biological monitoring will document changes in local habitat conditions and in local population productivity resulting from a combination of Action Agency actions. |

| PCEs | Pathway | Indicator | McKenzie River Baseline Condition | Effects of the Revised Proposed Action | Effects on VSP Parameters |
|---|---|---|---|---|---|
| Freshwater spawning sites<br>Freshwater rearing<br>Freshwater migration corridors | Watershed conditions | Road density and location | Moderate to low road densities exist in Blue River watershed and in South Fork McKenzie watershed above and below Cougar Dam. These roads are managed by the USFS; and corrective measures are not included as a part of the revised proposed action. | No change.<br><br>Moderate to low road densities exist in Blue River and South Fork McKenzie watersheds above and below USACE dams. These roads are managed by Oregon Dept. Transportation and the USFS; corrective measures are not included as a part of the revised proposed action. | No effect. |
| Freshwater spawning sites<br>Freshwater rearing<br>Freshwater migration corridors | Watershed conditions | Disturbance history | Disturbance regime is dominated by timber harvesting. Forests are dominated by early- to mid-successional stages, with some late-successional forests in wilderness areas in the Horse Creek and South Fork drainages. Timber harvesting has increased sediment delivery to streams, but decreased large wood input, resulting in degraded aquatic habitat.<br><br>Upper watershed is forested, but some is managed for timber production rather than ecosystem health. Lower watershed contains extensive agricultural, urban, and residential development. | The revised proposed action will not change the disturbance regime conditions. | No effect. |
| Freshwater spawning sites<br>Freshwater rearing<br>Freshwater migration corridors | Watershed conditions | Riparian reserves | *Headwater Forests Riparian Conditions:* Riparian areas in some tributaries contain mature riparian vegetation (e.g., Horse Creek and the South Fork McKenzie) but others (e.g., Quartz Creek, Mohawk River) are dominated by young alder or conifers. Many tributaries do not provide adequate shading or large wood recruitment. Riparian vegetation along confined reaches of the upper McKenzie River contains only 39% mature conifers.<br><br>*Floodplain Forest Riparian Conditions*: Many remaining patches of floodplain forest are interspersed with pastureland, highways, and residential development. Extent of floodplain vegetation restricted to a narrow band along river. Low large wood recruitment potential. | No effect. | No effect. |

In summary, corrective actions proposed by the Action Agencies in the McKenzie River subbasin have the potential to increase UWR spring Chinook salmon abundance, productivity, and spatial distribution. These VSP parameters are likely to improve as a result of more normalized water temperature conditions downstream of Cougar Dam, increased habitat complexity below Cougar Dam resulting from placement of LWD, improved ecosystem function and fish survival resulting from enhanced flow conditions downstream of Cougar and Blue River dams, reestablishing natural production in historic habitat located above Cougar Dam, and increased levels of marine derived nutrients in habitat located upstream of Cougar Reservoir. The implementation of major structural components of the revised proposed action depends upon the outcome of associated feasibility studies and subsequent project authorization and funding.

### 6.1.4. Effects of the Willamette Project Revised Proposed Action on UWR Spring Chinook Populations and Critical Habitat in the Middle Fork Willamette Subbasin

The component of the Willamette Project revised proposed action evaluated in this section is the continuing operation of USACE Hills Creek, Lookout Point, and Dexter dams and reservoirs on the Middle Fork Willamette River and Fall Creek Dam and Reservoir on Fall Creek. The Middle Fork Willamette downstream of Hills Creek, Lookout Point, and Dexter dams, as well as Fall Creek downstream of Fall Creek Dam, have been designated as critical habitat for UWR Chinook salmon. The PCEs identified in critical habitat include sites for spawning, rearing, and migration. Table 6-4 assesses the anticipated effects of the revised proposed action on PCEs and VSP parameters for spring Chinook and winter steelhead in the Middle Fork Willamette subbasin.

**Table 6-4. Effects of the Revised Proposed Action on Critical Habitat and Viability of Spring Chinook in the Middle Fork Willamette Subbasin**

| PCEs | Pathway | Indicator | Middle Fork Baseline Condition | Effects of the Revised Proposed Action | Effects on VSP Parameters |
|---|---|---|---|---|---|
| Freshwater spawning sites<br>Freshwater rearing<br>Freshwater migration corridors | Water quality | Temperature | Spring and summer releases from Hills Creek Dam are cooler than inflow; winter releases are warmer than inflow.<br><br>ODEQ 2002 CWA 303(d) database indicates exceedences of summer maxima for core rearing (61°F) and non-core rearing and adult and juvenile migration (64°F) in the Middle Fork Willamette below Dexter Dam and in Fall Creek below Fall Creek Dam.<br><br>ODEQ 2002 CWA 303(d) database indicates exceedences of summer maxima for core rearing (61°F) and non-core rearing and adult and juvenile migration (64°F) in the upper Middle Fork Willamette above Hills Creek Reservoir; Salt Creek; the North Fork of the Middle Fork Willamette; Lost Creek; Fall Creek above Fall Creek Dam; and other streams that are not affected by Willamette Project flow management.<br><br>Because the water is too cold, releases from Hills Creek Dam do not meet the minimum threshold for upstream migration (52°F) until early September. | The feasibility of constructing WTC at USACE projects in the Middle Fork subbasin will be assessed. If feasible and authorization & funding is obtained, implementing WTC at one or more of the projects would improve hatch and emergence timing and probably survival of naturally produced spring Chinook. Ecosystem function related to macro-invertebrate production and the growth of other fish species also would improve. The Action Agencies assume no benefit from this action at present because feasibility and funding are uncertain. | Initially, no change in effect. If and when WTC capability is developed and implemented, population abundance and productivity would increase. Habitat quality in the natural production areas below the dam would improve. Spawning activity and egg-to-fingerling survival is expected to increase resulting in the potential for improved abundance and productivity. Biological monitoring would document realized changes. |

| PCEs | Pathway | Indicator | Middle Fork Baseline Condition | Effects of the Revised Proposed Action | Effects on VSP Parameters |
|---|---|---|---|---|---|
| Freshwater spawning sites<br>Freshwater rearing<br>Freshwater migration corridors | Water quality | Total suspended solids/turbidity | ODEQ 2002 CWA 303(d) database does not report any streams as water quality limited due to turbidity. | The revised proposed action will not alter this condition. USACE dams in the Middle Fork will continue to trap high sediment loads resulting from storms occurring in the upper watershed and pass fine sediment downstream of the dams. | No change in effect. |
| Freshwater spawning sites<br>Freshwater rearing<br>Freshwater migration corridors | Water quality | Chemical contamination/nutrients | ODEQ 2002 CWA 303(d) database does not indicate that any streams were water quality limited due to excess nutrients.<br><br>Rotenone applied above Fall Creek Dam just before impoundment.<br><br>ODEQ 2002 CWA 303(d) database does not report any streams as water quality limited due to toxics. | The revised proposed action will not alter this condition. BMPs and spill prevention plans will be in place during any future construction activity associated with USACE projects in the Middle Fork to avoid or minimize any potential contamination.<br><br>Continued outplanting of spring Chinook above Hills Creek, Lookout Point, and/or Fall Creek reservoirs will aid in adding marine derived nutrients to these areas. | No effect. |
| Freshwater spawning sites<br>Freshwater rearing<br>Freshwater migration corridors | Water quality | Dissolved oxygen (DO) | ODEQ 2002 CWA 303(d) database indicates that Lost Creek was water quality limited for dissolved oxygen year-round. | The revised proposed action will not alter DO conditions. | No effect. |
| Freshwater spawning sites<br>Freshwater rearing<br>Freshwater migration corridors | Water quality | Total dissolved gas (TDG) | TDG measurements up to 125.5% of saturation within 0.3 miles below Dexter Dam and up to 112.5% at sites 2.3 and 4.6 miles downstream. | The revised proposed action will not alter this condition. | No effect. |

| PCEs | Pathway | Indicator | Middle Fork Baseline Condition | Effects of the Revised Proposed Action | Effects on VSP Parameters |
|---|---|---|---|---|---|
| Freshwater migration corridors | Habitat access | Physical barriers | *Barriers Below Dexter/Fall Creek Dams:* Eugene Canal Dam, an 8-foot high, laddered cement barrier that stretched 400-500 feet across the entire stream and diverted 200-300 cfs that reentered the Willamette below Eugene. Canal to Springfield or mill pond, located 2.5 miles above confluence with Coast Fork.<br><br>*Barriers between Lookout Point Reservoir and Hills Creek Dam:* Hatchery rack above Oakridge in the early part of the 20th century blocked nearly all adult spring Chinook; later moved to mouth of Salmon Creek where it diverted all returning adults to Salmon Creek Hatchery. Inefficient fish ladder at the Westfir Lumber Mill Dam completely blocked migration 1.3 miles above mouth of North Fork of the Middle Fork; breached in 1995.<br><br>*Fall Creek Dam as a Barrier to Upstream Migration:* Most adult spring Chinook salmon and some introduced winter steelhead trapped at Fall Creek Dam were trucked to McKenzie and other hatcheries; some released at a site two miles above head of reservoir. Since 1998, all spring Chinook salmon returning to the collection facility have been released above the dam. Upstream migrants could experience abrasion, mechanical injury, stress, migration delay, disease, and low DO levels in the trapping and transport facilities. 77 (incl. 27 unmarked) spring Chinook found dead at release site in August 2002 when large run overwhelmed the collection facility, leading to delay; USACE has taken corrective action.<br><br>*Fall Creek Dam as a Barrier to Downstream Migration:* Fish horn apertures on the upstream face of the dam were ineffective. Chinook smolt recoveries never exceeded 15.6% and winter steelhead emigrated at even lower rates. USACE passed smolts by draining the reservoir in the fall; 19 to 29% juvenile Chinook survival under this condition compared with 32% through the (mothballed) fish horn system (where most of the survivors had severe head and eye abrasions).<br><br>*Dexter and Lookout Point Dams as Barriers to Migration:* Neither project built with fish passage facilities. Upstream migrants trapped at Dexter are trucked to the Willamette Hatchery near Oakridge for spawning. ODFW began releasing adult spring Chinook into the North Fork of the Middle Fork Willamette in 1999 and 2002 and into Salt Creek in 2001. The ODFW released Chinook fingerlings into the reservoir to augment recreational trout fishery; 88% survival through turbines at Lookout Point. Survival through the Kaplan turbines at Dexter unknown (may be similar to Foster Dam, 92%).<br><br>*Hills Creek Dam as Barrier to Migration:* Hills Creek was built without fish passage facilities. ODFW began releasing adult spring Chinook above Hills Creek in 1993 and has occasionally released hatchery-reared Chinook fingerlings into the reservoir. 41% survival of juvenile Chinook through turbines; 68% through regulating outlet. | The revised proposed action will not alter this condition. USACE will continue to cooperate with ODFW in outplanting adult spring Chinook above Lookout Point, Fall Creek, and Hills Creek dams, which will continue to contribute an unknown (but presumably low) number of naturally produced adults to the local Middle Fork Willamette River population. Downstream fish passage may improve the current program. | Population abundance and productivity, and spatial distribution, have the potential to substantially increase as a result of successfully re-establishing a self-sustaining, naturally produced population of spring Chinook salmon in habitat located upstream of Dexter, Lookout Point, Fall Creek, and Hills Creek dams. |

| PCEs | Pathway | Indicator | Middle Fork Baseline Condition | Effects of the Revised Proposed Action | Effects on VSP Parameters |
|---|---|---|---|---|---|
| Freshwater spawning sites | Habitat elements | Substrate | Substrate has coarsened in the Middle Fork downstream of Dexter Dam. Channel downstream of USACE dams could lack spawning gravel. USACE reservoirs block sediment into the lower Middle Fork from 90% of the Middle Fork subbasin. Current sediment budget not creating and maintaining habitat needed by anadromous salmonids downstream of Dexter Dam. | Under the revised proposed action, a study will be performed to develop an effective plan for gravel monitoring and augmentation to maintain current gravel levels in the area below USACE dams. | No effect. |
| Freshwater rearing sites<br>Freshwater migration corridors | Habitat elements | Large woody debris (LWD) | *In Tributaries and Upper Middle Fork Mainstem:* Large wood does not meet USFS targets in most low-gradient upper Middle Fork tributaries, most of the North Fork Middle Fork drainage, Salmon Creek, Hills Creek, and the mainstem Fall Creek). Some large wood restoration efforts are underway in the upper subbasin (Salt Creek, Fall Creek).<br><br>*In the Mainstem Middle Fork:* Large wood into the lower Middle Fork Willamette River is blocked from 90% of the subbasin. The lower Middle Fork probably lacks large wood downstream of Dexter Dam. | Under the revised proposed action, a study will be performed to develop an effective plan for stockpiling LWD, which will then be made available to the USFS or others for use where appropriate in maintaining habitat complexity in the stream channel above or below USACE dams. | No effect. |
| Freshwater rearing sites<br>Freshwater migration corridors | Habitat elements | Pool frequency and quality | Pool frequency and quality in the Middle Fork Willamette below Dexter Dam is poor. There is less than one large holding pool per mile in the Middle Fork Willamette from Dexter Dam to Jasper Bridge. | The revised proposed action will not alter this condition. | No effect. |

| PCEs | Pathway | Indicator | Middle Fork Baseline Condition | Effects of the Revised Proposed Action | Effects on VSP Parameters |
|---|---|---|---|---|---|
| Freshwater spawning sites<br>Freshwater rearing<br>Freshwater migration corridors | Habitat elements | Off-channel habitat | Middle Fork Willamette River between Lookout Point and Hills Creek Dam is confined primarily to a single channel. Gravel bar surface area has decreased by 65% below Lookout Point Dam. 50% of lower 8 miles of the Middle Fork are protected by revetments. | Flow management measures under the revised proposed action may improve the condition of habitat. Because specific improvements cannot be described at this time, the Action Agencies make a conservative assumption that the revised proposed action will not appreciably change habitat conditions. | No effect. |
| Freshwater spawning sites<br>Freshwater rearing | Channel conditions and dynamics | Width/depth ratio | Channel forming processes in the Middle Fork Willamette below Dexter Dam have been restricted by changes to the natural hydrograph and reductions in sediment load and LWD. Dykaar (2005) noted the almost complete loss of first order avulsions in the post-dam era. | Reduction in peak flows in the Middle Fork Willamette below USACE dams and in Fall Creek below Fall Creek Dam will continue to limit channel forming processes/degrade channel conditions. However, the Action Agencies will undertake a study to develop an effective plan for providing stockpiled LWD for projects approved by the Services involving placement of LWD. Such projects can create pools and improve habitat diversity. Conservatively, the Action Agencies assume the revised proposed action will not degrade pool quality or habitat complexity, and will not appreciably enhance pool quality or habitat complexity by placement of LWD. | No effect. |

| PCEs | Pathway | Indicator | Middle Fork Baseline Condition | Effects of the Revised Proposed Action | Effects on VSP Parameters |
|---|---|---|---|---|---|
| Freshwater spawning sites<br>Freshwater rearing<br>Freshwater migration corridors | Channel conditions and dynamics | Streambank condition | Streambanks do not support natural floodplain function in the Middle Fork Willamette below Dexter Dam. | Implementing flow management measures may help restore more normative ecosystem function. Because specific improvements cannot be described at this time, the Action Agencies make a conservative assumption that the revised proposed action will not appreciably change streambank conditions. | No effect. |
| Freshwater rearing<br>Freshwater migration corridors | Channel conditions and dynamics | Floodplain connectivity | Floodplain is not frequently inundated, with less over-bank flow and side channel connectivity. Reduced nutrient exchange, reduced sediment exchange, reduced flood refugia for fish, and reduced establishment of new riparian forests. | Implementation of flow management measures may help restore more normative ecosystem function. If funded and implemented, habitat enhancement projects planned under GI studies, such as Willamette Floodplain Restoration and Eugene-Springfield Metro Waterways have the potential to improve off-channel habitat by removing impediments to flow and restoring normative ecosystem functions. Because specific improvements cannot be described at this time, the Action Agencies make a conservative assumption that the revised proposed action will not appreciably change floodplain connectivity. | No effect. |

| PCEs | Pathway | Indicator | Middle Fork Baseline Condition | Effects of the Revised Proposed Action | Effects on VSP Parameters |
|---|---|---|---|---|---|
| Freshwater spawning sites<br>Freshwater rearing<br>Freshwater migration corridors | Water quantity (flow/hydrology) | Change in peak/base flow | Frequency of channel-forming flows not of sufficient magnitude to create and maintain channel complexity and provide nutrients, organic matter, and sediment inputs from floodplain areas.<br><br>Increased fall flows may allow spring Chinook to spawn in areas that will be dewatered during active flood control operations.<br><br>Winter and spring flow reductions may have reduced rearing area and the survival of steelhead fry.<br><br>Increased summer flows may increase rearing area and the heat capacity of the stream.<br><br>Low summer flows in specific reaches (due to diversions) may reduce the juvenile rearing habitat area, block adult passage to upstream spawning areas, and decrease the heat capacity of the stream.<br><br>Flow fluctuations now occur at rates rapid enough to entrap and strand juvenile anadromous fish. | Under the revised proposed action, the hydrology in Fall Creek and the Middle Fork Willamette below USACE dams will continue to be affected by flood control operations, hydropower production, and seasonal reservoir filling and drafting. This will continue to result in reduced peak flows and augmented summer flows. However, the Action Agencies will evaluate the site-specific biological effects of current flow rates and experiment with managed variation in flow rates (e.g., pulsed flows) under flow studies included as part of the proposed action. Flow pulses may help to restore more normative ecosystem function.<br><br>Down ramping will be limited to 200 cfs per hour below USACE dams and ramping will be performed (whenever possible) only during hours of darkness (1 hour after sunset & 1 hour before sunrise) from January 1 through March 31 in order to minimize the potential for juvenile spring Chinook stranding. The Action Agencies will implement fish stranding and macroinvertebrate displacement studies and identify additional ramping measures, if needed and feasible. | Improved ramping rates and flow conditions in Fall Creek and Middle Fork Willamette could result in improved ecosystem health and function. Biological monitoring will document changes in local habitat conditions and in local population productivity resulting from a combination of Action Agency actions. |

| PCEs | Pathway | Indicator | Middle Fork Baseline Condition | Effects of the Revised Proposed Action | Effects on VSP Parameters |
|---|---|---|---|---|---|
| Freshwater spawning sites<br>Freshwater rearing<br>Freshwater migration corridors | Watershed conditions | Road density and location | High road densities exist in the Middle Fork Willamette watershed below Dexter Dam. | The revised proposed action will not alter this condition. High road densities exist in the Fall Creek and Middle Fork Willamette watersheds below USACE dams. These roads are managed by Oregon Dept. Transportation and USFS; corrective measures are not included as a part of revised proposed action. | No effect. |
| Freshwater spawning sites<br>Freshwater rearing<br>Freshwater migration corridors | Watershed conditions | Disturbance history | Disturbance regime is dominated by timber harvesting. Forests are dominated by early- to mid-successional stages, with few late-successional forests. Timber harvesting has increased sediment delivery to streams, but decreased large wood input, resulting in degraded aquatic habitat. Upper watershed is forested, but some is managed for timber production rather than ecosystem health. Lower watershed is mostly privately-owned, and while 65% of lower watershed is managed for timber production, the remainder consists of agricultural, urban, and residential development. | The revised proposed action will not change the disturbance regime conditions. | No effect. |
| Freshwater spawning sites<br>Freshwater rearing<br>Freshwater migration corridors | Watershed conditions | Riparian reserves | *Headwater Forests Riparian Conditions:*<br>Riparian areas in some tributaries contain mature riparian vegetation (e.g., small tributaries of Lookout Point, Fall Creek) but others (e.g., North Fork Middle Fork, Salt Creek, Little Fall Creek, and small tributaries of lower Middle Fork) are dominated by deciduous trees or conifers. Many tributaries do not provide adequate shading/large wood recruitment. Decreased extent of streamside riparian vegetation.<br><br>*Floodplain Forest Riparian Conditions:*<br>Many remaining patches of floodplain forest are interspersed with pastureland, highways, and residential development. Floodplain forests along lower river invaded by non-native species that hinder development of natural community. 74% of riparian forests along lower Middle Fork have low or medium large wood recruitment potential. Decreased surface area of gravel bars for potential young riparian stand recruitment. | The revised proposed action will not alter this condition. | No effect. |

In summary, corrective actions proposed by the Action Agencies in the Middle Fork Willamette subbasin have the potential to increase UWR spring Chinook salmon abundance, productivity, and spatial distribution. The VSP parameters that may improve as a result of more normalized water temperature conditions downstream of Hills Creek Dam and/or the Lookout Point/Dexter dam complex include increased habitat complexity below the Lookout Point/Dexter dam complex resulting from floodplain restoration and placement of LWD; improved ecosystem function and fish survival resulting from enhanced flow conditions downstream of Fall Creek Dam, Hills Creek Dam, and the Lookout Point/Dexter dam complex; expanding natural production and survival in habitat located upstream of Fall Creek Dam; reestablishing natural production in historic habitat located above Hills Creek Dam and/or the Lookout Point/Dexter dam complex; and increasing levels of marine derived nutrients in habitat located upstream of these dams and reservoirs. The implementation of major structural components of the revised proposed action depends upon the outcome of associated feasibility studies and subsequent project authorization and funding.

### 6.1.5. Effects of the Willamette Project Revised Proposed Action on UWR Spring Chinook Populations and Habitat in the Coast Fork Willamette Subbasin

The component of the Willamette Project revised proposed action evaluated in this section is the continuing operation of Cottage Grove and Dorena dams and reservoirs on the Row River, below Dorena Dam, and on the Coast Fork Willamette River downstream of the dams. The PCEs of functional habitat for fish present in the Coast Fork Willamette include sites for spawning, rearing, and migration. Table 6-5 assesses the anticipated effects of the revised proposed action on PCEs and VSP parameters for Chinook salmon in the subbasin.

**Table 6-5. Effects of the Revised Proposed Action on the Conservation Value of Habitat and Viability of Spring Chinook in the Coast Fork Willamette Subbasin**

| PCEs | Pathway | Indicator | Coast Fork Baseline Condition | Effects of the Revised Proposed Action | Effects on VSP Parameters |
|---|---|---|---|---|---|
| Freshwater spawning sites<br>Freshwater rearing<br>Freshwater migration corridors | Water quality | Temperature | The ODEQ 2002 CWA 303(d) database indicates exceedences of summer maximum temperatures for non-core rearing below Cottage Grove and Dorena dams.<br><br>Exceedences have also been reported in some unregulated reaches (i.e., not affected by Willamette Project flow management). | Water temperatures in the Row River downstream of Dorena Dam and in the Coast Fork Willamette below Cottage Grove Dam are cooler in the spring and summer and warmer in the fall and early winter than pre-dam conditions. Spring and summer temperatures result from thermal stratification in the reservoir and subsequent discharge from the hypolimnion. Fall and early winter temperatures result from the breakup of thermal stratification at reservoir turnover in the fall following storage of warm surface water in the epilimnion throughout the spring and summer. The revised proposed action will not alter this condition. | No change in effect. |
| Freshwater spawning sites<br>Freshwater rearing<br>Freshwater migration corridors | Water quality | Total suspended solids/turbidity | ODEQ's 2002 CWA 303(d) database does not report any streams as water quality limited due to excess turbidity. | Dorena and Cottage Grove reservoirs trap a portion of the suspended sediment load introduced by winter, spring, and summer runoff. Fractionation of the sediment load entering the reservoir results in retention of larger particulate fractions and concentration of fines in flows passed to below the dams. Accumulation of fine sediment fractions below the dams have contributed to bank and substrate armoring and to habitat simplification. The revised proposed action will not alter this condition. | No change in effect. |

| PCEs | Pathway | Indicator | Coast Fork Baseline Condition | Effects of the Revised Proposed Action | Effects on VSP Parameters |
|---|---|---|---|---|---|
| Freshwater spawning sites<br>Freshwater rearing<br>Freshwater migration corridors | Water quality | Chemical contamination/nutrients | The ODEQ's 2002 CWA 303(d) database lists the mainstem Coast Fork Willamette River from the mouth to RM 31.3 as impaired for anadromous fish passage due to mercury, which has been mined intensively in the Black Butte area in the upper drainage.<br><br>The ODEQ 2002 CWA 303(d) database does not indicate that any streams are water quality limited due to excess nutrients. | The revised proposed action will not alter this condition. | No effect |
| Freshwater spawning sites<br>Freshwater rearing<br>Freshwater migration corridors | Water quality | Dissolved oxygen (DO) | The ODEQ 2002 CWA 303(d) database indicates dissolved oxygen concentrations below the dynamic axial dispersion model's 7 standard for salmonid spawning from October 1 through May 31 in Camas Swale Creek, a tributary to the Coast Fork Willamette River near Cresswell (below Cottage Grove Dam). | The Willamette Project does not contribute to this issue; the revised proposed action will not alter this condition. | No effect |
| Freshwater spawning sites<br>Freshwater rearing<br>Freshwater migration corridors | Water quality | Total dissolved gas (TDG) | There is no data indicating that TDG concentrations exceed 110% saturation occur in areas used by ESA-listed fish species in the Coast Fork Willamette River subbasin. | The revised proposed action will not alter this condition. | No effect |
| Freshwater migration corridors | Habitat access | Physical barriers | No man-made barriers limit the viability of a demographically independent population. | Dorena Dam blocks upstream and downstream migration for all migratory fish species present in the Row River. Likewise, Cottage Grove Dam blocks upstream and downstream migration for all migratory fish species present in the Coast Fork Willamette River. The revised proposed action will not alter this condition. | No effect |

| PCEs | Pathway | Indicator | Coast Fork Baseline Condition | Effects of the Revised Proposed Action | Effects on VSP Parameters |
|---|---|---|---|---|---|
| Freshwater spawning sites | Habitat elements | Substrate | Substrate has probably coarsened downstream of Cottage Grove and Dorena dams.<br><br>River channel downstream of Cottage Grove and Dorena dams may be downcutting.<br><br>Current sediment budget not creating and maintaining habitat needed by anadromous salmonids. | Dorena and Cottage Grove dams block sediment (gravel and cobble) transport to the Row River and to the Coast Fork Willamette River, respectively, downstream of these dams. The revised proposed action will not alter this condition. | No change in effect. |
| Freshwater rearing sites<br>Freshwater migration corridors | Habitat elements | Large woody debris (LWD) | *In Headwater Tributaries:* Large wood is lacking in most small tributaries. Recruitment potential for large wood is low along most surveyed streams.<br><br>*Below Dams*: Reaches of the Row River and Coast Fork Willamette below Cottage Grove and Dorena dams, respectively, are probably deprived of large wood.<br><br>Riparian areas along mainstem Coast Fork and its tributaries downstream from Cottage Grove Dam, and along Row River downstream of Dorena Dam cannot produce and contribute adequate quantities of large wood to support effective ecosystem processes related to habitat complexity and rejuvenation, resulting in a lack of large wood-associated habitat needed for anadromous salmonid rearing and for invertebrate communities upon which they feed. | Dorena and Cottage Grove dams block the transport of LWD from current or future source areas located above the dams to the Row River and to the Coast Fork Willamette River downstream of these dams.<br><br>The USACE was actively involved in snag removal, riparian forest removal, channelization, and streambank armoring in the lower Coast Fork Willamette watershed during the twentieth century 20th Century. Flood damage reduction has contributed indirectly to the deforestation and development of downstream areas.<br><br>The revised proposed action will not alter this condition. | No effect |
| Freshwater rearing sites<br>Freshwater migration corridors | Habitat elements | Pool frequency and quality | Pool frequency and quality has been substantially reduced in the upper Willamette Basin in tributaries that have been heavily forested like the Coast Fork Willamette. Sedell and Everest (1991) compared the change in large pool areas that occurred from 1940 to 1990 in Willamette Basin watersheds "managed" for timber harvest as compared to those left "unmanaged" (i.e., wilderness areas). Managed forests experienced large losses in the proportion of pool habitat (e.g., Fall Creek -61%, South Fork McKenzie -82%). Only some streams remaining in unmanaged forests showed increases in the number of large pools. | The revised proposed action will not alter this condition. | No effect |

| PCEs | Pathway | Indicator | Coast Fork Baseline Condition | Effects of the Revised Proposed Action | Effects on VSP Parameters |
|---|---|---|---|---|---|
| Freshwater spawning sites<br>Freshwater rearing<br>Freshwater migration corridors | Habitat elements | Off-channel habitat | No quantitative data are currently available for the Row and Coast Fork Willamette rivers regarding off-channel habitat. Based on the findings of Sedell and Everest (1991), these streams likely have substantially less off-channel habitat, simplified mainstem habitat, and few new gravel bars or channel surfaces in comparison to pre-dam conditions. | The revised proposed action will not alter this condition. | No effect |
| Freshwater spawning sites<br>Freshwater rearing | Channel conditions and dynamics | Width/depth ratio | Channel forming processes in the Row River and in the Coast Fork Willamette downstream of Dorena and Cottage Grove dams, respectively, have been restricted by changes to their natural hydrographs and by reductions in their transportation of sediment load and LWD. Flow regulation, fractionation of the sediment load passed to below the dams, and accumulation of fine sediment fractions below Foster Dam have resulted in bank and substrate armoring (i.e., compaction and stabilization) and in habitat simplification. | Reduction in peak flows and blocked transport of sediment and large wood the Row River and in the Coast Fork Willamette River downstream of Dorena and Cottage Grove dams will continue to limit channel forming processes and habitat rejuvenation, or formation of new habitat. | No change in effect. |
| Freshwater spawning sites<br>Freshwater rearing<br>Freshwater migration corridors | Channel conditions and dynamics | Streambank condition | Streambanks do not support natural floodplain function in the Row River downstream of Dorena Dam or in the Coast Fork Willamette River downstream of Cottage Grove Dam. | Placement of riprap by the USACE to armor streambanks and stabilize them under high flow conditions resulted in loss of ecosystem function with respect to the dynamics of flow and channel forming processes. The revised proposed action will not alter this condition. | No change in effect. |

| PCEs | Pathway | Indicator | Coast Fork Baseline Condition | Effects of the Revised Proposed Action | Effects on VSP Parameters |
|---|---|---|---|---|---|
| Freshwater rearing<br>Freshwater migration corridors | Channel conditions and dynamics | Floodplain connectivity | Dorena and Cottage Grove dams have substantially decreased the magnitude and frequency of high flow events in the Row River and in the Coast Fork Willamette downstream of the dams. As a result, the floodplain is not frequently inundated by overbank flow and there is less side channel connectivity than occurred under pre-dam conditions. These factors result in reduced nutrient exchange, reduced sediment exchange, reduced areas of refuge for fish under high-flow conditions, and reduced opportunities for reestablishment of riparian forests. | Habitat enhancement, which may eventually be funded under the Willamette Floodplain Restoration Study, may improve off-channel habitat by removing impediments to flow and by softening bank stabilization applications. Because specific improvements cannot be described at this time, the Action Agencies make a conservative assumption that the revised proposed action will not appreciably change floodplain connectivity. | No effect |
| Freshwater spawning sites<br>Freshwater rearing<br>Freshwater migration corridors | Water quantity (flow/hydrology) | Change in peak/base flow | The frequency of flows with a channel-forming magnitude is insufficient to create and maintain channel complexity and to provide nutrients, organic matter, and sediment inputs from floodplain areas.<br><br>Increased summer flows may provide more rearing area for ESA-listed fish and may improve the heat capacity of the stream.<br><br>Low stream flow conditions are affected by water development and reservoir operations to a lesser extent in the Coast Fork Willamette River than in other Willamette subbasins.<br><br>Flow fluctuations below Dorena and Cottage Grove dams now occur at rates rapid enough to entrap and strand juvenile anadromous fish. | Changes in the natural flow hydrology in the Row River and in the Coast Fork Willamette River downstream of Dorena and Cottage Grove dams have resulted from flood control operations and seasonal reservoir filling and drafting. Flood control has substantially decreased the frequency of the pre-dam, 2-year channel forming flow events. Reservoir filling reduces outflow from the dams from February through May. Flows below the dams are augmented during the summer. Dam operations have also resulted in rapid decreases in stage that rarely occurred pre-dam except during or immediately after floods.<br><br>Under the revised proposed action, the hydrology in the Coast Fork Willamette below Dorena and Cottage Grove dams will continue to be affected by flood control operations and seasonal reservoir filling and drafting. This will continue to result in reduced peak flows and augmented summer flows. However, the Action Agencies will evaluate the site-specific biological effects of current flow rates and experiment with managed variation in flow rates (e.g., pulsed flows) under flow studies included as part of the revised proposed action. Flow pulses may help to restore more normative ecosystem function. Down ramping will be limited to 100 cfs per hour at Cottage Grove Dam and 200 cfs per hour (500 cfs maximum per day) at Dorena Dam. | Improved ramping rates and flow conditions in the Coast Fork Willamette River below the dams could result in improved ecosystem health and function. Biological monitoring will document changes in local habitat conditions resulting from a combination of Action Agency actions. |

| PCEs | Pathway | Indicator | Coast Fork Baseline Condition | Effects of the Revised Proposed Action | Effects on VSP Parameters |
|---|---|---|---|---|---|
| Freshwater spawning sites<br>Freshwater rearing<br>Freshwater migration corridors | Watershed conditions | Road density and location | The lower parts of the watershed contain extensive agricultural, urban, and residential development. Relatively high road densities exist in these parts of the watershed. | The revised proposed action will not alter this condition. | No effect |
| Freshwater spawning sites<br>Freshwater rearing<br>Freshwater migration corridors | Watershed conditions | Disturbance history | Disturbance regime is dominated by timber harvesting. About 97% of timber in the Row River drainage has been harvested, and 76% of the upper Coast Fork drainage has been harvested. Forests are dominated by early- to mid- successional stages with few late-successional forests. Timber harvesting has increased sediment delivery to streams, but decreased large wood input, resulting in degraded aquatic habitat. The upper parts of the watershed are forested, but most are managed for timber production rather than for healthy ecosystem function. | The revised proposed action will not alter this condition. | No effect |
| Freshwater spawning sites<br>Freshwater rearing<br>Freshwater migration corridors | Watershed conditions | Riparian reserves | *Headwater Forests Riparian Conditions:* Most riparian vegetation in the subbasin is less than 60 years old. The riparian conditions in many tributary areas do not provide adequate shading or large wood recruitment.<br><br>*Floodplain Forest Riparian Conditions:* Riparian areas in the lower watershed are constrained by Interstate 5. | The revised proposed action will not alter this condition. | No effect |

In summary, corrective actions proposed by the Action Agencies in the Coast Fork Willamette River Subbasin below Dorena and Cottage Grove dams have the potential to improve normative ecosystem functions and fish survival as a result of enhanced flow and habitat conditions downstream of the dams. The implementation of major structural components of the revised proposed action depends upon the outcome of associated feasibility studies and subsequent project authorization and funding.

### 6.1.6. Effects of the Willamette Project Revised Proposed Action on UWR Spring Chinook Populations and Habitat in the Long Tom River Subbasin

The component of the Willamette Project revised proposed action evaluated in this section is the continuing operation of USACE Fern Ridge Dam and Reservoir on the Long Tom River. The PCEs of functional habitat for fish in the Long Tom subbasin include sites for spawning, rearing, and migration. Table 6-6 assesses the anticipated effects of the revised proposed action on PCEs and VSP parameters for spring Chinook salmon in the subbasin.

**Table 6-6. Effects of the Revised Proposed Action on the Conservation Value of Habitat and Viability of Spring Chinook in the Long Tom Subbasin**

| PCEs | Pathway | Indicator | Long Tom Baseline Condition | Effects of the Revised Proposed Action | Effects on VSP Parameters |
|---|---|---|---|---|---|
| Freshwater spawning sites<br>Freshwater rearing<br>Freshwater migration corridors | Water quality | Temperature | ODEQ 2002 CWA 303(d) database indicates that 98% of summer temperature measurements at RM 4.7 exceeded maxima for core rearing (61°F) and non-core rearing and adult and juvenile migration (64°F) during the period 1986 through 1995.,<br><br>The maximum measured value, 84.2°F, exceeded the lethal temperature (assuming a 1-week exposure) for juvenile salmonid rearing.<br><br>Juvenile Chinook occupy the lower Long Tom during winter, when temperatures are below maxima. | Water temperatures in the Long Tom River downstream of Fern Ridge Dam are somewhat cooler in the spring and summer than pre-dam conditions. Spring and summer temperatures result from thermal stratification in the reservoir and subsequent discharge from the hypolimnion through the regulating outlet at a depth of about 30 feet. Fall and early winter temperatures result from the breakup of thermal stratification at reservoir turnover in the fall following storage of warm surface water in the epilimnion throughout the spring and summer. The revised proposed action will not alter this condition. | No change in effect. |
| Freshwater spawning sites<br>Freshwater rearing<br>Freshwater migration corridors | Water quality | Total suspended solids/turbidity | Only 5% of 41 turbidity measurements below Fern Ridge Dam during the 1990s had levels that exceeded 50 NTU, which ODEQ described as "unimpaired." However, 16% of total dissolved solids measurements exceeded 100 mg/L, which ODEQ described as "moderately impaired." | Fern Ridge Reservoir traps a portion of the suspended sediment load introduced by winter, spring, and summer runoff. Fractionation of the sediment load entering the reservoir results in retention of larger particulate fractions and concentration of fines in flows passed to below the dam. Accumulation of fine sediment fractions below the dam has contributed to bank and channel substrate armoring and to habitat simplification. The revised proposed action will not alter this condition. | No change in effect. |

| PCEs | Pathway | Indicator | Long Tom Baseline Condition | Effects of the Revised Proposed Action | Effects on VSP Parameters |
|---|---|---|---|---|---|
| Freshwater spawning sites<br>Freshwater rearing<br>Freshwater migration corridors | Water quality | Chemical contamination/nutrients | Most (98%) of 43 water samples collected below Fern Ridge Dam during the 1990s had total phosphorus concentrations that exceeded 0.05 mg/L, a condition described as "impaired" based on Governor's Watershed Enhancement Board recommendations. Fourteen pesticides were detected at a site near Bundy Bridge (Long Tom RM 1) during four sampling periods in 1994. | The revised proposed action will not alter this condition. | No effect |
| Freshwater spawning sites<br>Freshwater rearing<br>Freshwater migration corridors | Water quality | Dissolved oxygen (DO) | ODEQ 2002 CWA 303(d) list does not indicate that any streams in the Long Tom subbasin are water quality limited due to low DO concentrations. | No effect | No effect |
| Freshwater spawning sites<br>Freshwater rearing<br>Freshwater migration corridors | Water quality | Total dissolved gas (TDG) | ODEQ 2002 CWA 303(d) list does not indicate that any streams in the Long Tom subbasin are water quality limited due to TDG. | The revised proposed action will not alter this condition. | No effect |
| Freshwater migration corridors | Habitat access | Physical barriers | No man-made barriers at or below Fern Ridge Dam limit the viability of demographically independent salmonid populations of anadromous fish. | Fern Ridge Dam blocks upstream and downstream migration for all migratory fish species present in the Long Tom River. The revised proposed action will not alter this condition. | No effect |

| PCEs | Pathway | Indicator | Long Tom Baseline Condition | Effects of the Revised Proposed Action | Effects on VSP Parameters |
|---|---|---|---|---|---|
| Freshwater spawning sites | Habitat elements | Substrate | Amazon Creek and the mainstem Long Tom River have been channelized. Flow velocity and sediment transport capacity increased and the channels have incised. | Fern Ridge Dam blocks sediment (gravel and cobble) transport to the Long Tom River downstream of the dam. The revised proposed action will not alter this condition. | No change in effect. |
| Freshwater rearing sites<br>Freshwater migration corridors | Habitat elements | Large woody debris (LWD) | *In Headwater Tributaries*: Large wood does not meet ODFW benchmarks in Ferguson and Bear Creeks, which are the only two surveyed streams. Large wood levels are probably low in other tributaries due to timber harvesting.<br><br>*In the Mainstem Long Tom River*: Although no current estimates are available, the Long Tom River probably lacks large wood downstream of Fern Ridge Dam. | Fern Ridge Dam blocks the transport of LWD from current or future source areas located above the dam to the Long Tom River downstream of the dam.<br><br>Flood damage reduction has contributed indirectly to the de-forestation and development of downstream areas.<br><br>The revised proposed action will not alter this condition. | No effect |
| Freshwater rearing sites<br>Freshwater migration corridors | Habitat elements | Pool frequency and quality | Pool frequency and quality has been substantially reduced in the upper Willamette Basin in tributaries like the Long Tom River that have been heavily forested. Sedell and Everest (1991) compared the change in large pool areas that occurred from 1940 to 1990 in Willamette Basin watersheds "managed" for timber harvest as compared to those left "unmanaged" (i.e., wilderness areas). Managed forests experienced large losses in the proportion of pool habitat (e.g., Fall Creek -61%, South Fork McKenzie -82%). Only some streams remaining in unmanaged forests showed increases in the number of large pools. | The revised proposed action will not alter this condition. | No effect |

| PCEs | Pathway | Indicator | Long Tom Baseline Condition | Effects of the Revised Proposed Action | Effects on VSP Parameters |
|---|---|---|---|---|---|
| Freshwater spawning sites<br>Freshwater rearing<br>Freshwater migration corridors | Habitat elements | Off-channel habitat | About 61 miles of the mainstem Long Tom River are extensively channelized and it is predominantly a single channel. About 60 miles of Amazon Creek are channelized and simplified. | The revised proposed action will not alter this condition. | No effect |
| Freshwater spawning sites<br>Freshwater rearing | Channel conditions and dynamics | Width/depth ratio | Channel forming processes in the Long Tom River downstream of Fern Ridge Dams have been restricted by changes to the natural hydrograph and by reductions in the transportation of sediment load and LWD. Flow regulation, fractionation of the sediment load passed to below the dam, and accumulation of fine sediment fractions below Fern Ridge Dam have resulted in bank and substrate armoring (i.e., compaction and stabilization) and in habitat simplification. | Reduction in peak flows and blocked transport of sediment and large wood in the Long Tom River downstream of Fern Ridge Dam will continue to limit channel forming processes and habitat rejuvenation, or formation of new habitat. | No change in effect. |
| Freshwater spawning sites<br>Freshwater rearing<br>Freshwater migration corridors | Channel conditions and dynamics | Streambank condition | Streambanks do not support natural floodplain function in the Long Tom River downstream of Fern Ridge Dam. | Placement of riprap by the USACE to armor streambanks and stabilize them under high flow conditions resulted in loss of ecosystem function with respect to the dynamics of flow and channel forming processes. The revised proposed action will not alter this condition. | No change in effect. |
| Freshwater rearing<br>Freshwater migration corridors | Channel conditions and dynamics | Floodplain connectivity | Fern Ridge Dam has substantially decreased the magnitude and frequency of high flow events in the Long Tom River downstream of the dam. As a result, the floodplain is not frequently inundated by over-bank flow and there is less side channel connectivity than occurred under pre-dam conditions. These factors result in reduced nutrient exchange, reduced sediment exchange, reduced areas of refuge for fish under high-flow conditions, and reduced opportunities for re-establishment of riparian forests. | Habitat enhancement, which may eventually be funded under the Willamette Floodplain Restoration Study, may improve off-channel habitat by removing impediments to flow and by softening bank stabilization applications. Because specific improvements cannot be described at this time, the Action Agencies make a conservative assumption that the revised proposed action will not appreciably change floodplain connectivity. | No effect |

| PCEs | Pathway | Indicator | Long Tom Baseline Condition | Effects of the Revised Proposed Action | Effects on VSP Parameters |
|---|---|---|---|---|---|
| Freshwater spawning sites<br>Freshwater rearing<br>Freshwater migration corridors | Water quantity (flow/hydrology) | Change in peak/base flow | The frequency of flows with a channel-forming magnitude is insufficient to create and maintain channel complexity and to provide nutrients, organic matter, and sediment inputs from floodplain areas.<br><br>Increased summer flows may provide more rearing area for ESA-listed fish and may improve the heat capacity of the stream.<br><br>Low stream flow conditions are affected by water development and reservoir operations to a large extent in the Long Tom River subbasin than in other Willamette subbasins.<br><br>Flow fluctuations below Fern Ridge Dam are generally minor in magnitude except during flood management operations. | Changes in the natural flow hydrology in the Long Tom River downstream of Fern Ridge Dam have resulted from flood control operations and seasonal reservoir filling and drafting. Flood control has substantially decreased the frequency of the pre-dam, two-year channel forming flow events. Reservoir filling reduces outflow from the dams during February through May. Flows below the dams are augmented during the summer. Dam operations can also result in rapid decreases in stage during flood management operations that rarely occurred under pre-dam conditions except during or immediately after major floods.<br><br>Under the revised proposed action, the hydrology in the Long Tom River below Fern Ridge Dam will continue to be affected by flood control operations and seasonal reservoir filling and drafting. This will continue to result in reduced peak flows and augmented summer flows. Down ramping will be limited to 200 cfs per hour below the dam. | Improved ramping rates in the Long Tom River below Fern Ridge Dam could result in improved survival for resident and anadromous fish species, including spring Chinook salmon. |
| Freshwater spawning sites<br>Freshwater rearing<br>Freshwater migration corridors | Watershed conditions | Road density and location | The lower parts of the Long Tom watershed contain extensive agricultural, urban, and residential development. Relatively high road densities exist in these parts of the watershed. | The revised proposed action will not alter this condition. | No effect |

| PCEs | Pathway | Indicator | Long Tom Baseline Condition | Effects of the Revised Proposed Action | Effects on VSP Parameters |
|---|---|---|---|---|---|
| Freshwater spawning sites<br>Freshwater rearing<br>Freshwater migration corridors | Watershed conditions | Disturbance history | The disturbance regime is dominated by timber harvesting. Forests are dominated by early- to mid-successional stages, with few late-successional forests. Timber harvesting has increased sediment delivery to streams, but decreased large wood input, resulting in degraded aquatic habitat. | The revised proposed action will not alter this condition. | No effect |
| Freshwater spawning sites<br>Freshwater rearing<br>Freshwater migration corridors | Watershed conditions | Riparian reserves | Portions of the upper watershed are forested, but most is managed for timber production rather than ecosystem health. Lower watershed contains extensive agricultural, urban, and residential development. Portions of the upper watershed are heavily urbanized.<br><br>*In the Headwaters*: About 45% of riparian areas in the upper watershed have a moderate loss of function, and about 45% have a low loss of function. Many riparian areas consist of smaller-diameter trees with low large wood recruitment potential (Coyote Creek, mainstem Long Tom River). Some drainages have relatively intact riparian forests (Amazon, Elk, Spencer, and Ferguson creeks).<br><br>*In the Lower Floodplain*: About 46% of closed bottomland forest has a "high loss of function" rating. Many remaining patches of floodplain forest are interspersed with pastureland. Low large wood recruitment potential. | The revised proposed action will not alter this condition. | No effect |

In summary, corrective actions proposed by the Action Agencies in the Long Tom River below Fern Ridge Dam have the potential to protect and improve the survival of resident and anadromous fish species through summer flow augmentation below Fern Ridge Dam.

### 6.1.7. Effects of the Willamette Project Revised Proposed Action on UWR Spring Chinook and Winter Steelhead Populations and Critical Habitat in the Mainstem Willamette River

The component of the Willamette Project revised proposed action evaluated in this section is the continuing operation of the Willamette Project (i.e., 13 federal dams and associated streamside revetments) on the mainstem Willamette River upstream of Willamette Falls. The mainstem Willamette River has been designated as critical habitat for UWR Chinook salmon and for UWR steelhead. The PCEs identified in this portion of critical habitat include sites for rearing and for migration. Spawning occurs in tributary areas that have been evaluated separately. Table 6-7 assesses the anticipated effects of the revised proposed action upon the PCEs and VSP parameters for spring Chinook and winter steelhead in the mainstem Willamette River.

**Table 6-7. Effects of the Revised Proposed Action on Critical Habitat and Viability of Spring Chinook and Winter Steelhead in the Mainstem Willamette River**

| PCEs | Pathway | Indicator | Mainstem Willamette Baseline Condition | Effects of the Revised Proposed Action | Effects on VSP Parameters |
|---|---|---|---|---|---|
| Freshwater spawning sites<br>Freshwater rearing<br>Freshwater migration corridors | Water quality | Temperature | ODEQ 2002 CWA 303(d) database indicates that summer temperatures in the mainstem Willamette (RM 0 to 186) exceeded maxima for core and non-core rearing and adult and juvenile migration during 1986 through 1995.<br><br>Water stored in Willamette Project reservoirs is released during late July and August to protect mainstem water quality (including temperature). | Meeting minimum flow objectives in the mainstem Willamette during spring and early summer (April-June) will improve survival of juvenile and adult migrants. Maintaining higher flow volume will encourage more rapid emigration of smolts and will help retard the rate of thermal warming.<br><br>If implemented, WTC at Lookout Point would provide cooler water temperatures during fall and winter) and would substantially improve hatch and emergence timing and probably survival of naturally produced spring Chinook in the Middle Fork Willamette downstream of Lookout Point/Dexter. Providing warmer (i.e., more normative) spring and summer water temperatures downstream of Lookout Point/Dexter would also improve ecosystem function related to macroinvertebrate production and the growth of other fish species. However, providing these warmer water temperatures could exacerbate temperature-related water quality issues further downstream in the mainstem Willamette during spring and summer. The Action Agencies assume no benefit from this component of the revised proposed action, at present, because feasibility and funding are uncertain. | Abundance and productivity (i.e., survival) of spring Chinook and winter steelhead should increase in response to improved mainstem minimum flows.<br><br>If and when WTC capability is developed and implemented, population abundance and productivity would increase. Habitat quality in the natural production area below the Lookout Point/Dexter would improve. Both spawning activity and egg-to-fingerling survival would be expected to increase resulting in the potential for improved abundance and productivity (see Middle Fork Willamette River). Biological monitoring would document realized changes. |

| PCEs | Pathway | Indicator | Mainstem Willamette Baseline Condition | Effects of the Revised Proposed Action | Effects on VSP Parameters |
|---|---|---|---|---|---|
| Freshwater spawning sites<br>Freshwater rearing<br>Freshwater migration corridors | Water quality | Total suspended solids/turbidity | ODEQ 2002 CWA 303(d) database does not indicate exceedences of water quality criteria for turbidity. | Augmented summer flows will continue to aid in the dilution of fine sediment during the summer low-flow period. | No effect |
| Freshwater spawning sites<br>Freshwater rearing<br>Freshwater migration corridors | Water quality | Chemical contamination/nutrients | ODEQ 2002 CWA section 303(d) database indicates the following exceedences of criteria for the protection of anadromous fish passage: (1) Two out of 7 water column samples at RM 12.7 exceeded the criterion of 0.000024 ug/L for DDT. (2) For polynuclear aromatic hydrocarbons at RM 6, the 35-day average of 52,900 pg/L exceeded the criterion of 2,800 pg/L.<br><br>Potential adverse affects on anadromous fish passage due to pentachlorophenol in sediment near McCormick and Baxter creosoting site (RM 7).<br><br>ODEQ 2002 CWA 303(d) database does not indicate exceedences of water quality criteria for excess nutrients. | Augmented summer flows will continue to aid in the dilution of nutrients and chemical pollutants during the summer low-flow period. | No change in effect (a net benefit). |
| Freshwater spawning sites<br>Freshwater rearing<br>Freshwater migration corridors | Water quality | Dissolved oxygen (DO) | DO concentrations in the mainstem Willamette (RM 151 to 141.6) have fluctuated below ODEQ numerical criteria.<br><br>DO levels in the mainstem Willamette have increased since 1945, as evidenced by increased numbers of fish species that are relatively sensitive to low DO levels. | The revised proposed action will not directly alter the existing mainstem Willamette water quality conditions. WTC, if implemented at Lookout Point Dam, could exacerbate problems with high summer water temperatures in the upper mainstem Willamette River. | No effect |

| PCEs | Pathway | Indicator | Mainstem Willamette Baseline Condition | Effects of the Revised Proposed Action | Effects on VSP Parameters |
|---|---|---|---|---|---|
| Freshwater spawning sites<br>Freshwater rearing<br>Freshwater migration corridors | Water quality | Total dissolved gas (TDG) | There is no information indicating that total dissolved gas concentrations in the mainstem Willamette River have exceeded 110% of saturation. | No effect | No effect |
| Freshwater migration corridors | Habitat access | Physical barriers | *Willamette Falls as Barrier to Migration:* Willamette Falls (RM 26.6) is a natural barrier that has always restricted fish passage during low flows.<br><br>Navigation locks built in 1873 allowed some upstream fish passage; first crude rock fishway built at Willamette Falls in mid-1880s to early 1890s.<br><br>Falls developed for hydroelectric production in 1891 with as many as 52 turbines in operation at one time; juvenile Chinook turbine mortality rates are 7.7%-100%.<br><br>Sullivan Plant was closed during the downstream migration in the mid-1970s and 1980s; with structural improvements to the bypass in 1991, Sullivan Plant operates year-round. | No effect | No effect |
| Freshwater spawning sites | Habitat elements | Substrate | Mainstem Willamette is downcutting at several gage locations.<br><br>Sediment budget is not balanced due to extraction from gravel mining, retention in reservoirs, and lack of recruitment from eroding banks.<br><br>Substrate is probably armored. | High flows will continue to be curtailed. Cooperative efforts under the Willamette Bank Protection Program and Willamette Floodplain Restoration Study have potential to aid in some restoration of floodplain connectivity and channel habitat complexity, including the liberation of gravel and cobble substrate from streambank reserves. Because funding and extent of these actions is uncertain, the Action Agencies assume no net benefit. | No change in effect. |

| PCEs | Pathway | Indicator | Mainstem Willamette Baseline Condition | Effects of the Revised Proposed Action | Effects on VSP Parameters |
|---|---|---|---|---|---|
| Freshwater rearing sites<br>Freshwater migration corridors | Habitat elements | Large woody debris (LWD) | Lack of large wood in main channel and side channels. | High flows will continue to be curtailed. Cooperative efforts under the Willamette Bank Protection Program and Willamette Floodplain Restoration Study have the potential to aid in some restoration of riparian forest areas, floodplain connectivity, and channel habitat complexity, including long-term recruitment of LWD. For the revised proposed action, a plan will be developed for stockpiling LWD and making it available to the USFS or others for use in maintaining habitat complexity in stream channels above or below USACE dams; however, this is likely to have little, if any, impact on the mainstem Willamette River. Because funding and extent of these actions is uncertain, the Action Agencies assume no net benefit. | No change in effect. |
| Freshwater rearing sites<br>Freshwater migration corridors | Habitat elements | Pool frequency and quality | Pool frequency and quality in the mainstem Willamette River has been greatly reduced by dredging and channel simplification to develop and maintain waterborne transportation and to mine gravel. | High flows will continue to be curtailed. Cooperative efforts under the Willamette Bank Protection Program and Willamette Floodplain Restoration Study have the potential to aid in some restoration of riparian forest areas, floodplain connectivity, and channel habitat complexity, including long-term recruitment of LWD and the formation of side channels, backwater habitat, and pools. Because funding and extent of these actions is uncertain, the Action Agencies assume no net benefit. | No change in effect. |

| PCEs | Pathway | Indicator | Mainstem Willamette Baseline Condition | Effects of the Revised Proposed Action | Effects on VSP Parameters |
|---|---|---|---|---|---|
| Freshwater spawning sites<br>Freshwater rearing<br>Freshwater migration corridors | Habitat elements | Off-channel habitat | Substantial loss of off-channel habitat in the mainstem Willamette River. | High flows will continue to be curtailed. Cooperative efforts under the Willamette Bank Protection Program and Willamette Floodplain Restoration Study have the potential to aid in some restoration of riparian forest areas, floodplain connectivity, and channel habitat complexity, including long-term recruitment of LWD and the formation of side channels, backwater habitat, and pools. Because funding and extent of these actions is uncertain, the Action Agencies assume no net benefit. | No change in effect. |
| Freshwater spawning sites<br>Freshwater rearing | Channel conditions and dynamics | Width/depth ratio | Channel forming processes in the upper mainstem Willamette River have been restricted by changes in the natural hydrograph, by streambank armoring, and by reductions in LWD derived from riparian forests that have been removed. Channel length and complexity between Albany and Eugene was reduced by 45% to 50% since 1800 (Benner and Sedell 1997). The Newberg Pool located upstream of Willamette Falls has always been relatively deep and has not changed significantly from historic conditions. Land use practices (e.g., agriculture) that have resulted in elevated fine sediment loads have contributed to compaction and stabilization of substrates and overall habitat simplification. | High flows will continue to be curtailed. Cooperative efforts under the Willamette Bank Protection Program and Willamette Floodplain Restoration Study have the potential to aid in some restoration of riparian forest areas, floodplain connectivity, and channel habitat complexity, including long-term recruitment of LWD and the formation of side channels, backwater habitat, and pools. These more normative ecosystem functions would, in turn, result in an improved channel width to depth ratio and dynamic. Because funding and extent of these actions is uncertain, the Action Agencies assume no net benefit. | No change in effect. |

| PCEs | Pathway | Indicator | Mainstem Willamette Baseline Condition | Effects of the Revised Proposed Action | Effects on VSP Parameters |
|---|---|---|---|---|---|
| Freshwater spawning sites<br>Freshwater rearing<br>Freshwater migration corridors | Channel conditions and dynamics | Streambank condition | 46 miles of USACE revetments and 50 miles of private revetments along the mainstem Willamette prevent lateral channel migration.<br><br>65% of outer bends of meanders revetted.<br><br>Channel length in 1990 reduced to only 20%-30% of channel length in 1850.<br><br>Alcove and island area reduced to 20%-30% of that present in 1850.<br><br>River channel form does not change frequently, and new islands and gravel bars seldom form. | Cooperative efforts under the Willamette Bank Protection Program and Willamette Floodplain Restoration Study have the potential to aid in some restoration of riparian conditions on streambanks, which could eventually contribute to long-term recruitment of LWD. Because specific improvements cannot be described at this time, the Action Agencies make a conservative assumption that the revised proposed action will not appreciably change streambank conditions. | No effect |
| Freshwater rearing<br>Freshwater migration corridors | Channel conditions and dynamics | Floodplain connectivity | Floodplain is not frequently inundated, with less over-bank flow and side channel connectivity.<br><br>Reduced nutrient exchange, reduced sediment exchange, reduced flood refugia for fish, and reduced establishment of new riparian forests. | Cooperative efforts under the Willamette Bank Protection Program and Willamette Floodplain Restoration Study have the potential to aid in some restoration of riparian forest areas, floodplain connectivity, and channel habitat complexity, including long-term recruitment of LWD and the formation of side channels, backwater habitat, and pools. Because funding and extent of these actions is uncertain, the Action Agencies assume no net benefit. | No effect |
| Freshwater spawning sites<br>Freshwater rearing<br>Freshwater migration corridors | Water quantity (flow/hydrology) | Change in peak/base flow | Late winter and spring flow reductions may reduce the survival of outmigrating winter steelhead and spring Chinook smolts.<br><br>Spring flow reductions may reduce delays adult Chinook experience at the Willamette Falls hydro project during high flows.<br><br>Increased flows in summer may benefit juvenile Chinook by increasing rearing habitat area for rearing juveniles and by increasing the heat capacity of the system.<br><br>Frequency of channel-forming and over-bank flows has been greatly reduced. Human-caused increases in the rate of flow fluctuations are not a significant concern. | Under the revised proposed action, the hydrology in the mainstem Willamette River will continue to be affected. The Action Agencies will continue to implement and will evaluate the biological effectiveness of the current biological flow objectives and resulting flow rates. | Improved mainstem flow conditions will reduce risks to juvenile and adult ESA-listed fish species and are expected to result in improved migration conditions, and improved overall productivity. As a result, the health and abundance of local fish populations in the basin may increase. Biological monitoring will document changes in mainstem habitat conditions and in local population productivity resulting from a combination of Action Agency actions. |

| PCEs | Pathway | Indicator | Mainstem Willamette Baseline Condition | Effects of the Revised Proposed Action | Effects on VSP Parameters |
|---|---|---|---|---|---|
| Freshwater spawning sites<br>Freshwater rearing<br>Freshwater migration corridors | Watershed conditions | Road density and location | High road densities exist throughout the Willamette Valley near the mainstem as a result of agricultural, urban, industrial, and rural development. These are managed by Oregon Dept. Transportation; corrective measures are not included as a part of the revised proposed action. | No change | No effect |
| Freshwater spawning sites<br>Freshwater rearing<br>Freshwater migration corridors | Watershed conditions | Disturbance history | Prairie and oak savanna habitat is rare within the Willamette Valley foothills.<br><br>Lower watershed contains extensive agricultural, urban, and residential development.<br><br>Agriculture and development constitute almost 60% of the Willamette Valley lowland vegetation. | The revised proposed action will not change the disturbance conditions. | No effect |
| Freshwater spawning sites<br>Freshwater rearing<br>Freshwater migration corridors | Watershed conditions | Riparian reserves | Area of riparian forest along the mainstem Willamette in 1990 is 75-90% less than in 1850.<br><br>Many remaining patches of floodplain forest are interspersed with agriculture.<br><br>Low large wood recruitment potential.<br><br>Few continuous large patches of riparian forest.<br><br>Many forests contain non-native Himalayan blackberry and reed canarygrass that hinder development of young cottonwood forests.<br><br>Prairie and oak savanna habitat is rare within the Willamette Valley foothills. | No effect | No effect |

In summary, corrective actions proposed by the Action Agencies in the mainstem area of the Willamette River Basin have the potential to increase UWR spring Chinook salmon and winter steelhead abundance and productivity. These VSP parameters may improve in response to spring and summer flow management improvements and to improved floodplain connectivity, function, and habitat restoration. The implementation of major structural components of the revised proposed action depends upon the outcome of associated feasibility studies and subsequent project authorization and funding.

## 6.2. Continuing Operation of Willamette Basin Hatchery Mitigation Program

### 6.2.1. Effects of the Willamette Basin Hatchery Mitigation Program on Salmon and Steelhead ESUs below Willamette Falls and in the Lower Columbia River

Eleven salmon and steelhead ESUs interact with the UWR spring Chinook and summer steelhead hatchery programs only in the lower Willamette River below Willamette Falls and lower mainstem Columbia River. Potential impacts on these ESUs are expected in only two of the categories – competition/density-dependent effects and predation (Table 6-8). Documentation of adverse effects of hatchery releases in the lower Columbia River and estuary is limited. In its 2000 hatchery BiOp, the NMFS concluded that effects in the lower Columbia River migration corridor were likely minimal due to rapid movement of juvenile fish through the estuary, and no new information suggests otherwise. However, there is some evidence that hatchery spring Chinook rear in the lower Willamette, indicating some potential for competition and density-dependent effects (Friesen et al., 2004).

The annual release of hatchery fish in the Columbia River Basin (including the Willamette Basin) continues to be below the cap of 195 million fish established to limit the potential adverse effects of hatchery fish competing with natural-origin fish in the lower river migration corridors (NMFS 1999). Therefore, while there is the potential for some negative interactions, it is expected that the Upper Willamette hatchery programs are *not likely to adversely affect* the 11 salmon and steelhead ESUs below Willamette Falls and in the lower Columbia River.

**Table 6-8. Summary of Effects of Willamette Basin Hatchery Mitigation Program on ESUs below Willamette Falls and in the lower Columbia River**

| Hatchery Program | Hatchery Operations | Broodstock Collection | Genetic Introgression | Disease | Competition/ Density Dependence | Predation |
|---|---|---|---|---|---|---|
| Upper Willamette Spring Chinook | 0 | 0 | 0 | 0 | (-) | (-) |
| Upper Willamette Summer Steelhead | 0 | 0 | 0 | 0 | (-) | (-) |
| Upper Willamette Rainbow Trout | 0 | 0 | 0 | 0 | 0 | 0 |

| Hatchery Program | Residualism | Fisheries | Masking | Nutrient Cycling | Monitoring and Evaluation |
|---|---|---|---|---|---|
| Upper Willamette Spring Chinook | 0 | 0 | 0 | 0 | 0 |
| Upper Willamette Summer Steelhead | 0 | 0 | 0 | 0 | 0 |
| Upper Willamette Rainbow Trout | 0 | 0 | 0 | 0 | 0 |

Note: There are no discernable differences in effect among the 11 ESUs.
Key: 0 = No impact expected; (-) = may negatively impact; (+) = may positively impact.

### 6.2.2. Effects of the Willamette Basin Hatchery Mitigation Program on UWR Spring Chinook and Winter Steelhead

Schroeder and others (2006) described the results of RM&E associated with the USACE Willamette Hatchery Mitigation Program, as required by NMFS 2000 Hatchery BiOp. These activities were conducted primarily to further understanding regarding the potential impacts of the hatchery program, as very little work had previously occurred. Annual monitoring reports produced by the ODFW (Firman et al., 2002, 2003, 2004, 2005) provide additional data on the specific RM&E tasks.

This Supplemental BA combines information gathered from these monitoring efforts with general hatchery management and reform principles to summarize the effects of the UWR spring Chinook, summer steelhead, and rainbow trout hatchery mitigation programs on all ESA-listed salmon and steelhead ESUs for each of the following general categories of risk associated with artificial propagation programs: (1) operation of hatchery facilities; (2) broodstock collection; (3)genetic introgression; (4) disease; (5) competition/density-dependent effects; (6) predation; (7) residualism; (8) nutrient cycling; (9) masking; (10) fisheries; and (11) research, monitoring, and evaluation. The general effect of each risk is described in several BiOps previously issued by NMFS (NMFS 1999, 2002, 2003). More detailed descriptions of the effects of each hatchery program on ESA-listed species will be included in Section 2 of the HGMP for each hatchery program. Because the spring Chinook hatchery mitigation programs are operated as integrated hatchery programs and are expected to reduce overall extinction risk to the UWR spring Chinook ESU, the effects of these hatchery programs, as described in the revised proposed action, are described with respect to the four attributes of a viable salmonid population in Tables 6-9 to 6-12 for the North Santiam, South Santiam, McKenzie, and Middle Fork Willamette hatchery programs, respectively.

**Table 6-9. Potential Adverse Effects of North Santiam Hatchery Programs on North Santiam Populations of UWR Spring Chinook and Winter Steelhead**

| Risk Category | North Santiam Baseline Condition | Effect of the Revised Proposed Action | Likelihood of Adverse Effect | Net Effect of Revised Proposed Action |
|---|---|---|---|---|
| **Operation of Hatchery Facilities** | | | | |
| Facility failure | No catastrophic failures have occurred at Marion Forks Fish Hatchery. The facility is fully staffed on-site and employs safe fish health practices in accordance with IHOT guidelines. However, the facility is not equipped with a complete water alarm system, which poses a risk should water failure occur. Risk of catastrophic loss of the water supply is reduced by having two water supplies. | ODFW and USACE are developing a prioritized database of hatchery rehabilitation and maintenance needs at each hatchery facility, which will be implemented subject to available funds. Maintenance needs that reduce the risk of catastrophic hatchery failure are high priorities. Implementation of high-priority maintenance needs should reduce the risk of catastrophic failure. | Low | Reduces risk of adverse effect. |

| Risk Category | North Santiam Baseline Condition | Effect of the Revised Proposed Action | Likelihood of Adverse Effect | Net Effect of Revised Proposed Action |
|---|---|---|---|---|
| Water intakes | The Marion Creek and Horn Creek water supplies consist of screened intakes upstream of small diversion dams. Both water intakes are screened, but neither meets NMFS fry criteria. Both intakes are located above the uppermost distribution of anadromous salmonids, so the potential for take is low. | ODFW and USACE recently reinforced the apron on Marion Creek Diversion Dam, the primary water supply, thereby reducing the risk of failure. Upgrading fish screens on both water intakes to comply with NMFS fry criteria will be included in the long-term infrastructure maintenance plan. | Moderate | Reduces risk of adverse effect. |
| Effluent discharge | Effluent discharges from hatcheries can change water temperature, pH, suspended solids, ammonia, organic nitrogen, total phosphorus, and chemical oxygen demand in the receiving stream's mixing zone (Kendra 1991). Marion Forks Hatchery and the Minto Ponds Fish Facility comply with NPDES permits and IHOT standards, which minimizes the impacts of effluent. | ODFW will continue to comply with NPDES permits and IHOT standards. Maintenance and repair of gates, pipelines, and valves associated with the effluent ponds will ensure proper function.<br>No effect. | Low | No change in likelihood of adverse effect. |
| Broodstock collection - methods | Adults are collected at the Minto Fish Facility, which was not designed to sort hatchery and wild fish. All UWR spring Chinook salmon and winter steelhead that arrive at Minto are blocked by a diversion dam, crowded into a fish lock, anesthetized with $CO_2$, and dewatered for 30-40 seconds at least one time. These handling practices likely increase the incidence of pre-spawning mortality of natural- and hatchery-origin adults that are released to spawn either upstream of Minto Dam or into previously accessible habitat upstream of Detroit Dam or in the Little North Santiam River. Annual returns of hatchery and natural-origin spring Chinook to the Minto Facility have averaged approximately 3,600 between 1996 and 2006.<br><br>UWR winter steelhead are also handled at the Minto Fish Facility and passed upstream to spawn in the 4 miles downstream of Big Cliff Dam. | The Action Agencies propose to rebuild the Minto Collection Facility, with design beginning in 2008. The new facility will include water-to-water transfer and the ability to safely sort and load hatchery and natural-origin spring Chinook salmon and winter steelhead. These improvements should reduce the incidence of pre-spawning mortality of spring Chinook and winter steelhead that are handled at the Minto facility and released in areas where they are expected to spawn. | Certain | Reducing risk of adverse effects associated with collection. |

| Risk Category | North Santiam Baseline Condition | Effect of the Revised Proposed Action | Likelihood of Adverse Effect | Net Effect of Revised Proposed Action |
|---|---|---|---|---|
| Broodstock collection - adult removal | The broodstock collection goal for the Marion Forks Spring Chinook program is 600 adult fish. Through 2005, the percentage of natural-origin fish collected for broodstock has been <5% (Schroeder et al. 2006). This has amounted to less than 2.5% of the wild run in the North Santiam. | New collection protocols, as described in Table 3-8, incorporate a higher percentage of natural-origin adult spring Chinook into the broodstock, which will result in the direct take of up to 180 natural-origin spawners in low return years, and 300 natural-origin spawners in high return years, pending availability of natural-origin fish. While resulting in more direct take of natural-origin spawners, these protocols ensure that North Santiam spring Chinook program is consistent with an integrated hatchery program. Protocols may be modified based on RM&E results. | Certain, pending availability of natural- origin fish for broodstock. | Reduces risk |
| Genetic introgression | The North Santiam spring Chinook Hatchery Program was derived from the local broodstock collected at Minto Ponds, just downstream of Big Cliff Dam, with minimal out-of-basin influence. Myers et al. (2002) showed that this stock is most closely related to other natural and hatchery runs in the Upper Willamette ESU, with particular similarity to naturally produced fish in the McKenzie River. Very few wild fish (<5%) were incorporated into the North Santiam spring Chinook hatchery broodstock through the 2005 brood year.<br><br>There are some differences in life history characteristics between the hatchery and natural origin returning adults [e.g., size and age at return (Firman et al., 2005)] although these differences are less for the North Santiam population, possibly due to the smaller size of fish at release.<br><br>Hatchery summer steelhead spawn in similar areas used by UWR winter steelhead (Schroeder et al. 2006). However, no genetic work has been conducted to determine if interbreeding between summer and winter steelhead has occurred. | Modifications to broodstock collection protocol and the incorporation of more natural-origin adults into the broodstock will increase the influence of natural selective pressures on the populations. Thus, over time the hatchery populations should become extensions of the naturally spawning populations, genetically and in expression of physical traits.<br><br>If natural production in the North Santiam basin improves, the Action Agencies will work with ODFW to reduce the number of hatchery fish on the spawning grounds further. Experimental releases of smaller hatchery fish could allow expression of a variety of life history strategies and may reduce differences in life history characteristics of hatchery and natural-origin fish.<br><br>Scaling back summer steelhead recycling in North Santiam, or potential changes in juvenile release strategy to increase adult harvest should reduce incidence of summer steelhead spawning.<br><br>RM&E efforts, as prioritized by the FPHM committee will determine if summer steelhead are successfully spawning. Additional measures to reduce potential adverse effects on winter steelhead will be informed by RM&E; implementation will be collaboration with ODFW. | Likely | Reduces risk |

| Risk Category | North Santiam Baseline Condition | Effect of the Revised Proposed Action | Likelihood of Adverse Effect | Net Effect of Revised Proposed Action |
|---|---|---|---|---|
| Disease | Effluent from Marion Forks Fish Hatchery has the potential to transport fish pathogens out of the hatchery, where natural-origin fish may be exposed to infection. Releases of hatchery juvenile summer steelhead and spring Chinook from Minto Ponds Fish Facility could result in the transmission of pathogens to natural-origin fish rearing in the North Santiam below Minto Dam. | Continuing implementation of fish health policies and practices will reduce the possibility of disease transmission from hatchery fish to natural-origin fish. | Low | No change. |
| Competition/ density dependence | Juvenile hatchery fish released from the Minto Ponds Fish Facility compete with naturally produced fish for food and space in areas where they interact during downstream migration.<br><br>Adult hatchery fish returning to the North Santiam compete with naturally produced fish for redd sites. | Releasing an experimental group of hatchery spring Chinook at a smaller size to mimic natural life history strategies could increase the potential for competition. Release at a size that is smaller than naturally produced juveniles will reduce this risk. RM&E will document interactions; releases will be adjusted accordingly.<br><br>Ensuring volitional release of hatchery smolts and eliminating forced released of smolts (i.e., those that do not volitionally emigrate) should reduce the likelihood that hatchery-origin smolts will remain in the riverine environment to compete with naturally produced fish.<br><br>Scaling back recycling of adult summer steelhead collected at Minto Fish Facility, or changing release strategies of summer steelhead smolts, could reduce the incidence of adult summer steelhead competing for redd sites or producing juveniles that compete with, or predate up ESA-listed species.<br><br>Additional measures to reduce potential effects of predation and competition by summer steelhead and rainbow trout on ESA-listed species will be informed by RM&E and developed with ODFW and FPHM committee.<br><br>Transport of adult hatchery spring Chinook collected at Minto Ponds into areas upstream of USACE dams reduces the number of adult Chinook that could compete with natural-origin adults on spawning grounds below Big Cliff Dam. | Certain | Reduce risk |

| Risk Category | North Santiam Baseline Condition | Effect of the Revised Proposed Action | Likelihood of Adverse Effect | Net Effect of Revised Proposed Action |
|---|---|---|---|---|
| Predation | While juveniles are released at a size and time to encourage rapid outmigration, hatchery smolts released from the Minto Ponds Fish Facility consume naturally produced fry in the North Santiam River below Minto Dam (Firman et al. 2005).<br><br>Releases of hatchery smolts from the Minto Ponds Fish Facility could result in increases in predation by other predator species due to enhanced attraction resulting from these releases. | Ensuring volitional release of hatchery smolts and eliminating forced released of smolts (i.e., those that do not volitionally emigrate) should reduce the likelihood that hatchery-origin smolts will remain the riverine environment to compete with naturally produced fish. | Certain | No change |
| Residualism | While juveniles are released at a size and time to encourage rapid outmigration, a portion of the hatchery smolts released from Minto Ponds Fish Facility residualize in the North Santiam below Minto Dam. These fish consume naturally produced fish and compete for space and food. | Ensuring volitional release of hatchery smolts and eliminating forced released of smolts (i.e., those that do not volitionally emigrate) should reduce the likelihood that hatchery-origin smolts will remain the riverine environment to compete with naturally produced fish. | | |
| Nutrient cycling | Adult hatchery spring Chinook returning to the Minto Ponds Fish Facility add substantial amounts of fish biomass and nutrients to the North Santiam subbasin. | Adult returns not collected at Minto Ponds Fish Facility or spawned at the facility will contribute biomass and nutrients to the North Santiam River below Big Cliff Dam.<br><br>Adult returns not spawned at the Minto Ponds Fish Facility outplanted above Detroit Dam will contribute biomass and nutrients to the North Santiam River system. | Certain | No change |

| Risk Category | North Santiam Baseline Condition | Effect of the Revised Proposed Action | Likelihood of Adverse Effect | Net Effect of Revised Proposed Action |
|---|---|---|---|---|
| Masking | Adult hatchery fish (spring Chinook and summer steelhead) returning to the Minto Ponds Fish Facility stray into natural spawning areas confounding the ability to determine the annual abundance of naturally produced fish.<br><br>The high incidence of non-adipose fin-clipped adult Chinook that are of hatchery origin masks the true number of natural-origin fish incorporated into the broodstock. | Continuing to thermally shock all hatchery releases to mark otoliths will enhance ability to determine the annual abundance of naturally produced fish in the North Santiam River below Minto Dam.<br><br>Inserting coded wire tags into North Santiam spring Chinook releases will enable immediate detection of hatchery-origin fish. | Certain | Reduce risk |
| Fisheries | Fisheries managed for, or directed at, the harvest of hatchery-origin fish released from Minto Ponds Fish Facility result in the incidental harvest or mortality of naturally produced fish. | Potentially scaling back recycling of summer steelhead in the North Santiam basin or changing the release strategy to disperse harvest could decrease incidental harvest of UWR winter steelhead.<br><br>Continuing harvest of only hatchery origin fish will likely maintain current levels of incidental harvest. | Moderate | Potentially reduces risk. |
| Research, monitoring, and evaluation | Currently, a limited monitoring and evaluation program in the North Santiam Basin to determine the performance of the artificial production programs or to document the impact of the program on naturally produced fish. Without a thorough RM&E program, it is difficult to recommend changes to the hatchery mitigation program to reduce impacts on ESA-listed species. | Implementing an extensive RM&E program to monitor the performance and determine the impact of the existing program on naturally produced fish will inform the decision-making process for reforming the hatchery programs to reduce impacts on ESA-listed species. | Certain, pending available funding. | Reduce negative effect |

**Table 6-10. Potential Adverse Effects of South Santiam Hatchery Programs on South Santiam Populations of UWR Spring Chinook and Winter Steelhead**

| Risk Category | South Santiam Baseline Condition | Effect of the Revised Proposed Action | Likelihood of Adverse Effect | Net Effect of Revised Proposed Action |
|---|---|---|---|---|
| **Operation of Hatchery Facilities** | | | | |
| Facility failure | No catastrophic failures have occurred at South Santiam Fish Hatchery. The facility is fully staffed on-site and employs safe fish health practices in accordance with IHOT guidelines. However, the water supply to South Santiam Hatchery is river water from Foster Reservoir, which can be turbid following precipitation events. | ODFW and USACE are developing a prioritized database of hatchery rehabilitation and maintenance needs at each hatchery facility, which will be implemented subject to available funds. Maintenance needs that reduce the risk of catastrophic hatchery failure are high priorities. Implementation of high-priority maintenance needs should reduce the risk of catastrophic failure. | Low | Reduces risk of adverse effect. |
| Water intakes | The intake for South Santiam Hatchery is located in Foster Reservoir. The intake has a trash rack, but does not have fish screens that meet NMFS juvenile criteria. | Upgrading the fish screen on the water intake to comply with NMFS fry criteria will be included in the long-term infrastructure maintenance plan. | Moderate | Reduces risk of adverse effect. |
| Effluent discharge | Effluent discharges from hatcheries can change water temperature, pH, suspended solids, ammonia, organic nitrogen, total phosphorus, and chemical oxygen demand in the receiving stream's mixing zone (Kendra 1991). South Santiam Fish Hatchery complies with NPDES permits and IHOT standards, which minimizes the impacts of effluent. | ODFW will continue to comply with NPDES permits and IHOT standards. No effect. | Low | No change in likelihood of adverse effect. |

| Risk Category | South Santiam Baseline Condition | Effect of the Revised Proposed Action | Likelihood of Adverse Effect | Net Effect of Revised Proposed Action |
|---|---|---|---|---|
| Broodstock collection - method | Adults are collected at the Foster Fish Facility, which was not designed to sort hatchery and wild fish. All UWR spring Chinook salmon and winter steelhead that arrive at Foster pass upstream through one of two entrances, the first located in the spillway and the second adjacent to the powerhouse tailrace. The fish move up the pool-and-weir ladder to a holding pond located at the upstream end of the fish ladder. A finger weir traps fish within the holding pond. Fish are crowded into an anesthetic tank with a fish crowder, anesthetized with CO2, counted, identified by species, and loaded into a 1,000 gallon fish hopper or a long (150 ft.) pipe leading to the transportation truck.<br><br>These handling practices likely increase the incidence of pre-spawning mortality of natural- and hatchery-origin adults that are released to spawn upstream of Foster Dam. Annual returns of hatchery and natural-origin spring Chinook to the Foster Fish Facility have averaged about 4,100 between 1984 and 2003. Annual returns of winter steelhead have averaged about 413 fish from 1973-2005. | The Action Agencies propose to rebuild the Foster Fish Facility, as prioritized via the system configuration studies. The new facility will include water-to-water transfer and the ability to safely sort and load hatchery and natural-origin spring Chinook salmon and winter steelhead. These improvements should reduce the incidence of pre-spawning mortality of spring Chinook and winter steelhead that are handled at the facility and released in areas where they are expected to spawn. | Certain | Reducing risk of adverse effects associated with collection. |
| Broodstock collection - adult removal | The broodstock collection goal for the South Santiam Fish Hachery Chinook program is 900 adult fish. | New collection protocols, as described in Table 3-8, incorporate a higher percentage of natural-origin adult spring Chinook into the broodstock, which will result in the direct take of up to 300 natural-origin spawners pending availability of natural-origin fish. While resulting in more direct take of natural-origin spawners, these protocols ensure that the South Santiam Spring Chinook program is consistent with an integrated hatchery program. Protocols may be modified based on the results of RM&E. | Certain, pending availability of natural-origin fish for broodstock. | Net benefit to UWR spring Chinook by improving quality of hatchery broodstock for conservation purposes. |

| Risk Category | South Santiam Baseline Condition | Effect of the Revised Proposed Action | Likelihood of Adverse Effect | Net Effect of Revised Proposed Action |
|---|---|---|---|---|
| Genetic introgression | The South Santiam spring Chinook Hatchery Program was derived from the local broodstock collected at Foster Dam, with minimal out-of-basin influence. Very few wild fish (<5%) were incorporated into the North Santiam spring Chinook hatchery broodstock through the 2005 brood year.<br><br>There are some differences in life history characteristics between the hatchery and natural origin returning adults (Firman et al. 2005), although these differences are not statistically significant.<br><br>Hatchery summer steelhead spawn in areas used by UWR winter steelhead (Schroeder et al., 2006). However, no genetic work has been conducted to determine if interbreeding between summer and winter steelhead has occurred. | Modifications to broodstock collection protocol and the incorporation of more natural-origin adults into the broodstock will increase the influence of natural selective pressures on the populations. Thus, over time, the hatchery populations should become extensions of the naturally spawning populations, genetically and in expression of physical traits.<br><br>Experimental releases of smaller hatchery fish could allow expression of a variety of life history strategies and may reduce differences in life history characteristics of hatchery and natural-origin fish.<br><br>Potentially scaling back summer steelhead recycling in the North Santiam, or potential changes in juvenile release strategy to increase adult harvest should reduce the incidence of summer steelhead spawning.<br><br>RM&E efforts, as prioritized by the FPHM committee will determine if summer steelhead are successfully spawning.<br><br>Additional measures to reduce potential adverse effects on winter steelhead will be informed by RM&E; implementation will be collaboration with ODFW. | Likely | Reduce Risk |
| Disease | Effluent from the South Santiam Hatchery has the potential to transport fish pathogens out of the hatchery, where natural-origin fish may be exposed to infection. Releases of hatchery juvenile summer steelhead and spring Chinook from South Santiam Hatchery could result in the transmission of pathogens to natural-origin fish rearing in the South Santiam below Foster Dam. | Continuing implementation of fish health policies and practices will reduce the possibility of disease transmission from hatchery fish to natural-origin fish. | Low | No change |

| Risk Category | South Santiam Baseline Condition | Effect of the Revised Proposed Action | Likelihood of Adverse Effect | Net Effect of Revised Proposed Action |
|---|---|---|---|---|
| Competition/ density dependence | Juvenile hatchery fish released from the South Santiam Hatchery compete with naturally produced fish for food and space in areas where they interact during downstream migration.<br><br>Adult hatchery fish returning to the South Santiam compete with naturally produced fish for redd sites. | Releasing an experimental group of hatchery spring Chinook at a smaller size to mimic natural life history strategies could increase the potential for competition. Release at a size that is smaller than naturally produced juveniles will reduce this risk. RM&E will document interactions; releases will be adjusted accordingly.<br><br>Ensuring volitional release of hatchery smolts and eliminating forced released of smolts (i.e., those that do not volitionally emigrate) should reduce the likelihood that hatchery-origin smolts will remain the riverine environment to compete with naturally produced fish. Additional measures to reduce potential effects of predation and competition by summer steelhead and rainbow trout on ESA-listed species will be informed by RM&E and developed in coordination with ODFW and the FPHM committee.<br><br>Potential scaling back of recycling of adult summer steelhead collected at the Foster Fish Facility, or changing release strategies of summer steelhead smolts, could reduce the incidence of adult summer steelhead competing for redd sites or producing juveniles that compete with, or predate up ESA-listed species.<br><br>Transport of adult hatchery spring Chinook collected at the Foster Fish Facility into areas into areas upstream of USACE dams reduces the number of adult Chinook that could compete with natural-origin adults on the spawning grounds below Foster Dam. | Certain | Reduce risk |

| Risk Category | South Santiam Baseline Condition | Effect of the Revised Proposed Action | Likelihood of Adverse Effect | Net Effect of Revised Proposed Action |
|---|---|---|---|---|
| Predation | While juveniles are released at a size and time to encourage rapid outmigration, hatchery smolts released from the South Santiam Hatchery consume naturally produced fry in the South Santiam River below Foster Dam. (Firman et al., 2005).<br><br>Releases of hatchery smolts from the South Santiam Hatchery could result in increases in predation by other predator species due to enhanced attraction resulting from these releases. | Ensuring volitional release of hatchery smolts and eliminating forced released of smolts (i.e., those that do not volitionally emigrate) should reduce the likelihood that hatchery-origin smolts will remain the riverine environment to consume naturally produced fish.<br><br>Additional measures to reduce potential effects of predation and competition by summer steelhead and rainbow trout on ESA-listed species will be informed by RM&E and developed in coordination with ODFW and the FPHM committee. | Certain | No change |
| Residualism | While juveniles are released at a size and time to encourage rapid outmigration, a portion of the hatchery smolts released from South Santiam Hatchery residualize in the South Santiam below Foster Dam. These fish consume naturally produced fish and compete for space and food. | Ensuring volitional release of hatchery smolts and eliminating forced released of smolts (i.e., those that do not volitionally emigrate) should reduce the likelihood that hatchery-origin smolts will remain the riverine environment to compete with naturally produced fish. | | |
| Nutrient cycling | Adult hatchery spring Chinook returning to the Foster Fish Facility add substantial amounts of fish biomass and nutrients to the South Santiam subbasin. | Adult returns not collected at Foster Fish Facility will contribute biomass and nutrients to the South Santiam River below Foster Dam. Adult returns outplanted above Foster Dam will contribute biomass and nutrients to the South Santiam River. | Certain | No change |
| Masking | Adult hatchery fish (spring Chinook and summer steelhead) returning to the Foster Fish Facility stray into natural spawning areas confounding the ability to determine the annual abundance of naturally produced fish. The high incidence of non-adipose fin-clipped adult Chinook that are of hatchery origin masks the true number of natural-origin fish incorporated into the broodstock. | Continuing to thermally shock all hatchery releases to mark otoliths will enhance ability to determine the annual abundance of naturally produced fish in the South Santiam River below Foster Dam. Inserting coded wire tags into South Santiam spring Chinook releases will enable immediate detection of hatchery-origin fish. | Certain | Reduce risk |

| Risk Category | South Santiam Baseline Condition | Effect of the Revised Proposed Action | Likelihood of Adverse Effect | Net Effect of Revised Proposed Action |
|---|---|---|---|---|
| Fisheries | Fisheries managed for, or directed at, the harvest of hatchery-origin fish released from South Santiam Hatchery result in the incidental harvest or mortality of naturally produced fish. | Potentially scaling back recycling of summer steelhead in the South Santiam basin or changing the release strategy to disperse harvest could decrease incidental harvest of UWR winter steelhead.<br><br>Continuing harvest of only hatchery origin fish will likely maintain current levels of incidental harvest. | Moderate | Potentially reduces risk. |
| Research, monitoring, and evaluation | Currently, a limited monitoring and evaluation program in the South Santiam Basin is used to determine the performance of the artificial production programs or to document the impact of the program on naturally produced fish. Without a thorough RM&E program, it is difficult to recommend changes to the hatchery mitigation program to reduce impacts on ESA-listed species. | Implementing an extensive RM&E program to monitor the performance and determine the impact of the existing program on naturally produced fish will inform the decision-making process for reforming the hatchery programs to reduce impacts on ESA-listed species. | Certain, pending available funding. | Reduce negative effect |

**Table 6-11. Potential Adverse Effects of McKenzie Hatchery Programs on the McKenzie Population of UWR Spring Chinook**

| Risk Category | McKenzie Baseline Condition | Effect of the Revised Proposed Action | Likelihood of Adverse Effect | Net Effect of Revised Proposed Action |
|---|---|---|---|---|
| **Operation of Hatchery Facilities** | | | | |
| Facility failure | No catastrophic failures have occurred at McKenzie Hatchery. The facility is fully staffed on-site and employs safe fish health practices in accordance with IHOT guidelines.<br><br>No catastrophic failures have occurred at Leaburg Hatchery. The hatchery has experienced several outbreaks of IHN disease. | ODFW and the USACE are developing a prioritized database of hatchery rehabilitation and maintenance needs at each hatchery facility, which will be implemented subject to available funds. Maintenance needs that reduce the risk of catastrophic hatchery failure are high priorities. Implementation of high-priority maintenance needs should reduce the risk of catastrophic failure. | Low | Reduces risk of adverse effect. |
| Water intakes | The intake for McKenzie Hatchery is located in Leaburg Canal. The intake has a rotating traveling screen, but does not have fish screens that meet NMFS juvenile criteria. The intake for Leaburg Hatchery is located in Leaburg Lake. The intake does not have fish screens that meet NMFS juvenile criteria. | Upgrading the fish screen on the water intake to comply with NMFS fry criteria will be included in the long-term infrastructure maintenance plan. | Moderate | Reduces risk of adverse effect. |
| Effluent discharge | Effluent discharges from hatcheries can change water temperature, pH, suspended solids, ammonia, organic nitrogen, total phosphorus, and chemical oxygen demand in the receiving stream's mixing zone (Kendra 1991). Leaburg and McKenzie Hatcheries comply with NPDES permits and IHOT standards, which minimizes the impacts of effluent. | ODFW will continue to comply with NPDES permits and IHOT standards. Maintenance and repair of gates, pipelines, and valves associated with the effluent ponds will ensure proper function. No effect. | Low | No change in likelihood of adverse effect. |

| Risk Category | McKenzie Baseline Condition | Effect of the Revised Proposed Action | Likelihood of Adverse Effect | Net Effect of Revised Proposed Action |
|---|---|---|---|---|
| Broodstock collection - method | Adults are collected at the McKenzie Hatchery, which was not designed to sort hatchery and wild fish. All UWR spring Chinook salmon pass upstream through a pool-and-weir ladder to a holding pond located at the upstream end of the fish ladder. A finger weir traps the fish within the holding pond. Fish are crowded into a fish lock with a fish crowder, anesthetized with CO2, counted, sorted, and loaded into a truck via a 50 ft. transport pipe or into the adult holding ponds via return pipe.<br><br>These handling practices likely increase the incidence of pre-spawning mortality of hatchery-origin adults that are released to spawn upstream of Cougar Dam. Annual returns of hatchery and natural-origin spring Chinook to McKenzie Hatchery have averaged about 3,000 fish. | The Action Agencies propose to upgrade McKenzie Hatchery. The new facility will include water-to-water transfer and the ability to safely sort and load hatchery and natural-origin spring Chinook salmon. These improvements could reduce the incidence of pre-spawning mortality of spring Chinook and winter steelhead that are handled at the facility and released in areas where they are expected to spawn. | Certain | Reducing risk of adverse effects associated with collection. |
| Broodstock collection - adult removal | The broodstock collection goal for McKenzie Hatchery is 1,200 adult fish. | New collection protocols, as described in Table 3-8, incorporate a higher percentage of natural-origin adult spring Chinook into the broodstock, which will result in the direct take of up to 400 natural-origin spawners pending availability of natural-origin fish. While resulting in more direct take of natural-origin spawners, these protocols ensure that the McKenzie Hatchery Chinook program is consistent with an integrated hatchery program. Protocols may be modified based on the results of RM&E. | Certain, pending availability of natural- origin fish for broodstock. | Net benefit to UWR spring Chinook by improving quality of hatchery broodstock for conservation purposes. |

| Risk Category | McKenzie Baseline Condition | Effect of the Revised Proposed Action | Likelihood of Adverse Effect | Net Effect of Revised Proposed Action |
|---|---|---|---|---|
| Genetic introgression | The McKenzie spring Chinook Hatchery Program was derived from the local broodstock collected at McKenzie Hatchery, with minimal out-of-basin influence. Very few wild fish (<10%) were incorporated into the McKenzie spring Chinook hatchery broodstock through the 2005 brood year.<br><br>There are some differences in life history characteristics between the hatchery and natural origin returning adults in terms of run timing and age class distribution (Firman et al. 2005). Juvenile life history strategies between hatchery and natural-origin fish also differ (Willis et al. 1995). | Modifications to broodstock collection protocol and the incorporation of more natural-origin adults into the broodstock will increase the influence of natural selective pressures on the populations. Thus, over time, the hatchery populations should become extensions of the naturally spawning populations, genetically and in expression of physical traits.<br><br>Managing escapement of hatchery fish onto the spawning grounds upstream of Leaburg Dam should reduce the influence of hatchery selective pressures on the McKenzie spring Chinook population and allow the selective forces of the natural environment to drive expression of suppressed alleles. However, the time frame for realizing this effect depends on the mechanism chosen to reduce hatchery spawning; and feasibility of implementation.<br><br>Experimental releases of smaller hatchery fish could allow expression of a variety of life history strategies and may reduce differences in life history characteristics of hatchery and natural-origin fish. | Certain, but timeframe for reducing risk associated with hatchery fish on the spawning grounds will depend on course of action identified by the FPHM committee and the timeframe in which all partners can implement an action. | Improve |
| Disease | Effluent from McKenzie and Leaburg Hatchery has the potential to transport fish pathogens out of the hatchery, where natural-origin fish may be exposed to infection. Releases of juvenile spring Chinook from McKenzie Hatchery and juvenile steelhead and catchable rainbow trout from Leaburg Hatchery could result in the transmission of pathogens to natural-origin fish rearing in the McKenzie River. | Continuing implementation of fish health policies and practices will reduce the possibility of disease transmission from hatchery fish to natural-origin fish.<br><br>Continuing to release summer steelhead in the McKenzie River that return to the area upstream of Leaburg Dam will contribute to above-natural incidence of IHNV in the McKenzie watershed that could impact the ESA-listed species. | Low | No change |

| Risk Category | McKenzie Baseline Condition | Effect of the Revised Proposed Action | Likelihood of Adverse Effect | Net Effect of Revised Proposed Action |
|---|---|---|---|---|
| Competition/ density dependence | Juvenile spring Chinook released from McKenzie Hatchery and juvenile steelhead and catchable rainbow trout from Leaburg Hatchery compete with naturally produced fish for food and space in areas where they interact during downstream migration.<br><br>Adult hatchery fish returning to McKenzie Hatchery compete with naturally produced fish for redd sites. | Releasing an experimental group of hatchery spring Chinook at a smaller size to mimic natural life history strategies could increase the potential for competition. Release at a size that is smaller than naturally produced juveniles will reduce this risk. RM&E will document interactions; releases will be adjusted accordingly.<br><br>Ensuring volitional release of hatchery smolts and eliminating forced released of smolts (i.e., those that do not volitionally emigrate) should reduce the likelihood that hatchery-origin smolts will remain the riverine environment to compete with naturally produced fish.<br><br>Additional measures to reduce potential effects of predation and competition by summer steelhead and rainbow trout on ESA-listed species will be informed by RM&E and developed in coordination with ODFW and the FPHM committee.<br><br>Transport of adult hatchery spring Chinook collected at McKenzie Hatchery and the Cougar Fish Collection Facility into areas into areas upstream of USACE dams reduces the number of adult Chinook that could compete with natural-origin adults on the spawning grounds above Leaburg Dam. | Certain | Reduce risk |

| Risk Category | McKenzie Baseline Condition | Effect of the Revised Proposed Action | Likelihood of Adverse Effect | Net Effect of Revised Proposed Action |
|---|---|---|---|---|
| Predation | While juveniles are released at a size and time to encourage rapid outmigration, hatchery smolts released from the Leaburg and McKenzie Hatcheries consume naturally produced fry in the McKenzie River (Firman et al., 2005).<br><br>Releases of hatchery smolts from McKenzie and Leaburg Hatcheries could result in increases in predation by other predator species due to enhanced attraction resulting from these releases. | Ensuring volitional release of hatchery smolts and eliminating forced released of smolts (i.e., those that do not volitionally emigrate) should reduce the likelihood that hatchery-origin smolts will remain the riverine environment to consume naturally produced fish.<br><br>Additional measures to reduce potential effects of predation and competition by summer steelhead and rainbow trout on ESA-listed species will be informed by RM&E and developed in coordination with ODFW and the FPHM committee. | Certain | No change |
| Residualism | While juveniles are released at a size and time to encourage rapid outmigration, a portion of the hatchery smolts released from McKenzie and Leaburg Hatcheries residualize in the McKenzie River. These fish consume naturally produced fish and compete for space and food. | Ensuring volitional release of hatchery smolts and eliminating forced released of smolts (i.e., those that do not volitionally emigrate) should reduce the likelihood that hatchery-origin smolts will remain the riverine environment to compete with naturally produced fish. | | |
| Nutrient cycling | Adult hatchery spring Chinook returning to McKenzie Hatchery add substantial amounts of fish biomass and nutrients to the McKenzie subbasin. | Adult returns not collected at McKenzie Hatchery will contribute biomass and nutrients to the McKenzie River. Adult returns outplanted above Cougar Dam will contribute biomass and nutrients to the South Fork McKenzie River. | Certain | No change |

| Risk Category | McKenzie Baseline Condition | Effect of the Revised Proposed Action | Likelihood of Adverse Effect | Net Effect of Revised Proposed Action |
|---|---|---|---|---|
| Masking | Adult hatchery fish (spring Chinook) returning to McKenzie Hatchery stray into natural spawning areas confounding the ability to determine the annual abundance of naturally produced fish.<br><br>The high incidence of non-adipose fin-clipped adult Chinook that are of hatchery origin masks the true number of natural-origin fish incorporated into the broodstock. | Continuing to thermally shock all hatchery releases to mark otoliths will enhance ability to determine the annual abundance of naturally produced fish in the McKenzie River Basin.<br><br>Inserting coded wire tags into McKenzie Hatchery spring Chinook releases will enable immediate detection of hatchery-origin fish.<br><br>Increasing homing to McKenzie Hatchery and reducing the incidence of hatchery fish spawning upstream of Leaburg Dam should reduce the masking effect of the UWR spring Chinook program. | Certain | Reduce risk |
| Fisheries | Fisheries managed for, or directed at, the harvest of hatchery-origin fish released from McKenzie Hatchery result in the incidental harvest or mortality of naturally produced fish. | Continuing harvest of only hatchery origin fish will likely maintain current levels of incidental harvest. | Moderate | Potentially reduces risk. |
| Research, monitoring, and evaluation | Currently, a limited monitoring and evaluation program in the McKenzie Basin is used to determine the performance of the artificial production programs or to document the impact of the program on naturally produced fish. Without a thorough RM&E program, it is difficult to recommend changes to the hatchery mitigation program to reduce impacts on ESA-listed species. | Implementing an extensive RM&E program to monitor the performance and determine the impact of the existing program on naturally produced fish will inform the decision-making process for reforming the hatchery programs to reduce impacts on ESA-listed species. | Certain, pending available funding. | Reduce negative effect |

**Table 6-12. Potential Adverse Effects of the Middle Fork Willamette Hatchery Programs on the Middle Fork Willamette Population of UWR Spring Chinook**

| Risk Category | Middle Fork Willamette Baseline Condition | Effect of the Revised Proposed Action | Likelihood of Adverse Effect | Net Effect of Revised Proposed Action |
|---|---|---|---|---|
| **Operation of Hatchery Facilities** | | | | |
| Facility failure | No catastrophic failures have occurred at Willamette Hatchery or Dexter Ponds. The facility is fully staffed on-site and employs safe fish health practices in accordance with IHOT guidelines. Risk of catastrophic loss of incubating eggs is reduced by having two water supplies. | ODFW and the USACE are developing a prioritized database of hatchery rehabilitation and maintenance needs at each hatchery facility, which will be implemented subject to available funds. Maintenance needs that reduce the risk of catastrophic hatchery failure are high priorities. Implementation of high-priority maintenance needs should reduce the risk of catastrophic failure. | Low | Reduces risk of adverse effect. |
| Water intakes | The intake for Willamette Hatchery is located in Salmon Creek. The intake for Dexter Holding and Rearing Ponds is located in Dexter Reservoir. The intake for the Fall Creek Fishway is located in Fall Creek Reservoir. These screens do not meet NMFS juvenile criteria. | Upgrading the fish screen on the water intake to comply with NMFS fry criteria will be included in the long-term infrastructure maintenance plan. | Moderate | Reduces risk of adverse effect. |
| Effluent discharge | Effluent discharges from hatcheries can change water temperature, pH, suspended solids, ammonia, organic nitrogen, total phosphorus, and chemical oxygen demand in the receiving stream's mixing zone (Kendra 1991). Willamette Hatchery and Dexter Holding and Rearing Ponds comply with NPDES permits and IHOT standards, which minimizes the impacts of effluent. | ODFW will continue to comply with NPDES permits and IHOT standards. Maintenance and repair of gates, pipelines, and valves associated with the effluent ponds will ensure proper function. No effect. | Low | No change in likelihood of adverse effect. |

| Risk Category | Middle Fork Willamette Baseline Condition | Effect of the Revised Proposed Action | Likelihood of Adverse Effect | Net Effect of Revised Proposed Action |
|---|---|---|---|---|
| Broodstock collection - method | Adults are collected at the Dexter Holding and Rearing Ponds, which was not designed to sort hatchery and wild fish. All UWR spring Chinook arriving at Dexter Dam are guided by the dam to a fish ladder entrance located on the east side of the powerhouse. The fish move up the pool-and-weir ladder through a vee trap to a holding pond located at the upstream end of the fish ladder. The pond is equipped with a power crowder that is used to crowd fish into the fish lock. Fish that enter the lock are hydraulically lifted with a brail floor to the sorting area. Fish are metered out of the lock over a dewatering screen and into an anesthetic tank. The fish are anesthetized with CO2, identified by species, counted, and loaded into a transportation truck. Broodstock are transported to Willamette Hatchery in Oakridge approximately 30 minutes from the Dexter Holding and Rearing Ponds. Fish in excess of broodstock requirements are outplanted in the Middle Fork Willamette Basin above Lookout Point and Hills Creek Dams.<br><br>These handling practices likely increase the incidence of pre-spawning mortality of natural- and hatchery-origin adults that are released to spawn upstream of Dexter Dam. Annual returns of hatchery and natural-origin spring Chinook to Dexter Holding and Rearing Ponds ranged from 4,686 -17,928 in 1990-2002. | The Action Agencies propose to rebuild Dexter Holding and Rearing Ponds. The new facility will include water-to-water transfer and the ability to safely sort and load hatchery and natural-origin spring Chinook salmon. These improvements could reduce the incidence of pre-spawning mortality of spring Chinook that are handled at the facility and released in areas where they are expected to spawn. | Certain | Reducing risk of adverse effects associated with collection. |
| Broodstock collection - adult removal | The broodstock collection goal for the Willamette Hatchery Chinook program is 1,700 adult fish. | New collection protocols, as described in Table 3-8, incorporate a higher percentage of natural-origin adult spring Chinook into the broodstock, which will result in the direct take of up to 500 natural-origin spawners pending availability of natural-origin fish. While resulting in more direct take of natural-origin spawners, these protocols ensure that the Middle Fork Willamette Spring Chinook program is consistent with an integrated hatchery program. Protocols may be modified based on the results of RM&E. | Certain, pending availability of natural-origin fish for broodstock. | Improve; net benefit to UWR spring Chinook by improving quality of hatchery broodstock for conservation purposes. |

| Risk Category | Middle Fork Willamette Baseline Condition | Effect of the Revised Proposed Action | Likelihood of Adverse Effect | Net Effect of Revised Proposed Action |
|---|---|---|---|---|
| Genetic introgression | The Middle Fork Willamette spring Chinook Hatchery Program was derived from local broodstock collected at Dexter Ponds on the Middle Fork Willamette, with minimal out-of-basin influence. Very few wild fish (<5%) were incorporated into the Middle Fork Willamette spring Chinook hatchery broodstock through the 2005 brood year.<br><br>Despite the relatively low number of natural-origin fish, there are significant differences in life history characteristics between the hatchery and natural origin returning adults in terms of size at return (Firman et al., 2005). Juvenile life history strategies between hatchery and natural-origin fish also differ.<br><br>However, due to the extremely low abundance of natural-origin spring Chinook in the Middle Fork basin, the hatchery population likely harbors the majority of remaining genetic material for this population. | Modifications to broodstock collection protocol and the incorporation of more natural-origin adults into the broodstock will increase the influence of natural selective pressures on the populations. Thus, over time, the hatchery populations should become extensions of the naturally spawning populations, genetically and in expression of physical traits.<br><br>Managing escapement of hatchery fish onto the spawning grounds upstream of Leaburg Dam should reduce the influence of hatchery selective pressures on the McKenzie spring Chinook population and allow the selective forces of the natural environment to drive expression of suppressed alleles. However, the time frame for realizing this effect depends on the mechanism chosen to reduce hatchery spawning; and feasibility of implementation.<br><br>Experimental releases of smaller hatchery fish could allow expression of a variety of life history strategies and may reduce differences in life history characteristics of hatchery and natural-origin fish. | Certain; reductions in risks of genetic introgressio n will likely be long-term, due to the low availability of natural-origin fish to incorporate into the broodstock. | Improve over time |
| Disease | Effluent from Willamette Hatchery and Dexter Holding and Rearing Ponds has the potential to transport fish pathogens out of the hatchery, where natural-origin fish may be exposed to infection. Releases of hatchery juvenile summer steelhead and spring Chinook from Dexter Holding and Rearing Ponds and Fall Creek Fishway could result in the transmission of pathogens to natural-origin fish rearing in the Middle Fork Willamette River or Fall Creek. | Continuing implementation of fish health policies and practices will reduce the possibility of disease transmission from hatchery fish to natural-origin fish. | Low | No change |

| Risk Category | Middle Fork Willamette Baseline Condition | Effect of the Revised Proposed Action | Likelihood of Adverse Effect | Net Effect of Revised Proposed Action |
|---|---|---|---|---|
| Competition/ density dependence | Juvenile hatchery fish released from Dexter Holding and Rearing Ponds and Fall Creek Fishway compete with naturally produced fish for food and space in areas where they interact during downstream migration.<br><br>Adult hatchery fish returning to Dexter Holding and Rearing Ponds and Fall Creek Fishway compete with naturally produced fish for redd sites. | Releasing an experimental group of hatchery spring Chinook at a smaller size to mimic natural life history strategies could increase the potential for competition. Release at a size that is smaller than naturally produced juveniles will reduce this risk. RM&E will document interactions; releases will be adjusted accordingly.<br><br>Ensuring volitional release of hatchery smolts and eliminating forced released of smolts (i.e., those that do not volitionally emigrate) should reduce the likelihood that hatchery-origin smolts will remain the riverine environment to compete with naturally produced fish. Additional measures to reduce potential effects of predation and competition by summer steelhead and rainbow trout on ESA-listed species will be informed by RM&E and developed in coordination with ODFW and the FPHM committee.<br><br>Transport of adult hatchery spring Chinook collected at Dexter Holding and Rearing Ponds into areas upstream of USACE dams reduces the number of adult Chinook that could compete with natural-origin adults on the spawning grounds below Dexter Dam. | Certain | Reduce risk |
| Predation | While juveniles are released at a size and time to encourage rapid outmigration, hatchery smolts released from Dexter Holding and Rearing Ponds and Fall Creek Fish Fishway consume naturally produced fry in the Middle Fork Willamette below Dexter Dam. Releases of hatchery smolts from Dexter Holding and Rearing Ponds and Fall Creek Fishway could result in increases in predation by other predator species due to enhanced attraction resulting from these releases. | Ensuring volitional release of hatchery smolts and eliminating forced released of smolts (i.e., those that do not volitionally emigrate) should reduce the likelihood that hatchery-origin smolts will remain the riverine environment to consume naturally produced fish. | Certain | No change |

| Risk Category | Middle Fork Willamette Baseline Condition | Effect of the Revised Proposed Action | Likelihood of Adverse Effect | Net Effect of Revised Proposed Action |
|---|---|---|---|---|
| Residualism | While juveniles are released at a size and time to encourage rapid outmigration, a portion of the hatchery smolts released from Dexter Holding and Rearing Ponds and Fall Creek Fishway residualize in the Middle Fork Willamette Basin. These fish consume naturally produced fish and compete for space and food. | Ensuring volitional release of hatchery smolts and eliminating forced released of smolts (i.e., those that do not volitionally emigrate) should reduce the likelihood that hatchery-origin smolts will remain the riverine environment to compete with naturally produced fish. | | |
| Nutrient cycling | Adult hatchery spring Chinook returning to Dexter Holding and Rearing Ponds and Fall Creek Fishway add substantial amounts of fish biomass and nutrients to the Middle Fork Willamette subbasin. | Adult returns not collected at Dexter Holding and Rearing Ponds will contribute biomass/ nutrients to the Middle Fork Willamette below Dexter Dam. Adult returns outplanted above Dexter/Fall Creek dams contribute biomass/nutrients to the Middle Fork Willamette and Fall Creek subbasins. | Certain | No change |
| Masking | Adult hatchery fish returning to Dexter Holding and Rearing Ponds and Fall Creek Fishway stray into natural spawning areas confounding the ability to determine the annual abundance of naturally produced fish. The high incidence of non-adipose fin-clipped adult Chinook that are of hatchery origin masks the true number of natural-origin fish incorporated into the broodstock. | Continuing to thermally shock all hatchery releases to mark otoliths will enhance ability to determine the annual abundance of naturally produced fish in the Middle Fork Willamette Basin. Inserting coded wire tags into Willamette spring Chinook releases will enable immediate detection of hatchery-origin fish. | Certain | Reduce risk |
| Fisheries | Fisheries managed for, or directed at, the harvest of hatchery-origin fish released from Willamette Hatchery result in the incidental harvest or mortality of naturally produced fish. | Continuing harvest of only hatchery origin fish will likely maintain current levels of incidental harvest. | Moderate | Potentially reduces risk. |
| Research, monitoring, and evaluation | Currently, a limited monitoring and evaluation program in the Middle Fork Willamette Basin is used to determine the performance of the artificial production programs or to document the impact of the program on naturally produced fish. Without a thorough RM&E program, it is difficult to recommend changes to hatchery mitigation program to reduce impacts on ESA-listed species. | Implementing an extensive RM&E program to monitor the performance and determine the impact of the existing program on naturally produced fish will inform the decision-making process for reforming the hatchery programs to reduce impacts on ESA-listed species. | Certain, pending available funding. | Reduce negative effect |

Because all impacts of hatchery programs cannot be completely eliminated, there will always be the potential for the spring Chinook salmon, summer steelhead, and rainbow trout hatchery programs to negatively impact natural-origin UWR spring Chinook salmon and winter steelhead. Tables 6-13 and 6-14 list the potential impacts of the proposed artificial propagation programs on listed UWR spring Chinook and winter steelhead. Those programs that "may negatively impact" are addressing these

impacts through measures put in place to minimize the impacts (see Chapter 3), although it is uncertain if the negative impacts can be completely eliminated. Research, monitoring, and evaluation efforts will be developed and prioritized through the FPHM Committee and will aim to further define the extent of adverse impacts and inform implementation of measure to reduce adverse effects.

### Table 6-13. Summary of Potential Effects of Willamette Hatchery Programs on UWR Spring Chinook

| Hatchery Program | Hatchery Operations | Broodstock Collection | Genetic Introgression | Disease | Competition/ Density Dependence | Predation |
|---|---|---|---|---|---|---|
| Upper Willamette Spring Chinook | 0 | 0 | (-) | (-) | (-) | (-) |
| Upper Willamette Summer Steelhead | 0 | 0 | 0 | (-) | (-) | (-) |
| Upper Willamette Rainbow Trout | 0 | 0 | 0 | (-) | (-) | (-) |

| Hatchery Program | Residualism | Fisheries | Masking | Nutrient Cycling | Monitoring and Evaluation |
|---|---|---|---|---|---|
| Upper Willamette Spring Chinook | (-) | (-) | (-) | (+) | (+) |
| Upper Willamette Summer Steelhead | (-) | (-) | 0 | (+) | (+) |
| Upper Willamette Rainbow Trout | (-) | (-) | 0 | (+) | (+) |

Key: 0 = No impact expected; (-) = may negatively impact; (+) = may positively impact.

### Table 6-14. Summary of Potential Effects of Willamette Hatchery Programs on UWR Winter Steelhead

| Hatchery Program | Hatchery Operations | Broodstock Collection | Genetic Introgression | Disease | Competition/ Density Dependence | Predation |
|---|---|---|---|---|---|---|
| Upper Willamette Spring Chinook | 0 | 0 | 0 | (-) | (-) | (-) |
| Upper Willamette Summer Steelhead | 0 | 0 | (-) | (-) | (-) | (-) |
| Upper Willamette Rainbow Trout | 0 | 0 | (-) | (-) | (-) | (-) |

| Hatchery Program | Residualism | Fisheries | Masking | Nutrient Cycling | Monitoring and Evaluation |
|---|---|---|---|---|---|
| Upper Willamette Spring Chinook | (-) | (-) | 0 | (+) | (+) |
| Upper Willamette Summer Steelhead | (-) | (-) | (-) | (+) | (+) |
| Upper Willamette Rainbow Trout | (-) | (-) | (-) | (+) | (+) |

Key: 0 = No impact expected; (-) = may negatively impact; (+) = may positively impact.

With this revised proposed action, the Action Agencies have attempted to reduce the risks summarized above by implementing hatchery reform actions whenever possible, and by pursuing RM&E to identify the most prudent future actions to minimize risks to viability. As described in Chapter 3, the UWR spring Chinook hatchery mitigation program will be operated as an integrated program to support recovery of the UWR spring Chinook ESU. Therefore, while there will inherently be some risks to viability associated with any hatchery program, the spring Chinook hatchery programs should also benefit the ESU. Table 3-7 summarized the effects of Willamette artificial production programs on VSP attributes for UWR Chinook salmon and was based on the NMFS 2005 updated *Listing Determination and Hatchery Listing Policy* (70 FR 37160). Table 6-15 summarizes the overall effects of the Willamette hatchery program as described in the revised proposed action in this Supplemental BA on the UWR spring Chinook salmon ESU, and focuses on the benefits of an integrated hatchery program on the viability of the ESU.

**Table 6-15. Effects of the Willamette Hatchery Program as Described in the Revised Proposed Action on the Viability of UWR Spring Chinook Salmon ESU**

| VSP Parameter | Effect of Existing Hatchery Program on UWR Spring Chinook Viability (per 2005 NMFS review) | Effects on Viability | Effect of USACE Hatchery Program Described in the Supplemental BA | Net Effect of Revised Proposed Action on Risks to Viability |
|---|---|---|---|---|
| Abundance | Benefit from hatchery fish on total abundance (+) | Benefit/ decreases risk | Release of hatchery spring Chinook that return as adults will continue to benefit overall abundance of UWR spring Chinook ESU. The percentage of hatchery returns to each basin is described in Schroeder and others (2006).<br><br>Operation of the hatchery program as an integrated program with the reforms described in this BA should improve the quality of adult hatchery returns. | Maintain benefit; potentially further decrease risk |
| | Benefit from hatchery fish being outplanted as live adults upstream of impassable dams and producing smolts (+) | | Progeny from outplants released into historical habitat upstream of Detroit/Big Cliff, Foster (and potentially Green Peter), Cougar, Lookout Point/Dexter, and Hills Creek dams that successfully outmigrate and return as adults will continue contribute to overall abundance of the UWR spring Chinook ESU. RM&E will determine the extent of this contribution.<br><br>If changes in outplanting protocol, project operations, and/or structural modifications to the projects decrease pre-spawning | |

| VSP Parameter | Effect of Existing Hatchery Program on UWR Spring Chinook Viability (per 2005 NMFS review) | Effects on Viability | Effect of USACE Hatchery Program Described in the Supplemental BA | Net Effect of Revised Proposed Action on Risks to Viability |
|---|---|---|---|---|
| | | | mortality of outplants and/or survival of juvenile outmigrants, then abundance of naturally produced spring Chinook could increase as a result of the proposed action.<br><br>RM&E of juvenile production; passage through the reservoir/dam complexes; and adult returns of hatchery-origin and natural-origin adults will define the extent of this contribution over time. | |
| | Stable returns to all hatcheries ensures continuation of a genetic reserve (+) | | Modifications to broodstock collection protocol and the incorporation of more naturally produced fish into the broodstock will increase the influence of natural selective pressures on the populations. Thus, over time, the hatchery populations should become extensions of the naturally spawning populations, genetically and in expression of physical traits. | |
| Productivity | High pre-spawning mortality of hatchery and natural fish on spawning grounds limits number of spawners (-) | Neutral/ uncertain | | Neutral/uncertain; RM&E will further define effects and identify and reduce adverse effects. |
| | No information that hatchery programs increase productivity (R/S) of natural spawners (?) | | While spawning ground surveys indicate that hatchery fish comprise a large percentage of natural spawners in some basins (Schroeder et al., 2006), it is unknown if these spawners are successful or if their progeny decrease overall productivity relative to natural-origin spawners.<br><br>RM&E will identify the relative success of hatchery-origin and natural-origin spawners. Interactions of hatchery releases (e.g., competition or predation) with naturally produced juveniles could adversely effect juvenile production. RM&E will describe the | |

| VSP Parameter | Effect of Existing Hatchery Program on UWR Spring Chinook Viability (per 2005 NMFS review) | Effects on Viability | Effect of USACE Hatchery Program Described in the Supplemental BA | Net Effect of Revised Proposed Action on Risks to Viability |
|---|---|---|---|---|
| | | | nature and extent of this impact and identify options for reducing any adverse effects. | |
| | Replacement rates of fish to hatcheries (spawner-spawner) have averaged greater than 1 (+) | | Maintaining the majority of current spring Chinook hatchery releases should maintain replacement rates. | |
| | Hatchery fish provide carcass nutrients in historic habitat upstream of dams (+) | | Outplanting of adult fish into habitat upstream of USACE dams will continue to provide a source of marine-derived nutrients and associated benefits to juvenile productivity. Benefits to productivity will be greater if structural or operational modifications (as identified by the system configuration studies) improve survival of outmigrating juveniles. | |
| Spatial Structure | Benefit from hatchery fish released into historic habitat above dams by expanding spatial distribution within species' historical range (+) | Benefit/ decreases risk | Continuing to outplant adult spring Chinook into habitat upstream of USACE dams will provide short-term benefits to spatial structure of the spring Chinook ESU. Should RM&E and the Willamette Basin Review determine that long-term reintroduction is feasible and self-sustaining populations are established upstream of USACE dams, the ESU would benefit greatly from increase in spatial structure.<br><br>Should Action Agencies agree that long-term reintroduction of UWR spring Chinook into historical habitat (and assoc. structural modification) is prudent, the risks to viability associated with extensive loss of spawning habitat would be reduced and the ability of the ESU to withstand a catastrophic event will increase. | Benefit, decreases risk; potential significant reductions in risk if reintroduction is determined to be feasible. |
| | Benefits from adults outplanted into historic habitats below dams (Calapooia River, Little North Fork Santiam) by expanding spatial distribution within species' historical range (+) | | | |
| | Substantial reintroductions of spring Chinook into historic habitat will likely benefit the ESU by expanding spatial distribution within species' historical range. This will likely increase productivity and reduce the risk of catastrophic events adversely affecting the entire ESU (+) | | | |
| Diversity | Potential negative effects from high incidence of hatchery fish spawning naturally in the Clackamas and McKenzie (the two | Neutral/ uncertain | The Action Agencies propose to develop a strategy for reducing the incidence of hatchery fish spawning upstream of Leaburg Dam | Improvement due to broodstock management; potential improvements in long-term resulting from management of |

| VSP Parameter | Effect of Existing Hatchery Program on UWR Spring Chinook Viability (per 2005 NMFS review) | Effects on Viability | Effect of USACE Hatchery Program Described in the Supplemental BA | Net Effect of Revised Proposed Action on Risks to Viability |
|---|---|---|---|---|
| | areas with the most remaining habitat and natural production) (-) | | within 6 months of issuance of the BiOp, which will include working with other entities (incl. EWEB and ODFW) to develop a strategy for funding/constructing potential structural modifications at Leaburg Dam. The strategy would also include mechanism for increasing attraction of adult spring Chinook to McKenzie Hatchery. | |
| | Hatchery fish have some different life history characteristics than natural fish (smolt release timing, size, age at return, etc) (-) | | Modifications to broodstock collection protocol and the incorporation of more natural-origin fish into the broodstock will increase the influence of natural selective pressures on the hatchery population. Thus, over time, the hatchery component of the populations should become more similar to the natural-origin populations, both genetically and in expression of life history traits (e.g., run timing, age at return, etc). Modifications to release strategies and protocols (e.g., experimental release of smaller fish) could improve life history characteristics as well by increasing the percentage of larger, older adults in returns. | hatchery fish above Leaburg Dam in the McKenzie River. |
| | Potential positive effects in areas where dams have blocked the majority of historical habitat and hatchery stocks are the only remnants of the historic run (North Santiam, South Santiam, Middle Fork Willamette) (+) | | Maintaining the use of these stocks will ensure continuity of a genetic reserve that can be used to rebuild naturally spawning populations in the subbasins. Management as integrated programs by implementing the reform strategies described herein (or those proposed by the HSRG and adopted by ODFW and USACE), should improve the genetic integrity of the hatchery component of each population by promoting the selective pressures of the natural environment over those in the hatchery. | |

In summary, there are potential adverse effects and risks associated with operation of the spring Chinook hatchery program and these risks vary by population. However, the Action Agencies, through ODFW, plan to manage the spring Chinook hatchery program (including the spring Chinook outplanting program) as an integrated program that will reduce the overall extinction risk of the ESU. Risks to genetic diversity will be managed and reduced over time, and improved in those basins where the hatchery population comprises a significant portion of overall abundance. Hatchery returns will contribute to overall abundance in several basins, and the outplanting program will benefit to spatial structure, and potentially productivity and abundance. Overall, operation of the spring Chinook hatchery program as proposed should reduce the extinction risk of the UWR spring Chinook salmon ESU.

# 7. CUMULATIVE EFFECTS

## 7.1. Summary of Cumulative Effects Described in the 2000 Biological Assessment

Implementing regulations for ESA define "cumulative effects" as those effects caused by future projects and activities unrelated to the action under consideration (not including discretionary Federal actions) that are reasonable certain to occur within the action area (50 CFR 402.02). Since all future discretionary Federal actions are subject to consultation under Section 7 at some point in time, their effects will be considered at that time and are not included in an assessment of cumulative effects.

Chapter 7 of the 2000 BA included an analysis non-Federal activities and cumulative effects influencing listed species on each of the tributaries on which Corps dams are located, and on the mainstem Willamette River. The 2000 BA concluded that because of the large scale and scope of the Willamette Project, and the indirect effects that occur throughout the Willamette River basin as a result of flood control and other authorized and incidental purposes, it is difficult to distinguish between the many actions that are indirectly related to the project from those that are unrelated. That section therefore simply summarized all actions not directly related to the construction and operation of the Willamette Project and considers them to have cumulative effects on listed species that may occur above and beyond effects directly related to the Project.

Throughout the basin, increasing urbanization has either eliminated or adversely affected habitat for listed species throughout the Willamette River basin (PNERC 1998). Oregon's three largest population centers, Portland, Salem, and Eugene-Springfield are located along the mainstem Willamette River and account for more than two-thirds of the state's total population. With respect to fish habitat, urbanization has resulted in increased point and non-point source water pollution, increased peak flows, reduced base flows, channel erosion, landslides, channelization, and reduced habitat complexity and availability. Increased population density leads to increased legal and illegal harvest and harassment of listed species.

Agriculture is a significant land use throughout the basin above Willamette Falls that has adversely affected water quality. Associated nonpoint sources (e.g., nutrients, fertilizers, and pesticides) and physical habitat degradation (e.g., increased sedimentation, removal of riparian vegetation, channel bank protection works) have likely been detrimental to fish. Water withdrawal for irrigation and municipal purposes exacerbates naturally occurring summer low flow conditions in tributaries, leading to increased pollutant concentrations and higher water temperatures (ODFW 1990b; Fuhrer et al. 1996).

Timber harvest is the most significant land use upstream of the Willamette Project dams, and has had a significant influence on fish populations and habitat in each of the major subbasins (McIntosh et al. 1995; PNERC 1998). Harvest in riparian zones has resulted in decreased delivery of large woody debris to the river system. ODFW (1990c) reported that large woody debris was in short supply in most streams in the Willamette National Forest, which has been associated with reduced instream cover, loss of pool habitat, reduced storage of gravel, and loss of hydraulic complexity (Spence et al. 1996).

Water quality degradation has occurred throughout the Willamette River basin as a result of human development, which have likely resulted in significant cumulative effects to listed fish species.

The 2000 BA concluded that each of the major categories of non-Federal actions (urbanization, agriculture, timber harvesting, etc.) and their associated effects can be expected to increase in

frequency, magnitude, and/or duration as human populations and other land and water uses increase within the basin. Hence, the cumulative effects of the actions described below are likely to exacerbate any adverse effects that the Willamette Project may have on listed species. Many of the activities and effects identified have existed for a long time (e.g., see Thompson et al. 1966).

## 7.2. Significant Changes Subsequent to the 2000 BA

There are a multitude of non-Federal actions and measures initiated and underway in the Willamette Basin subsequent to 2000 that cumulatively could be expected to significantly effect listed species. Similarly to the conclusion of the earlier BA, it is difficult to distinguish between the many actions that are indirectly related to the project from those that are unrelated. However, the Action Agencies recognize two ongoing initiatives that can be expected to have significant cumulative effects in the Basin: (1) Upper Willamette ESA Recovery Planning; and (2) Implementation of the Willamette Basin TMDL Water Quality Management Plan. ESA Recovery Planning and TMDL Water Quality Management Plans are described in Section 2.5

Individually, these two initiatives provide frameworks for non-Federal agencies and entities and the general public, to undertake actions and measures designed to significantly improve conditions for listed species in the Basin by targeting major limiting factors outside of the responsibility of the Federal Action Agencies. Further, they provide a context in which the Federal actions described within this Supplemental BA can be integrated with non-Federal actions to produce more comprehensive plans for ESA species protection and recovery through the basin. Collectively, Recovery Planning and TMDL Water Quality Management Plan implementation can be expected to moderate the cumulative effects on listed species described in the 2000 BA.

# 8. CONCLUSIONS

## 8.1. Fish Species

It is inferred from the analysis presented in the 2000 Biological Assessment (USACE 2000) together with the additional information presented in this Supplemental Biological Assessment, that the Willamette Project is ***likely to adversely affect*** ESA-listed UWR spring Chinook salmon, UWR winter steelhead, bull trout, and Oregon chub located in habitat above Willamette Falls. The Willamette Project is ***not likely to adversely affect*** ESA-listed species located in habitat below Willamette Falls.

## 8.2. Wildlife and Plant Species

Of the fourteen listed and proposed endangered and threatened wildlife and plant species, the Willamette Project is ***likely to adversely affect*** the following ESA-listed species: Fender's blue butterfly, Kincaid's lupine, Bradshaw's desert parsley, and Willamette daisy. The Willamette Project will have ***no effect*** on the gray wolf, the marbled murrelet, or golden paintbrush. The Willamette Project is ***not likely to adversely affect*** the remaining species of concern.

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